ECOLOGICAL IMPACT ASSESSMENT
(TERRESTRIAL AND AQUATIC ECOLOGY, FAUNA AND AVIFAUNA)

300MW PHOTOVOLTAIC ELECTRICITY GENERATION FACILITY

on

PORTIONS 6 AND 3 OF FARM 187 OLYVENKOLK, KENHARDT DISTRICT

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OCTOBER 2018

TABLE OF CONTENT

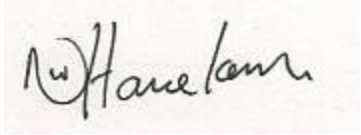
COMPLIANCE WITH THE APPENDIX 7 OF THE AMENDED 2014 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REGULATIONS

REQUIREMENTS OF APPENDIX 6 – GN 326	**ADDRESSED IN SPECIALIST REPORT**
1. (1) A specialist report prepared in terms of these Regulations must contain - a) details of: i) the specialist who prepared the report; and ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 1.1
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Original attached to formal application to Department of Environmental Affairs (DEA). Included in beginning of report
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1.3
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.1.3
e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	Section 1.1.5
f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 1.3.6
g) an identification of any areas to be avoided, including buffers;	Section 1.3.6
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 1.3.6. Figure 5.
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3.5
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	Section 1.5
k) any mitigation measures for inclusion in the Environmental	Section 1.3.9

REQUIREMENTS OF APPENDIX 6 – GN 326	ADDRESSED IN SPECIALIST REPORT
Management Programme (EMPr);	
l) any conditions for inclusion in the environmental authorisation;	Section 1.7 &1.8
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 1.7
n) a reasoned opinion - i) as to whether the proposed activity or portions thereof should be authorised; and ii) if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 1.8
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	EIR Comments and Response Report
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	EIR Comments and Response Report
q) any other information requested by the competent authority.	N/A

I **Nicolaas Willem Hanekom**, as the appointed Specialist hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I:

- in terms of the general requirement to be independent:
    - other than fair remuneration for work performed in terms of this application, have no business, financial, personal or other interest in the development proposal or application and that there are no circumstances that may compromise my objectivity; or
    - am not independent, but another specialist (the “Review Specialist”) that meets the general requirements set out in Regulation 13 has been appointed to review my work (Note: a declaration by the review specialist must be submitted);
- in terms of the remainder of the general requirements for a specialist, have throughout this EIA process met all of the requirements;
- have disclosed to the applicant, the Environmental Assessment Practitioner (EAP), the Review EAP (if applicable), the Department and Interested and Affected Parties (I&APs) all material information that has or may have the potential to influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application; and
- am aware that a false declaration is an offence in terms of Regulation 48 of the EIA Regulations, 2014 (as amended).

Signature of the Specialist:	 **Nicolaas Hanekom** **Pri.Sci.Nat (Ecology) 400274/11**
Date:	20 October 2018

ECOLOGICAL IMPACT ASSESSMENT

This report presents the findings of the Ecological Impact Assessment (including Terrestrial Ecology and Aquatic Ecology, Fauna and Avifauna) that was prepared by Nicolaas Hanekom as part of the EIA for the proposed PV project, located near Kenhardt, within the Northern Cape Province.

1.1. INTRODUCTION AND METHODOLOGY

1.1.1. Background & Competency

Nicolaas Hanekom is a registered Professional Natural Scientist in the ecological science field with the South African Council for Natural Scientific Professions ("SACNASP") and a qualified Environmental Assessment Practitioner ("EAP") who holds a Masters Technologiae, Nature Conservation ("Vegetation Ecology and Biodiversity Assessment") degree from the Cape Peninsula University of Technology.

Hanekom attended and obtained a certificate on Integrated Protected Area Planning at the Centre for Environmental Development, University of KwaZulu Natal. He has presented lectures in two subjects at the Cape Peninsula University of Technology (Technologiae Nature Conservation). He has 26 years of environmental planning experience and ecological management, working for Free State and Western Cape Nature Conservation departments.

RELEVANT PUBLICATIONS / SPECIALIST ASSESSMENT REPORTS

- Hanekom, N. January 2011. Cape Solar Energy Electricity Generation Facility. Farm 187/3 & 187/13 Kenhardt. Biodiversity and Ecological Baseline Survey. (Included Terrestrial and aquatic ecological assessments, fauna and avifauna and water use authorization applications)

- Hanekom, N. March 2011. Green Continent Partners 10 MW Energy Electricity Generation Facility. Farm 187/7 Kenhardt. Biodiversity and Ecological Baseline Survey. (Included Terrestrial and aquatic ecological assessments, fauna and avifauna and water use authorization applications)

- Hanekom, N. November 2012. Green Continent Partners 75 MW Energy Electricity Generation Facility. Farm 187/8 Kenhardt. Biodiversity and Ecological Baseline Survey. (Included Terrestrial and aquatic ecological assessments, fauna and avifauna and water use authorization applications)

- Hanekom, N. November 2012. Wine Estate Capital Management 75 MW Energy Electricity Generation Facility. Farm 187/12 Kenhardt. Biodiversity and Ecological Baseline Survey. (Included Terrestrial and aquatic ecological assessments, fauna and avifauna and water use authorization applications)

- Hanekom, N. September 2011. Carmelo Investments 416 Solar Park Farm Diepkuil No 531. Biodiversity Baseline Survey.

- Hanekom, N. July 2011. Prieska Photvoltaic Power Generation Project. Prieska Commonage Northern Cape. Biodiversity and Ecological Baseline Survey. (Included Terrestrial and aquatic ecological assessments and water use authorization applications)

- Hanekom, N. October 2012. Witteklip Erf 123 Extension, Vredenburg. Biodiversity Baseline Survey. (Included Terrestrial and aquatic ecological assessments and water use authorization applications)

- Hanekom, N. October 2014. Baseline Biodiversity Survey and Wetland Delineation for ECCA Holdings: Cape Bentonite Mine on Erf 1412 Near Heidelberg. Prepared for: Shangoni Management Services Pry (Ltd). October 2014.

- Hanekom, N. February 2016. Freshwater Impact Assessment Laingsburg Flood Damage Repairs & Storm Water Infrastructure.

- Hanekom, N. March 2016. Ecological Assessment for Swartland Municipality - Upgrades To Voortrekker/Bokomo Road And Voortrekker/Rozenburg Road Intersections and Upgrade to the Diep River Bridge, Malmesbury on A Portion Of Erf 327, Malmesbury (Road) Erf 1530, Diep River Bridge Crossing, and Erf 1528, Property South of Diep River where Road Widening and Turning Circle Will Be Constructed. (Freshwater Ecology Inputs and Water Use Registration)

- Hanekom, N. June 2016. Freshwater Impact Assessment. McGregor Bridge, Robertson Bridge and Willem Nels River Maintenance Management Plan. (Freshwater Ecology assessment and input as well as Water Use Registration)

- Hanekom, N. June 2017. Water Use Authorization Application Risk Matrix. Orange Grove Trust Vegetation Clearing and Agricultural Development on Portion 4 of Farm Glen Heatlie No 316, Worcester. (Freshwater ecological inputs in EIA process and Water Use Registration).

- Hanekom, N. March 2017. Water Use Authorization Application Risk Matrix Prepared For: Witzenberg Municipality Sand Mine Farm 1 Prince Alfred Hamlet. (Freshwater ecological inputs in EIA process and Water Use Registration).

- Hanekom, N. August 2017. Proposed Hartmanshoop Agri Vegetation Clearing Project and Irrigation on Erf 686, Laingsburg. (Freshwater ecological inputs in Water Use Registration).

- Hanekom, N. August 2010. Elandskloof Farm 475 Citrusdal Biodiversity Baseline Survey. This Biodiversity Assessment Covering Terrestrial and Aquatic Aspects to Inform Decisions Regarding The Proposed Elandskloof Weir Flood Damage Project On Farm 475, In The Citrusdal Area.

1.1.2. Conditions Relating to this Report

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

This report may not be altered or added to without the prior written consent of the author. This restraint also refers to electronic copies of this report which are supplied as sub portion of other reports, including main reports. Similarly, any recommendations, statements, or conclusions drawn from or based on this report must specifically refer to this report. If such comments form part of a main report for this investigation, the report must be included in its entirety as an appendix or separate section to the main report.

1.1.3. Scope and Objectives

The establishment of the PV facility exceeding thresholds stipulated within the EIA Regulations and requires an Application for Environmental Authorisation to be submitted to the relevant, mandated authority (i.e. the National Department of Environmental Affairs (DEA), as well as the undertaking of an EIA Process. This Ecological Impact Assessment specialist study is being undertaken as part of the EIA Process in order to evaluate and inform on the biophysical and ecological aspects of the receiving environment in relation to the proposed PV facility.

This biophysical evaluation of the land upon which the PV facility is proposed to be established was undertaken during different periods over the last couple of years. The first site survey was conducted on 19 January 2011 from 17H00 to 21 January 2011, 08H00. Nicolaas Hanekom stayed over on the farm at the yard for the two nights. Site

specific field surveys were conducted on the 19 January, on the 20 January from and on the 21 January 2011. Surveys included nocturnal and diurnal sampling. The weather on the 19th and 20th was hot with thunderclouds developing in a far distance. A cold front passes the morning of the 21st January with occasional rain drops falling. The area was visited again on March 2011 (one day), October 2011 (one day), August 2012 (one day), October 2013 (two days), 11 to 13 April 2017 and end August (one day) 2018. The ideal period for the assessment of habitat within this region is following the onset of rains, which in this region, normally arises in the later summer months. The sampling and analysis of the site during the early summer season provides suitable data and results to present an informed decision on the local ecology. Other season surveys were also conducted. For the purposes of the Avifauna study the specialist site visits and three seasons of on-site bird monitoring was conducted, in accordance with the best practice guidelines. The proposed project falls under Regime 2 on account of being of 'medium' avifaunal sensitivity and greater than 150ha in extent. This means it requires two to three site visits of 3 to 5 days duration each over 6 months. Two (three day) site surveys, one (two days) and four (one day) site visits were conducted thereby exceeding the minimum requirements. All survey vantage points included the proposed development site, the bigger property and surrounding properties as well as the powerline routes.

The assessments entailed both a literature review of the region, as well as on site evaluations, during which specific primary data was collected and evaluated. In addition, the identification of key ecological features on and adjacent to the site was undertaken allowing for the interpretation of the prevailing habitat form and associated processes.

All data collected in the field and during the literature review was evaluated and interpreted in order to provide an understanding of the nature of the prevailing environment at a landscape and habitat level. In addition, specific evaluation of data relating to habitat form and structure was undertaken, aiding in the identification of bio-physical anomalies within the prevailing environment. Such variance may be considered to be indicative of differing habitat forms, which under consideration, may be of higher order ecological value in relation of the prevailing environment.

1.1.4. Terms of Reference

The overall objectives of the Ecological Impact Assessment are to:

- Identify and establish an understanding of the site under consideration at a landscape scale of evaluation with particular consideration being given to aquatic or important terrestrial habitats, as they may be identified.
- Provide an evaluation and status of habitat composition and significance within the site in order to evaluate the potential impact of the proposed development on the ecological function of the site.
- Assess the actual and potential impacts arising from the proposed development on both the habitat and fauna within the study site. Such impacts may be directly

applicable to the site and contained within the site boundaries, or may be indirect impacts, which may have ramifications outside of the site boundary, or may be of a cumulative nature in terms of impacts arising from similar developments or activities within the region.
- Provide guidance on the implementation of mitigation measures that serve to moderate any negative impacts that may arise on site as a consequence of the development.

The Scope of Work is based on the following broad terms of reference, which have been specified for this specialist study:

- Review detailed information relating to the project description and precisely define the environmental risks to the terrestrial and aquatic environment and consequences for ecology.
- Compile a baseline description of the terrestrial and aquatic ecology (including avifauna) of the study area, and provide an overview of the entire study area in terms of ecological significance and sensitivity (i.e. in terms of the major habitat forms within the study area, giving due consideration to terrestrial ecology (flora), terrestrial ecology (fauna) and freshwater ecosystems/wetlands).
- Provide specific ecological data in respect of the floral, faunal and aquatic components of the site using ground-truthing methods, with an emphasis on those areas considered to be of “high” and possibly, “moderate” sensitivity (based on the desktop study).
- Based on the desktop study, undertake field work and sampling across the site to record relevant data and to compile an overview of the habitat under review.
- Collate all data collected during the field work and undertake a review using methodologies that allow for the comparison of biological data.
- Consider wetlands (endoreic pans) and associated water resources within the site in terms of significance within the catchment, habitat value and significance and delineation of extent through preliminary on-site evaluation and the use of aerial imagery interpretation (where these arise). Determine if a Water Use License is required.
- Undertake a faunal investigation on site.
- Provide a detailed terrestrial and aquatic ecological sensitivity map of the site, including mapping of disturbance and transformation on site.
- Identify and categorize the potential direct, indirect and cumulative impacts (in line with the impact assessment methodology provided in the EIA Report on the terrestrial and aquatic ecology, communities and ecological processes within the site during the construction, operation and decommissioning phases of the project.
- Provide input to the EMPr, including mitigation and monitoring requirements to ensure that the impacts on the terrestrial and aquatic ecology are limited.
- Compile an assessment report qualifying the risks and potential impacts of the development on terrestrial and aquatic ecology in the study area and impact evaluations.

Specific ToR

- A description of the methodology used to determine significant potential environmental impacts;
- A description of environmental issues identified during the environmental impact assessment process;
- An assessment of direct, indirect and cumulative impacts in terms of standard criteria;
- A description and assessment of all alternatives identified during the EIA process;
- Recommendations that include mitigation measures for potentially significant impacts to be included in the EMP;
- An indication of the extent to which issues can be addressed by the adoption of achievable mitigation measures;
- A description of any assumptions, uncertainties and gaps in knowledge; and
- An environmental impact statement which contains a summary of the key findings of the environmental impact assessment; as well as positive and negative implications of the proposed activity versus the alternatives.
- Review the Comments and Responses Report to ensure that all relevant issues or concerns relevant to the specialist's field of expertise are addressed.
- A detailed description of the study's methodology; indication of the locations and descriptions of the development footprint, and all other associated infrastructures that they have assessed and are recommending for authorisations.
- Provide a detailed description of all limitations to the studies. All specialist studies must be conducted in the right season and providing that as a limitation will not be allowed.
- Please note that the Department considers a 'no-go' area, as an area where no development of any infrastructure is allowed; therefore, no development of associated infrastructure including access roads is allowed in the 'no-go' areas.
- Should the specialist definition of 'no-go' area differ from the Departments definition; this must be clearly indicated. The specialist must also indicate the 'no-go' area's buffer if applicable.
- All specialist studies must be final, and provide detailed/practical mitigation measures and recommendations, and must not recommend further studies to be completed post EA.
- Should specialists recommend specific mitigation measures, these must be clearly indicated.
- Identified cumulative impacts must be clearly defined, and where possible the size of the identified impact must be quantified and indicated, i.e. hectares of cumulatively transformed land.
- Identified cumulative impacts associated with the proposed development must be rated with the significance rating methodology used in the process.
- Detailed process flow and proof must be provided, to indicate how the specialist's recommendations, mitigation measures and conclusions from the various similar

developments in the area were taken into consideration in the assessment of cumulative impacts and when the conclusion and mitigation measures were drafted for this project.

- The cumulative impacts significance rating must also inform the need and desirability of the proposed development.
- A cumulative impact environmental statement on whether the proposed development must proceed.
- A hydrological assessment must be conducted and must also assess the impacts on the surface hydrology of the proposed development area and must be included in the EIAr. The terms of reference for the study must include, inter alia the following:
    - Identification and sensitivity rating of all surface water courses for the impact phase of the proposed development;
    - Identification, assessment of all potential impacts to the water courses and suggestion of mitigation measures; and,
    - Recommendations on the preferred placement of the facility and all associated infrastructure and preference must be provided to the avoidance of the watercourses on the property.
- An Avifaunal Assessment must be conducted as part of the EIAr. The terms of reference for the study must include, inter alia the following:
    - Determine the impacts that the proposed activity (including the powerline) may have on avifauna;
    - Must cover at a minimum the summer and winter seasons;
    - The assessment must include mitigation measures to discourage the avifauna from entering the solar field as well and limit nesting and breeding grounds within the solar field.
    - The avifaunal specialist study must be expanded to include vantage point surveys as well as flight paths to consider how birds will move through the property. The study must also propose adequate mitigation measures to reduce the facilities impacts on avifauna frequenting the area.
    - Assess the cumulative impact on avifauna within the site and within the local area.
    - The avifauna specialist studies· must be conducted according to the latest Bird life South Africa/Endangered Wildlife Trust: Best practice guidelines for avian monitoring and impact mitigation.

1.1.5. Approach and Methodology

1.1.5.1. Terrestrial Ecology, fauna and avifauna

A literature review and desktop analysis was undertaken prior to the field investigation, utilizing various sources including the South African National Biodiversity Institute (SANBI) data and other relevant sources. Recent and historical aerial imagery of the site was reviewed in order to identify points for investigation during the field survey. Utilising the above information, a field investigation was undertaken as indicated in section 1.1.3 of the report above, whereby:

- Sites of geomorphological or topographic variance were identified and subjected to an evaluation of species present within transects established across the selected site.
- Species were identified and collated.
- Additional random sample points were selected from other sites surrounding the proposed impacted areas for comparative purposes.
- Any additional species of significance (e.g. *Aloidendron dichotomum* and *Aloe claviflora*), not identified within the sample sites were also noted.

As explained below, the ideal period for the assessment of habitat within this region is following the onset of rains, which in this region, normally arises in the later summer months. The sampling and analysis of the site during the early and late summer season, as well as other seasons provides suitable data and results to present an informed decision on the local ecology.

All data was collated and subjected to evaluation using methods in order to:
- Give consideration to the overall structure of habitat within the subject site.
- Identify any habitat anomalies that may be identified in such analysis.
- Allow for the interpretation of such data in order to prioritise and evaluate habitat form and structure within the study area.

In addition, using methods identified in the then Department of Water Affairs (now Department of Water and Sanitation) “A Practical Field Procedure for Identification of Wetlands and Riparian Areas” (2008), wetland and riparian areas were identified.

Such evaluations utilised both geomorphological, geohydromorphic edaphic conditions and botanical indicators in order to identify such components. Where riparian and wetland systems are identified and lie within 500 m, or within a water course and its 100m buffer area of the proposed development/activity, an application in terms of Section 21 c and i, of the National Water Act (1998) is required to be submitted to the mandated authority.

Further consideration of the cumulative impacts associated with the development at a broader landscape level of evaluation was undertaken. Such cumulative impact assessment was based upon the general understanding of “cumulative impacts”. Evidently, this report will only consider the bio-physical components of the site in the landscape context. The assessment of the cumulative ecological and hydrological impacts was undertaken, based upon the following:
- A comparison of similar developments to the PV project land use within 10 kilometres of the proposed site. The identification of sites was based upon in-house data.
- Comparison was made across all identified sites in order to identify the habitat forms affected by the establishment of the PV facilities.
- Comparison was made in terms of the “transformation” of Bushmanland Arid

Grassland, which is the habitat form subject to transformation within the PV facility.
- The cumulative and comparative loss of Bushmanland Arid Grassland was subject to interrogation in order to identify the contribution of the PV facility to the over-all loss of such habitat.
- The study has been conducted according to the best practice guidelines for "assessing and monitoring the impact of solar power generating facilities on birds in Southern Africa" compiled by **BirdLife** in **January 2017.**

1.1.5.2. Freshwater Ecology

Input into the overall project was driven by the following Terms of Reference, which required the specialist to:
- Identify and describe freshwater ecosystems in the study area based on existing data and an onsite survey;
- Place freshwater ecosystems in a regional context and describe freshwater ecosystem-dependent fauna and flora species present;
- Classify, describe and map freshwater ecosystems in terms of their ecological sensitivity and functional value;
- Comment on and map freshwater ecosystem sensitivity in terms of ecologically important habitats, ecological corridors and linkages with other ecological systems;
- Identify potential impacts of the proposed project on freshwater ecosystems;
- Assess the direct, indirect and cumulative impacts (pre and post-mitigation) of the final location of infrastructure (and alternatives, if applicable) on freshwater ecosystems in the study area using the prescribed impact assessment methodology and
- Recommend practicable mitigation measures to avoid and/or minimise/reduce impacts and enhance benefits;

1.1.5.2.1 Freshwater Ecological Assessment Sites and Site Selection
The sites were visually assessed. Intermediate Habitat Integrity Assessment (IHIA) the Riparian Vegetation Response Assessment Index (VEGRAI) and the Ecological Importance and Sensitivity (EIS) were used to assess the risks to the freshwater ecology at the impact area.

1.1.5.2.2. Visual Assessment of Aquatic Assessment Points
Each site was selected in order to identify current conditions, with specific reference to impacts from surrounding activities where applicable. Both natural constraints placed on ecosystem structure and function, as well as anthropogenic alterations to the systems identified, were identified by observing conditions and relating them to professional experience. Photographs of each site were taken to provide visual records of the conditions at the time of assessment. Factors which were noted in the site-specific visual assessments included the following:
- Upstream and downstream significance of each point, where applicable;
- Significance of the point in relation to the study area;

- Stream morphology;
- Instream and riparian habitat diversity;
- Stream continuity;
- Erosion potential;
- Depth flow and substrate characteristics;
- Signs of physical disturbance of the area; and
- Other life forms reliant on aquatic ecosystems.

1.1.5.2.3. Intermediate Habitat Integrity Assessment (IHIA)

It is important to assess the habitat of riverine systems in order to aid in the interpretation of the results of the community integrity assessments by taking habitat conditions and impacts into consideration. The general habitat integrity of the sites was assessed based on the application of the IHIA for (Kemper; 1999). The IHIA protocol, as described by Kemper (1999), was used using the site-specific application protocols. This is a simplified procedure, which is based on the Habitat Integrity approach developed by Kleynhans (1996). The IHIA is conducted as a first level exercise, where a comprehensive exercise is not practical. The Habitat Integrity of each site was scored according to 12 different criteria which represent the most important (and easily quantifiable) anthropogenically induced possible impacts on the system. The instream and riparian zones were analysed separately, and the final assessment was then made separately for each, in accordance with Kleynhans' (1999) approach to Habitat Integrity Assessment. Data for the riparian zone is, primarily interpreted in terms of the potential impact on the in-stream component. The assessment of the severity of impact of modifications is based on six descriptive categories with ratings. Analysis of the data was carried out by weighting each of the criteria according to Kemper (1999). By calculating the mean of the in-stream and riparian Habitat Integrity scores, an overall Habitat Integrity score can be obtained for each site. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitats of the sites. The method classifies Habitat Integrity into one of six classes, ranging from unmodified/natural (Class A), to critically modified (Class F) (Table 1 below).

Table 1: Classification of Present Ecological State Classes in terms of Habitat Integrity [Based on Kemper 1999]

Ecological Category	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions	20-39

Ecological Category	Description	Score (% of total)
	is extensive.	
F	Modifications have reached a critical level and the lotic system has been modified completely with almost complete loss of natural habitat and biota. In worst instances basic ecosystem functions have been destroyed and changes are irreversible.	0-19

1.1.5.2.4. Riparian Vegetation Response Assessment Index (VEGRAI)

Riparian vegetation is described in the NWA (Act No 36 of 1998) as follows: "riparian habitat" includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

VEGRAI is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results (Kleynhans *et al* 2007). Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into an Ecological Category) (Refer to Table 1).
The level of aquatic assessment undertaken was considered to be adequate for this study.

1.1.5.2.5. Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) of riparian areas is an expression of the importance of the aquatic resource for the maintenance of biological diversity and ecological functioning on a local scale to a broader scale; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007) (Table 2).

Table 2: List of the EIS categories used in the assessment tool (Kleynhans & Louw, 2007)

EISC	General description	Range of median
Very high	Quaternaries/delineations that are considered to be unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers	>1-≤2

EISC	General description	Range of median
	(in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.	
Low/marginal	Quaternaries/delineations which are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

Table 3: Rating scheme used for the assessment of riparian EIS (Kleynhans & Louw, 2007)

Score	Channel Type	Conservation context			Vegetation and Habitat Integrity	Connectivity	Threat status of Vegetation Type
0	Ephemeral Stream	Non-FEPA river	No status	None/ Excluded	No natural remaining	None	No Status
1	Stream non-perennial		Upstream management area	Available	Very poor	Very poor	Least threatened
2	Stream-perennial flow		Rehab FEPA		Poor	Low	Vulnerable
3	Minor river-non-perennial flow		Fish corridor	Earmarked for conservation	Moderately modified	Moderate	Near Threatened
4	Minor river-perennial flow		Fish support area		Largely natural	High	Endangered
5	Major river-perennial flow	FEPA river	River FEPA	Protected	Unmodified / natural habitat	Very high	Critically Endangered

1.1.5.2. Assumptions and limitations

The assessment was undertaken using a random sampling method. As such, minor outliers within the site may not have been evaluated. The random sampling method, if correlated to topography and other aspects, is however a robust method of evaluating habitat across a large area.

1.1.5.3. Source of Information

This assessment was undertaken utilising:

- 1:50 000 topographic mapping sourced from the Surveyor General's office; and
- Aerial imagery sourced from Google Earth.
- Aerial imagery sourced from ESRI.

In addition, use was made of the following data:

- Wetland and riparian habitat Geographic Information System (GIS) data sourced from the National Freshwater Ecological Priority Area Programme of South African National Biodiversity Institute (SANBI);
- SANBI veld types data; and
- Literature as referenced

1.2. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO TERRESTRIAL, AQUATIC ECOLOGY AND HYDROLOGICAL FEATURES

The proposed project will require the following key actions that are relevant to ecological, fauna and avifauna aspects of the site:

- Cordoning and fencing of the site during both the construction and operational phases. This component of the project usually entails the establishment of a security fence which remains *in situ* for the lifetime of the project (i.e. for the operational phase). For the construction phase, the construction area may also be cordoned off with temporary fencing.
- Clearance or partial clearance of topographic features and significant vegetation where applicable during the construction phase.
- Establishment of roadways (i.e. internal gravel access roads) and hardpanning of surfaces, with minor storm water management aspects being introduced during the construction and operational phases.
- Establishment of module arrays with concomitant cabling and provision of invertors within arrays. The footing of the module framework is founded into the ground using an earth screw or similar method. Cables are placed in trenches.
- Establishment of step up transformer and the on-site substation. This facility is expected to occupy an area of approximately 1 ha. It is fenced and isolated from the balance of the site.
- Construction of 22kV lines to connect on site blocks to the onsite substation and the 132kV line to Aries Substation.

The establishment of site will be limited to trenching, road construction and limited impacts when the shrews or poles of the platforms are anchored. The fencing of the site will however exclude certain ecological functioning form the surrounding habitat.

A detailed project description is included in the Draft EIA Report, which includes dimensions and specifications of the proposed project components.

1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT.

1.3.1. Locality

The facility will be constructed close to the Aries ESKOM substation south of the town Kenhardt, Northern Cape (See Figure 1 below) on a portion of Farm Olyvenkolk 187/6. The property where the facility is being considered covers an area of approximately

710ha, the extent of which is larger than the footprint required for the facility's developmental footprint. The site falls within the quarter degree grid 2920BD.

The study site is situated approximately 37km southwest of Kenhardt, east of the Aries Eskom substation. The study area is south of the gravel road from Kenhardt to Pofadder. The gravel road turns west of the R27 south of the town Kenhardt.

Cabinet has approved the gazetting of eight Renewable Energy Development Zones (REDZ) and five Power Corridors, which will assist South Africa with its electricity challenges. The site is situated in the Western Power Corridor. “These Renewable Energy Development Zones and Power Corridors are geographical areas where wind and solar photovoltaic technologies can be incentivized and where ‘deep’ grid expansion can be directed and where regulatory processes will be streamlined. The REDZs act as energy generation hubs and provide anchor points for grid expansion, thereby allowing for strategic and proactive expansion of grid into these areas. This will ensure that the grid expansion does not hamper the progress of the renewable energy power purchase agreement process. “The REDZs and Power Corridors support two of the 18 Strategic Integrated Projects (SIPs) that were identified in the Infrastructure Development Plan, which is aimed at promoting catalytic infrastructure development to stimulate economic growth and job creation,” the department of Environmental Affairs. The department has embarked on a programme of Strategic Environmental Assessments (SEAs) for large-scale developments to support the SIPs. This will ensure that when required, environmental authorisations are not a cause for delay. “The intention of undertaking Strategic Environmental Assessments is to pre-assess environmental sensitivities within the proposed development areas at a regional scale to simplify the site specific environmental impact assessments (EIA) when they are undertaken, and to focus the assessment requirements to addressing the specific sensitivity of the site,” the department said. The REDZs and Power Corridors were identified through the development of three Strategic Environmental Assessments as part of the department’s Strategic Environmental Assessment programme. According to the department, the outputs of the three SEAs were gazetted in February 2018 to allow them to be implemented.

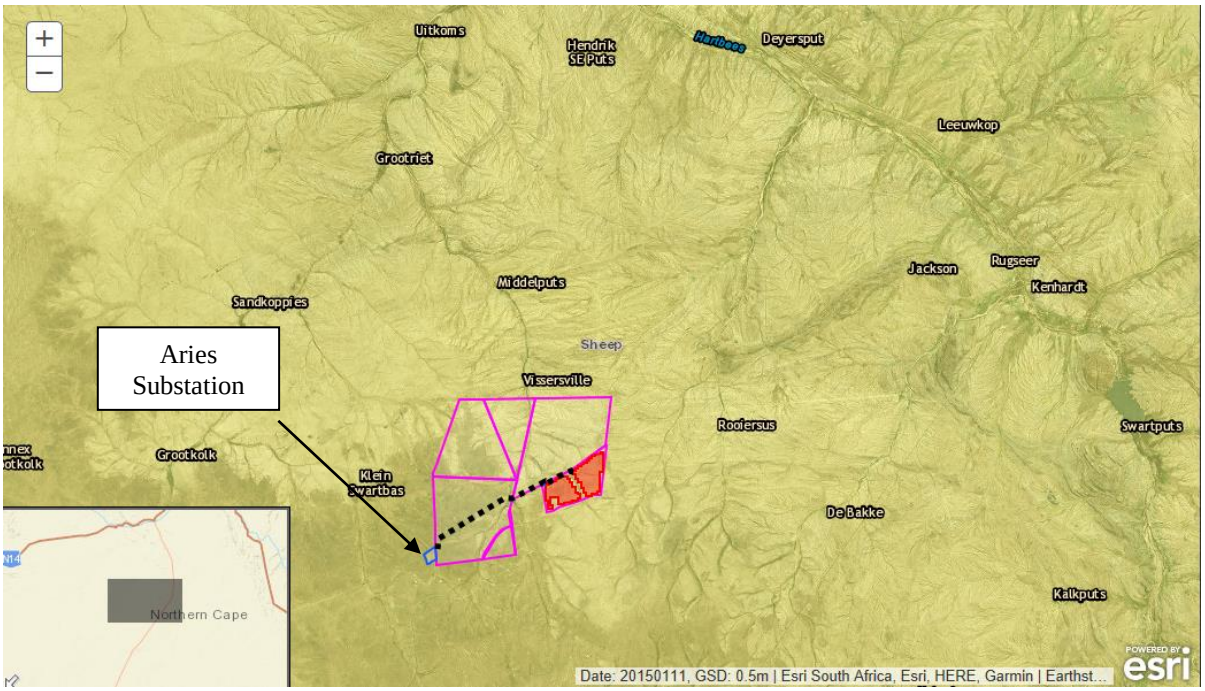


Figure 1: Locality Map

1.3.2. Topography

The study site is located mostly on flats plains which slope gently by a 20m drop over 2km towards the north and west. This landscape is typical of the broader region within which the study area is located and the pattern repeats itself up 30km in any direction. The plains are situated at an elevation of 960 above msl. The highest point on the plains within the study site is on the southern side of the site and it drains down to a flat area in the north. The site is situated in a very arid part of South Africa. Several drainage lines drain the water collected on the site towards the north, which eventually feed into the upper catchment of the Graafwatersrivier, a non-perennial river to the north of the study area.

1.3.3. Soils

The soils can be classified as shallow, red soils with high base status, occasionally calcareous. The dominant soil is classified as quaternary to recent sands and sandy soil of the Gordonia Formation (Kalahari Group) and Mbizane Formation (Permo-Carboniferous Dwyka Group, Karoo Supergroup) which is often stony/rocky. It is a low potential soil, supporting only grazing due to the shallow soils.

1.3.4. Climate

The study area is characterised by an arid climate. Kenhardt normally receives about 70mm of rain per year, with most rainfall occurring mainly during autumn. It receives the lowest rainfall (0mm) in June and the highest (23mm) in March. The monthly distribution

of average daily maximum temperatures shows that the average midday temperatures for Kenhardt range from 19°C in June to 33°C in January. The region is the coldest during July when the mercury drops to 2.6°C on average during the night. Consult the charts below (Figures 2-4) for an indication of the monthly variation of average minimum daily temperatures.

Figure 2: Average rainfall (mm)

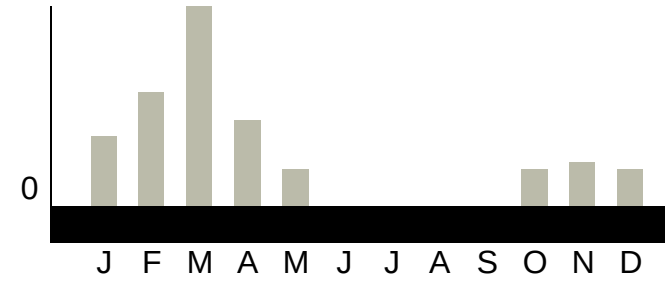


Figure 3: Average midday temperature (°C)

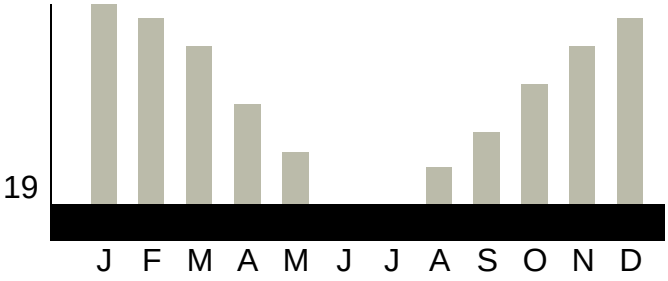
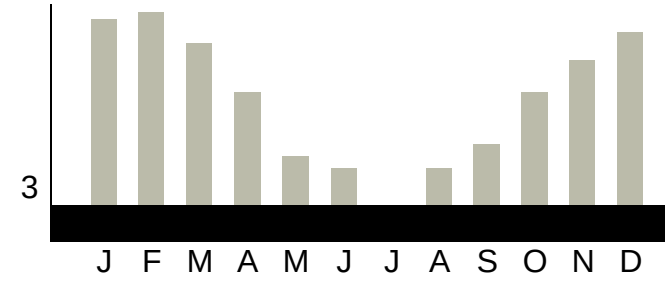


Figure 4: Average night-time temperature (°C)



1.3.5. Geology

The geology according to Almond (2011) is outlined on the 1: 250 000 geology map 2920 Kenhardt (Council for Geoscience, Pretoria; Fig. 5 herein). An explanation to the Kenhardt geological map has been published by Slabbert *et al.* (1999). Several of the

relevant rock units are also treated in the explanations for the adjacent 1: 250 000 sheets such as the Britstown sheet to the southeast (Prinsloo 1989), the Pofadder sheet to the west (Agenbacht 2007) and the Sakrivier sheet to the south (Siebrits 1989).

According to the Kenhardt 1: 250 000 geology map the construction site of the proposed PV power station is underlain by the Permocarboniferous **Dwyka Group** (Karoo Supergroup, **C-Pd**). Dwyka sediments underlie most of the western portion of farm Olyvenhoutkolk 187, with Quaternary alluvium lining the major water courses. Both these rock units are present in the vicinity of the Olyvenhoutskolk farmstead (black circle in Fig. 2) where most of the proposed construction will take place. Small exposures of Mokolian (Mid Proterozoic) basement rocks of the **Namaqua-Natal Province** (De Bakken Granite, **Mdk**, and the Kokerberg Formation, **Mko**) occur in the north-eastern portion of farm Olyven Kolk 187. These two-billion-year-old granitoid intrusions and highly metamorphosed sediments (*cf* Cornell *et al.* 2006) are largely mantled by Quaternary wind-blown sands and associated fluvial sediments and pedocretes of the **Gordonia Formation** (Kalahari Group, **Q**). Since the Mokolian basement rocks are unfossiliferous and will not be directly affected by the proposed development, they will not be considered further here. Satellite images show that the landscape in the study area is extensively dissected by distal tributaries of the Orange River, notably the non-perennial Graafwater River that flows northwards into the Hartbeesrivier and thence into the Orange.

Dwyka Group

Permocarboniferous glacially-related sediments of the **Dwyka Group** (**C-Pd** in Fig. 2) underlie the thin, superficial cover of Gordonia sands, calcrete and Late Caenozoic alluvium both north and south of the Orange River and crop out at surface within the study area southwest of Kenhardt. The geology of the Dwyka Group has been summarized by Visser (1989), Visser *et al.* (1990) and Johnson *et al.* (2006), among others. The geology of the Dwyka Group along the north-western margin of the Main Karoo Basin as far east as Prieska has been reviewed by Visser (1985). Other studies on the Dwyka in or near the Prieska Basin include those by Visser *et al.* (1977-78; summarized by Zawada 1992) and Visser (1982). Fairly detailed observations by Prinsloo (1989) on the Dwyka beds on the northern edge of the Britstown 1: 250 000 geology sheets are in part relevant to the more proximal (near-source) outcrops at Kenhardt. Massive tillites at the base of the Dwyka succession (**Elandsvlei Formation**) were deposited by dry-based ice sheets in deeper basement valleys. Later climatic amelioration led to melting, marine transgression and the retreat of the icesheets onto the continental highlands in the north. The valleys were then occupied by marine inlets within which drifting glaciers deposited dropstones onto the muddy sea bed ("boulder shales"). The upper Dwyka beds (**Mbizane Formation**) are typically heterolithic, with shales, siltstones and fine-grained sandstones of deltaic and / or turbiditic origin. These upper successions are typically upwards-coarsening and show extensive soft-sediment deformation (loading and slumping). Varved (rhythmically laminated) mudrocks with gritty to fine gravely drop stones indicate the onset of highly seasonal climates, with warmer intervals leading occasionally even to limestone precipitation.

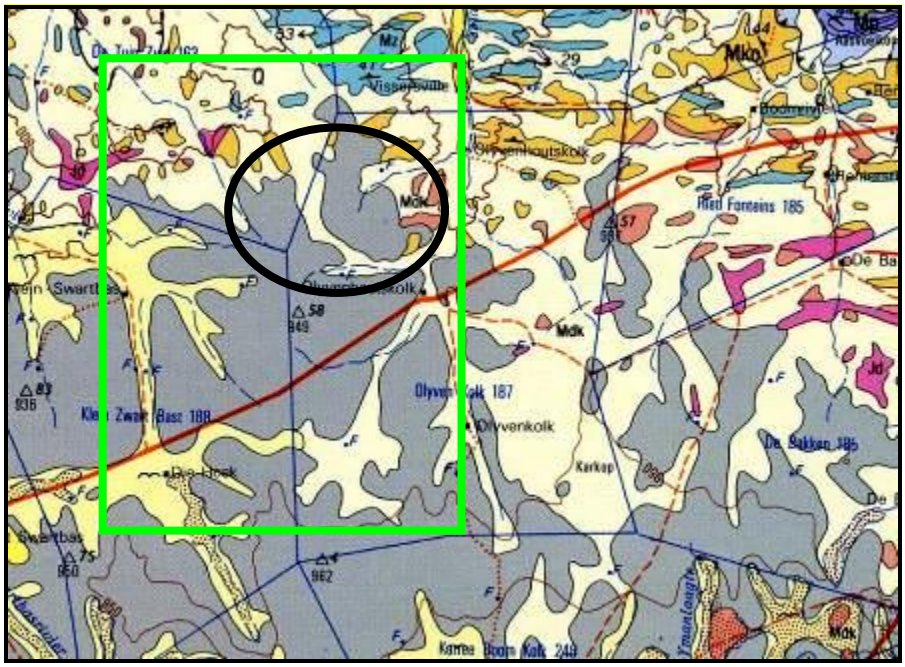


Figure 5: Extract from 1: 250 000 geological map 2920 Kenhardt (Council for Geoscience, Pretoria) showing the approximate location of proposed facility study area on the northern part of farm Olyven Kolk 187 (Green rectangle). Construction will largely take place in the vicinity of the Olyvenhoutskolk farmstead (small black ellipse), in an area that is underlain by Quaternary alluvium (pale yellow) and Dwyka glacial deposits at depth (grey).

Figure 6: Approximately 4m deep quarry south of the study area

1.3.6. Terrestrial Ecology

According to Mucina and Rutherford (2006), the study area lies within the Orange River Broken Veld vegetation type of the Northern Cape. The site is not isolated as it forms

part of an extended natural veld area used as extensive grazing for sheep and cattle farming.

According to Mucina and Rutherford (2006), there are an estimated 5400 plant species in the Northern Cape Province. These plants occur in six large vegetation units known as biomes. Each biome is a broad ecological unit that represents major life zones of large natural areas, defined mainly by vegetation structure and climate. According to Mucina and Rutherford (2006), there are six biomes in the Northern Cape, namely the Savanna Biome, Nama Karoo Biome, Succulent Karoo Biome, Fynbos Biome, Grassland Biome & Desert. The proposed site falls within the Nama Karoo biome. Each biome is subdivided into vegetation types, which are groups of plant communities that share similar ecosystem processes and have similar climatic and geological requirements. There are many vegetation types in the Northern Cape. The Orange River Nama Karoo is an example of one of these vegetation types, within the Nama Karoo Biome. It is found along most of the Orange River from its confluence with the Vaal River near Kimberley to the Richtersveld in the far north-western corner of the Northern Cape. A common plant of this vegetation type is the Quiver Tree (Kokerboom) *Aloidendron dichotomum* that grows on the broken, rocky terrain.

The Surveyor General's 1: 50 000 topocadastral maps and google images indicates that the entire site consists of natural vegetation. This was confirmed during the site survey (Figure 7).

Figure 7: General terrestrial characteristics of the study area

The terrestrial vegetation area was identified as Other Natural Areas and the non-perennial Graafwater River and riparian zone with its 100m buffer area was identified as an Ecological Support Area[1]. The study area is not regionally important from a biodiversity point of view and the survey found that the impact of the proposed development will not have any significant effects on the biodiversity and connectivity of the specific site or region.

Individual plant localities were not plotted in detailed. The site was surveyed and plant communities were identified and species recorded. The habitat approach was preferred. Species collection was focused on the different plant communities present on site.

The study area has been impacted upon to some degree by livestock farming, although the vegetation is in relatively good condition and natural. The recent drought has denuded the vegetation on the study site. The vegetation of the study area is dominated by *Stipagrostis ciliata var. capensis, Stipagrostis obtusa, Stipagrostis uniplumis var. uniplumis, Salsola tuberculata*, *Eriocephalus ericoides*, *Rhigozum trichotomum*, etc.

The Bushmanland Arid Grassland (Not Threatened) on the site is in a good condition, although sparsely vegetated due to the low rainfall.

Plant species recorded during the field surveys over the years included:

- *Prosopis sp* (non-perennial rivers)
- *Vachellia karoo* (non-perennial rivers)
- *Agave rigida var. sisalana*
- *Eriocephalus encoides (kappokbos)*
- *Chrysocoma ciliata*
- *Rhigozum trichotomum*
- *Pterthrix spinescens*
- *Aloidendron dichotomum (Quiver Tree)*
- *Phaeoptilum sponsum*
- *Zygophyllum gilfillanii*
- *Salsola tuberculata*
- *Limeum aethipicum*
- *Thesium lineatum*
- *Cenchrus ciliaris*
- *Schmidtia kalihariensis*
- *Stipagrostis ciliata var. capensis*
- *Stipagrostis obtusa*
- *Stipagrostis uniplumis var. uniplumis*
- *Fingerhuthia africana*

[1] Holness. S & Oosthuysen.E. 2016. Critical Biodiversity Areas of the Northern Cape: Technical Report

- *Eragrostis curvula (Increaser IIb)*
- *Pelargonium sp.*
- *Felicia muricata*
- *Tribulus cristatus*
- *Lycium cinereum*

Aloe claviflora, Aptosimum spinescens, Aloidendron dichotomum (Northern Cape Nature Conservation Act (1998)) and *Boscia albitrunca* (National Forest Act & Northern Cape Nature Conservation Act (1998)) are the only rare and endangered species known to occur in the area. Of the above only *Aloidendron* were noted on the study site and *Aloe claviflora* adjacent to the site on the bigger property.

No other rare and endangered species were observed on the proposed impacted site. However, no parts of these plants may be harvested, collected or disturbed without a valid permit from Northern Cape Nature Conservation. The proposed development infrastructure will not impact on this species.

The proposed development will not impact significantly on the biodiversity pattern at neither the community or at an ecosystem level provided that the non-perennial Graafwater River and its 100m buffer area (Identified Ecological Support Area), the Nama Karoo Bushmanland Flat Pans and the clusters of *Aloidendron dichotomum* and its 100m buffer area is protected as a No-Go Area, manage as sensitive areas and excluded from the development area as shown in Figure 8 below.

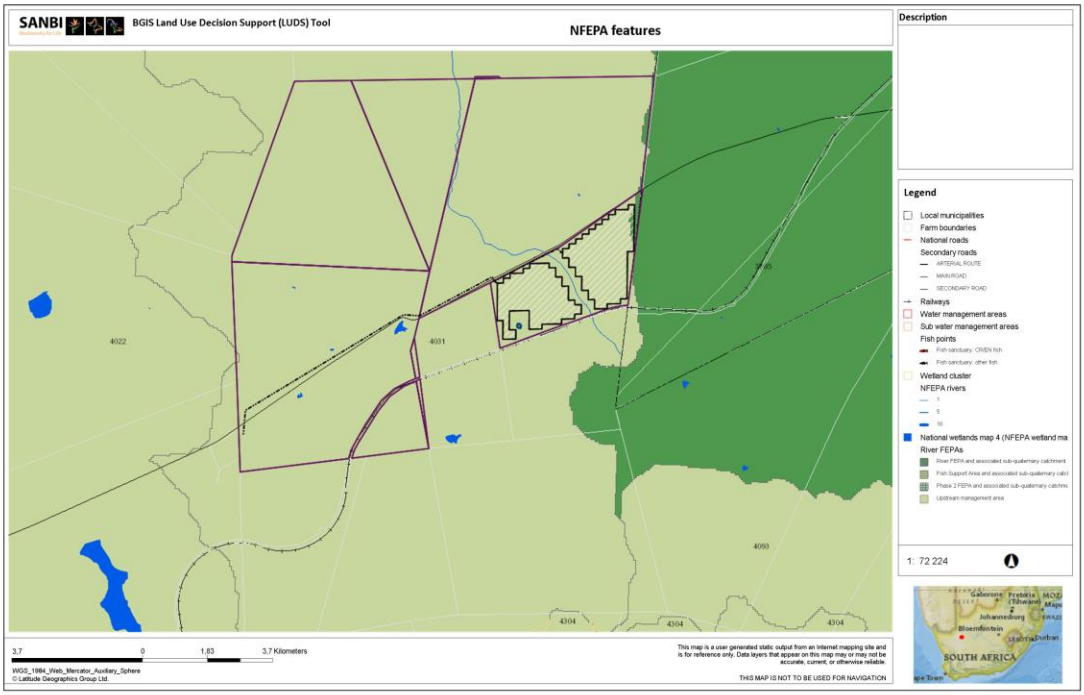


Figure 8: Ecological Sensitive Areas (Blue – sensitive non-perennial rivers and pan)

1.3.7. Freshwater Ecology (Hydrological features, "Aquatic" and "Riparian" Habitat)

The site is located in the Lower Orange catchment (Department of Water and Sanitation (DWS) Primary Drainage Region D), within the Lower Orange Water Management Area (WMA). The proposed water uses would pass through sections of the D53D quaternary catchment. D53D is drained primarily by the Orange River.

Two biodiversity conservation mapping initiatives are of relevance to the freshwater ecosystems within the study area; the Northern Cape Biodiversity Spatial Plan (2016) mapping initiatives that were undertaken on a regional basis and the National Freshwater Ecosystem Priority Areas (NFEPA) mapping initiative. The non-perennial Graafwater River was classified as a NFEPA river. A Nama Karoo Bushmanland Flat Pan was recorded during the site survey which was not recorded as a NFEPA wetland. Three NFEPA artificial wetlands (two dams and one weir dam in Graafwater River) was recorded on portion 3 close to the 132 kV powerline connection route to Aries Substation. The 132kV powerline connecting the PV facility to the Eskom grid will not impact on these artificial wetland dams and weir (refer to figure 8 above). The powerline will run parallel to an existing Eskom powerline which mitigate and reduce its impacts on ecology and avifauna.

The non-perennial river that will be impacted were identified as an Aquatic Ecological Support Area (ESA) and the terrestrial areas surrounding the impacted zones as Other Natural Areas (ONA) in the latest Northern Cape Biodiversity Spatial Plan (2016) (Figure 9).

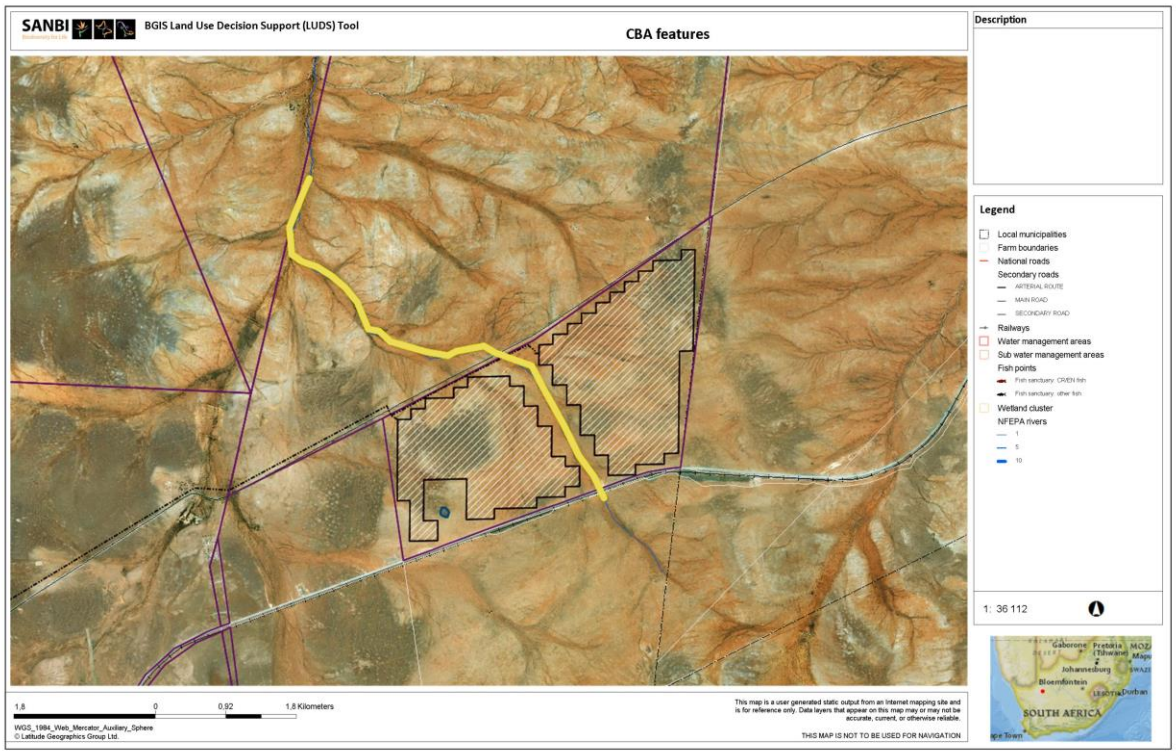


Figure 9: CBA mapped in study area.

The ESA identified are not essential for meeting biodiversity targets, but play an important role in supporting the functioning of protected areas or CBAs, and are often vital for delivering ecosystem services. The objective of these ESA's is to be maintained in a functional, near-natural state. Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised (Figure 10).

Figure 10: Non-perennial River catchment and ecological condition on the property.

The non-perennial Graafwater River and other sensitive non-perennial tributaries identified in between the proposed PV infrastructure is impacted and crossed by the Kenhardt to Pofadder gravel road as well as farm tracts. Livestock grazing occurs and impacted on the non-perennial watercourse.

Within the site, surface flow is primarily by means of shallow channels that may vary on a temporal basis according to factors such as changes in the prevailing wind regime, vegetation growth or the movement of livestock. As such, these dendritic channels are often ephemeral in nature and do not show specific hygrophilous vegetation characteristics, nor do they show the presence of geohydromorphic soils. The absence of these indicators is due primarily to the fluctuating levels of inundation in these drainage features, over extended periods of time which is also driven by the intensity and erratic rainfall experienced in this region.

Flow is generally sluggish under these conditions, and following the cessation of rains, the water rapidly drains from site on account of the percolative, sandy conditions, or is lost to evaporation. Soils in these systems, may as a consequence of such evaporation, prove to be slightly saline in nature (Mucina and Rutherford, 2006). Given the absence of definitive geohydromorphic indicators, the Graafwater non-perennial river and other sensitive non-perennial tributaries on site have been delineated according to

hydrogeomorphological features and an apparent change in vegetation form from a sparse and arrested growth form, to a more verdant state, associated with drainage. The delineation of the non-perennial river and one of the pans identified is also confirmed by the NFEPA map. Hydrogeomorphological features are indicated primarily by evidence of flow or deposition of materials (Brinson *et al* 1993; USDA 2008) while verdant vegetation establishment is a combination of both improved plant water relations and increased nutrient availability. Therefore, major drainage features are associated with a combination of both verdant vegetation structure and form as well as significant geomorphic indicators, while the depth and expanse of dendritic drainage features can also be utilized to distinguish between minor drainage lines (generally considered to be 'rills' and ephemeral in nature) and more permanent features ('gullies'), which are more defined in morphological character.

Although short lived, in terms of the presence of water within these features, this non-perennial river does bestow intermittent hydrological benefit to the landscape and can be considered groundwater "recharge zones" in respect of the local subsurface hydrology. From a biotic perspective, the drainage lines do serve as seasonally important refugia and congregation points for *inter alia* invertebrates (e.g. Class Odonata) and vertebrates (e.g. Order Anura) (faunal aspects are described further in more detail below in this report).

Dendritic drainage features are evident in the site, which can be described as shallow, geologically driven channels that may in turn be further excavated by the movement of livestock. These features show very little evidence of regular flow and are generally identified through the more verdant growth of small woody shrubs such as *Lycium cinereum*. These dendritic drainage lines were not identified as ecological sensitive areas and the PV facility will be constructed over these areas. These dendritic drainage features must however be maintained inside the PV facility underneath and in between the panels in order to discharge storm water generated on the site.

A photographic record of the non-perennial Graafwater River (Figures 11 and 12) was made in order to provide a visual record of the condition of the assessment site as observed during the field assessment. The photographs taken are presented, followed by a Table 4 summarising the observations for the various criteria made during the visual assessment undertaken at each point.

Figure 11: Photo of condition of the NFEPA on site Graafwater Non-perennial River.

Figure 12: Photo of condition of the NFEPA on site Graafwater Non-perennial River and buffer area.

Table 4: Descriptions of the location of proposed PV facility in relation to mapped non-perennial river

Characteristics	Non-perennial Graafwater River on site which will be located in between PV facility infrastructure.
Significance of the point	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.
Surrounding anthropogenic activities	The site is situated at the point where the infrastructure will be placed next to the non-perennial river.
Riparian zone characteristics	The riparian zone at this point is in moderate condition as result of the grazing impacts.
Depth characteristics	The potentially affected river reach is characterised by a single channel, approximately 10m wide at this point, which has a bed comprising mostly sand and rocks.
Flow conditions	Within the site, surface flow is primarily by means of shallow channels that may vary on a temporal basis according to factors such as changes in the prevailing wind regime, vegetation growth or the movement of livestock. As such, these dendritic channels are often ephemeral in nature and do not show specific hygrophilous vegetation characteristics, nor do they show the presence of geohydromorphic soils. The absence of these indicators is due primarily to the fluctuating levels of inundation in these drainage features, over extended periods of time which is also driven by the intensity and erratic rainfall experienced in this region.
Water clarity	No water was flowing during time of site visit.

Vegetation habitat characteristics	Hydrogeomorphological features are indicated primarily by evidence of flow or deposition of materials (Brinson *et al* 1993; USDA 2008) while verdant vegetation establishment is a combination of both improved plant water relations and increased nutrient availability.
Erosion potential	Low erosion potential if the proposed mitigation measures below are implemented.

Habitat Assessment of the Graafwater Non-Perennial River

Instream Habitat Integrity

Weights	14	13	13	13	14	10	9	8	6		
REACH	Water abstraction	Flow modification	Bed modification	Channel modification	Water quality	Inundation	Exotic macrophytes	Exotic fauna	Solid waste disposal	Total Score (%)	Classification
Impacted Site	0	11	11	11	3	2	2	2	2	78.52	D: Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred. This is primarily due to the Sishen-Saldanha Railway and Gravel road crossings.

None	Small	Moderate	Large	Serious	Critical

Riparian Zone Habitat Integrity

Weights	13	12	14	12	13	11	12	13		
REACH	Vegetation removal	Alien encroachment	Bank erosion	Water abstraction	Flow modification	Channel modification	Water quality	Inundation	Total Score (%)	Classification
Impacted Site	2	2	2	0	22	22	2	23	62.84	C: Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.

None	Small	Moderate	Large	Serious	Critical

From the results of the application of the IHIA to the impacted site, it is evident that the rivers reach is modified and that the loss of natural habitat, biota and basic ecosystem functions is large. Instream impacts included a large impact from flow modifications, inundation as well as bed and channel modifications as a result of the upstream Sishen-Saldanha Railway line crossing and downstream gravel road crossing. Overall, the site achieved a 47.04 % score for instream integrity.

Riparian impacts included a large impact from flow modifications, and bed and channel modifications as a result of the upstream Sishen-Saldanha Railway line crossing and downstream gravel road crossing. Overall, the site achieved a 62.84% score for instream integrity.

The site obtained an overall IHIA rating of 54.94%, which indicates the loss of natural habitat, biota and basic ecosystem functions is large (Class D conditions).

Riparian Vegetation Response Assessment Index (VEGRAI)

Table 5: The overall VEGRAI score of the impacted area

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	60,0	22,5	3,3	2,0	60,0
NON MARGINAL	70,0	43,8	3,5	1,0	100,0
2.0					160,0
LEVEL 3 VEGRAI (%)				66,3	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				3,4	

The score attained for the VEGRAI indicated that the riparian system falls into the category C. This indicates that the loss of natural habitat, biota and basic ecosystem functions is moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.

Ecological Importance and Sensitivity (EIS)

Table 6: Results of the EIS assessment for the affected watercourse

Component	**Score**	**Confidence**	**Comments/description**
Channel type	3	5	Non-perennial river.
Conservation context	5	5	No Status
Vegetation and habitat Integrity	3	5	Moderately modified
Connectivity	3	5	Some connection impacts as a result of the railway and road crossings.
Threat Status of Vegetation Type	1	5	Vegetation has least concern conservation status
EIS Category	**1.6**		**Moderate Importance**

EIS considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale. The median of the resultant score is calculated to derive the EIS category.

The non-perennial river is considered to be of moderate ecological importance.

Given the nature of the area as described above, those areas that may be considered to be of ecological significance within the site have been mapped and presented at a spatial level. The setting aside of these areas from development is based purely on the objective of reducing the level of transformation in the prevailing surface drainage regime from the site. No additional sites of ecological significance that should be excluded from the development footprint have been identified. A 100 m “buffer” or

“setback” around the identified drainage line and Nama Karoo Bushmanland Pan has been established, which is indicated as the “norm” and recommended by the various authorities. This buffer is considered acceptable in light of the fact that hydrogeomorphic features are the primary dictate in the identification and delineation of the major drainage lines, rather than other functional features such as geohydromorphic soil conditions or botanical species diversity and compositional variation. It is evident that exclusion areas of greater extent around the major drainage line would incorporate extensive tracts of land which are in no way indicative of the concentrated surface hydrology. The application of 100 m set back from such features is expected to accommodate both the variation in habitat structure and the erosive action associated with gullies and larger drainage features.

The nature of PV facilities, such as that envisaged is such that much of the land occupied by the PV modules is left unimpeded by development and surface flow ostensibly follows the lay of the land. Some impediments to flow may arise at points around roadways or related infrastructure. However this is of limited consequence. In addition, the presence of the modules across the site, generally serves to alter plant-edaphic relationships through the concentration of water at points and increased shading, leading to improved water retention within soils. This situational change has low level ecological ramifications.

1.3.8. Terrestrial Fauna

Fauna that are endemic to the region are considered to be typical of a harsh dry environment, with limited habitat variation across the study area giving rise to a primarily uniform distribution of such species. As is typical of the region, a large number of fossorial and burrowing species, including mammals and invertebrates, were identified across the site in general. Such species included ground squirrel (*Xerus inauris),* aardvark (*Orycteropus afer*), as well as the porcupine (*Hystrix africaeaustralis*). Most larger mammals located within the subject site are not reliant upon the study area in particular and are likely to forage over extensive ranges that extend beyond the site boundaries. Estes (1992) indicates that suricates may use warrens for a number of months or possibly years, before relocating. Suricates are quite capable of establishing warrens within solar parks following their construction, while aardvark and other fossorial species are able to excavate under fencing, which may have initially served to exclude them from the site.

Some 36 species are known to occur in the bigger area (Smithers 1983). The following table lists the Red Data listed mammal species which are predicted, or confirmed to occur in the general area and possibly within the site study area (Friedman & Daly, 2004).

Table 7: Red Data listed mammal species which are predicted or confirmed to occur in the general area and possibly within the site study area.

COMMON NAME	SCIENTIFIC NAME	RED DATA CATEGORY	PREDICTED OCCURENCE
Lesueur's Wing-gland Bat	*Cistugo lesueuri*	Near Threatened	Unlikely
Cape Serotine Bat	*Neoromicia capensis*	Least Concern	Possible
Egyptian Split Faced Bat	*Nycteris thebaica*	Near Threatened	Possible
Egyptian Free-tailed Bat	*Tadarida aegyptiaca*	Least Concern	Possible
Rock Hyrax	*Procavia capensis*	Least Concern	Unlikely
Black-backed Jackal	*Canis mesomelas*	Least Concern	Definitive
Caracal	*Caracal caracal*	Least Concern	Definitive
Yellow Mongoose	*Cynictis penicillata*	Least Concern	Possible
Small Grey Mongoose	*Galerella pulverulenta*	Least Concern	Likely
Small-spotted Genet	*Genetta genetta*	Least Concern	Likely
Striped Polecat	*Ictonyx striatus*	Least Concern	Present
Bat-eared Fox	*Otocyon megalotis*	Least Concern	Definitely
Leopard	*Panthera pardus*	Least Concern	Not Present
Aardwolf	*Proteles cristatus*	Least Concern	Present
Cape Fox	*Vulpes chama*	Least Concern	Unlikely
Springbok	*Antidorcas marsupialis*	Least Concern	Present to the north of the site
Reddish-grey Musk Shrew	*Crocidura cyanea*	Data Deficient	Unlikely
Cape Hare	*Lepus capensis*	Least Concern	Unlikely
Scrub Hare	*Lepus saxatilis*	Least Concern	Possible
Short-tailed Gerbil	*Desmodillus*	Least	Possible

COMMON NAME	SCIENTIFIC NAME	RED DATA CATEGORY	PREDICTED OCCURENCE
	auricularis	Concern	
Hairy Footed Gerbil	*Gerbillurus paeba*	Least Concern	Possible
Spectacled Dormouse	*Graphiurus ocularis*	Least Concern	Possible
Porcupine	*Hystrix africaeaustralis*	Least Concern	Present on site
Aardvark	*Orycteropus afer*	Least Concern	Likely
Black Rhinoceros	*Diceros bicomis bicomis*	Critical Endangered	Not present
Gemsbok	*Oryx gazella*	Least concern	Not present
Steenbok	*Raphicerus campestris*	Least Concern	Present west of site
Common duiker	*Sylvicapra grimmia*	Least concern	Not present
African Wild Cat	*Felis silvestris*	Least concern	Likely
Honey Badger	*Mellivora capensis*	Least concern	Likely
Suricate	*Suricata suricatta*	Least Concern	Likely
Smith's Rock Elephant Shrew	*Elephantulus rupestris*	Least Concern	Unlikely
Round-eared Elephant –shrew	*Macroscelides proboscideus*	Least Concern	Unlikely
Namaqua Rock Mouse	*Aethomys namaquensis*	Least Concern	Likely
Brush-tailed Hairy-footed Gerbil	*Gerbillurus vallinus*	Least Concern	Unlikely
Large-eared Mouse	*Malacothrix typica*	Least concern	Unlikely
Multimammate Mouse	*Mastomys coucha*	Least concern	Unlikely
Karoo Bush Rat	*Otomys unisulcatus*	Least concern	Unlikely
Brants' Whistling Rat	*Parotomys brantsii*	Least concern	Unlikely
Littledale's Whistling Rat	*Parotomys littledalei*	Least concern	Unlikely
Springhare	*Pedetes capensis*	Least	Likely

COMMON NAME	SCIENTIFIC NAME	RED DATA CATEGORY	PREDICTED OCCURENCE
		concern	
Pygmy Rock Mouse	*Petromyscus collinus*	Least concern	Unlikely
Striped Mouse	*Rhabdomys pumilio*	Least concern	Likely
Bushveld Gerbil	*Tatera leucogaster*	Data Deficient	Unlikely
Cape Ground Squirrel	*Xerus inauris*	Least concern	Present.

The following (TOPS 2007[2]) species is likely to occur in the study areas, but none were recorded during field surveys:

- *Atelerix frontalis* (South African Hedgehog) Protected
- *Cordylus spp (*Girdled lizard) Protected
- *Pterinochilus spp* (Baboon spider) Protected
- *Opistophthalmus spp* (Burrowing scorpions). Possible burrow entrance found during survey) Protected

The bats will be unaffected by development, as there are no roosting sites within the affected area that could be impacted upon by development. The species listed above occurring on site will not be affected negatively. The impact of the proposed development on them will be of low significance. Their home ranges are much bigger than the proposed development and there are huge undeveloped home ranges for these species in the surrounding landscape.

The following mammal species were observed on the bigger site during the survey:

- *Proteles cristatus* (Aardwolf spoor)
- *Ictonyx striatus* (Striped polecat)
- *Xerus inauris* (Ground squirrel)
- *Hystrix africaeaustralis* (Porcupine)
- *Otocyon megalotis* (Bat Eared Fox)
- *Raphicerus campestris* (Steenbok)
- *Antidorcas marsupialis* (Springbok)
- *Felix caracal* (spoor)

With respect to amphibians, Minter *et al* (2004) states that “habitat loss or modification as a result of agriculture and other forms of human activity remains the most important single threat to the survival of amphibian populations. The scale of such changes and their relative permanence are the major cause. At greatest risk are species that have

[2] TOPS – Threatened or Protected Species (GN R151 of the National Environmental Management: Biodiversity Act (Act 10 of 2004))

limited distributions." *Tomopterna cryptotis* (Tremolo sand frog) is likely to occur in the bigger area, but were not observed or recorded on site. These species will however be mostly present in the non-perennial drainage river and its riparian zone which will not be impacted upon. These areas are located inside the 100m no development zones.

As reported in Branch (1988) 26 reptile species are likely to inhabit the area. The following reptiles were observed on site during the survey:

- *Psammobates tentorius verroxii* (Tent tortoise)
- *Agama hispida* (Spiny agama)
- *Chondrodactylus turneri* (Turner's thick-toed gecko)
- *Mabaya capensis* (Cape Skink)
- *Stigmochelys pardalis* (Leopard Tortoise)

The Bushmanland tent tortoise (*Psammobates tentorius verroxii*) is one of three sub species of tent tortoise within South Africa. This relatively small tortoise is not typical of the "tent tortoise family", in terms of its carapace shape and form. Although listed in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (http://www.iucnredlist.org) as 'least concern", the tortoise is generally sparsely distributed across the desert regions of South Africa. Other tortoise species that are likely to occur within the subject area include the serrated tortoise (*P oculiferus*) and possible species of padloper (*Homopus spp*). Tortoises are the species of terrestrial fauna most likely to be directly affected by the establishment of PV facilities. Tortoise succumb to habitat change within the PV facility (particularly where points of refuge may be altered – e.g. the loss of scrapes and burrows in the ground or changes in forage material), while fencing in general, may restrict the range of tortoise. The presence of electric fencing may also be lethal to tortoises that directly encounter live wires, as the animal withdraws into its carapace to avoid electrocution. If the tortoise is unable to extend its neck from the shell on account of the presence of the electric fence, it is rendered immobile, leading to the animal eventually starving to death through its inability to forage. Further mortalities may arise during the construction and operation phases, as a consequence of increased vehicular traffic affecting animals both on roadways that lie outside of the site and within construction areas.

No Red Listed amphibian or reptile species are known to occur in the area of the development site. The proposed development will not have a significant impact on reptiles or amphibians. The reptiles and amphibians may move outside the proposed development area during construction, but will be able to move back afterwards.

Invertebrates are also likely to show varying trends in populations across the subject site. As indicated above, habitat and climatic state are the major drivers of faunal presence within the region, with most species being transitory in any given area and their presence being subject to the availability of vegetation cover, water and other resources.

Insect species observed during the survey includes:

- *Lamarckiana sp.*
- *Bullacris intermedia*
- *Lacustana pardanlina*
- *Culex sp*
- *Pseudolynchia canariensis*
- *Messor capensis*
- *Camponotus fulvopilosus*
- *Grysllus simaculatus*
- *Empusa guttula*
- *Psammotermes allocerus*
- *Hodotermes mossambicus*
- *Trithemis arteriosa*
- *Arachnid solifugae*
- *Opistophthalmus spp* (Burrowing scorpions). Possible burrow entrance found during survey)

The impact of the photovoltaic facility on terrestrial fauna is considered to be “moderate to low”, with the most vulnerable species that are likely to be directly affected by mortalities, being tortoise. The most significant effect of the PV facility on terrestrial fauna will however be through the exclusion of certain species from the site, which may in turn, favour other species that are capable of foraging and living within the secured PV facility. For example, predators may be excluded from the site to the benefit of prey species within the PV fence perimeter. Such state may give rise to low level skewing of populations at a localized level, with possible concomitant changes in habitat form and structure associated with such population change.

1.3.9. Birds (Avifauna)

This arid area is home to several large terrestrial bird and raptor species, the most important of which are Ludwig’s Bustard *Neotis ludwigii*, Kori Bustard *Ardeotis kori*, Secretary bird *Sagittarius serpentarius*, Karoo Korhaan *Eupodotis vigorsii,* Verreaux’s Eagle *Aquila verreauxii* and Martial Eagle *Polemaetus bellicosus*. In addition to being classified as threatened regionally and in some cases globally, most of these species are facing significant threats to their survival from existing impacts in the arid parts of South Africa. In addition, this area is home to an assemblage of arid zone adapted smaller bird species including larks, sparrow-larks, chats and others. Most important of these from a conservation perspective are Red Lark *Calendulauda burra* and Sclater’s Lark *Spizocorys sclateri*, both of which are listed as regionally threatened species (Vulnerable and Near-threatened respectively), have very restricted ranges and have been recorded in the broader area within which the study area is situated. Stark’s Lark *Spizocorys starki* is also an important endemic present in the area, and Burchell’s Courser *Cursorius rufus* (Vulnerable) is a nomadic species which occurs in the broader

area[3].

62 species are known to occur in the bigger area (Hockey *et al* 2006). The following species were observed during the survey:

- *Alopochen aegyptiaca*
- *Bubo africanus*
- *Coluba guinea*
- *Neotis ludwigii*
- *Eupodotis vigorsii*
- *Pterolcles namaqua*
- *Charadrius tricollaris*
- *Melicras canorus*
- *Polemaetus bellicosus*
- *Falco biarmicus*
- *Telophorus zeylonus*
- *Corvus albus*
- *Lanius collaris*
- *Hirundo fuligula*
- *Prinia maculosa*
- *Chersomanus albosfasciata var. garrula*
- *Chrthilauda sub coronate*
- *Erythoropygia coryphaeus*
- *Myrmecochchla formicrivora*
- *Philetairus socius*
- *Motacilla capensis*

Considering the bird and habitat data collected on site it is concluded that the following species will be most at risk if the proposed development goes ahead:

- Ludwig's Bustard;
- Kori Bustard;
- Karoo Korhaan;
- Red Lark;
- Sclater's Lark; and
- Stark's Lark.

There are many more endemic but not Red Listed species which will also be of concern, however, this report deemed the above suite of species a good surrogate for those more common species in terms of impact assessment and management.

[3] Smallie. J. (2017). Avifauna Impact Assessment for the Proposed Development of a 100 MWac Solar Photovoltaic Facility (SKEERHOK PV 1) on the farm Smutshoek 395, north-east of Kenhardt, Northern Cape Province.

The proposed development will not impact significantly on any listed bird species. In 1998, 122 South African IBAs were identified and listed in Barnes (1998). This inventory was revised to 112 IBAs in 2015 (Marnewick et al. 2015). IBAs have also had considerable and increasing relevance when responses have been developed to a number of wider environmental issues, such as habitat loss, ecosystem degradation, climate change and the sustainable use of resources. The proposed development is not located inside or in close proximity to an IBA area. The closest IBA to the proposed development is the Mattheus-Gat Conservation Area Bird which is approximately 140km west of the proposed development. There are no known bird flightpaths over the proposed development. Species known to occur in the study site that will be impacted upon by the proposed development, would simply fly away and move out to the surrounding areas during construction and move back afterwards. Generally speaking, the potential effect of Solar PV installations on avifauna is not considered an issue of relevance in a comparative assessment done of Solar PV installations around the world. None of the Red Data Listed avifauna should be specifically threatened, either in number or habitat by the proposed development, should such species occur on the development site they can simply move to extensive, nearby undisturbed habitat during construction and move back afterwards. The solar panels will not sterilise the ecology totally. Vegetation will still grow under and between the open corridors during the operational phase. A possible impact assessed and recorded in this study on avifauna would be collusions with powerlines. Our confidence in predictions based on the availability of information and specialist knowledge is High (70-100%).

Red Listed species of avifauna could include the following:

- *Polemaetus bellicosus*
- *Neotis ludwigii*
- *Falco biarmicus*

1.4. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

The proposed establishment of a PV facility within the study site is considered to elicit a requirement for compliance with the following legislation applicable to this assessment.

- The National Environmental Management: Biodiversity Act (Act 10 of 2004)
- The National Water Act (Act 36 of 1998)
- The National Forest Act (Act 84 of 1998)
- The Northern Cape Nature Conservation Act (Act 9 of 2009)
- The Conservation of Agricultural Resources Act (Act 43 of 1983)

The potential applicability of the abovementioned acts to the subject site is provided below:

The National Environmental Management: Biodiversity Act (Act 10 of 2004)
This Act serves to control the disturbance and land utilisation within certain habitats, as well as the planting and control of certain exotic species. The proposed development, taking place in the identified environment, may not necessitate any particular application for a change in land use from an ecological perspective. However, the effective disturbance and removal of species identified above, as well as possible other species (i.e. TOPS species), will require specific permission from the applicable authorities. In addition, the planting and management of exotic plant species on site, if and where required, will be governed by the Alien and Invasive Species (AIS) regulations, which were gazetted in 2014. These regulations compel landowners to manage exotic weeds on land under their jurisdiction and control.

The National Water Act (Act 36 of 1998)
The National Water Act controls activities in and around water resources, as well as the general management of water resources, including abstraction of groundwater and disposal of water. Authorisation for changes in land use, up to 500 m from a defined (water source) wetland system and 100m from a defined water sources (river) will require an application for a Water Use Licence from the Department of Water and Sanitation. A Water Use Licence will be required in respect of the proposed development under Section 21 (c) and (i), of the Act, however such license should not preclude this development.

The National Forest Act (Act 84 of 1998)
The National Forest Act (Act 84 of 1998) governs the removal, disturbance, cutting or damage and destruction of identified “protected trees”. Listed species that may be encountered within the site include *Boscia* spp (none recorded on the impacted area during field surveys). It is unlikely that an application for the “clearing of a *natural forest*”, as defined within the Act, will be required on the site in question.

The Northern Cape Conservation Act
The Northern Cape Conservation Act under its pertinent regulation governs the disturbance of species listed in above, or possibly other species not yet identified on site. In particular, the relocation or redress of species such as *Psammobates tentorius verroxii, Aloidendron dichotomum* and *Aloe claviflora* will require a permit in terms of this Act to allow for the relocation or confinement of these and other species. Such requirement may arise where the authorisation holder may wish to remove species from site and relocate to another site, or possibly hold specimens for a short period. Permits of this nature have been issued to other Independent Power Producers in order to remove nuisance species such as aardvark.

Invasive species are controlled by the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) - Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014.

This Act will be applicable to the project if and where such plants arise within or adjacent to the project area. Notably most listed alien invasive species are propagated and driven by the disturbance of land during and following construction.

As the proposed sites are not within protected areas, nor within 5 kilometres of a protected area, are not within 10 kilometres of a World Heritage site and do not form part of a critical biodiversity area (CBA), the various regulations within the National Environmental Management Act and the NEM Protected Areas Act are not applicable to this site. It is also noted that the site does not fall within any expansion area in terms of a conservation strategy for the Northern Cape.

1.5. IDENTIFICATION OF KEY ISSUES

The subject site is to be considered a xeric to semi-xeric environment, with limitations in the presence of aquatic or wetland environments in both temporal and spatial terms. With this in mind, consideration of issues arising from the proposed development is undertaken at an integrated level. The following key issues were identified:

1.5.1 Construction Phase

The following potential impacts during the Construction Phase can be summarised:

- Alteration of habitat structure and composition;
- Ousting (and recruitment) of various fauna and avifauna;
- Changes in the geomorphological state of drainage lines (i.e. changes to surface drainage patterns) due to construction activities leading to change in plant communities and general habitat structure, within the site and immediately adjacent to it;
- Increased electrical light pollution, leading to changes in nocturnal behavioural patterns of fauna and avifauna;
- Changes in edaphics (soils) on account of excavation and import of soils, leading to the alteration of plant communities and fossorial species in and around these points; and
- Exotic weed invasion.

1.5.2 Operational Phase:

The following potential impacts during the Operational Phase can be summarised:

- Continued alteration of habitat structure and composition on account of continuing low-level anthropogenic impacts, such as “shading of vegetation” from arrays;
- Ousting (and recruitment) of various fauna and avifauna on account of long-term changes in the surrounding habitat/environment;
- Changes in the geomorphological state of drainage lines on account of long-term climatic changes and the concomitant change in the nature of the catchment on account of the land use change;
- Exotic weed invasion as a consequence of regular and continued disturbance of site;
- Avifauna impacts due to collisions with powerlines here and

- Nesting of birds in and on the constructed infrastructure

1.5.3 Decommissioning Phase

Such alterations and changes will be dependent upon the expectant post-decommissioning land use. However, abandonment of the site would probably result in:

- A reversion to the present stage, where continued grazing by livestock will arise;
- Changes in the geomorphological state of drainage lines as hydraulic changes arise within the catchment; and
- Exotic weed invasion as a consequence of abandonment of site and cessation of weed control measures.

1.5.4 Cumulative Impacts

The cumulative impacts associated with the proposed PV Projects must be seen against the background of the establishment of other, similar PV projects and ESKOM powerlines within the region. It is evident that the incorporation of other land use changes within the region cannot be applied in terms of evaluating cumulative impacts on account of the nature of the prevailing land use (primarily livestock ranching) and the rural and hence sparse and sporadic nature of such changes as they may apply to the region. The consideration of cumulative impacts is of relevance to expansive projects such as this on account of the fact that they generally result in the loss of habitat. A total of 7 other large-scale PV facilities were identified (within 10km of the proposed PV project) as having been authorised or are currently under consideration by one or more authorities. Significant ESKOM powerlines, up to 400kV dissect surrounding area. All if this has an already cumulative impact on the surrounding environment.

Cumulative impacts from a terrestrial ecology perspective

The identified sites have not been subject to further interrogation. Some areas within these sites have been set aside or excluded from development.

However, based on the information at hand, it is evident that:

- Individual PV sites vary between 150ha and 500ha in extent
- All sites fall within the Bushmanland Arid Grassland and Bushmanland Basin Shrubland veld types
- Significant ESKOM powerlines, up to 400kV dissect surrounding area.

While the habitat affected by the PV facilities may be small from a quantitative perspective, some consideration should be given to the following qualitative but cumulative impacts that are likely to arise, these include:

- The increased dissection of habitat on account of increasing levels of infrastructure. The proposed PV facilities and powerlines, as well as associated service roads and other infrastructure will give rise to the further dissection of habitat within the region.
- The increased presence of exotic and disturbance driven plant species. With increasing levels of anthropogenic activity on various sites and within the surrounding area, the propensity for plant invasion or the dominance of species that

are tolerant of higher levels of disturbance will see such species dominating and perhaps ousting other less tolerant species.

- Increased and expanded anthropogenic influences across the region. The nature of the surrounding PV facilities, electrical infrastructure and other support infrastructure suggests that human activity will arise at points that are presently only intermittently visited by a farmer or his staff. Greater levels of human activity can be anticipated across the area, with the likely influence of ousting particular species of fauna and avifauna.
- Vegetation and habitat alteration - change in ecological processes and habitat – reversion to secondary habitat structure at transformed sites.
- Recruitment and behavioural change in fauna and avifauna- changes in ecological processes and habitat.

1.6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

A number of potential impacts have been identified in Section 1.5. These potential negative impacts are given further consideration below, with possible mitigation measures being proposed.

Alternative 1: Preferred Layout	**Ecological Impacts**
PLANNING, DESIGN AND DEVELOPMENT PHASE	
Potential impact and risk:	**Alteration of habitat structure and composition**
Nature of impact:	**The ousting of fauna through anthropogenic activities, disturbance of refugia and general change in habitat.** **Increased shading, as a consequence of the PV arrays, will lead to changes in plant water relations and possible changes in plant community structures within the site.**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss impacted on indigenous vegetation and habitat.**
Probability of occurrence:	**4 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**High**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss impacted on indigenous vegetation and**

	habitat.
Cumulative impact prior to mitigation:	**Loss impacted on indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**56 - Medium**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Non-perennial rivers, pans and sensitive areas as identified in this report and their buffer areas should be avoided and a no-go buffer be applied around them.** **All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted on.** **Care should be taken not to introduce or propagate alien plant species/weeds during construction.** **Plant rescue operations** **Exotic weed control** **Fauna and avifauna sweep of site** **The maintenance of vegetation and avoidance of the "blading" or clearance.**
Residual impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.**
Significance rating of impact after	**48 - Medium**

mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	
OPERATIONAL PHASE	
Potential impact and risk:	**Alteration of habitat structure and composition**
Nature of impact:	**Alteration of ecological processes on account of the exclusion of certain fauna, inherent to the functional state of the land within the PV facility**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss impacted on indigenous vegetation and habitat.**
Probability of occurrence:	**3 (Probable)**
Degree to which the impact may cause irreplaceable loss of resources:	**Moderate**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss impacted on indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**48 - Medium**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Provision of critter paths within the fencing should be considered in the design.** **Promote and support faunal presence and activities within the proposed PV facility**
Residual impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities**

	will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 20km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**36 – Medium**
DECOMMISSIONING AND CLOSURE PHASE	
Potential impact and risk:	**Ecological Processes**
Nature of impact:	**A reversion of present faunal population states within the study area;**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 1 (0 – 1 years)**
Consequence of impact or risk:	**Loss impacted on indigenous vegetation and habitat.**
Probability of occurrence:	**4 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**High**
Degree to which the impact can be reversed:	**High**
Indirect impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss impacted on indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**52 - Medium**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Non-perennial rivers, pans and sensitive**

	areas as identified in this report and their buffer areas should be avoided and a no-go buffer be applied around them. **All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted.** **Care should be taken not to introduce or propagate alien plant species/weeds during construction.** **Plant rescue operations** **Exotic weed control** **Fauna and avifauna sweep of site** **The maintenance of vegetation and avoidance of the "blading" or clearance.**
Residual impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**48 - Medium**

Alternative 2: Alternative Layout	**Ecological Impacts**
PLANNING, DESIGN AND DEVELOPMENT PHASE	
Potential impact and risk:	**Alteration of habitat structure and composition**
Nature of impact:	**Note: Alternative 2's layout does not exclude Bushmanland Basin pan identified during the field survey.** **The ousting of fauna through anthropogenic**

	activities, disturbance of refugia and general change in habitat. **Increased shading, as a consequence of the PV arrays, will lead to changes in plant water relations and possible changes in plant community structures within the site.**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 5**
Consequence of impact or risk:	**Loss impacted on indigenous vegetation and habitat.**
Probability of occurrence:	**5 (Definite)**
Degree to which the impact may cause irreplaceable loss of resources:	**High**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss impacted on indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**85 - High**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Non-perennial rivers, pans and sensitive areas as identified in this report and their buffer areas should be avoided and a no-go buffer be applied around them.** **All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted.** **Care should be taken not to introduce or propagate alien plant species/weeds during construction.** **Plant rescue operations**

	Exotic weed control **Fauna and avifauna sweep of site** **The maintenance of vegetation and avoidance of the "blading" or clearance.**
Residual impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**80 - High**
OPERATIONAL PHASE	
Potential impact and risk:	**Alteration of habitat structure and composition**
Nature of impact:	**Alteration of ecological processes on account of the exclusion of certain fauna, inherent to the functional state of the land within the PV facility**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss impacted on indigenous vegetation and habitat.**
Probability of occurrence:	**3 (Probable)**
Degree to which the impact may cause irreplaceable loss of resources:	**Moderate**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss impacted on indigenous vegetation and habitat.**

Cumulative impact prior to mitigation:	**Loss impacted on indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**42 - Medium**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Provision of critter paths within the fencing should be considered in the design.** **Promote and support faunal presence and activities within the proposed PV facility**
Residual impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 20km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**36 – Medium**
DECOMMISSIONING AND CLOSURE PHASE	
Potential impact and risk:	**Ecological Processes**
Nature of impact:	**A reversion of present faunal population states within the study area**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 1 (0 – 1 years)**
Consequence of impact or risk:	**Loss impacted on indigenous vegetation and habitat.**

Probability of occurrence:	**4 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**High**
Degree to which the impact can be reversed:	**High**
Indirect impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss impacted on indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**44 - Medium**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Non-perennial rivers, pans and sensitive areas as identified in this report and their buffer areas should be avoided and a no-go buffer be applied around them.** **All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted.** **Care should be taken not to introduce or propagate alien plant species/weeds during construction.** **Plant rescue operations** **Exotic weed control** **Fauna and avifauna sweep of site** **The maintenance of vegetation and avoidance of the "blading" or clearance.**
Residual impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if**

	all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**33 - Medium**

Alternative 1: Preferred Layout and 2 Alternative	**Ecological Impacts**
PLANNING, DESIGN AND DEVELOPMENT PHASE	
Potential impact and risk:	**Alteration of surface drainage patterns on account of construction activities leading to change in plant communities and general habitat structure**
Nature of impact:	**The ousting of fauna through anthropogenic activities, disturbance of refugia and general change in habitat** **Changes in the geomorphological state of drainage lines as hydraulic changes arise within the catchment**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss impacted on indigenous vegetation and habitat.**
Probability of occurrence:	**4 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**High**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss impacted on indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**56 - Medium**

Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Non-perennial rivers, pans and sensitive areas as identified in this report and their buffer areas should be avoided and a no-go buffer be applied around them.** **All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted.** **Undertaking and completion of earthworks and road construction outside of the high rainfall period (if possible).** **Avoidance of significant sculpting of land and maintenance of the general topography of the site** **Maintenance of a high level of housekeeping onsite during the construction phase.** **Inspection of drainage features immediately outside of the footprint of the proposed PV facility and undertakes removal of solid waste and litter on a regular basis.**
Residual impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**48 - Medium**

OPERATIONAL PHASE	
Potential impact and risk:	**Alteration of surface drainage patterns on account of construction activities leading to change in plant communities and general habitat structure** **Changes in the geomorphological state of drainage lines as hydraulic changes arise within the catchment**
Nature of impact:	**Alteration of ecological processes on account of the exclusion of certain fauna, inherent to the functional state of the land within the PV facility**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss impacted on indigenous vegetation and habitat.**
Probability of occurrence:	**3 (Probable)**
Degree to which the impact may cause irreplaceable loss of resources:	**Moderate**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss impacted on indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**48 - Medium**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Non-perennial Graafwater River and the pan should be avoided and a no-go buffer of 100m be applied around them.** **All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of**

	surface area is impacted. **Undertaking and completion of earthworks and road construction outside of the high rainfall period (if possible).** **Avoidance of significant sculpting of land and maintenance of the general topography of the site** **Maintenance of a high level of housekeeping onsite during the construction phase.** **Inspection of drainage features immediately outside of the footprint of the proposed PV facility and undertakes removal of solid waste and litter on a regular basis.**
Residual impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**36 – Medium**
DECOMMISSIONING AND CLOSURE PHASE	
Potential impact and risk:	**Ecological Processes**
Nature of impact:	**Alteration of surface drainage patterns on account of construction activities leading to change in plant communities and general habitat structure** **Changes in the geomorphological state of drainage lines as hydraulic changes arise within the catchment**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 1 (0 – 1 years)**
Consequence of impact or risk:	**Loss impacted on indigenous vegetation and habitat.**

Probability of occurrence:	**4 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**High**
Degree to which the impact can be reversed:	**High**
Indirect impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss impacted on indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**52 - Medium**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Non-perennial rivers, pans and sensitive areas as identified in this report and their buffer areas should be avoided and a no-go buffer be applied around them.** **All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted.** **Undertaking and completion of earthworks and road construction outside of the high rainfall period (if possible).** **Avoidance of significant sculpting of land and maintenance of the general topography of the site** **Maintenance of a high level of housekeeping onsite during the construction phase.** **Inspection of drainage features immediately outside of the footprint of the proposed PV facility and undertakes removal of solid waste and litter on a regular basis.**
Residual impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact**

	being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 20km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**48 - Medium**

Alternative 1: Preferred Layout and 2 Alternative	**Ecological Impacts**
PLANNING, DESIGN AND DEVELOPMENT PHASE	
Potential impact and risk:	**Changes in edaphics (soils) on account of excavation of soils, leading to the alteration of plant communities and fossorial species in and around these points.**
Nature of impact:	**Habitat change and alteration in fauna and faunal behaviour**
Extent and duration of impact:	**Extent 1 & Duration 1**
Consequence of impact or risk:	**Loss impacted on indigenous vegetation and habitat.**
Probability of occurrence:	**2 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**Low**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss impacted on indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**8 - Low**
Degree to which the impact can be	**Low**

avoided:	
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Ripping of compact soils when and where extensive compaction arises**
Residual impacts:	**Loss impacted on indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**Low**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**6 - Low**

Alternative 1: Preferred Layout and 2 Alternative	**Ecological Impacts**
PLANNING, DESIGN AND DEVELOPMENT PHASE	
Potential impact and risk:	**Increased electrical light pollution (ELP), leading to changes in nocturnal behavioural patterns amongst fauna**
Nature of impact:	**Habitat change and alteration in fauna and Faunal behaviour**
Extent and duration of impact:	**Extent 1 & Duration 1**
Consequence of impact or risk:	**Loss of significantly impacted upon indigenous vegetation and habitat.**
Probability of occurrence:	**2 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**Low**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss of significantly impacted upon indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss of significantly impacted upon indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**8 - Low**
Degree to which the impact can be avoided:	**Low**

Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Reduce level of lighting and placement of lighting to be judiciously considered at time of implementation**
Residual impacts:	**Loss of significantly impacted upon indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**Low**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**6 - Low**
OPERATIONAL PHASE	
Potential impact and risk:	**Increased ELP, leading to changes in nocturnal behavioural patterns amongst fauna**
Nature of impact:	**Habitat change and alteration in fauna and Faunal behaviour**
Extent and duration of impact:	**Extent 1 & Duration 1**
Consequence of impact or risk:	**Loss of indigenous vegetation and habitat.**
Probability of occurrence:	**2 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**Low**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss of indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**8 - Low**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Reduce level of lighting and placement of**

	lighting to be judiciously considered at time of implementation
Residual impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**Low**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**6 - Low**

Alternative 1: Preferred Layout and 2 Alternative	**Ecological Impacts**
PLANNING, DESIGN AND DEVELOPMENT PHASE	
Potential impact and risk:	**Exclusion or entrapment of in particular large fauna, on account of the fencing of the site.**
Nature of impact:	**Habitat change and alteration in fauna and faunal behaviour**
Extent and duration of impact:	**Extent 1 & Duration 1**
Consequence of impact or risk:	**Loss of indigenous vegetation and habitat.**
Probability of occurrence:	**2 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**Low**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss of indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**8 - Low**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Ensure that the live electrical fence wire is not placed at ground level.** **Conduct regular (daily) inspections of the fence line to address any animals that may**

	be affected by the fence
Residual impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**Low**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**6 - Low**
OPERATIONAL PHASE	
Potential impact and risk:	**Exclusion or entrapment of in particular large fauna, on account of the fencing of the site.**
Nature of impact:	**Habitat change and alteration in fauna and faunal behaviour. Alteration of ecological processes on account of the exclusion of certain fauna, inherent to the functional state of the land within the PV facility.** **The fencing of the site, possibly with electric fencing, is likely to impact on faunal behaviour, leading to the exclusion of certain species and possible mortalities**
Extent and duration of impact:	**Extent 1 & Duration 1**
Consequence of impact or risk:	**Loss of indigenous vegetation and habitat.**
Probability of occurrence:	**2 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**Low**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss of indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**6 - Low**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Ensure that the live electrical fence wire is not placed at ground level.**

	Conduct regular (daily) inspections of the fence line to address any animals that may be affected by the fence **Provision of critter paths within the fencing should be considered in the design.** **Promote and support faunal presence and activities within the proposed PV facility**
Residual impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**Low**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**6 - Low**

Alternative 1: Preferred Layout	**Avifauna Impacts**
PLANNING, DESIGN AND DEVELOPMENT PHASE	
Potential impact and risk:	**Habitat loss/alteration.**
Nature of impact:	**Impact of layout on birds - exclusion of bird species from habitats. Loss of habitat and disturbance of resident bird species.**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss of significantly impacted upon indigenous vegetation and habitat.**
Probability of occurrence:	**4 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**High**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss of indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**56 - Medium**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**

Proposed mitigation:	**Non-perennial rivers, pans and sensitive areas as identified in this report and their buffer areas should be avoided and a no-go buffer be applied around them.** **All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted.** **Care should be taken not to introduce or propagate alien plant species/weeds during construction.** **A site-specific avifaunal walk through should be conducted by a qualified ornithologist as part of the site specific EMP just prior to construction, so as to ensure that no sensitive bird species have started breeding on or near site. If any such sites are found case specific mitigation measures will need to be designed.** **Facility lighting during construction & operation should be kept to a minimum and should make use of latest technology to ensure that light disturbance is minimised. This will also reduce the attraction of insects (and in turn insectivorous birds) to the facility.**
Residual impacts:	**Loss of significantly impacted upon indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**48 - Medium**

OPERATIONAL PHASE	
Potential impact and risk:	**Habitat loss/alteration.**
Nature of impact:	**Impact of layout on birds - exclusion of bird species from habitats. Loss of habitat and disturbance of resident bird species.**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss of indigenous vegetation and habitat.**
Probability of occurrence:	**3 (Probable)**
Degree to which the impact may cause irreplaceable loss of resources:	**Moderate**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss of indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**48 - Medium**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Daily management must discourage the avifauna from entering the solar field as well as limiting nesting and breeding grounds within the solar field. None required for the impact of the facility on birds. For the impact of the birds nesting on the facility, we recommend nest management on a case by case basis under the supervision of an avifaunal specialist and in conformance with all relevant national and provincial legislation. Survey vantage points must include the whole PV facility, substations and powerlines all the way to the Aries substation.** **We recommend that the operational phase EMP include provision for application to the**

	provincial authority for permits for any necessary nest management. **Facility lighting during operation should be kept to a minimum and should make use of latest technology to ensure that light disturbance is minimised. This will also reduce the attraction of insects (and in turn insectivorous birds) to the facility.**
Residual impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**36 – Medium**
DECOMMISSIONING AND CLOSURE PHASE	
Potential impact and risk:	**Habitat loss/alteration.**
Nature of impact:	**Impact of layout on birds - exclusion of bird species from habitats. Loss of habitat and disturbance of resident bird species.**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss of indigenous vegetation and habitat.**
Probability of occurrence:	**4 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**High**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss of indigenous vegetation and habitat.**

Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**56 - Medium**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Non-perennial rivers, pans and sensitive areas as identified in this report and their buffer areas should be avoided and a no-go buffer be applied around them.** **All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted.** **Care should be taken not to introduce or propagate alien plant species/weeds during construction.** **A site-specific avifaunal walk through should be conducted by a qualified ornithologist as part of the site specific EMP just prior to construction, so as to ensure that no sensitive bird species have started breeding on or near site. If any such sites are found case specific mitigation measures will need to be designed.** **Facility lighting during construction & operation should be kept to a minimum and should make use of latest technology to ensure that light disturbance is minimised. This will also reduce the attraction of insects (and in turn insectivorous birds) to the facility.**
Residual impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are**

	adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**48 - Medium**

Alternative 2: Alternative Layout	**Avifauna Impacts**
PLANNING, DESIGN AND DEVELOPMENT PHASE	
Potential impact and risk:	**Habitat loss/alteration.**
Nature of impact:	**Note: Alternative 2's layout does not exclude Bushmanland Basin pan identified during the field survey.** **The Sociable Weaver, inhabits the dry parts of the Northern Cape. These birds utilize more *Aloidendron dichotomum* (Quiver Trees) than thorn trees for nests because in many areas the biggest trees available are these tree aloes.** **Birds are drawn to these flowers in winter where they feed on the nectar produced by the flowers.** **Impact of layout on birds - exclusion of bird species from habitats. Loss of habitat and disturbance of resident bird species.**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss of indigenous vegetation and habitat.**
Probability of occurrence:	**5 Definite**
Degree to which the impact may cause irreplaceable loss of resources:	**High**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss of indigenous vegetation and habitat.**

Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**70 - High**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Non-perennial rivers, pans and sensitive areas as identified in this report and their buffer areas should be avoided and a no-go buffer be applied around them.** **All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted.** **Care should be taken not to introduce or propagate alien plant species/weeds during construction.** **A site-specific avifaunal walk through should be conducted by a qualified ornithologist as part of the site specific EMP just prior to construction, so as to ensure that no sensitive bird species have started breeding on or near site. If any such sites are found case specific mitigation measures will need to be designed.** **Facility lighting during construction & operation should be kept to a minimum and should make use of latest technology to ensure that light disturbance is minimised. This will also reduce the attraction of insects (and in turn insectivorous birds) to the facility.**
Residual impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are**

	adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**70 - High**
OPERATIONAL PHASE	
Potential impact and risk:	**Habitat loss/alteration.**
Nature of impact:	**Note: Alternative 2's layout does not exclude Bushmanland Basin pan identified during the field survey.** **The Sociable Weaver, inhabits the dry parts of the Northern Cape. These birds utilize more *Aloidendron dichotomum* (Quiver Trees) than thorn trees for nests because in many areas the biggest trees available are these tree aloes.** **Birds are drawn to these flowers in winter where they feed on the nectar produced by the flowers.** **Impact of layout on birds - exclusion of bird species from habitats. Loss of habitat and disturbance of resident bird species.**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss of indigenous vegetation and habitat.**
Probability of occurrence:	**3 (Probable)**
Degree to which the impact may cause irreplaceable loss of resources:	**Moderate**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss of indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation	**42 - Medium**

(e.g. Low, Medium, Medium-High, High, or Very-High)	
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**None required for the impact of the facility on birds. For the impact of the birds nesting on the facility, we recommend nest management on a case by case basis under the supervision of an avifaunal specialist, and in conformance with all relevant national and provincial legislation.** **We recommend that the operational phase EMP include provision for application to the provincial authority for permits for any necessary nest management.** **Facility lighting during construction & operation should be kept to a minimum and should make use of latest technology to ensure that light disturbance is minimised. This will also reduce the attraction of insects (and in turn insectivorous birds) to the facility.**
Residual impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**36 – Medium**
DECOMMISSIONING AND CLOSURE PHASE	

Potential impact and risk:	**Habitat loss/alteration.**
Nature of impact:	**Note: Alternative 2's layout does not exclude Bushmanland Basin pan identified during the field survey.** **The Sociable Weaver, inhabits the dry parts of the Northern Cape. These birds utilize more *Aloidendron dichotomum* (Quiver Trees) than thorn trees for nests because in many areas the biggest trees available are these tree aloes.** **Birds are drawn to these flowers in winter where they feed on the nectar produced by the flowers.** **Impact of layout on birds - exclusion of bird species from habitats. Loss of habitat and disturbance of resident bird species.**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss of indigenous vegetation and habitat.**
Probability of occurrence:	**5 Definite**
Degree to which the impact may cause irreplaceable loss of resources:	**High**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss of indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**70 - High**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Non-perennial rivers, pans and sensitive areas as identified in this report and their**

	buffer areas should be avoided and a no-go buffer be applied around them. **All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted.** **Care should be taken not to introduce or propagate alien plant species/weeds during construction.** **A site-specific avifaunal walk through should be conducted by a qualified ornithologist as part of the site specific EMP just prior to construction, so as to ensure that no sensitive bird species have started breeding on or near site. If any such sites are found case specific mitigation measures will need to be designed.** **Facility lighting during construction & operation should be kept to a minimum and should make use of latest technology to ensure that light disturbance is minimised. This will also reduce the attraction of insects (and in turn insectivorous birds) to the facility.**
Residual impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.**
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**70 - High**

Alternative 1 and 2: Preferred and alternative layout	**Avifauna Impacts**

PLANNING, DESIGN AND DEVELOPMENT PHASE	
Potential impact and risk:	**Collusion with powerlines and electrocution.**
Nature of impact:	**Loss of bird species**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss of indigenous vegetation and habitat.**
Probability of occurrence:	**4 (most likely)**
Degree to which the impact may cause irreplaceable loss of resources:	**High**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss of indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**64 - High**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Construct powerlines in existing and approved servitudes and routes.**
Residual impacts:	**Loss of bird species**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE rather than the current HIGH.**
Significance rating of impact after mitigation	**60 - Medium**

(e.g. Low, Medium, Medium-High, High, or Very-High)	
OPERATIONAL PHASE	
Potential impact and risk:	**Collusion with powerlines and electrocution.**
Nature of impact:	**Loss of bird species**
Extent and duration of impact:	**Extent 2 (On site or within 100 m of the site) & Duration 4 (>15 years)**
Consequence of impact or risk:	**Loss of indigenous vegetation and habitat.**
Probability of occurrence:	**3 (Probable)**
Degree to which the impact may cause irreplaceable loss of resources:	**Moderate**
Degree to which the impact can be reversed:	**The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken**
Indirect impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact prior to mitigation:	**Loss of indigenous vegetation and habitat.**
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**48 - Medium**
Degree to which the impact can be avoided:	**Low**
Degree to which the impact can be managed:	**High**
Degree to which the impact can be mitigated:	**Moderate**
Proposed mitigation:	**Bird monitoring is required. Bird striking's must be recorded and reflectors installed at collusion zones.**
Residual impacts:	**Loss of indigenous vegetation and habitat.**
Cumulative impact post mitigation:	**In terms of cumulative impacts, the construction of multiple additional facilities will result in the overall cumulative impact being HIGH negative. The cumulative impact assessment assumes the worst-case scenario of up to 7 solar facilities being constructed in this 10km radius. However, if all the mitigation measures in the EMP are adhered to, this would reduce the significance of the impacts by approximately half. This would probably result in the significance being rated as MODERATE**

	rather than the current HIGH.
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	**36 – Medium**
DECOMMISSIONING AND CLOSURE PHASE	
Potential impact and risk:	**None. Impact removed**
Nature of impact:	
Extent and duration of impact:	
Consequence of impact or risk:	
Probability of occurrence:	
Degree to which the impact may cause irreplaceable loss of resources:	
Degree to which the impact can be reversed:	
Indirect impacts:	
Cumulative impact prior to mitigation:	
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	
Degree to which the impact can be avoided:	
Degree to which the impact can be managed:	
Degree to which the impact can be mitigated:	
Proposed mitigation:	
Residual impacts:	
Cumulative impact post mitigation:	
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	

1.7. INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

Utilising the above information must be included in the Environmental Management Programme that would be associated with the proposed development.

Pre-Construction:

- Pre-construction evaluation and possible plant rescue operations;

- A site-specific avifaunal walk through should be conducted by a qualified ornithologist
- Identification of laydown areas, roadways and infrastructure, particularly in respect of floral and faunal presence; and
- Authorizations, Licenses or permitting requirements in terms of the National Water Act and Northern Cape Conservation Act.

Construction Phase:

- Site induction and interaction on ecological aspects;
- Site inspection of any fauna and avifauna within the construction area during post fencing completion;
- Monitoring of operations, including species presence within site, mortalities and sightings;
- Maintenance of vegetation and avoidance of unnecessary clearance of site;
- Exotic weed management; and
- Erosion control measures to be implemented where applicable.

Operational Phase:

- Monitoring of faunal and avifauna activities within the fenced area of the site and immediate proximity of site;
- Management of faunal intrusion through the fencing, including possible mortalities;
- Consideration of lighting regime around the site and the impact of ELP.
- Nest management on a case by case basis under the supervision of an avifaunal specialist, and in conformance with all relevant national and provincial legislation.
- Vegetation management on site – consideration of redress methods of growth and habitat form around site;
- Exotic weed management; and
- Erosion control measures.
- Bird monitoring is required. Bird striking's must be recorded and reflectors installed at collusion zones should such collusion zones become evident during monitoring.

1.8. CONCLUSION AND RECOMMENDATIONS

The ecological and avifauna assessment of the proposed PV site included a comparative review of the entire property on the relevant portion of the Farm Olyvenkolk 187/6 which lies within the proposed PV complex. Such evaluation included consideration of the bio physical state of drainage systems, topographical features, avifauna and a holistic review of all components within the ecological landscape. The evaluation of the results of desktop and field surveys and sampling identified and served to develop a plan for the exclusion of particular areas from any proposed development of a PV facility. The sampling and analysis of the site during the early and late summer season, as well as other seasons provides suitable data and results to present an informed decision on the local ecology.

Included in the assessment was consideration of terrestrial and hydrological systems, as well as fauna and avifauna. Major impacts identified as a consequence of the development proceeding relate to, *inter alia*:

- Changes in the broader habitat as a consequence of variation in physical factors within the site (e.g. shading of vegetation, changes in surface water flow regime);
- Changes in the broader surface and possibly sub surface hydrology; and
- The ousting, and in some cases, recruitment of species, with subsequent variation in populations in and around the development.
- The possible impact of the powerlines on avifauna species.

The ecological evaluation has determined that with the exclusion of the identified non-perennial Graafwater River and Nama Karoo Bushmanland Flat Pan from the development, within the subject site, the requisite ecological components associated with these features will be retained in a broader perspective, with only subtle changes to the eco-geomorphology of these systems becoming evident on minor drainage features or where plant communities may have to be removed or relocated. There will be minor to moderate changes evident in the terrestrial environment resulting from the development, which in turn will be manifest in changes in faunal and avifauna components of the environment.

The alternative layout is not supported as it will have an impact on ecological features. The layout assessed will impact on a Nama Karoo Bushmanland Flat Pan.

Given the above information, it is evident that with the placement of the proposed solar PV facility as per the preferred layout and within the boundaries of the areas identified, this development and mitigation measures included in the EMPr, this development will have a low to medium impact on ecological features.

As such, authorisation may be granted for the proposed preferred layout and development of the site as a PV generation facility. Management of the site should however include:

- Avoidance of excessive clearance of vegetation within the site;
- Management of exotic weed invasion that may arise;
- Management of fauna and avifauna within the site and surrounds, as well as the incorporation of “wildlife” porosity into fence lines and the implementation of measures on the energised fence line to avoid mortalities to wildlife;
- General land management practices to avoid excessive erosion, dust emissions and possible sources of pollution to ground and surface water resources.
- Construction of powerlines within existing servitudes and next to existing powerlines as far as possible to avoid impacts on avifauna; and
- Monitoring of powerlines and PV facility in terms of the EMPr requirements

The report finds that the proposed development should not impact negatively on any

conservation worthy species. No significant breeding, roosting or habitat on the site will be impacted upon. Most living organisms will move out of the area when construction starts and back when construction is finished. Those ones not mobile, such as tortoises, snakes, invertebrates, reptiles and plants, must be search and rescued. Areas disturbed during construction should be rehabilitated. The 100m buffer area next to the non-perennial Graafwater River and Nama Karoo Bushmanland Flat pan must be maintained.

Riparian and wetland systems were identified within 500m, and within 100m from a watercourse. An application in terms of Section 21 c and i, of the National Water Act (1998) is required to be submitted to the mandated authority.

No additional survey or further assessment is in our view recommended.

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