Scoping and Environmental Impact Assessment for the proposed Development of a 75 MW Solar Photovoltaic Facility (GEMSBOK SOLAR PV6) on Portion 8 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape Province

EIA REPORT

CHAPTER 9:

Avifaunal Impact Assessment

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LIST OF ABBREVIATIONS

BFD	Bird Flight Diverter
DEA	Department of Environmental Affairs
EBA	Endemic Bird Area
EIA	Environmental Impact Assessment
IBA	Important Bird Area
QDGC	Quarter-degree square cell
SBA	Secondary Bird Area

GLOSSARY

Definitions	
Acute effect value	The concentration at and above which statistically significant acute adverse effects are expected to occur.
Aquifer	A geological formation that has structures or textures that hold water or permit appreciable water movement through them.
Aquitard	A formation or group of geological formations with low permeability that retards the flow of groundwater.
Azonal habitat	A habitat type that is small and imbedded within larger habitat units. It is often not possible to map azonal habitat types.
Chronic effect value	The concentration limit that is safe for all or most populations even during continuous exposure.
Guild	A manner or way a species forage and breed to minimise competition with other species. Complex habitat types are often characterised by high guild diversity.
Passerine	Small birds of the large order Passeriformes. These species are often referred to as perchin birds.
Stenotopic	Pertaining to a bird species that are specialised or requires specialised habitat during part o its life-cycle (e.g. gravel, sandy soils).
Acute effect value	The concentration at and above which statistically significant acute adverse effects ar expected to occur.

EXECUTIVE SUMMARY

The information provided in this report forms part of a Stage 2 initial baseline avifaunal investigation. Data sources included relevant literature, observations obtained during a site investigation (04 – 11 December 2015) and (3) personal correspondence with avifaunal specialists.

The following key considerations were identified and noted:

- Various sampling techniques (including bird point counts) were used to evaluate bird richness and relative abundance in the proposed study area (primarily by means of fixed point counts);
- Eleven bird species habitat types were identified, ranging from *Salsola – Stipagrostis* short shrubveld, *Salsola* outcrops and gravel plains to *Prosopis glandulosa* watercourses and artificial livestock watering points. The artificial watering points and shrubveld correlated with high bird species richness, while the quartz gravel plains provided habitat for specialised bird species (mainly larks);
- A total of 88 bird species was confirmed during the investigation in the study area;
- The study area supported habitats for many Threatened and Near-threatened bird species, with five species recorded during the investigation: Martial Eagle *Polemaetus bellicosus* (Endangered), Ludwig's Bustard *Neotis ludwigii* (Endangered), Red Lark *Certhilauda burra* (Vulnerable), Karoo Korhaan *Eupodotis vigorsii* (Near Threatened) and Sclater's Lark *Spizocorys sclateri* (Near Threatened);
- The study area supported a high richness of near-endemic species and bird species restricted to the Namib-Karoo Biome;
- The study area was represented by three distinct avifaunal assemblages consisting of an assemblage confined to the *Prosopis glandulosa* watercourses, an assemblage confined to the artificial watering points and a large and varied assemblage confined to the shrubveld – outcrop mosaics;
- A large part of the study area contains sensitive habitat based on the occurrence of Threatened and Near-threatened bird species. The artificial livestock watering holes, dams and all quartz and dolerite outcrops were identified as being of high avifaunal sensitivity. Most of these areas support local populations of the Threatened Ludwig's Bustard and Red Lark and the near Threatened Karoo Korhaan and Sclater's Lark. In addition, it also provides habitat for the Burchell's Courser, *Cursorius rufus* and Lanner Falcon *Falco biarmicus*.

A list of potential impacts and the pre-mitigation significance of these impacts that could occur during the phases of the project are detailed below:

Construction phase impacts:

- Habitat loss, fragmentation and displacement of Threatened and Near -Threatened species and species loss – The significance ranges from Very high to Moderate (before mitigation) and from High to Low (after mitigation) depending on the sensitivity of the site.
- Displacement and disturbances caused to birds due to noise generation – The significance is High (before mitigation) and Moderate (after mitigation).

Operational phase impacts:

- Increased bird mortalities due to collision with the infrastructure – The significance is Moderate (before mitigation and after mitigation).

- Cleaning of the solar PV panels could result in water pollution – The significance is negligible (before and after mitigation) since filtered water will be used.
- Facilitation of nest –building activities and roosting of birds – The significance is Moderate (before mitigation) and Low (after mitigation).
- Bird mortalities caused by collision with overhead power lines –The significance is Very high (before mitigation) and High (after mitigation).

Decommissioning phase impacts:

- Increased competition with generalist species and a decline in species richness during rehabilitation – The significance is Moderate (before mitigation) and Low (after mitigation).

Cumulative impacts:

- Exploitation of natural resources by the workforce during construction and operation –The significance is High (before mitigation) and Moderate (after mitigation).
- Increased loss of habitat and bird mortalities on a regional scale – The significance is Very high (before mitigation) and High (after mitigation).

Key mitigation measures include:

- Additional long-term data collection and analysis of bird distribution and abundance to refine the sensitivity analysis;
- Concentrating development on areas with lower avifaunal sensitivity;
- Appropriate marking of power lines with bird flight devices and monitoring their effectiveness;
- Applying buffer zones to sensitive habitat types and sensitive features;
- Where possible (depending on the sensitivity of the habitat and the surface area of the habitat), increase the distance between neighboring arrays (currently 3 m) and allow for single-axis tracking of the sun which will increase the amount and frequency of sunlight made available to the vegetation underneath the arrays (thereby decreasing the “shade-out” effect). This will facilitate rehabilitation which will minimize possible changes/ shifts to the avifaunal composition (with relevance to specialists vs. generalists); and
- Avoid construction at or in close proximity to sensitive areas (this is especially relevant to optimal breeding habitat and at areas where these birds were observed) during the months of August – November when most korhaan, bustard and lark species are breeding.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R982	Addressed in the 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;	Appendix A of the EIA Report
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix B of the EIA Report
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 9.1.1.1.
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 9.1.1.3. and Section 9.1.1.5.
e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	Section 9.1.1.3.
f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	Section 9.3.1.5.
g) an identification of any areas to be avoided, including buffers;	Section 9.3.1.5. and Section 9.6.1.3 (also Section 9.8)
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;	Layout maps of the proposed footprint of the sites were provided.
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 9.1.1.5.
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 9.3
k) any mitigation measures for inclusion in the EMPr;	Section 9.6
l) any conditions for inclusion in the environmental authorisation;	Section 9.8 and Section 9.9
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9.8
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 9.9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	EWT representative (Bird and Renewable Energy Manager, Samantha Ralston-Paton)
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Yes, please refer to draft guideline document from BirdLife SA (Jenkins et al., 2015)
q) any other information requested by the competent authority.	No

9 AVIFAUNAL ASSESSMENT

9.1 INTRODUCTION AND METHODOLOGY

This chapter presents the Avifaunal Impact Assessment that was prepared by Mr. Lukas Niemand (of Pachnoda Consulting cc) as part of the EIA for the proposed solar PV facility of the Phase 2 Nieuwehoop Solar Park near Kenhardt in the Northern Cape Province.

9.1.1 Scope and Objectives

The scope of work and objectives for the current study are summarised as follow:

- To describe the relevant baseline conditions relating to the avifaunal assemblages in the study area;
- To provide a database of bird assemblages/species/taxa confirmed from the area of investigation;
- An indication of important bird habitat and protected areas on or near the study area that hold important bird congregations likely to be affected by the proposed development;
- An indication of possible bird flight routes corresponding to the study area;
- To provide an indication of the occurrence of globally and nationally threatened and near threatened bird species on the study area;
- An indication of the likelihood or risk of bird collisions;
- To describe the anticipated impacts of the proposed development on the avifauna during the construction and operational phase;
- To provide recommendations and a description on how the negative environmental impacts as described above will be managed;
- To consider the cumulative impacts of the proposed development on the avifauna of the area; and
- To identify the need for a monitoring program during the construction and operational phases.

9.1.2 Terms of Reference

The terms of reference include the following:

- A description of the dominant species and functional guilds occurring in the area, including migratory species and their habitat associations;
- A description of the different micro-habitat types and important bird foraging and roosting sites on the study site;
- A description of threatened, rare, endemic or conservation important species in the area; and
- A description of the relative ecological importance of the specific habitat types in the area under investigation.

The investigation entailed three components which are discussed in more detail below:

1. A literature review of the bird communities relevant to the study area;
2. A site visit and habitat evaluation phase; and
3. A reporting component.

Component 1: Literature Review

Component 1 consisted of a literature review of the area under investigation to collate as much information as possible prior to fieldwork. This will include (although was not limited to):

- Previous biodiversity studies conducted in the area;
- Relevant sources of information such as:
  - The IUCN Red list for bird species, Version 2015-4;
  - The national Red Data Book of Birds (Taylor *et al.,* 2015);
  - The South African Bird Atlas Project 1 (Harrison *et al*., 2004) and SABAP2;
  - The important bird and biodiversity areas of South Africa (Marnewick *et a*l., 2015);
  - The database of the Coordinated Road Counts;
  - Communication with other avifaunal specialists; and
  - Guidelines to minimise the impact on birds of Solar Facilities and Associated Infrastructure in South Africa (Smit, 2012)[1].

Component 2: Field Work

Component 2 entailed a site visit (undertaken from 4-11 December 2015) and assessment of macro-habitat characteristics with the aim to evaluate the bird assemblages and potential bird flight routes in relation the proposed development. Data were collected by means of fixed point counts to evaluate the dominance and presence of bird species from each particular habitat area.

Fieldwork included the following:

- Active searching and the compilation of a bird inventory while traversing as much of the habitat types as possible;
- The occurrence of cryptic or elusive Red Data species was verified by playback of their respective calls;
- The identification and mapping of areas while focusing on structural and topographical cues that represent suitable habitat for species of concern;
- A landscape analysis of important flyways or daily flight paths corresponding to important landscape features (e.g. rivers, ravines and topographical features); and
- Preliminary density estimates were collected by means of point counts to evaluate the dominant/typical species and their respective relative densities at each site. At each point the number of bird species seen was recorded, as well as their respective abundances and distance from the observer (by means of a rangefinder). Each point count lasted approximately 10 minutes. To ensure the independence of observations, points were at least 200 m apart. The data generated from the point counts were analysed according to Clarke and Warwick (1994) based on the computed percentage contribution (%) of each species including the consistency (calculated as the similarity coefficient/standard deviation) of its contribution to each habitat type.

Component 3: Compilation of Specialist Report

Component 3 entailed the compilation of this specialist bird report and consist of the following:

- A description of the relevant baseline conditions associated with the bird community corresponding to the study area;
- An indication of important bird habitat in or near the study area;
- An indication of the occurrence of Threatened, Near -Threatened or endemic bird species, including those with restricted distribution ranges;
- An identification of "hotspot" areas or areas with high concentrations of birds (important foraging or roosting areas) within, or in close proximity to the study area;
- The compilation of a sensitivity map;
- A description of potential impacts, and practical mitigation measures to be implemented ; and

[1] The assessment was conducted according to the guidelines proposed by Smit (2012). However, it should be noted that new draft guidelines (Jenkins *et al*., 2015) appeared during this study. .

- The need for monitoring programs during pre-construction and operational phases of the project.

9.1.3 Approach and Methodology

Literature review and information base
A literature review of the area under investigation was commissioned to collate as much information as possible prior to fieldwork and data collection. The information sources literatures were consulted and are considered as key references:

- Hockey *et. al.* (2005), Harrison *et. al.* (1997) and del Hoyo *et. al.* (1992-2011) were consulted for general information on the life history attributes of the relevant bird species. They also provide basic distributional information on a small scale;
- Marnewick *et al*. (2015) was consulted for information regarding the biogeographic affinities (e.g. restricted-range species or species restricted to a particular biome) of selected bird species in the study area;
- The conservation status of bird species was categorised according to the global IUCN Red List of threatened species (IUCN, 2015) and a recent regional conservation assessment by Taylor *et al*. (2015);
- Distributional data was sourced from the first South African Bird Atlas Project (SABAP1) and verified against Harrison *et. al.* (1997) for species corresponding to the quarter-degree grid cells (QDGC) 2921AB (Witdorp) and 2921AD (Steynsput). The SABAP1 data provide a "snapshot" of the abundance and composition of species recorded within a quarter degree grid cell (QDGC) which was the sampling unit chosen (corresponding to an area of approximately 15 min x 15 min). It should be noted that the atlas data makes use of reporting rates that were calculated from observer cards submitted by the public as well as citizen scientists. It provides an indication of the thoroughness of which the QDGCs were surveyed between 1987 and 1991;
- Additional distributional data were sourced from the second South African Bird Atlas Project (SABAP2; www.sabap2.adu.org.za). Since bird distributions are dynamic (based on landscape changes such as fragmentation and climate change), SABAP2 was born (and launched on 1 July 2007) from with the main difference being SABAP1 that all sampling is done at a finer scale known as pentad grids (5 min lat x 5 min long, equating to 9 pentads within a QDGC). Therefore, the data are more site-specific, recent and more comparable with observations made during the site visit (due to increased standardisation of data collection). The pentad grids relevant to this project include (7 grids) 2905_2115, 2905_2120, 2905_2125, 2910_2115, 2910_2120, 2915_2115 and 2915_2120; and
- The choice of scientific nomenclature, taxonomy and common names were recommended by the International Ornithological Committee (the IOC World Bird Names, V.6.1), unless otherwise specified (see www.worldbirdnames.org as specified by Gill and Donsker, 2016). The updated nomenclatural sequence of Hackett *et. al*. (2008) and del Hoyo *et. al*. (2014) were adopted according to recent phylogenetic studies which differ from the more traditional classification of Sibley and Ahlquist (1990). Colloquial (common) names were used according to Hockey *et. al.* (2005) to avoid confusion.

Field surveys, data collection and analyses
Field surveys were performed during the latter part of the "short" Nama-Karoo wet season (the rainy season is bimodal and a short period of rain is also evident during late November and early December). The study site was visited during 04 - 11 December 2015. In order to describe the baseline conditions and the avifaunal assemblages in the study area, it was necessary to obtain information on the local distribution and abundance of species present by applying the following techniques:
__Point count surveys__

Local bird distribution and abundance data were collected by means of 49 fixed point counts (Buckland *et. al.,* 1993; Ralph *et al.* 1995; Sutherland *et al*. 2004) to determine dominant and indicator species, and to differentiate between the assemblages present in the study area (Figure 9.1). It also provides an indication of the relative abundance of each species and will be used during the pre-construction monitoring phase to obtain estimates of the relative density of the passerine assemblage. The use of point counts is the preferred method to use for cryptic or elusive species. It is also the preferred method for line transect counts where access is problematic, or when the terrain is complex. It is very efficient for gathering a large amount of data in a short period of time (Sutherland, 2006). The spatial placement of the point counts was determined by a stratified random sampling design which strove to ensure coverage of each habitat type (Sutherland *et al.,* 2004).

All point counts were located at least 200 m apart to improve the independence of observations. Each point count was surveyed for a period of 30 minutes using Swarovski 8.5 x 42 EL binoculars and a Swarovski 30-70 x 95 ATX spotting scope. The following data were collected when surveying a point: the identity of each bird seen, the number of individuals of each species seen during each observation (group size) and the distance between the observer and the bird/group expressed in meters (using a Bushnell Laser Rangefinder). Observations were truncated at 200 m in order to standardize data collection and to ensure independence of observations. Based on the truncation, the average area of each point is 12.56 ha. The following assumptions were adhered to (Buckland *et al*., 1994):

- All birds on the point must be seen and correctly identified. This assumption is almost impossible to meet in the field as some birds in the vicinity may be overlooked due to cryptic plumage, elusive behavior and non-vocalization (especially true for members of the Alaudidae larks). Therefore, it can only be assumed that the proportion of birds seen during the point count represents the total assemblage at the point.
- All birds must be recorded at their initial location. None of the birds moved in response to the presence of the observer, and birds flying past without landing were omitted from the analysis. In other words, no bird was recorded more than once.

<u>Ad hoc (random) surveys</u>

To obtain a more complete inventory of birds present (apart from those observed during the point counts), all bird species observed while moving between point counts were identified and noted. Particular attention was devoted to suitable roosting, foraging and nesting habitat for Threatened or Near- threatened species. Besides visual observations, bird species were identified by means of their calls and other signs such as nests, discarded egg shells and feathers.

<u>Playback/broadcasting of bird vocalisations</u>

The playback of bird calls/songs was used to detecting/confirm the occurrence of elusive or cryptic species where it is possible that a species could be overlooked when not vocal or actively foraging (e.g. certain lark species such as Sclater's Lark *Spizocorys sclateri*). Special care was taken to keep disturbance to a minimum and not to affect the bird's natural behavior (e.g. to prevent unnecessary habituation).

<u>Primary analyses and matrix</u>

All data collected were presented in a matrix, with rows representing the relative abundances of each bird species, and columns representing respective point counts within each of the sampled habitat types (see Niemand, 2001). This matrix formed the basis for the proceeding analyses (Appendix 1).

The observations were converted to relative abundance values. The relative abundances of each species in each habitat type were standardized due to unequal sample sizes of the point counts located within each habitat type. There are several measures to describe the similarity of species abundance values between samples, and in this study the Bray-Curtis similarity coefficient was used. The index describes the similarity between species a and b (B-CSab) and was calculated as:

$$B\text{-}CSab = (2\sum \min (x\_ca,x\_cb))/(\sum x\_ca\sum x\_cb)$$

where xca and xcb are fourth-root transformed parameters (abundance, relative densities) of species a and species b respectively.

All multivariate analyses were performed using the software package PRIMER v5.0. This was done by calculating Bray-Curtis similarities between every pair of samples to construct a similarity matrix. This matrix was subsequently used to discriminate between habitat types through cluster analysis and ordination techniques (using non-metric multidimensional scaling) and analysis of similarities. The importance of very abundant species had to be down-weighted in order to give some importance to low abundance or rare species. This was achieved by performing a fourth root transformation on the data (Clarke and Warwick, 1994).

Patterns in community/assemblage composition
A comparison of the avifaunal communities relative to each habitat type was performed using multivariate community analysis of Bray-Curtis similarity coefficients. The calculated similarity matrix of transformed data was exposed to a cluster analyses based on hierarchical agglomerative clustering with group-average linking, as described by Clarke and Warwick (1994). Therefore sampling entities (point counts) that group together (being more similar) have similar bird compositions. Hierarchical agglomerative clustering was used to map the inter-relationships between the point counts in an ordination with a specified number of dimensions (Kruskal and Wish, 1978). Significant differences between the assemblages or samples within a cluster were tested using the program ANOSIM (Clarke and Green, 1988).

The program SIMPER was used to determine the percentage contribution of each species to each habitat type, as well as the consistency of its contribution to the similarity between the different point counts in each habitat type (Clarke and Warwick, 1994). Species with high consistencies represent typical species for the given community. The same program was used to measure the dissimilarity between habitat types. Therefore, species that contribute most to the dissimilarity between two sites are good discriminant/indicator species of the particular habitat (Niemand, 2001).

Patterns in abundance and diversity
The mean number of species (S) and Shannon-Weaver diversity index (H') were calculated for each habitat type (refer to Magurran (1988) for a description of the Shannon-Weaver diversity index).
Rarefaction was used to calculate the expected number of species (E[Sn]) in a random sample of n individuals less than the original sample of N individuals. The advantage of rarefaction is that it adjusts the number of species expected from each sample if all were reduced to a standard size.

All observations were processed and submitted to the South African Bird Atlas Project (SABAP2).

9.1.4 Avifaunal sensitivity

The avifaunal sensitivity of any piece of land is based on its inherent ecosystem service and overall preservation of biodiversity. In addition, the sensitivity of any piece of land is a key consideration when identifying impacts.

Ecological Function and Connectivity
The extent to which a site is ecologically connected to surrounding areas is an important determinant of its sensitivity. Systems with a high degree of landscape connectivity or with extensive woodland and drainage systems are considered to be more sensitive and will be those contributing to important avifaunal flyways or overall preservation of bird diversity.

Avifaunal Importance

Avifaunal importance relates to species diversity, endemism (unique species or unique processes) and the presence of topographical features or primary habitat with the intrinsic ability to sustain threatened species and those protected by legislation.

Sensitivity Scale

- *High* – Sensitive ecosystems with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered to be important for the maintenance of ecosystem integrity (e.g. riverine floodplains and woodland). Most of these systems represent ecosystems with high connectivity with other important bird flight paths or with high bird diversity while providing suitable habitat for a number of threatened or rare species. These areas should be protected;
- *Medium* – These are partially modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems or ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species; and
- *Low* – Degraded and highly disturbed/transformed systems with little ecological function and are generally very poor in species richness and guild diversity.

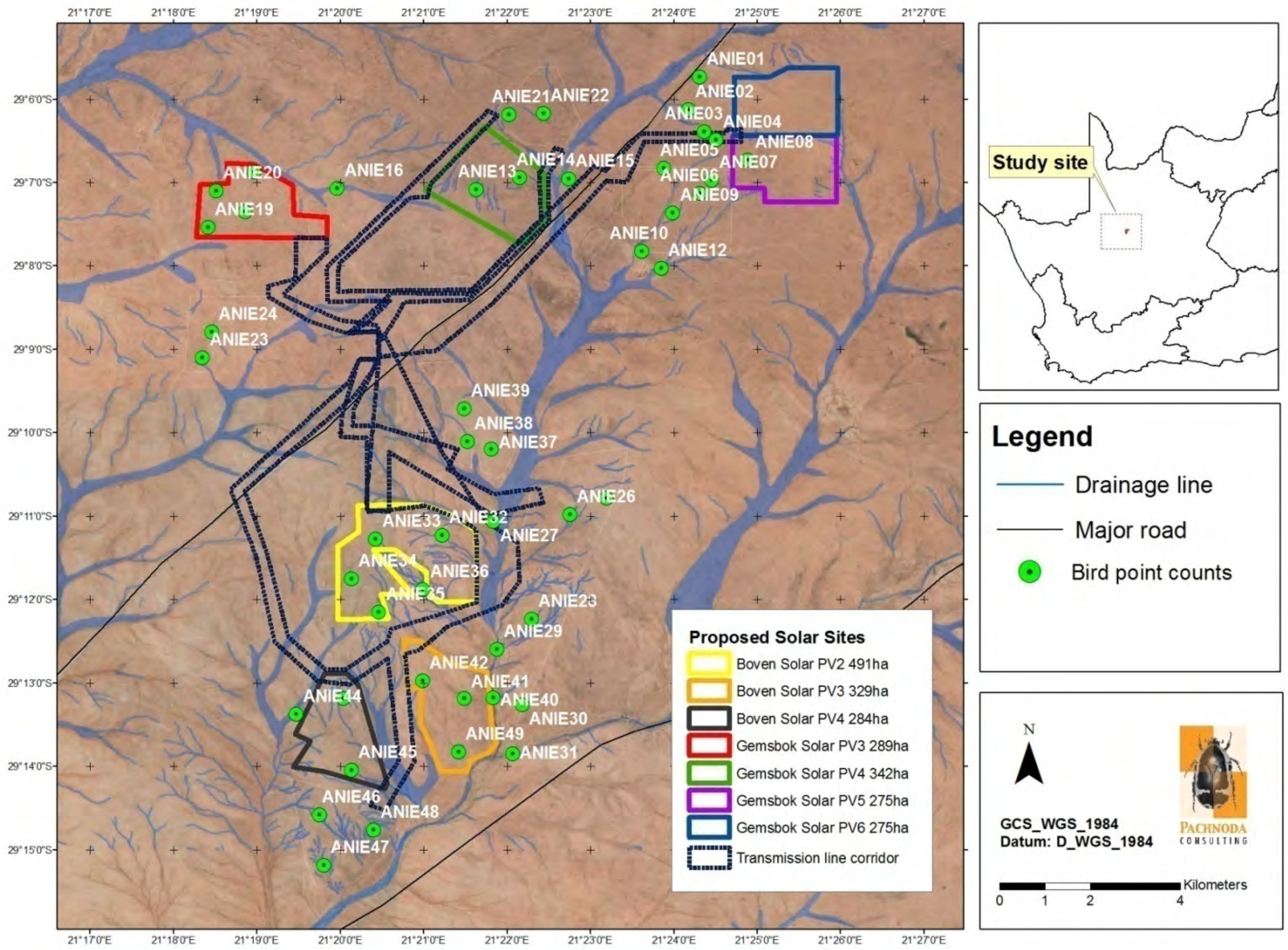

Figure 9.1: A satellite image illustrating the geographic localities of the bird point counts on the study area.

9.1.5 Assumptions and Limitations

Third-party information and citizen science datasets

- It is assumed that third party information (obtained from government, academic/research institutions, non-governmental organisations) is accurate and true;
- Some of the datasets/information are out of date and distribution ranges may have changed although these datasets still provide insight into historical distribution ranges of relevant species;
- The datasets/information bases are mainly small-scale and could not always consider azonal habitat types that may be present in the study area (e.g. artificial livestock watering points). In addition, these datasets encompass surface areas larger than the study area, which could include habitat types and species that are not present in the study area itself. Therefore, the potential to overestimate species richness is highly likely while it is also possible that certain cryptic or specialist species could have been be overlooked in the past; and
- Some of the datasets (e.g. SABAP2) managed by the Animal Demography Unit at the University of Cape Town are still in progress and are planned to run indefinitely.

Access and coverage

- The study area is under private ownership and is managed as a livestock (sheep) farm. The study area is in a rather remote part of the country and not always accessible to the general public. Since most of the species distribution ranges concerning the relevant datasets are subject to observations made by the public (citizen scientists), it is likely that many species have been overlooked or not catalogued for the area (e.g. some of the pentad grids represent gaps and to date have not been surveyed); and
- Some parts of the study area could not be accessed due to the absence of roads.

Temporal and spatial scale of surveys

- In order to obtain a comprehensive understanding of the dynamics of the bird communities in the study area, as well as the status of endemic, rare or threatened species, assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, due to time constraints such long-term studies are not feasible and thus study was based on instantaneous (a “snapshot”) sampling sessions;
- The inventories and working lists in this document are by no means exhaustive, and are a reflection of the dominant taxa on the study area obtained during the series of instantaneous sampling sessions. A comprehensive inventory, irrespective of the taxon or group of taxa can only be achieved during long-term temporal sampling;
- The information presented in this document only has reference to the investigated study area(s) and cannot be applied to any other area without prior investigation;
- The point counts were selected *a priori* based on a stratified sample model according to broad-scale habitat units and satellite imagery (e.g. Google Earth and QuickBird imagery). By using an *a priori* sampling protocol, sampling bias along access roads and the edge effects caused by roads is eliminated.

<u>Climate and seasonality</u>

- The survey was conducted during from 4-11 December 2015, thereby corresponding to the summer season. The study area lies within the Bushmanland Arid Grassland, a regional vegetation with a bimodal rainfall pattern. It receives part of its annual rainfall during December and again during late February to April (peak in March; Mucina and Rutherford, 2006);
- The survey corresponded to the November/December rainfall period. It was not conducted during the other seasons nor did it take place during optimal of precipitation events during late February to April. It should, therefore, be interpreted as an early summer season survey and it is

highly recommended that a second survey (as part of the preconstruction monitoring phase) be conducted during late March/early April; and

- The survey had to be conducted during the drought, i.e. hot, dry conditions with the absence of precipitation which induced dormancy in most of the higher vascular plant species. This obviously affected invertebrate prey and graminoid seed abundance, resulting in biased bird observations (e.g. underestimated bird richness and abundance) since many of the birds are either granivores or active insectivores dependent on the cover of foliage to obtain insectivorous prey and seeds.

Draft Best Practice Guidelines (by Jenkins et al*. 2015)*

- The current assessment was performed according to the guidelines drafted by Smit (2012);
- The new Draft Guidelines by (Jenkins *et al*. 2015) appeared after this study was commissioned. Therefore it was not possible to incorporate all the aspects required by the 2015 Guidelines, although every effort was made to incorporate/address at least part of the required guideline aspects;
- According to the 2015 draft Guideline Document the following is of relevance to the current assessment:
    - The development refers to an aggregate of seven PV solar farms, each occupying an ecological footprint of 220 ha. Based on the perceived avifaunal sensitivity of each site, the sites are at least regarded to be part of an avian assessment *Regime 2* (it qualifies at least as an area with an average (mean) avifaunal sensitivity that is medium based on local populations of priority bird species and the presence of locally significant bird movement corridors);
    - The current survey is regarded as a detailed Stage 1 assessment which includes a data collection session during the dry period in the early summer season (part of Stage 2);
    - This survey excludes seasonal and comprehensive pre-construction data collection although a first early summer season session has been completed. However, another data collection session is recommended during the wet season (corresponding to peak rainfall events) and another during the the winter (dry and cold season) (pers. comm., Samantha Ralston-Paton of EWT);
    - The survey excludes any vantage point surveys. However, it does identify a number of potential vantage points in the landscape that should be used as stations during future data collection surveys (a minimum of 12 hours should be accumulated at each vantage point on each site visit, and coverage should include all times of the day); and
    - The impact assessment is considered preliminary and only lists the likely impacts according to a single data collection session of approximately six full survey days. A detailed impact assessment (Stage 3) is only possible once Stage 2 of the assessment has been completed (referring to the data collection phase).

The mobility of birds, home range size and project size

- Most birds are highly mobile, in particular those living in the Nama-Karoo which are invariably highly nomadic (e.g. larks and buntings). Taking into account the mobility of these species, as well as the large territories (or home ranges) occupied by some of the larger terrestrial species (bustards) and birds of prey (eagles), it was decided to assess the proposed sites at the landscape level (as opposed to each individual site). Therefore, the avifaunal attributes of each site were surveyed at a spatial scale that encompasses all the sites collectively rather than independently (i.e. each site separately).

9.1.6 Source of Information

Please refer to section 9.1.3

9.2 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE AVIFAUNA

9.2.1 Background

Pachnoda Consulting cc was contracted by the CSIR Environmental Management Services on behalf of the project developer to provide a fauna and avifaunal assessment report for Phase 2 of the proposed Nieuwehoop Solar Park near Kenhardt in the Northern Cape. The project entails the design, construction and operation of seven 75 megawatt (MW) Solar Photovoltaic (PV) power generation plants to be located on Portion 3 of the Gemsbok Bult Farm 120, Portion 8 of Gemsbok Bult Farm120 and the Remaining extent of the Boven Rugzeer Farm 169 (Figure 9.2). The surface extent of the proposed plant sites ranges from 275 ha to 491 ha. It is proposed that the facilities will be connected to the Eskom Nieuwehoop substation (currently under construction) via 132 kV power lines. The electrical corridor is also shown in Figure 9.2 below.

The project entails the following solar PV plants:

1. Gemsbok Solar PV3 on Portion 3 of Gemsbok Bult Farm 120 (289 ha);
2. Gemsbok Solar PV4 on Portion 3 of Gemsbok Bult Farm120 (342 ha)
3. Gemsbok Solar PV5 on Portion 8 of Gemsbok Bult Farm120 (275 ha);
4. Gemsbok Solar PV6 on Portion 8 of Gemsbok Bult Farm120 (275 ha);
5. Boven Solar PV2 on Remaining Extent of Boven Rugzeer Farm169 (491 ha);
6. Boven Solar PV3 on Remaining Extent of Boven Rugzeer Farm 169 (329 ha); and
7. Boven Solar PV4 on Remaining Extent of Boven Rugzeer Farm169 (284 ha).

9.2.2 Regional vegetation type

The study area lies in the Nama-Karoo Biome and more particularly, in the Bushmanland Bioregion as defined by Mucina and Rutherford (2006). It contains two ecological types (Figure 9.3):

1. *Bushmanland Arid Grassland* – This ecological type is prominent in the study area and comprises extensive plains with a slightly sloping plateau that is sparsely dominated by “white” grasses such as *Stipagrostis* spp. and *Salsola* shrub.

It conforms to the habitat requirements of many plains species including Kori Bustard *Ardeotis kori*, Ludwig’s Bustard *Neotis ludwigi*i, Karoo Korhaan *Eupodotis vigorsii*, Burchell's Courser *Cursorius rufus*, Double-banded Courser *Rhinoptilus africanus* and Stark's Lark *Spizocorys starki*. In general, this ecological type supports extensive sheep farms, with some areas heavily encroached with dense shrub (e.g. *Rhigozum trichotomum*) due to overgrazing.

2. *Bushmanland Vloere* – This is an azonal habitat characterized by inland saline vegetation. This ecological type is prominent along the major drainage lines where it is present as small ephemeral pans. It plays an important role in connecting many of the smaller pans and ancient tributaries with each other.

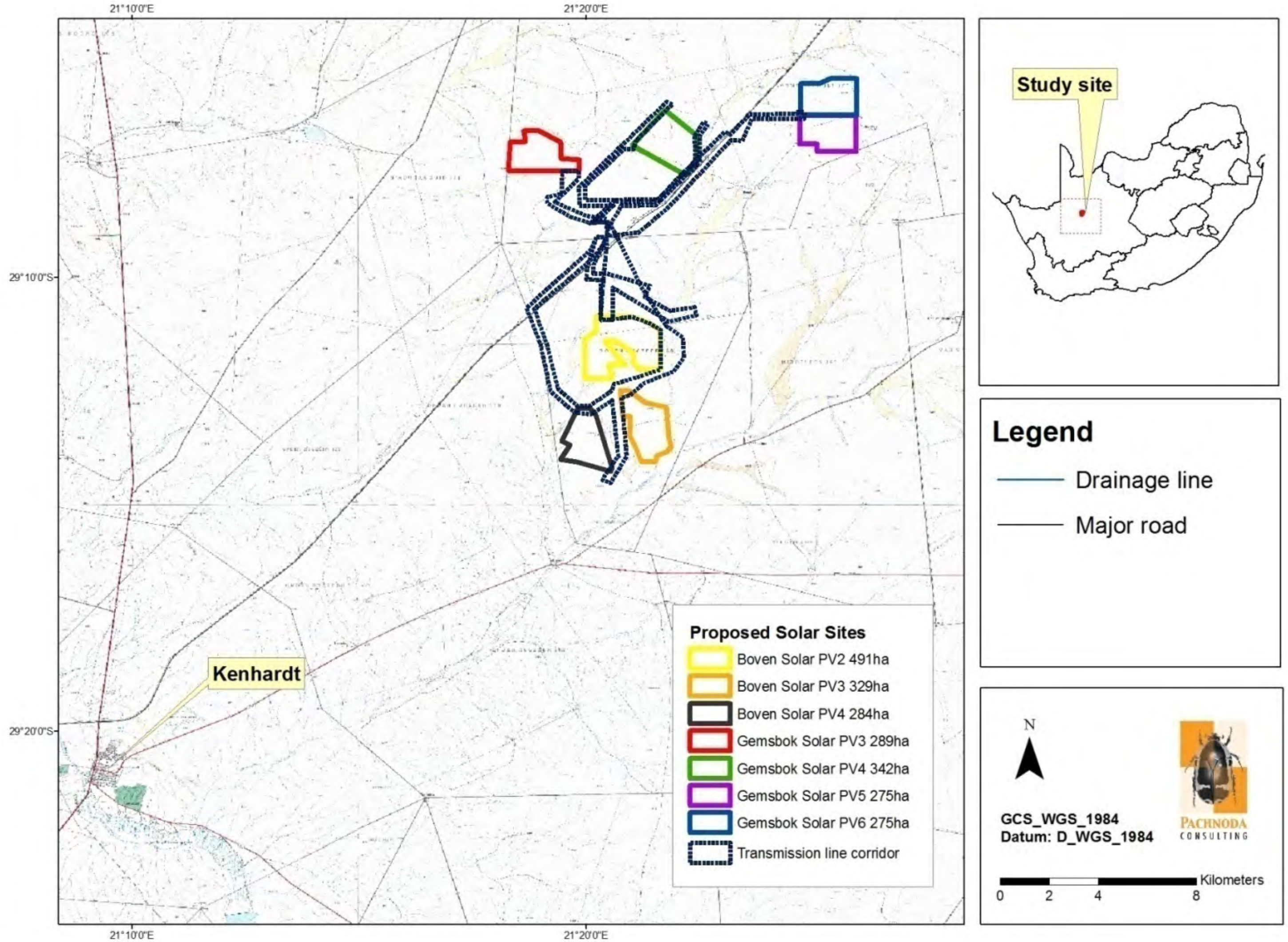

Figure 9.2: Topo-cadastral image showing the location of the seven PV plants forming part of Phase 2 of the Nieuwehoop Solar Park Project near Kenhardt, Northern Cape.

The centres of these ephemeral pans are often devoid of vegetation although its edges are characterised by the presence of non-succulent forbs such as *Rhigozum trichotomum* and species of *Salsola* and *Lycium*. Some areas form thickets of *Parkinsonia africana, Lebeckia lineariifolia* and *Vachellia (=Acacia) karroo*.

Bird diversity is positively correlated with vegetation structure. Therefore, floristic richness is not regarded to be the most important contributor to the observed patterns in bird abundance and spatial distribution. The Northern Cape, in particular the Namib-Karoo Biome, is generally poor in bird species richness although considered to be an important habitat for many terrestrial and often cryptic bird species such as larks, korhaans, bustards and chats. However, the Northern Cape is an important speciation centre for larks and stenotopic warblers. It therefore hosts a small assemblage of endemic (or near-endemic) species such as the Sclater's Lark *Spizocorys sclateri* and the Cinnamon-breasted Warbler *Euryptila subcinnamomea*. The lark species are typical Bushmanland Basin endemics, and many species of this region are also threatened by habitat destruction (Barnes, 2000) or alteration (e.g. grazing).

9.2.3 Land Cover

According to the South African National dataset of 2013-2014 (Geoterrainimage, 2015) the study area contains the following land cover categories (Figure 9.4):

Natural areas:
- Bare non-vegetated areas confined to gravel and calcrete plains;
- Low shrubland; and
- Woodland/open bush confined to the Bushmanland Vloere.

Transformed areas:
- Linear infrastructure (roads); and
- Bare soils confined to localised mining activities.

From the land cover dataset it is evident that most of the study area is covered by natural vegetation (mainly low shrubland) with very little transformation having taken place. However, the spatial heterogeneity of the landscape is monotonous and rather uniform.

9.2.4 Conservation Areas, Protected Areas and Important Bird Areas (IBAs)

There are no formal conservation or protected areas in the immediate vicinity of the study area. The nearest protected areas are Augrabies Falls National Park and Witsand Nature Reserve, which are located respectively 110 km north-west and 120 km north-east of the study area.

The avifaunal importance of a particular area is often analysed based on BirdLife International's criteria to evaluate and identify Important Bird Areas (IBAs). The criteria used are those developed by the BirdLife International Secretariat (Fishpool, 1997).

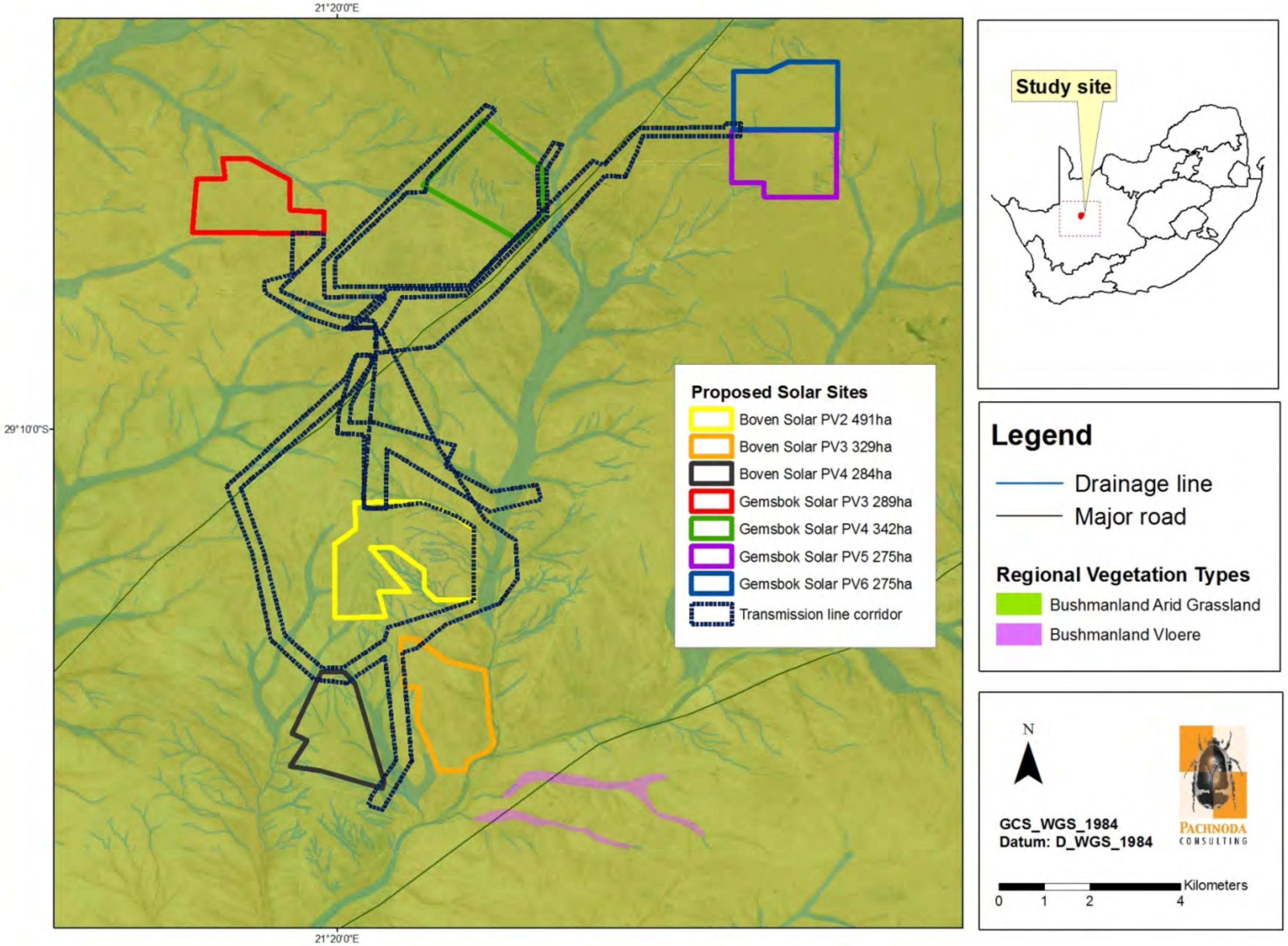

Figure 9.3: Satellite image illustrating the regional vegetation types traversed by the proposed power line corridors. Vegetation type categories were chosen according to Mucina and Rutherford (2006).

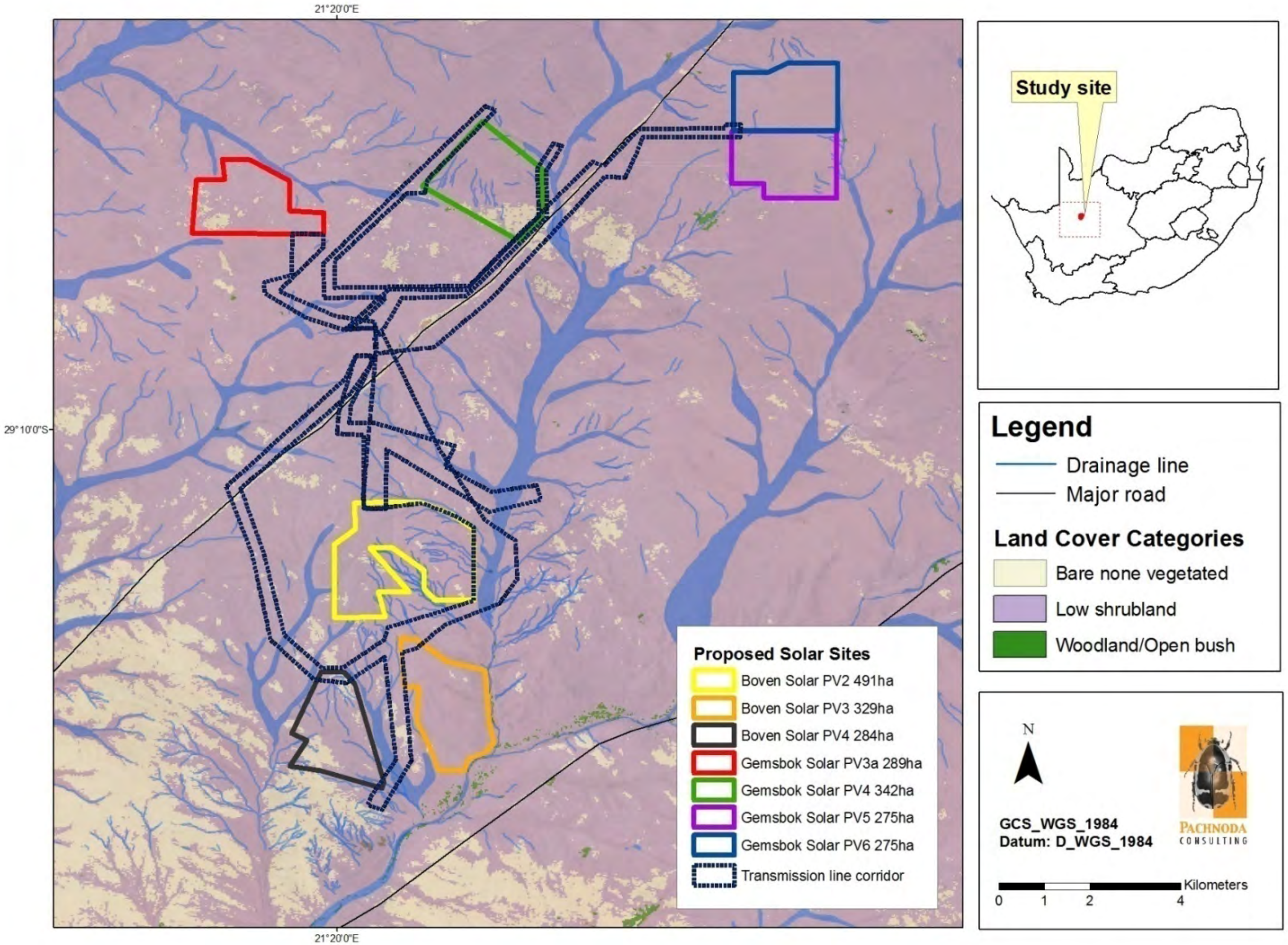

Figure 9.4: Land cover categories (Geoterrainimage, 2015) corresponding to the proposed study area.

Birdlife International IBA identification criteria:

- *Category A1*: the regular presence of significant numbers of globally threatened species. In general only IUCN species listed as Critically Endangered, Endangered or Vulnerable are considered. The regular presence of a Critical or Endangered species, irrespective of population size, at a site may be sufficient for a site to qualify as an IBA. For Vulnerable species, the presence of more than threshold numbers at a site is necessary to trigger selection;
- *Category A2*: the area holds a significant component of a group of species whose breeding distributions is restricted to an Endemic Bird Area (EBA) or Secondary Area. In other words, an EBA provides habitat for two or more species with restricted ranges co-occur and have global distributions of less than 50 000 km^2. It is noteworthy that 70% of these species are also globally threatened. A Secondary Area (SA) holds one or more restricted-range species, but does not qualify as an EBA because less than two species are entirely confined to it. A typical SA includes a single restricted-range species which does not overlap in distribution with any other restricted-range species. For SAs, species occur where there are disjunct records of one or more restricted-range species, which are clearly geographically separate from any of the EBAs;
- *Category A3*: the area holds significant numbers of species whose distributions are largely confined to one biome. These species have shared distributions greater than 50 000 km^2.
- *Category A4*: the area may qualify on any one or more of the four criteria listed below:
    - The area is known to hold on a regular basis more or less1% of a biogeographic population of a congregatory waterbird species;
    - The area is known to hold on a regular basis more or less 1% of the global population of a congregatory seabird or terrestrial species;
    - The area is known or thought to hold on a regular basis more or less 20 000 waterbirds or more or less 10 000 pairs of seabirds of one or more species; and
    - The area is known or thought to exceed thresholds set for migratory species at bottleneck sites.

The study area does not contain any IBAs. The nearest IBAs to the study area are the Augrabies Falls National Park (SA029; located 110 km north-west of the study site) and the Mattheus-Gat Conservation Area (SA034; located 144 km west of the study area) (Marnewick *et al*., 2015). The latter area is one of a few areas which provide protection to the globally threatened Red Lark *Certhilauda burra* and the Near-Threatened Sclater's Lark *Spizocorys sclateri*.

9.3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

9.3.1 Avifauna macro-habitat types

Apart from the regional vegetation types, the local composition and distribution of the vegetation communities in the study area are a consequence of a combination of factors e.g. soil texture, geology, topography (plains vs. drainage systems), and grazing disturbance (presence of livestock). These have culminated in a number of habitat types described below (see Figure 9.5 and Figure 9.6):

1. Aloe dichotoma – Tetradenia retrofracta outcrops
This unit is mainly confined to the Gemsbok Solar PV4 site where it is restricted to granite surface rock. It is characterized by a high density of *Aloe dichotoma* trees on very shallow rocky soils. However, the topography is undulating, with most of the unit occurring on mid- and upper slopes. Therefore, it does not conform to the open flat gravel plains so typical of the surrounding landscape, but is littered with large bounders which appear as prominent features.

Although more important in providing refuge for reptiles and small mammals, it is less important for birds. Although the *Aloe dichotoma* trees are utilized by Sociable Weavers *Philetairus socius* as nesting platforms and by smaller accipitirine raptors (e.g. pale-chanting goshawk *Melierax canorus*) as hunting posts.

2. Salsola – Stipagrostis short shrubveld
This habitat type is dominant in the study area and occurs on relatively flat topography on shallow sandy soils. It consists of short shrubs which are evenly spaced which allow for the free movement of large non-passerine terrestrial bird species (e.g. bustards and Korhaan species). The occurrence of *Stipagrostis* grasses is important since it provides essential foraging habitat for a variety of seed-eaters (mainly lark taxa). It is an important habitat for animals that require large home ranges and is the preferred foraging habitat for the Endangered Ludwig's Bustard *Neotis ludwigii* and the Near- threatened Karroo Korhaan *Eupodotis vigorsii.* It also sustains a large population of Northern Black Korhaan *Afrotis afraoides*.

3. Zygophyllum microphyllum – Pteronia calcrete plains
This habitat type is widely scattered and patchy (azonal and could not be accurately delineated) where it conforms to white gravelly soils on open undulating plains and a sparse basal cover of dwarf shrubs. It is therefore part of the *Salsola – Stipagrostis* short shrubveld where it occurs on rocky calcrete soils.

The calcrete plains are often utilized by large terrestrial birds when foraging (especially Ludwig's Bustard Karoo Korhaan *Eupodotis vigorsii* and the Vulnerable Burchell's Courser *Cursorius rufus*). It also supports many lark species (Alaudidae).

4. Salsola outcrops
This habitat type is prominent on the Boven Solar PV2 site. It is essentially confined to gravelly plains with shallow rocky soils dominated by a stunted shrub layer consisting primarily of *Salsola spp*. The floristic structure of this habitat is transitional between the *Zygophyllum microphyllum – Pteronia* calcrete plains and the *Salsola – Stipagrostis* short shrubveld.

This unit also encapsulates many smaller azonal habitat types which include quartz outcrops and smaller patches of dark gravel plains which provide potential breeding habitat for the near threatened Sclater's Lark.

5. *Tetradenia retrofracta* quartz outcrops
These consist of scattered patches of white quartz plains, which are mainly located on the southern solar sites such as Boven Solar PV2. Although not regarded as an important habitat for most birds, probably due to the small surface area of the respective patches of outcrops, it is often utilized during the heat of the day as roosting habitat by many birds since the ambient ground temperature is much lower than on adjacent habitat (due to the highly reflective surfaces of the pebbles). It is nevertheless an important breeding habitat for Sclater's Lark.

6. *Rhigozum trichotomum* watercourse
These are small drainage lines which are seldom wider than 5 m and often strongly dominated by the shrub *Rhigozum trichotomum*, a secondary species which tends to proliferate as a result of soil disturbance or overgrazing. The dominance of this shrub is best explained by episodic disturbance events caused by surface water runoff during peak rainfall events precipitation, resulting in superficial scarring of the soil profile and the transport of sediment.

The drainage lines are important dispersal corridors for smaller passerines (e.g. pendulina tits *Anthoscopus* spp., eremomelas *Eremomela* spp., prinias *Prinia* spp. and Rufous-eared Warbler *Malcorus pectoralis*), allowing these species to colonise other habitat types consisting of shrubveld.

7. *Prosopis glandulosa* watercourse and *Roepera morgsana* floodplains
These habitat types are restricted to large highly seasonal and non-perennial watercourses which are wider than 5 m. They are critically important since they act as daily flyways for many bird species in the

region while the prominent shrub and low tree layer (mainly the exotic *Prosopis glandulosa*) increases the local vertical habitat heterogeneity and niche space which is directly proportional to avifaunal richness, especially species restricted to the Namib-Karoo Biome.

In addition, it also contains a distinct bird assemblage of arid bushveld species (e.g. Chestnut-vented Tit-babbler *Sylvia subcaeruleum*, Pririt Batis *Batis pririt* and Karoo Thrush *Turdus smithii)* which are atypical of the surrounding plains and shrubveld.

8. Koppies and prominent dolerite outcrops
These units represent prominent landscape features which include small dolerite inselbergs. They are mainly located outside any of the proposed solar sites, although providing habitat for rock-loving/rock-dwelling birds. They are also often used by birds of prey as hunting or roosting posts.

These koppies/prominent outcrops serve as excellent locations from which vantage point surveys can be conducted, and should be included in the design of future bird surveys.

9. Artificial impoundments/dams
These are small ephemeral waterbodies providing surface drinking water to livestock and free-roaming game when inundated (they were all dry during the current survey). These ephemeral waterbodies are sparsely distributed throughout the study area and comprised of open, trampled vegetation that were in most instances surrounded by *Rhigozum trichotomum*. These areas are often focal areas for small seed-eating birds and nomadic waterbirds, in particular the South African Shelduck *Tadorna cana*. They often also attract large numbers of Namaqua Sandgrouse *Pterocles namaquus*.

10. Artificial livestock drinking holes
These are watering points providing drinking water to livestock (mainly sheep). However, they act as congregation areas for many of the smaller seed-eating birds including Sclater's Lark and the biome-restricted Stark's Lark. They often attract large numbers of Namaqua Sandgrouse and hunting birds of prey.

11. Other habitat types (infrastructure and anthropogenic habitat)
These are represented by a number of distribution power lines and isolated stands of large Eucalyptus trees (the latter are confined to homesteads only) which are often used as platforms by Sociable Weavers to construct their massive nests and perching habitat for birds of prey.

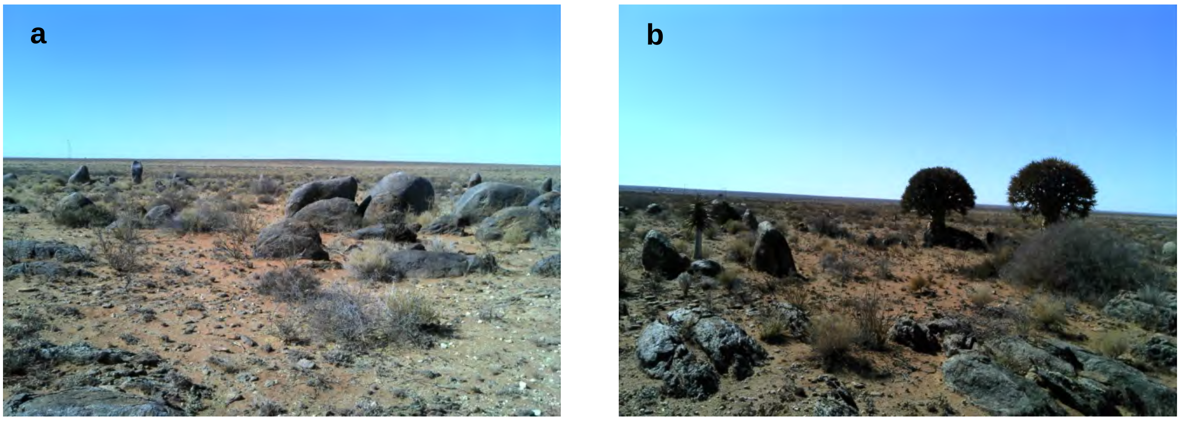

Figure 9.5 (a-b): Images illustrating the dominant habitat types on the study area: *Aloe dichotoma – Tetradenia retrofracta* outcrops.

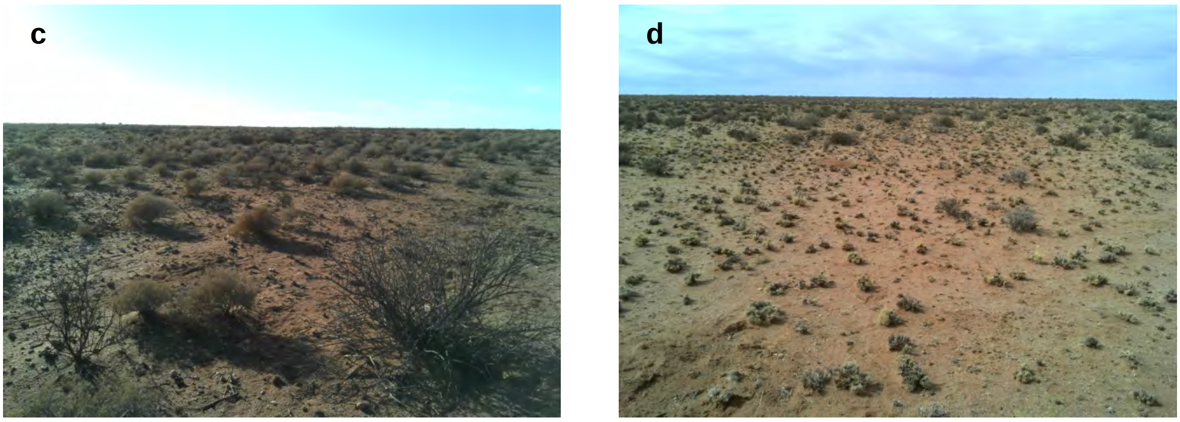

Figure 9.5 (c-d): Images illustrating the dominant habitat types on the study area: *Salsola – Stipagrostis short shrubveld.*

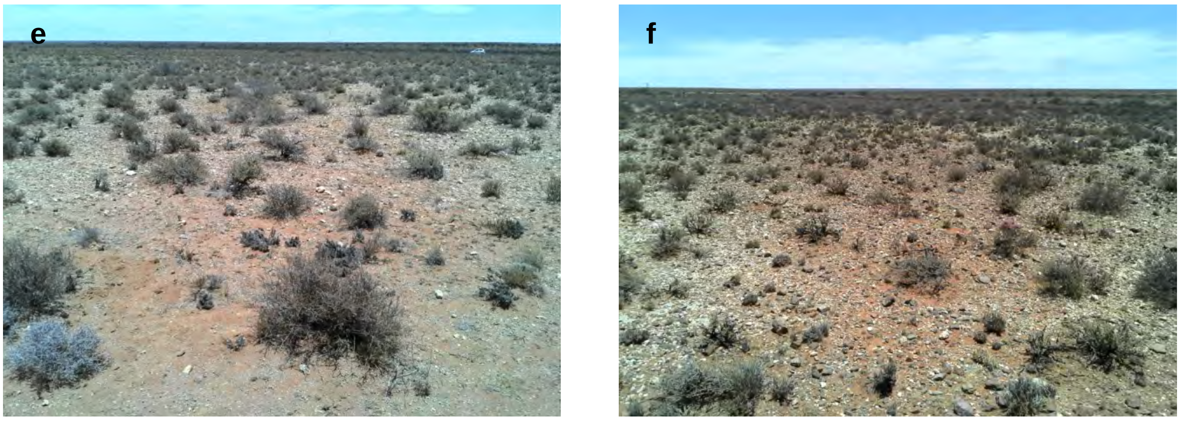

Figure 9.5 (e-f): Images illustrating the dominant habitat types on the study area: *Zygophyllum microphyllum – Pteronia* calcrete plains.

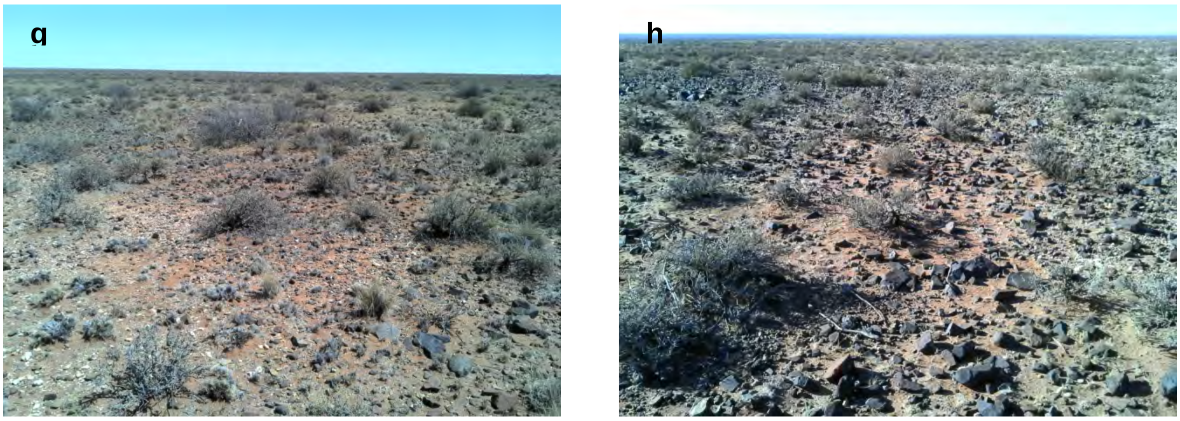

Figure 9.5 (g-h): Images illustrating the dominant habitat types on the study area: *Salsola* outcrops (mainly dark dolerite plains).

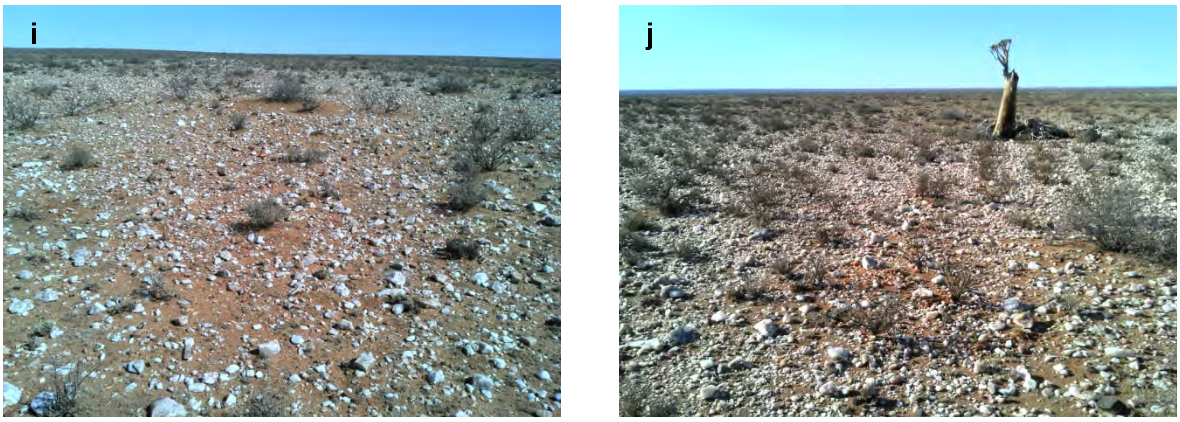

Figure 9.5 (i-j): Images illustrating the dominant habitat types on the study area: *Tetradenia retrofracta* quartz outcrops.

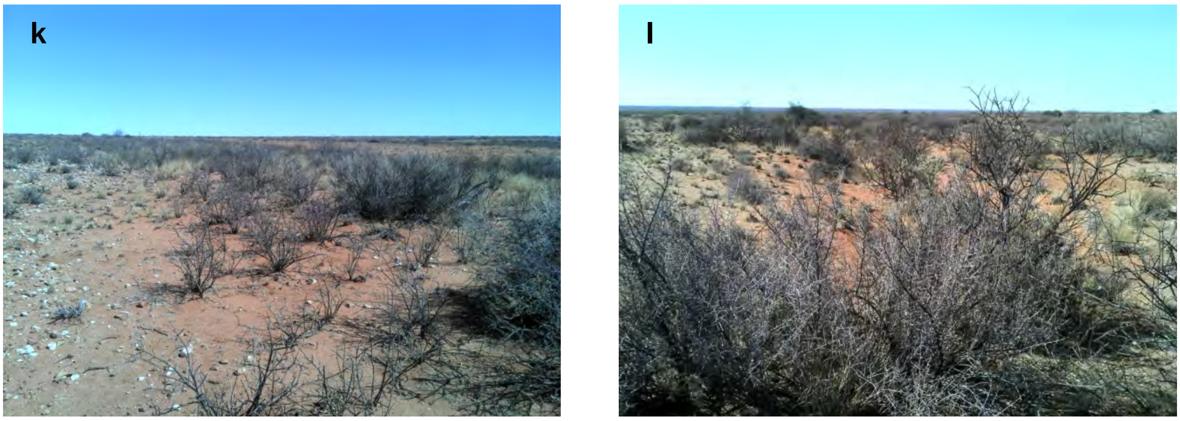

Figure 9.5 (k-l): Images illustrating the dominant habitat types on the study area: *Rhigozum trichotomum* watercourse.

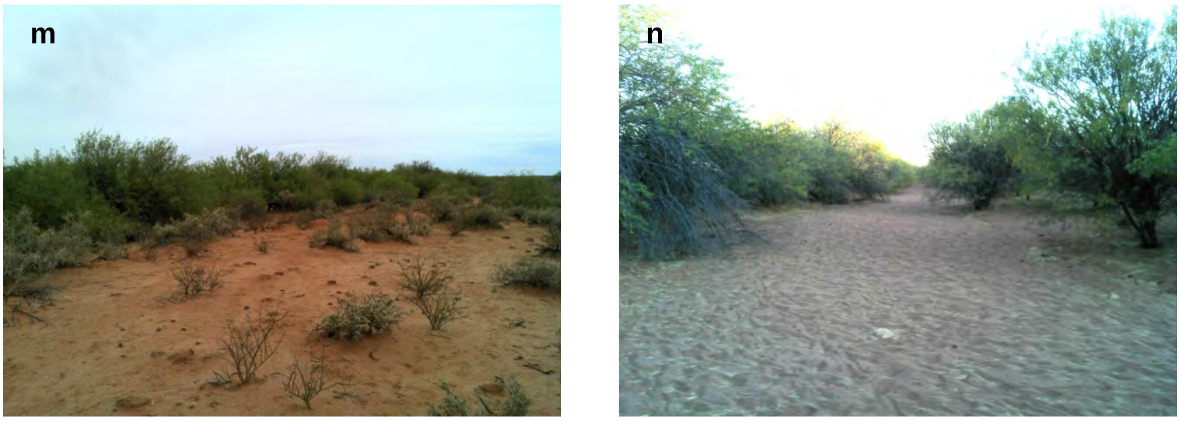

Figure 9.5 (m-n): Images illustrating the dominant habitat types on the study area: *Rhigozum trichotomum* watercourse.

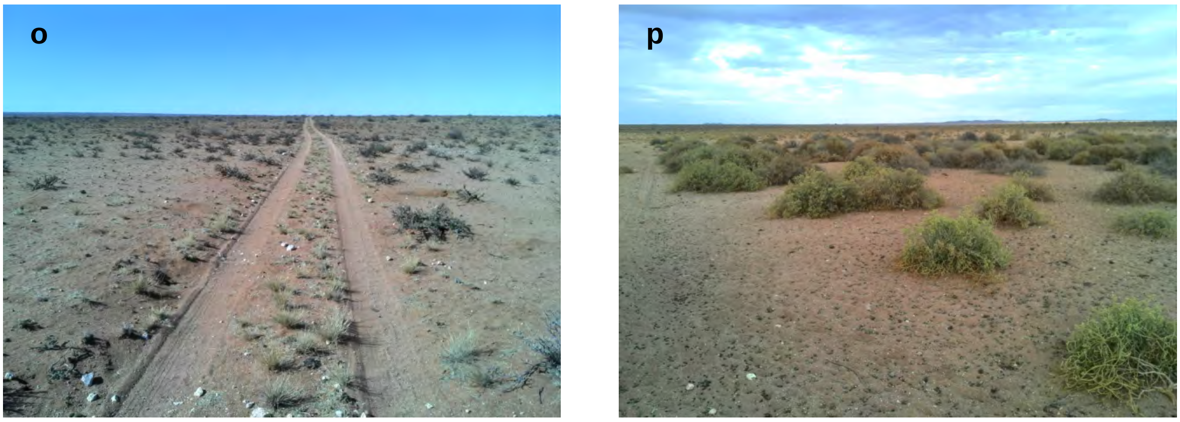

Figure 9.5 (o-p): Images illustrating the dominant habitat types on the study area: *Roepera morgsana* floodplain.

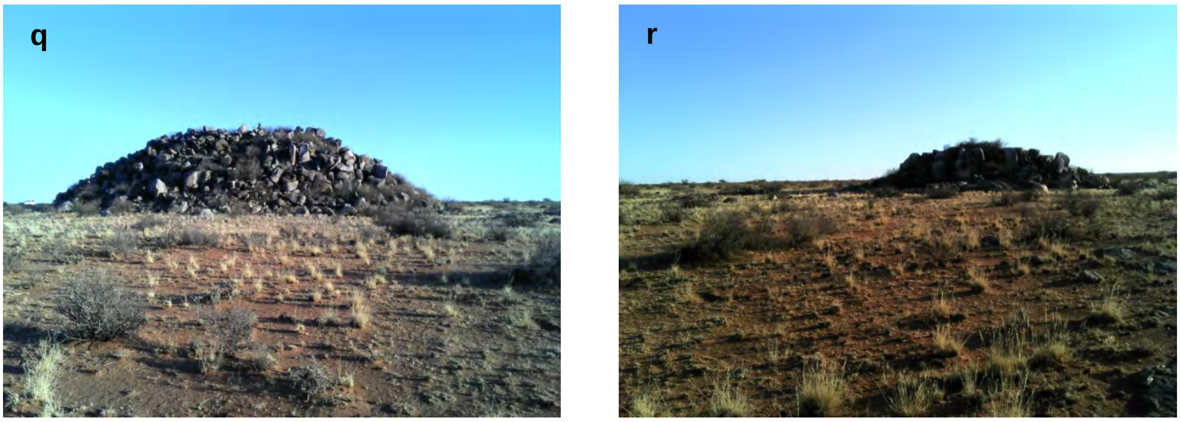

Figure 9.5 (q-r): Images illustrating the dominant habitat types on the study area: Koppies and prominent outcrops.

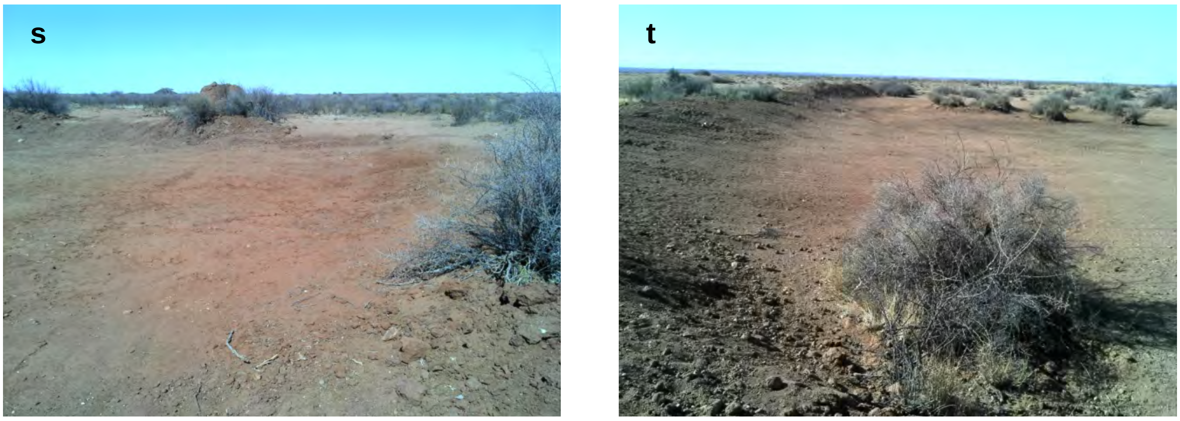

Figure 9.5 (s-t): Images illustrating the dominant habitat types on the study area: Artificial dams.

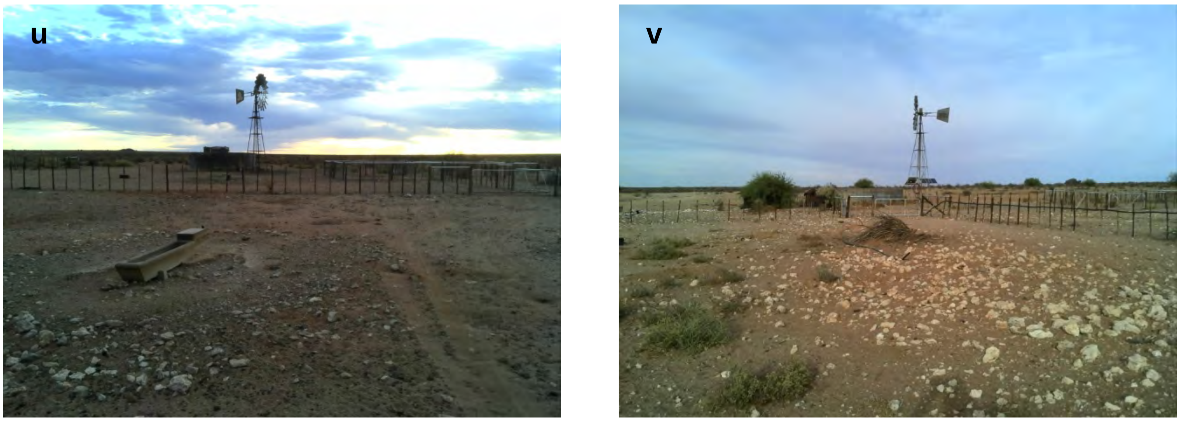

Figure 9.5 (u-v): Images illustrating the dominant habitat types on the study area: Artificial livestock watering points.

Figure 9.5 (w-x): Images illustrating the dominant habitat types on the study area: power lines, linear infrastructure and *Eucalyptus* stands with Sociable Weaver *Philetairus socius* nests.

9.3.2 Species richness and summary statistics

According to the South African Bird Atlas Project (SABAP1: Harrison *et al.*, 1997) and SABAP2, approximately 91 bird species[2] were recorded from the quarter degree grid cells (2921AD Witdorp & 2921AD Steynsput) and pentad grids that overlap with the study area (range = 63-75 species; see Table 9.1). This equates to 9.4 % of the approximate 970 species listed for the southern African subregion[3]. The area was poorly surveyed during the establishment of the SABAP2 database, when only three of the seven pentad grids corresponding to the study area were visited. According to the SABAP2 database, the study area is more likely to support an average of 22.2 species per pentad grid (www.sabap2.adu.org.za). The SABAP2 statistic was obtained from three pentad grids representing three independent observations[4].

However, 88 species were observed in the study area during the survey (December 2015) which effectively corresponds to 96.7 % of the number of species expected to be present (see Appendix 2). On a national scale, the species richness in the study area is considered low (Figure 9.7) although it contains several threatened and near threatened species (please refer to section below dealing with species of conservation concern).

Table 9.1: Summary of the total number of species, Red Listed species (Taylor *et. al.*, 2015); IUCN, 2015), endemics and biome-restricted species (Marnewick *et al*., 2015) expected to occur and observed within the study area. Values in brackets refer to the percentage of expected species that were observed during the survey.

Parameter	Expected	Observed
Total number of species	91	88 (96.7 %)
Number of Red Listed species (Taylor, et al. 2015) & IUCN, 2015)*	8	5 (62.5 %)
Number of biome-restricted species (Marnewick *et al*., 2015 – Namib-Karoo and Kalahari Highveld)**	14	11 (78.5 %)
Number of restricted-range species (Marnewick *et al*., 2015)	1	1 (100 %)
Number of endemics (Hockey *et. al*., 2005)	23	19 (82.6 %)
Number of near-endemics (Hockey *et. al*., 2005)	27	23 (85.1 %)

* - only in South Africa (including Lesotho and Swaziland).
** - only species occurring within the geographic boundaries of South Africa (including Lesotho and Swaziland) were considered.

[2] Sclater's Lark *Spizocorys sclateri* and Red Lark *Certhilauda burra* were added to the list although it was not recorded during SABAP1 and SABAP2. It was added to the analysis since it has a high probability to occur.
[3] A geographical area south of the Cunene and Zambezi Rivers (includes Namibia, Botswana, Zimbabwe, southern Mozambique, South Africa, Swaziland and Lesotho).
[4] Based on three full protocol cards submitted (range=17 – 30).

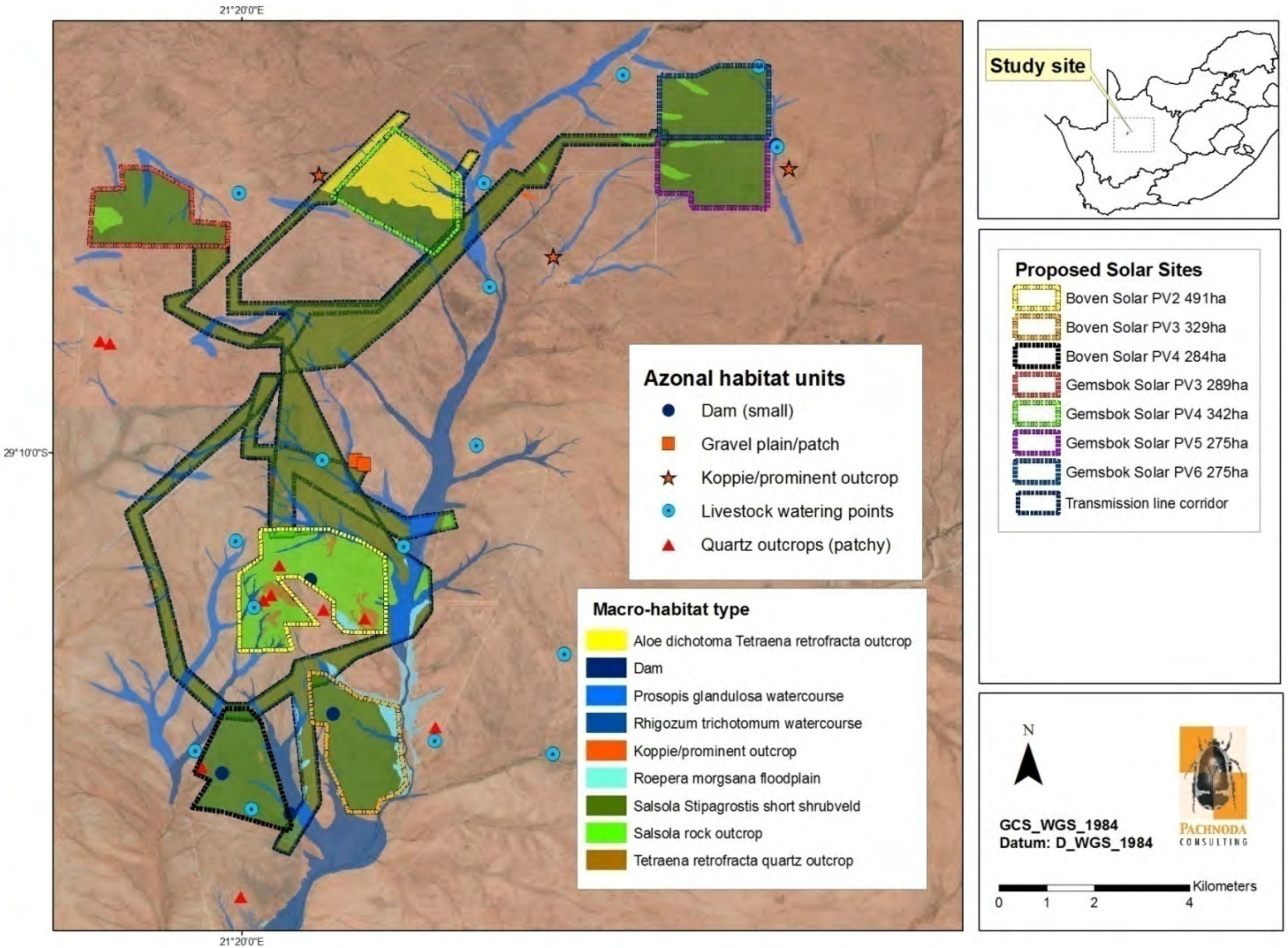

Figure 9.6: Satellite image illustrating the macro-habitat types in the study area (including proposed power line corridors).

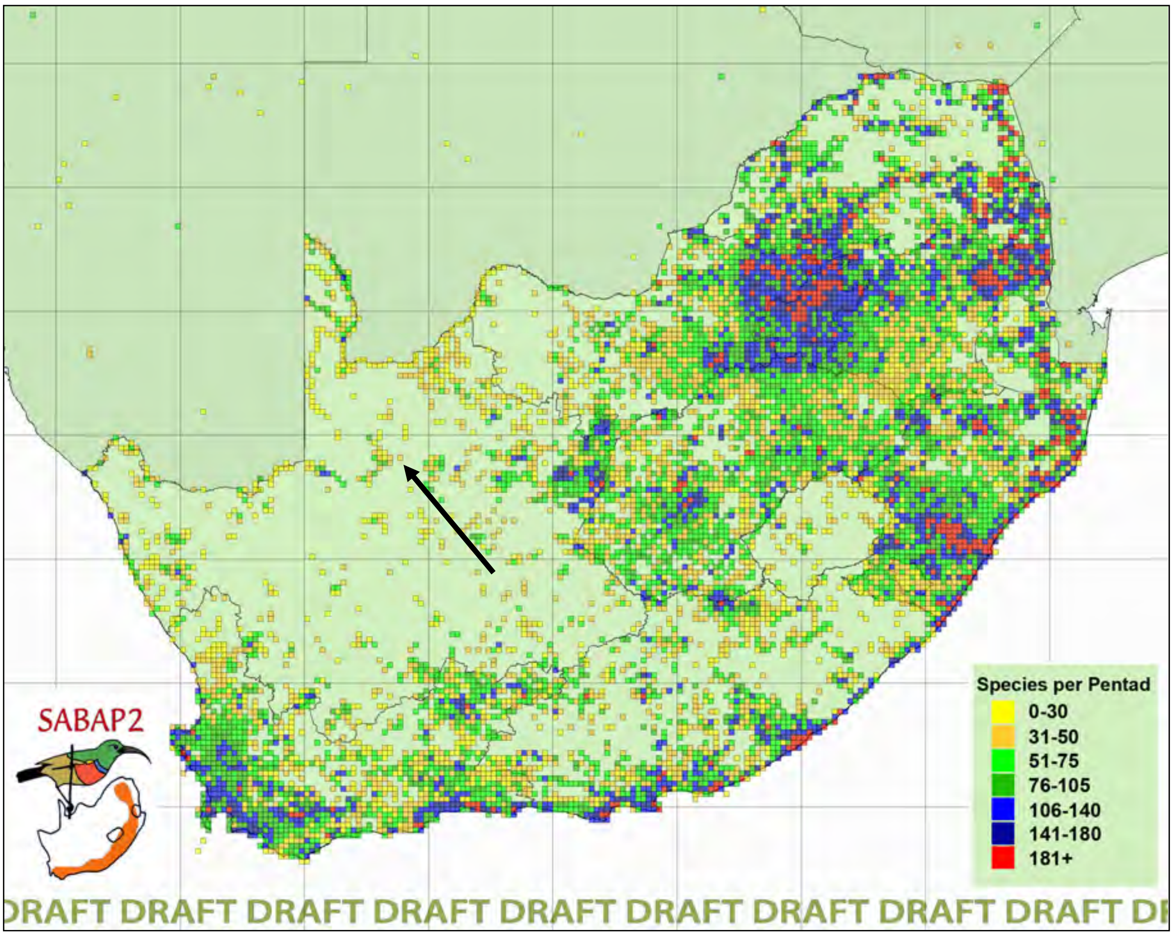

Figure 9.7: The bird species richness per pentad grid in comparison with the study area (see arrow). According to the SABAP2 database, the study area hosts between 0-30 species (Source: SABAP2/ADU).

The observed number of species is within the limit (e.g. the species accumulation curve has reach the saturation threshold with no additional species recorded after 49 sampling sites; Figure 9.8) of the number of species expected to occur (>50 %), and provides a realistic indication of the thoroughness and general coverage of the study area during the survey (Table 9.1 and Figure 9.8). The area was poorly represented by endemic bird species, but showed a moderate to good representation of biome-restricted near-endemic species, respectively (Table 9.1 and Table 9.2).

Table 9.2: Expected and observed biome-restricted species (Marnewick et al., 2015) on the study area.

Species	Kalahari-Highveld	Nama-Karoo	Observed/Expected
Kalahari Scrub-robin (*Erythropygia coryphaeus)*	X		Observed
Sociable Weaver (*Philetairus socius*)	X		Observed
Ludwig's Bustard (*Neotis ludwigii*)		X	Observed
Karoo Korhaan (*Eupodotis vigorsii*)		X	Observed
Karoo Chat (*Emarginata schlegelii*)		X	Expected
Karoo Long-billed Lark (*Certhilauda subcoronata*)		X	Observed
Red Lark (*Certhilauda burra)*		X	Observed
Sclater's Lark (*Spizocorys sclateri*)		X	Observed
Stark's Lark (*Spizocorys starki*)		X	Observed
Black-eared Sparrow-Lark (*Eremopterix australis*)		X	Observed
Sickle-winged Chat (*Emarginata sinuata)*		X	Observed
Tractrac Chat (*Emarginata tractrac*)		X	Expected
Pale-winged Starling (*Onychognathus nabouroup)*		X	Observed
Namaqua Warbler (*Phragmacia substriata*)		X	Expected

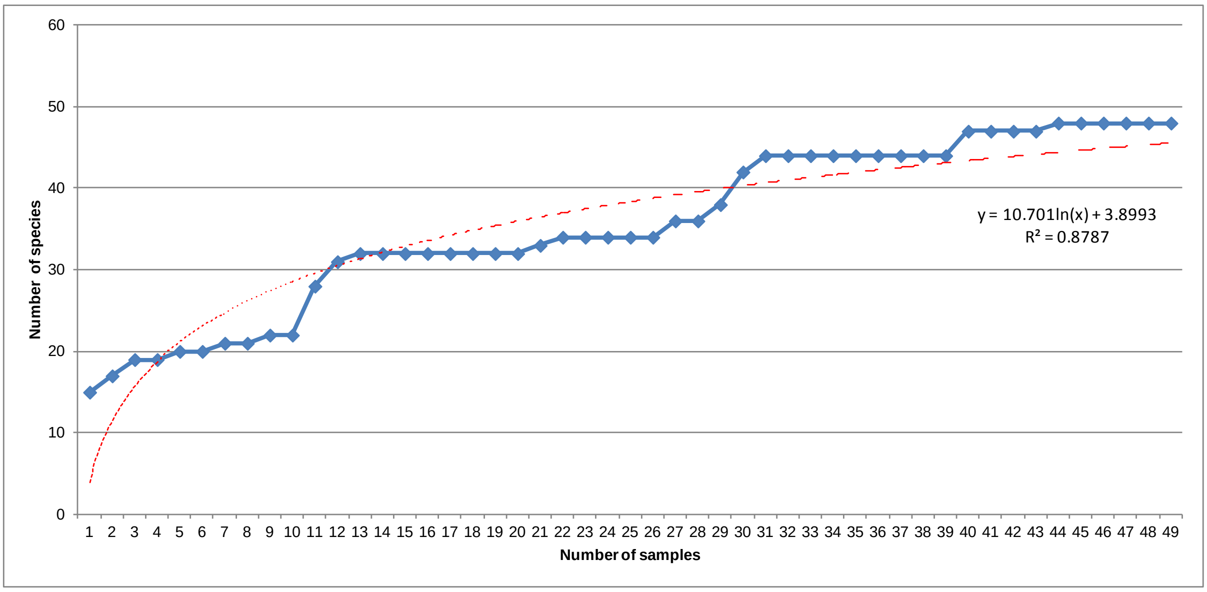

Figure 9.8: Species accumulation curve based on 49 samples (point counts).

9.3.3 Dominance and rarity (low abundance species)

An analysis of bird data generated from the point counts showed that Stark's Lark, a highly nomadic species that is well known for appearing in large numbers depending on local rainfall patterns, was the most dominant species on the study area. Other prominent species include the Sabota (Bradfield's) Lark *Calendulauda sabota bradfieldi,* the Spike-heeled Lark *Chersomanes albofasciata* and the Rufous-eared Warbler *Malcorus pectoralis*. The mean abundance and percentage contribution of seven dominant bird species in the study area are presented in Table 9.3. Examination of the dominant taxa shows a prominent arid "Bushmanland" assemblage dominated by cryptic members of the Alaudidae, Cisticolidae and Emberizidae. With the exception of two predominantly insectivorous species (*c*. Rufous-eared Warbler *M. pectoralis* and Spike-heeled Lark *Chersomanes albofasciata*) the dominant bird composition on the study site consists mainly of passerine granivores which are highly dependent on the availability of grass seeds pertaining to *Stipagrostis*. It is evident that the graminoid genus *Stipagrostis* forms a prominent constituent of the *Salsola – Stipagrostis* short shrubveld. Although widespread, this habitat unit provides an important foraging resource to many granivore species confined to the Nama-Karoo. In addition, three of the dominant taxa are also restricted to the Namib-Karoo Biome of which Sclater's Lark *Spizocorys sclateri* is near threatened.

Table 9.3: The mean abundance and percentage contribution of seven dominant bird species in the study area.

Species	Mean abundance/point count	Consistency	Percentage Contribution
Starks's Lark *Spizocorys starki*	6.37	1.24	51.86
Sabota Lark *Calendulauda sabota bradfieldi*	1.27	0.68	16.35
Spike-heeled Lark *Chersomanes albofasciata*	1.73	0.41	8.22
Rufous-eared Warbler *Malcorus pectoralis*	0.55	0.40	6.30
Black-eared Sparrowlark *Eremopterix australis*	1.06	0.24	2.80
Lark-like Bunting *Emberiza impetuani*	2.35	0.25	2.57
Sclater's Lark *Spizocorys sclateri*	0.51	0.19	2.11

The rare species with low abundance values in the study area are listed in Table 9.4. Many of these species were counted only once or twice during the point count surveys. However, although widespread, these species occur naturally at low densities within the Nama-Karoo Biome and are limited by the very patchy occurrence of a tree canopy and vertical habitat heterogeneity.

Table 9.4: The low abundance (rare) species in the study area with contributions of < 0.01 %. * - according to observations made during the investigation.

Species	Av. Abundance	Habitat preference*
Southern Masked Weaver *Ploceus velatus*	0.02	Mainly confined to areas with good tree cover, invariably near surface water.
Southern Red Bishop *Euplectes orix*	0.06	Invariably associated with areas of permanent surface water.
Sickle-winged Chat *Emarginata sinuata*	0.02	A typical low-abundant Namib-Karoo resident.
Mountain Wheatear *Oenanthe monticola*	0.04	Restricted to prominent outcrops/koppies.
Red Lark *Certhilauda burra*	0.02	A highly localised substrate specialist, occurring on ecotones where deep red sandy patches are prominent.
Double-banded Courser *Rhinoptilus africanus*	0.02	Confined to plains, in particular calcrete plains.
Familiar Chat *Cercomela familiaris*	0.04	Mainly confined to large outcrops and koppies.
Grey Tit *Melaniparus afer*	0.04	Mainly well-vegetated watercourses and hills.
Karoo Thrush *Turdus smithii*	0.02	Mainly confined to areas with good tree cover and gardens.
Black-faced Waxbill *Estrilda erythronotos*	0.04	Arid thornveld and well-vegetated watercourses.

It is evident that these birds are numerically limited by habitat extent and habitat specialization. Some species are invariably associated with large outcrops and well-vegetated watercourses, all of which are spatially patchy. Other species are limited by the patchy presence of deep sandy substrate or availability of surface water.

9.3.4 Species composition and assemblage structure

An ordination (based on hierarchical agglomerative clustering) of the point count data illustrates no significant differences between counts from the shrubveld, outcrops and smaller watercourses (Global R=0.38, p=0.05) (Figure 9.9). The only prominent differences and typical assemblages occur within the *Prosopis glandulosa* watercourses and the livestock watering points. The probable cause for the non-significant and weak differentiation between observations in the shrubveld and outcrops is best explained by the nomadic strategies and opportunistic behavior of these bird species. Most are highly nomadic and for this reason show less prominent associations with a specific habitat structure. For most of these species, being granivores and insectivores, the availability of food overrides vertical niche differentiation and habitat specialization. However, exceptions do occur (e.g. the Red Lark *C. burra*), although these species are uncommon and not abundant.

The main avifaunal assemblages in the study area are summarized as follow: (according to a clustering ordination – Figure 9.9):

- ***Assemblage confined to the* Prosopis glandulosa *watercourses:* -**

It is typified by high number of Yellow Canary *Crithagra flaviventris*, Karoo Scrub-Robin *Cercotrichas coryphoeus* and Southern Fiscal *Lanius collaris*. Indicator species (species mainly restricted to this assemblage) include the Fawn-coloured Lark *Calendulauda africanoides*, Chestnut-vented Tit-babbler *Sylvia subcaeruleum*, Pririt Batis *Batis pririt* and White-browed Sparrow-weaver *Plocepasser mahali*.

- ***An assemblage confined to the artificial watering points:–***

It is typified by a diverse composition of species which include dominants like the Lark-like Bunting *Emberiza impetuani*, Grey-backed Sparrowlark *Eremopterix verticalis*, Namaqua Sandgrouse *Pterocles namaquus* and Stark's Lark *Spizocorys starki*. Indicator species (species mainly restricted to this assemblage) include the Cape Sparrow *Passer melanurus*, White-throated Canary *Crithagra albogularis*, Southern Red Bishop *Euplectes orix* and Namaqua Dove *Oena capensis*.

- ***A large and varied assemblage confined to the shrubveld – outcrop mosaics:-***

It is typified by high numbers of Stark's Lark *S. starki*, Sabota Lark *Calendulauda sabota,* Spike-heeled Lark *Chersomanes albofasciata* and Rufous-eared Warbler *Malcorus pectoralis*. Indicator species (species mainly restricted to this assemblage) include the Sclater's Lark *Spizocorys sclateri*, Karoo Korhaan *Eupodotis vigorsii*, Northern Black Korhaan *Afrotis afraoides* and Cape Penduline Tit *Anthocopus minutus*.

9.3.5 Species richness and diversity

A subjective comparison between broad-scale (macro-) habitat types reveals that the highest richness (number of species) of bird species is present at the artificial watering points, shrubveld and along the *Prosopis glandulosa* watercourses (Table 9.5).

Table 9.5: Summary of the observed species richness of the prominent habitat types in the study area. H' – Shannon-Weaver diversity index (H'_{loge}).

Habitat Type	Number of species	Mean number of individuals	H'
Artificial Watering point	31	65.00	2.51
Shrubveld	20	21.50	2.09
Prosopis watercourse	20	14.50	2.73
R. trichotomum watercourse	15	17.17	2.25
Dam	13	66.50	1.82
Koppie	12	29.00	2.08
Low outcrops	10	7.43	1.56
A. dichotoma outcrops	9	25.50	1.37

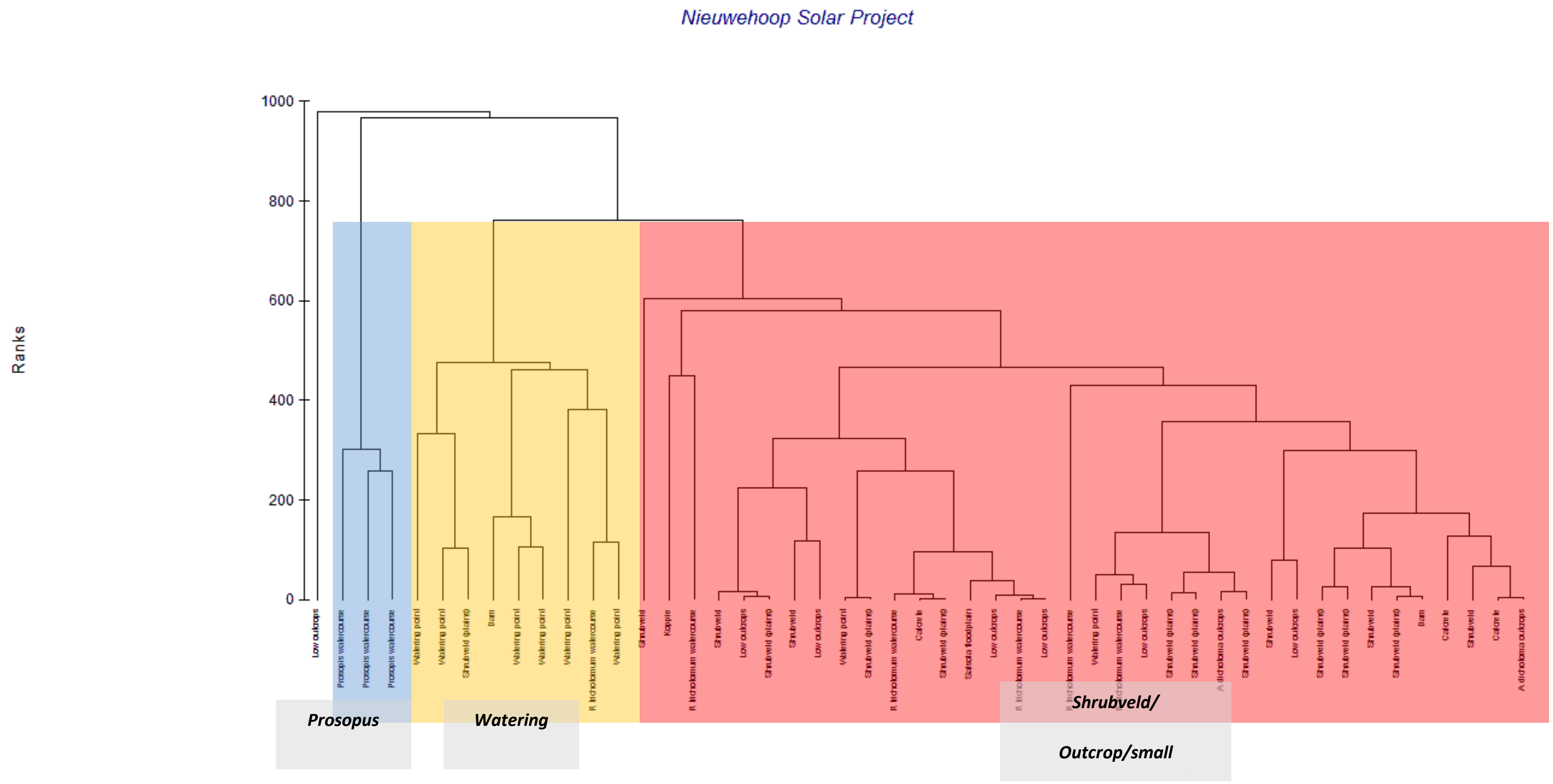

Figure 9.9: Dendrogram based on hierarchical agglomerative clustering according to abundance values of bird species in the study area.

The highest bird diversity (when also measuring the equitability among bird individuals or evenness), was observed at the artificial watering points followed by the prominent outcrops (koppies) and dams (empty during the survey) (Figure 9.10). The composition in shrubveld was less diverse (moderate diversity, along with the smaller watercourses), possibly due to a low equitability among its members which was influenced by non-deterministic immigration and recruitment during nomadic events. The lowest diversity was observed on the low outcrops associated with the dolerite and quartz gravel plains. These areas are often devoid of vegetation (except for a few dwarf succulents) and only a few hardy species can persist in these areas. However, the black dolerite plain habitat is an important breeding area for Sclater's Lark *S. sclateri*.

9.3.6 Species of Conservation Concern

An overview of bird species of conservation concern that could occur on the study area based on their historical distribution ranges and the presence of suitable habitat is provided in Table 9.6. According to Table 9.6, a total of eight species could occur in the study area including three globally threatened species, one globally near-threatened species, five regionally threatened species and three regionally Near-threatened species. Noteworthy species observed in the study area include the Endangered Ludwig's Bustard *Neotis ludwigii*, the Vulnerable Martial Eagle *Polemaetus bellicosus*, the Vulnerable Red Lark *Certhilauda burra*, the Near Threatened Karoo Korhaan *Eupodotis vigorsii* and the Near threatened Sclater's Lark *Spizocorys sclateri*.

Both the Vulnerable Lanner Falcon *Falco biarmicus* and Burchell's Courser *Cursorius rufus* were not observed during the surveys, but have both a high probability to occur based on the presence of suitable habitat.

Most of these species (especially the bustards, korhaans and larks) occupy large home ranges consisting of open habitat or open sparsely vegetated gravel plains. Therefore, extensive and lightly vegetated shrubveld plains provide optimal habitat for many of these terrestrial bird species.

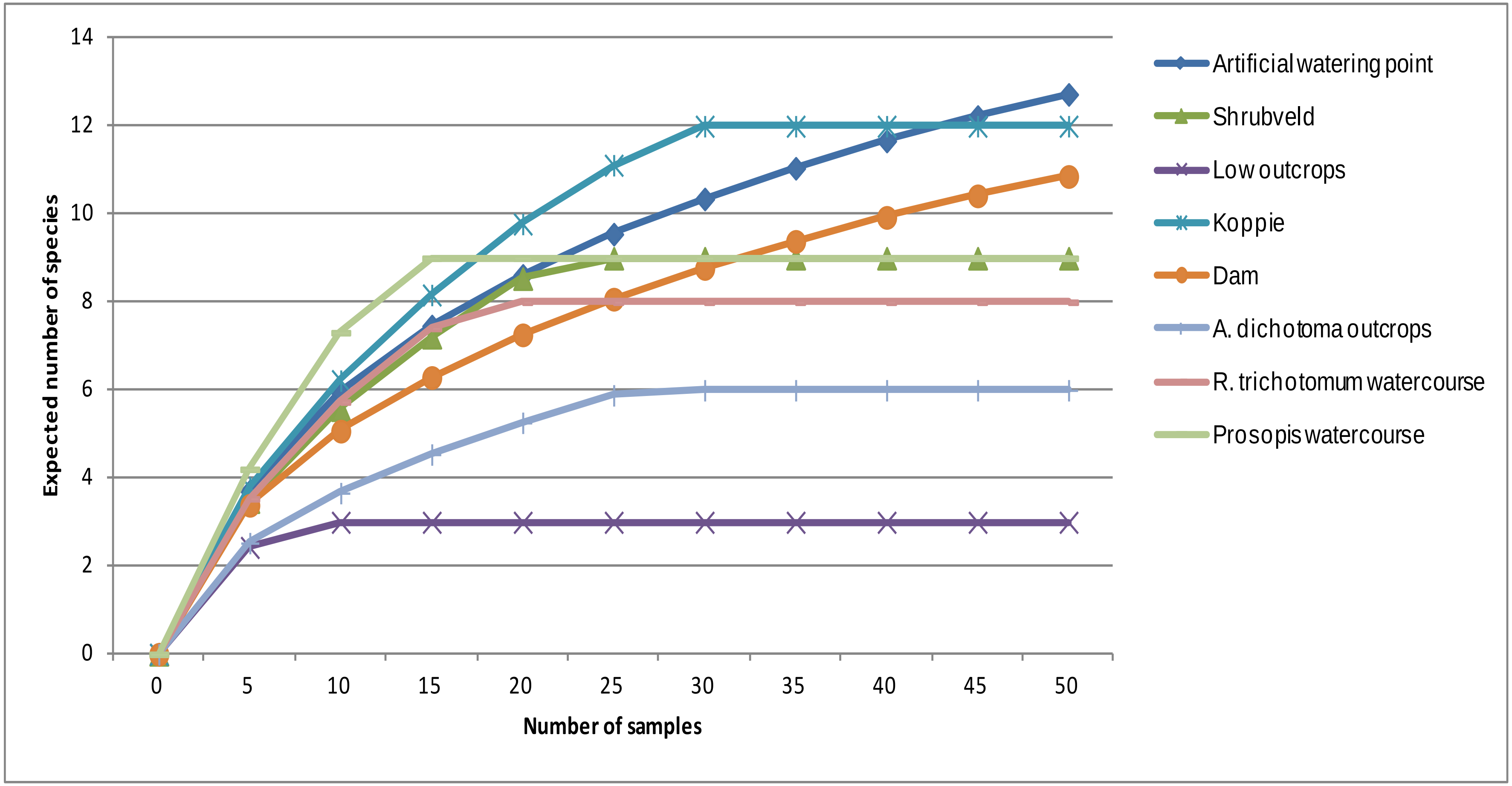

Figure 9.10: Rarefaction curves for the prominent bird numbers on the habitat units.

Table 9.6: Bird species of conservation concern that could utilise the study area based on their historical distribution range and the presence of suitable habitat. Red list categories according to the IUCN (2015)* and Taylor *et al.* (2015). Species highlighted in grey were confirmed in the study area during the survey.**

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP1 (n=23)	Mean Reporting rate: SABAP2 (n=3)	Preferred Habitat	Potential Likelihood of Occurrence
Ardeotis kori (Kori Bustard)	Near-threatened	Near-threatened	20	100	Arid open lowland savanna and karroid shrub.	Low, regarded as a rare on the study area.
Cursorius rufus (Burchell's Courser)	-	Vulnerable	8	100	Open sparsely vegetated plains and stony gravelly semi-desert.	High, regarded as a resident on gravel plains.
Eupodotis vigorsii (Karoo Korhaan)	-	Near-threatened	25.5	-	Low shrubland and open grassy plains.	High and resident on the study site.
Falco biarmicus (Lanner Falcon)	-	Vulnerable	15	-	Varied, but prefers to breed in mountainous areas.	An occasional foraging visitor to the study area.
Neotis ludwigii (Ludwig's Bustard)	Endangered	Endangered	-	100	Arid savanna and open karroid shrub.	High, regarded as a resident on the study area, especially on calcrete plains and open level shrubveld.
Polemaetus bellicosus (Martial Eagle)	Vulnerable	Endangered	30	-	Varied, from open karroid shrub to lowland savanna.	Regarded as a regular foraging visitor. Breeding not confirmed.
Certhilauda burra (Red Lark)	Vulnerable	Vulnerable	-	-	Shale or alluvial plains or red sand dunes	A highly localised resident.
Spizocorys sclateri (Sclater's Lark)		Near-threatened	-	-	Stony to arid gravel plains, especially on quartz and dolerite plains.	A fairly common resident on the study area.

A brief account of confirmed species (highlighted in grey above) with a high likelihood of occurring in the project area is presented below:

Martial Eagle *Polemaetus bellicosus*

*The Martial Eagle*is globally listed as Vulnerable (BirdLife International, 2013) while a recent conservation assessment has upgraded the species from regionally Vulnerable to Endangered (Taylor *et al*. 2015) due to rapid declines in South Africa during the last 10 years (owing to habitat loss due to overgrazing, and due to poisoning; Taylor *et al.* 2015). Although it has an extensive range across most of sub-Saharan Africa, it is nowhere common and generally occurs at low densities. The regional population size is estimated at approximately 800 mature individuals.

The Martial Eagle is a large and charismatic species that is more numerous in large conservation areas although it also occurs on large game farms, or areas where human density remains sparse (for example the Nama-Karoo). It is regarded as a regular foraging visitor in the study area and immediate surroundings, which is believed to be part of an extensive home range used by a local breeding pair of birds[5]. It requires exceptionally large home ranges in excess of 130 km^2 (Brown *et. a*l., 1982) and sometimes even up to 1000 km^2, accentuating the importance of additional foraging habitat for the long-term survival of this species. During the study, a foraging adult bird was observed (07/12/2015) on the northern part of the study area (in close proximity to the Gemsbok Solar PV4 and PV3 project areas) where there are *Aloe dichotoma - Tetradenia retrofracta* outcrops (Figure 9.11).

Figure 9.11 also shows a preliminary (and subjective) 10 km area of optimal foraging habitat applied to the observation. The purpose of the area is merely to indicate the preferred habitat of the observed individual and the proposed area that should be screened during consecutive site visits (as part of Stage 2; *Jenkins et al.*, 2015)

[5] The current assessment is part of the Second Stage 2 (data collection) phase, and represents the first series of pre-construction data collection. To realistically evaluate the foraging patterns and distribution of this species on the study site, additional follow-up surveys are required (as promulgated by Jenkins et al., 2015).

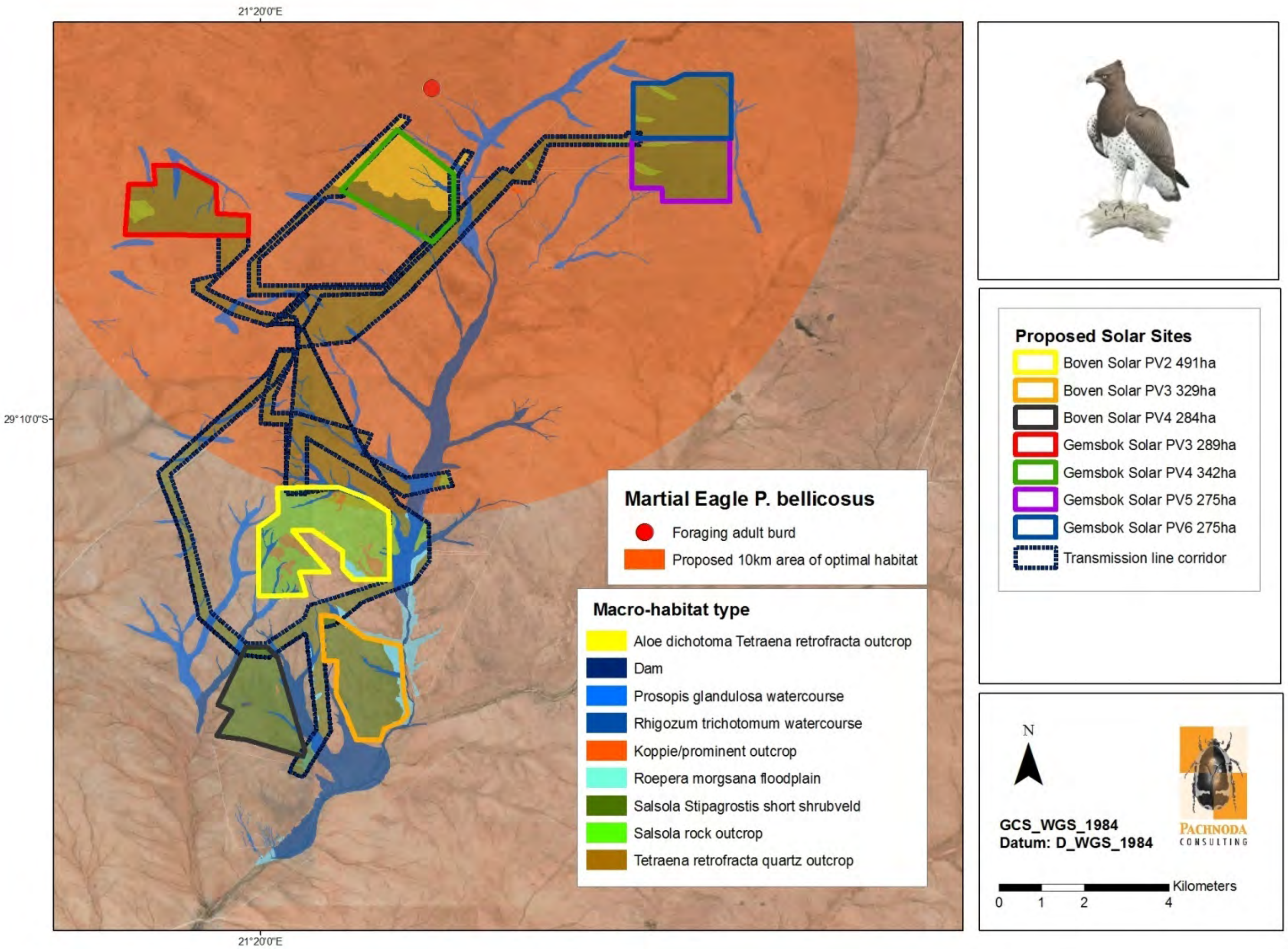

Figure 9.11: Satellite image illustrating the occurrence of the Endangered Martial Eagle *Polemaetus bellicosus* on the study area.

Ludwig's Bustard *Neotis ludwigii*

Ludwig's Bustard is globally listed as Endangered (Taylor *et al*., 2015) due to rapid recent declines in South Africa with a prediction of >50% reduction of the population during the next 30 years if current threats persist (Taylor *et al.* 2015). In 2000, the regional population was estimated to be approximately 27 000 - 60 000 individuals (Barnes, 2000).

Ludwig's Bustard is extremely susceptible to collisions with electricity distribution and telephone lines, which are regarded as one of the main threats to this species (Barnes, 2000; Allen, 2005). Smallie and Van Rooyen (2003) have already shown that an average of one bird is killed every 12 to 14 km by power lines in the Karoo. In addition, Smallie and Van Rooyen (2006) reported up to 181 bustards were killed by overhead power lines during a period spanning from 1996 to 2005. These figures are of concern, especially since the South African population is rapidly declining due to power line collisions - a trend that is anticipated to continue until more effective mitigation measures are invented.

The spatial homogeneity of the shrubveld plains makes it difficult to isolate specific areas of frequent occurrence since the birds could occur in virtually the entire study area. The potential "hotspots" with high expected reporting rates for Ludwig's Bustards in the area are shown in Figure 9.12. Seven individuals were confirmed during the field assessment based on four independent observations (Figure 9.12).

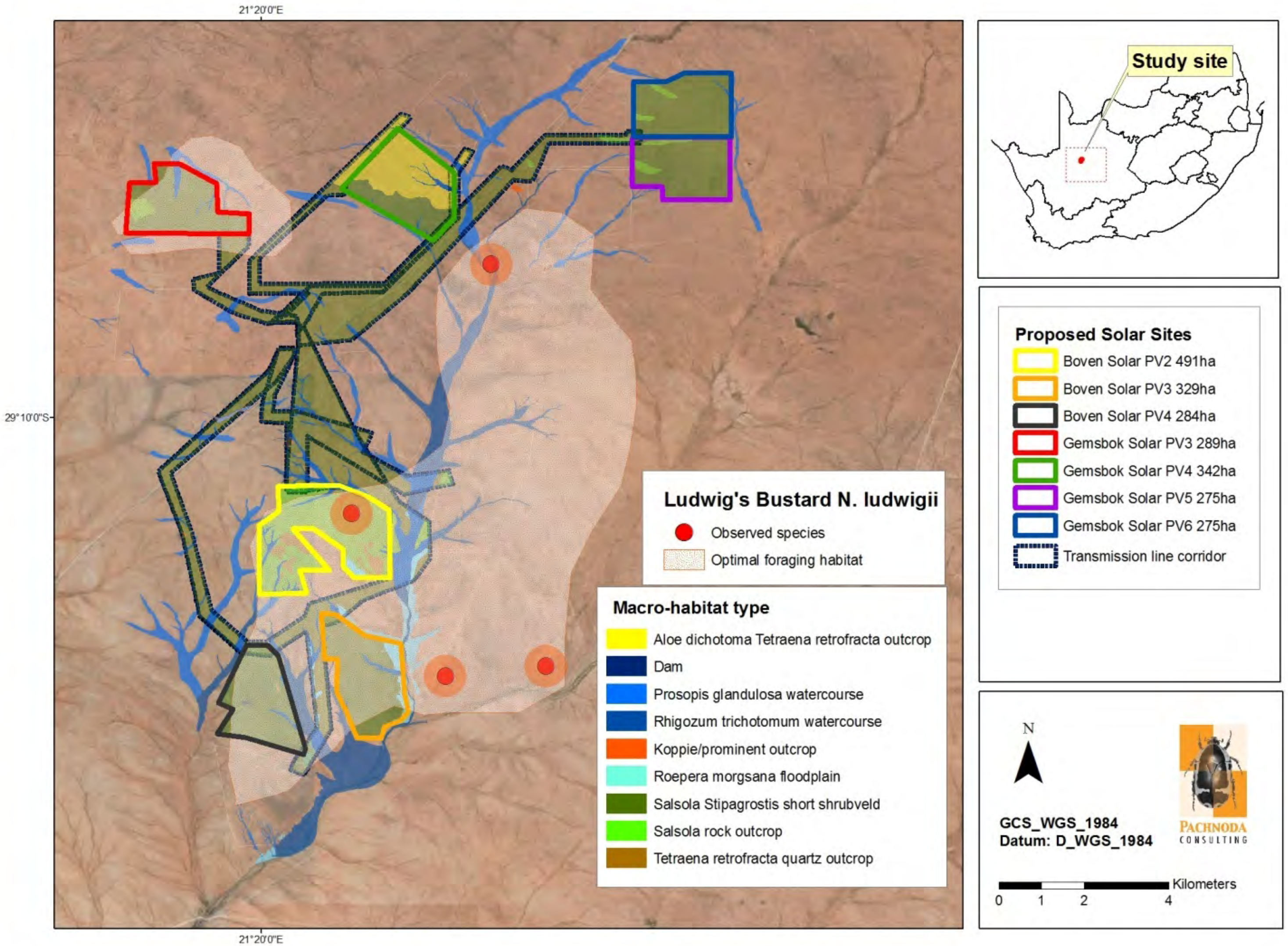

Figure 9.12: Satellite image illustrating the occurrence of the Endangered Ludwig's Bustard *Neotis ludwigii* in the study area.

Red Lark *Certhilauda burra*

The Red Lark is globally listed as Vulnerable (Taylor *et al*. 2015) due to its highly restricted distribution range (it is a range-restricted species) (Taylor *et al.,* 2015) and ongoing habitat transformation caused by trampling and overgrazing by livestock (in particular cattle). The regional population is estimated to be less than 10 000 mature individuals. It is a habitat specialist which is also invariably associated with either red sand dunes (e.g. fossil Koa dunes) or open shale or alluvial plains. Its occurrence is also closely tied with the presence of *Stipagrostis* grass, of which the seeds make a primary part of its diet.

The Red Lark has a very restricted distribution in the Northern Cape where it is only found on well-vegetated (5-25 % basal cover) dunes or flats that are dominated by *Stipagrostis ciliata* or *S. brevifolia* (Dean *et al*., 1991).

A single observation (06/12/2015) of a pair (represented by the "*harei*" form) was confirmed from red sandy soils near the base of a prominent outcrop on the northern section of the study area (Figure 9.13). The observation was made during the early hours of the morning (04:26 AM) when a male was engaged in full song. This is the first confirmed record of this species north of Kenhardt, and highlights the fact that this species was formerly overlooked in the area. However, it could also suggest a range expansion of its distribution. The nearest record of this species, south-east of Kenhardt based on dated museum records, and nearest extant population occur immediately to the north of Brandvlei. Although it is not spatially confined to one of the proposed solar sites, it is located in close proximity to a proposed power line corridor. Caution is advised during the construction process to prevent an overspill of activities which could result in the displacement of the species from its preferred habitat.

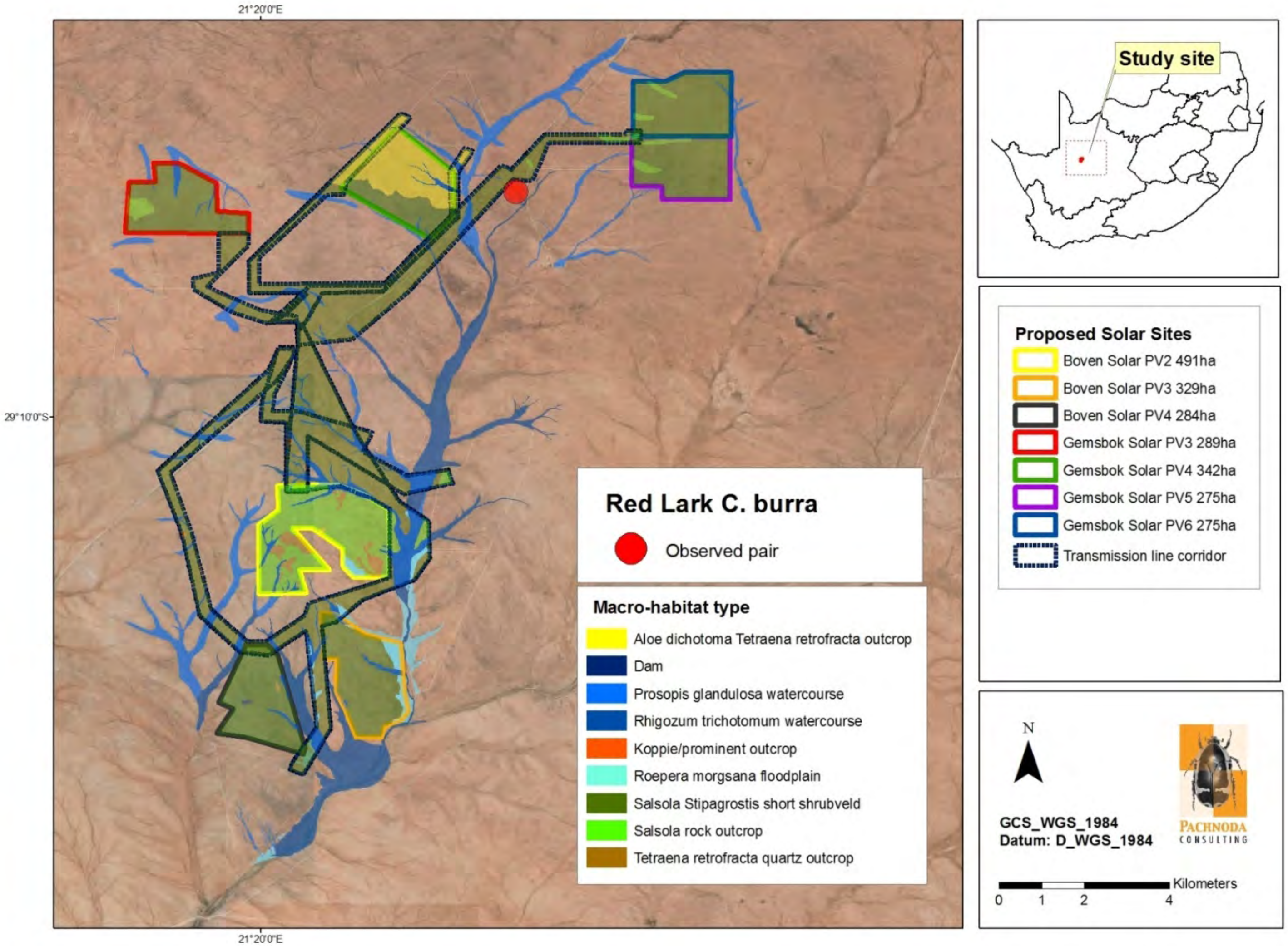

Figure 9.13: Satellite image illustrating the occurrence of the Vulnerable Red Lark *Certhilauda burra* in the study area.

Karoo Korhaan *Eupodotis vigorsii*

The Karoo Korhaan is listed as Near-threatened (Taylor *et al*. 2015) since the regional population has undergone a decline of nearly 30 % during the last 10 years. The regional population size is estimated at approximately 250 000 birds (Taylor *et al*., 2015).

Similarly to the Ludwig's Bustard *N. ludwigii,* the Karoo Korhaan is also susceptible to collisions with electricity distribution and telephone lines, but other threats include poisoning (during locust-control operations and climate change).

This species was widespread and fairly abundant in the study area, thereby making predictions regarding its distribution difficult - it could occur virtually anywhere in the entire study area. The extent of occurrence (*c*. 9 430 ha) of the Karoo Korhaan on the study site based on eight independent observations of 16 (eight pairs) individuals is illustrated in Figure 9.14.

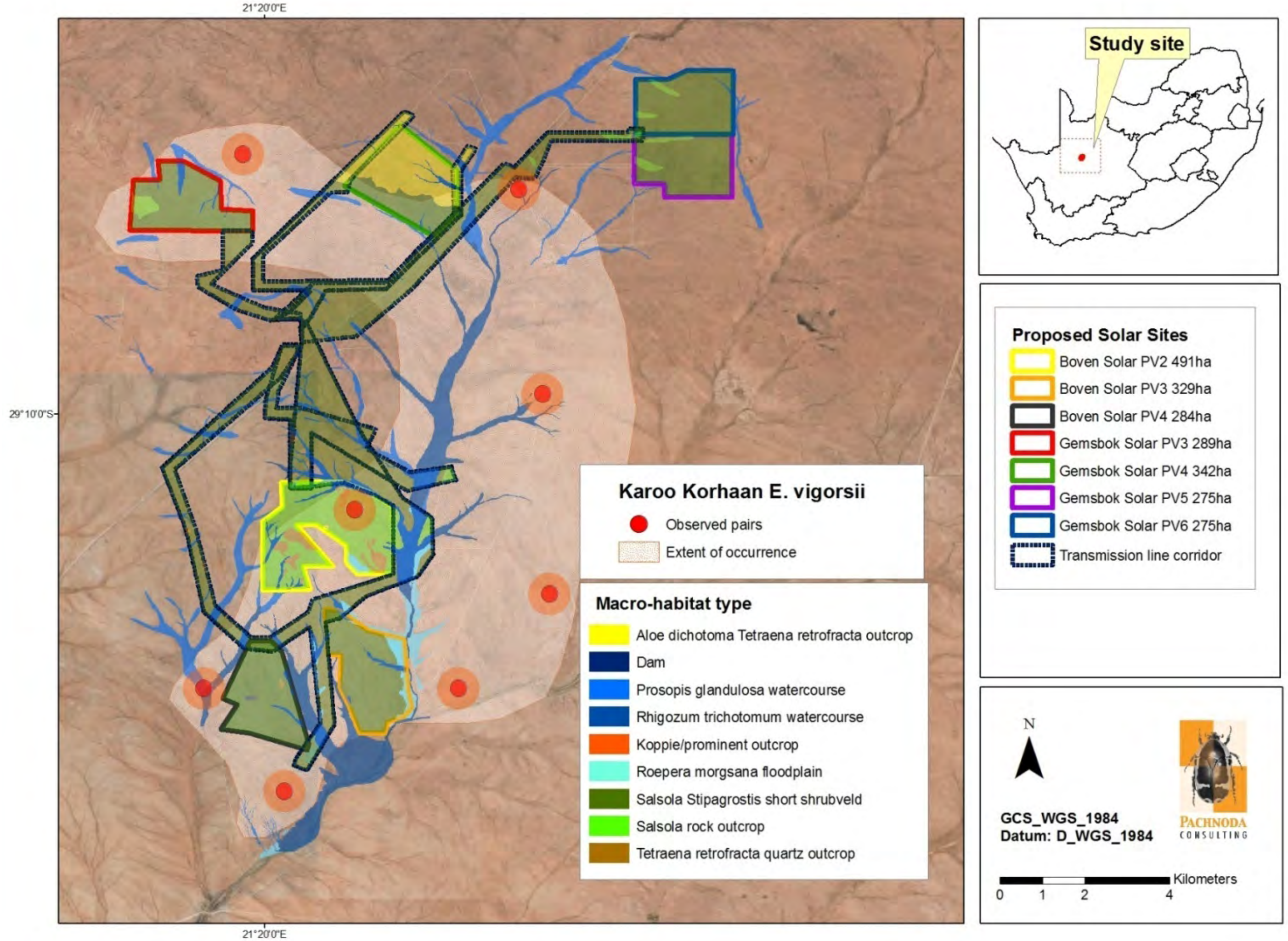

Figure 9.14: Satellite image illustrating the extent of occurrence of the Near-threatened Karoo Korhaan *Eupodotis vigorsii* in the study area.

Sclater's Lark *Spizocorys sclateri*

Sclater's Lark is listed as Near-threatened (Taylor *et al*., 2015) owing to its small global distribution range and fragmented meta-population (Taylor *et al.,* 2015). Apart from being under-recorded, it does not appear to have undergone any range contraction or population declines.

Sclater's Lark has a very restricted distribution in the Northern Cape (and Western Cape near Beaufort West) where it is only found on rather desolate stony or gravelly plains, especially on black dolerite and quartz plains.

It was fairly widespread and scattered in the study area given the presence of suitable breeding and foraging habitat (according to seven observations representing 11-12 individuals; Figure 9.15).

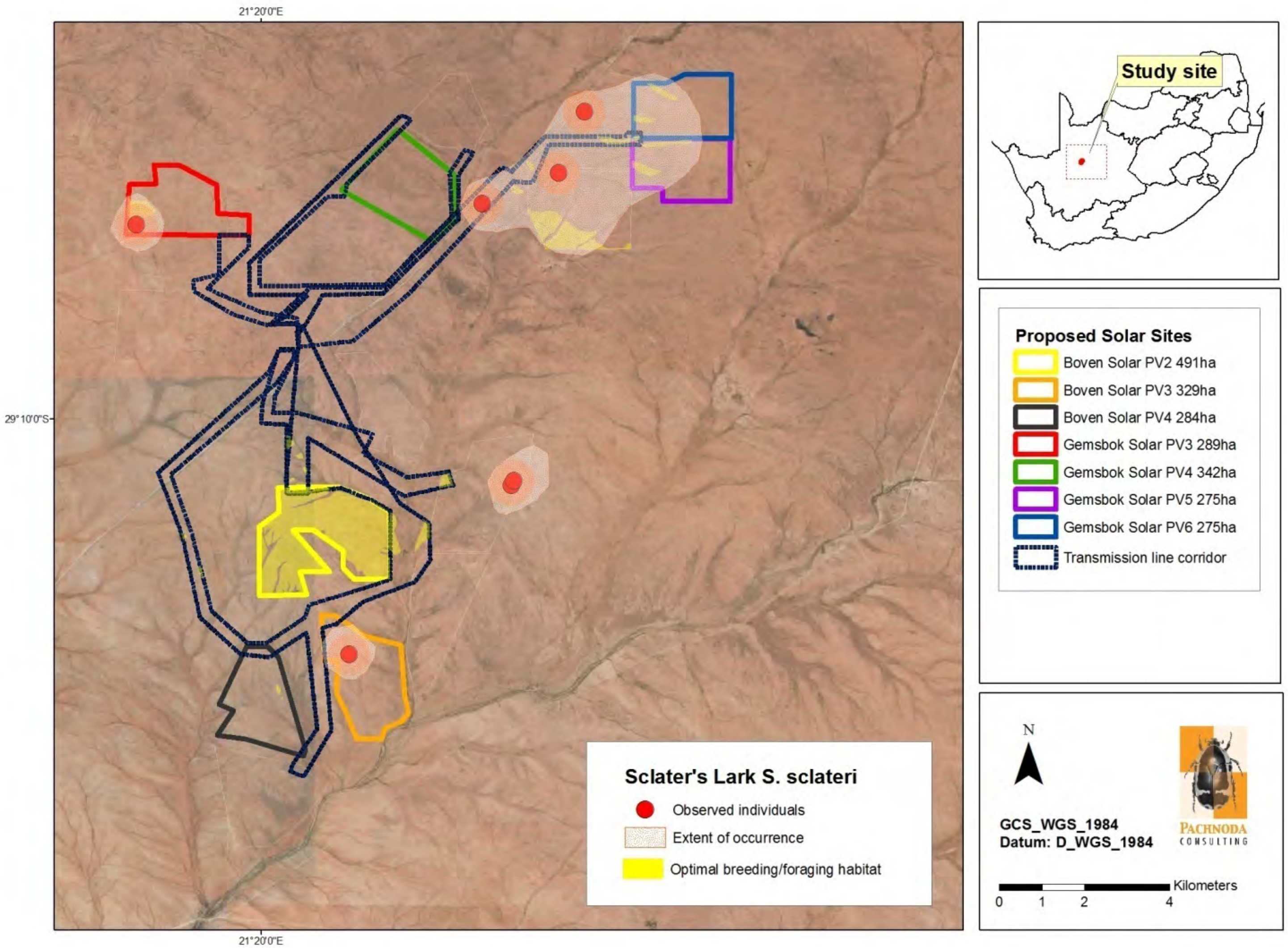

Figure 9.15: Satellite image illustrating the extent of occurrence and optimal habitat of the Near-threatened Sclater's Lark *Spizocorys sclateri* in the study area.

9.3.7 Avifaunal Sensitivity analysis

The sensitivity analysis should be regarded as preliminary since it is only based on observations and data obtained during a single instantaneous sampling session of eight calendar days. For further refinement and to obtain realistic estimates of the distribution and abundance of the bird population in the area it is recommended that the current data collection regime be repeated by undertaking a number of surveys over different seasons.

Notwithstanding the above, Figure 9.16 and Figure 9.17 illustrate composite avifaunal sensitivity maps based on the presence of Threatened and Near-threatened bird species and the occurrence of important avifaunal habitat:

Areas of high ecological sensitivity
As shown in Figure 9.16 and Figure 9.17, all habitat with the confirmed occurrence of Threatened and Near threatened bird species, artificial livestock watering holes, dams, major watercourses and all quartz and dolerite outcrops are identified as being of high avifaunal sensitivity. Most of these areas support local populations of the Threatened Ludwig's Bustard and Red Lark and the Near threatened Karoo Korhaan and Sclater's Lark. In addition, it also provides habitat for the Burchell's Courser and Lanner Falcon.

The dams and watering points also support high avifaunal diversities and often also atypical compositions when inundated, thereby contributing to the local bird diversity. With respect to the power lines, all major watercourses are sensitive since the spanning of this habitat types could elevate the risk of bird collisions.

The major watercourses are generally regarded as important, especially since they act as movement corridors for a variety of bird species and contribute towards the daily dispersal of large birds and other waterbird species when inundated. When dry, they are still regarded as important (and are regarded as sensitive when spanned by power lines) based on their unique avifaunal composition and their contribution in facilitating the dispersal of smaller passerine bird species within a relatively arid Biome.

Areas of medium to high ecological sensitivity
These habitat types are dominant in the study area and represent an extensive area of open shrubland and plains network which provide foraging habitat for large terrestrial bird species. However, the precautionary principle is highly applicable to this area, since the outcome of the sensitivity analysis is based on a single instantaneous sampling session. Therefore, additional sampling is required to improve the resolution of the sensitivity layer and to make an objective distinction between habitats which are of high and/or medium ecological importance.

Areas of medium ecological sensitivity
These areas are represented by the *Aloe dichotoma - Tetradenia retrofracta* outcrops, *Salsola* outcrops and the *Rhigozum trichotomum* watercourses. The faunal composition of these units comprise of widespread species typical of the region. These habitat units are fairly widespread and abundant in the region. The *Aloe dichotoma* trees also provide nesting habitat for the Sociable Weaver *Philetairus socius* and for some small raptors such as the Pale Chanting Goshawk *Melierax canorus*.

Areas of low ecological sensitivity
Currently none of the habitat types is regarded as being of low avifaunal sensitivity.

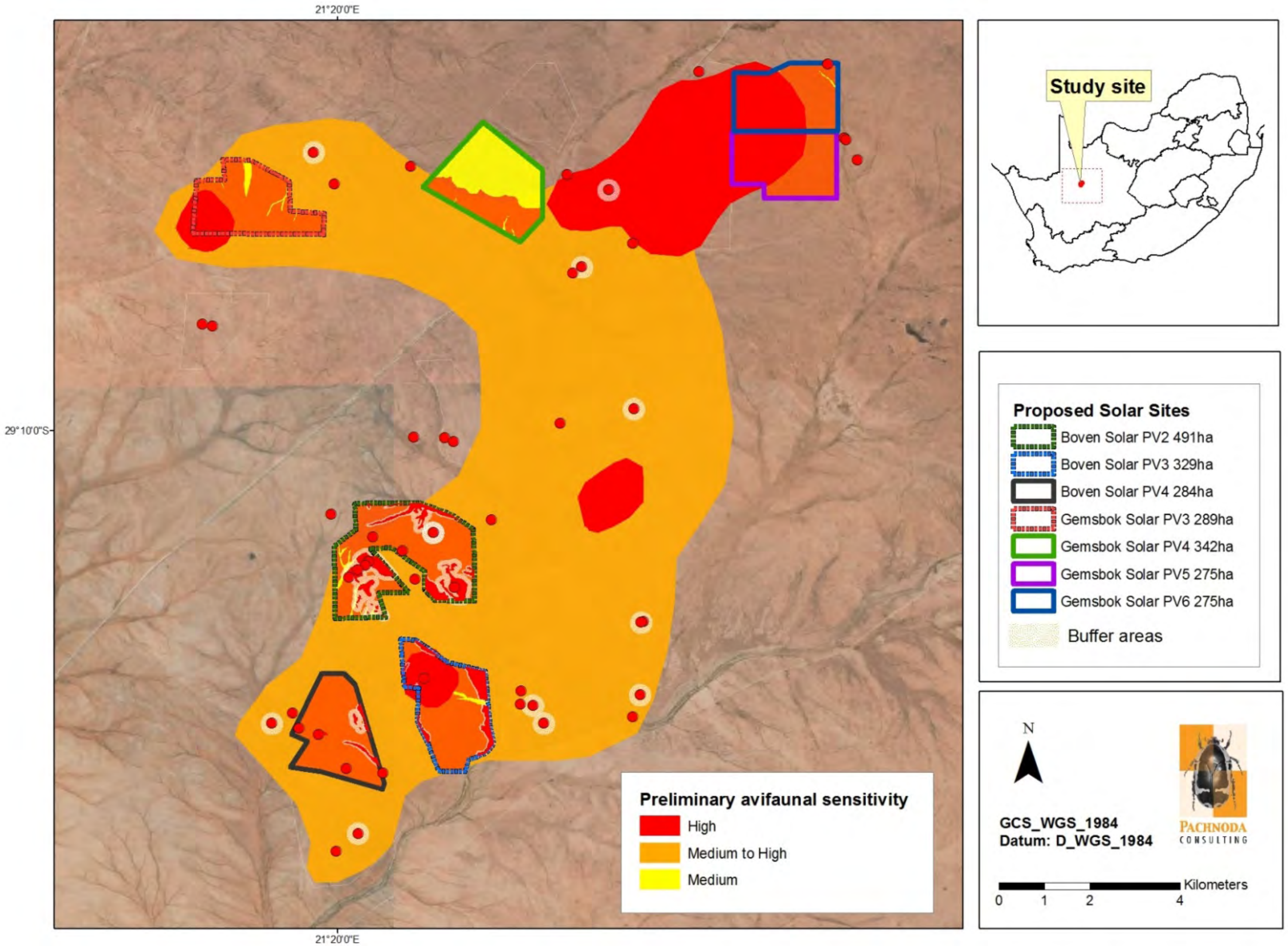

Figure 9.16: A composite preliminary sensitivity map based on the occurrence of Threatened and Near-threatened bird species and important bird habitats on the proposed solar sites (including a 250 m buffer area added to Ludwig's Bustard and Karoo Korhaan observations, 100 m buffer area to quartz outcrops, prominent outcrops and watering points and 32 m buffer area to major watercourses).

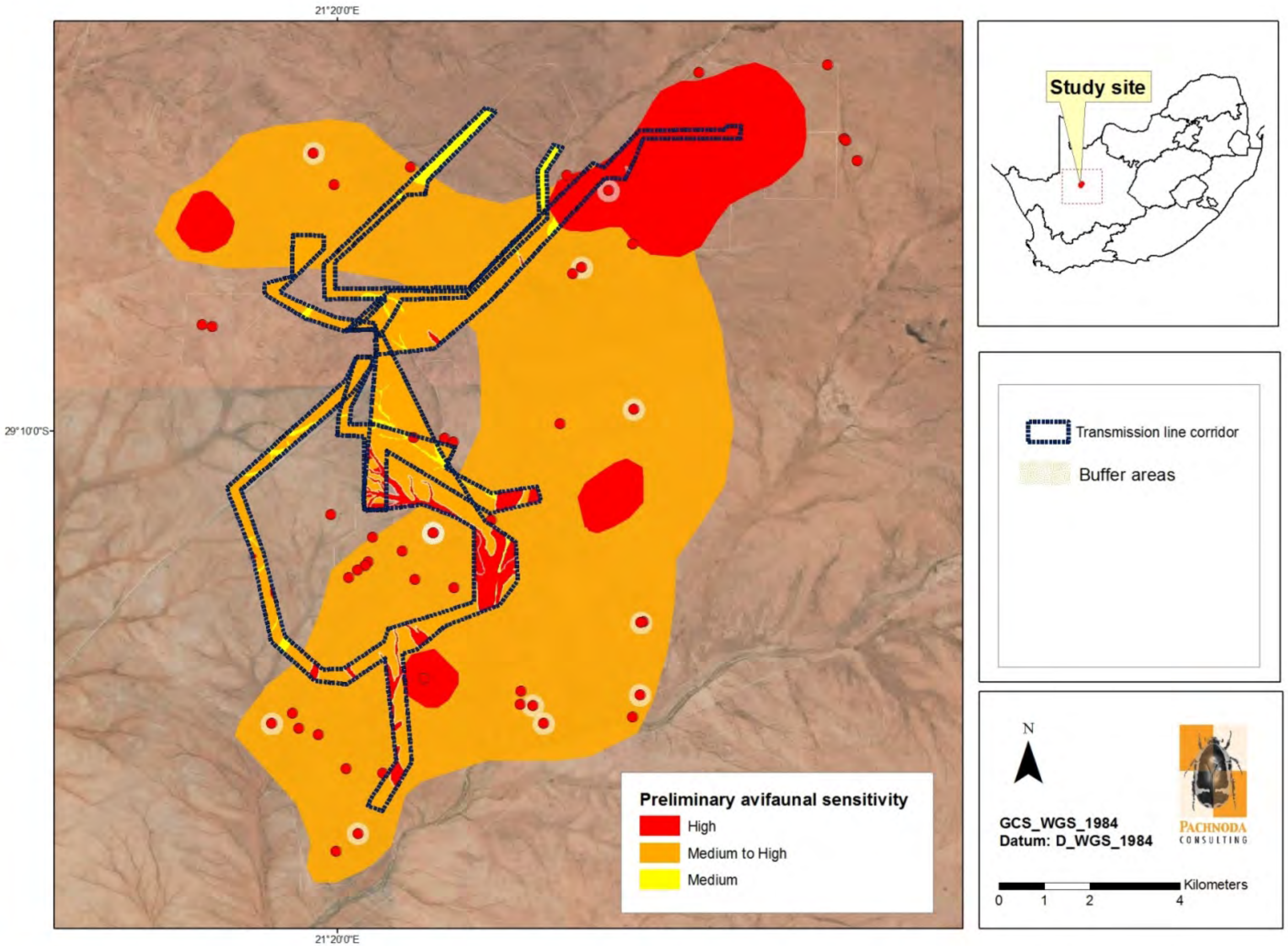

Figure 9.17: A composite preliminary sensitivity map based on the occurrence of Threatened and Near threatened bird species and important bird habitats along the proposed power line corridor (including a 250 m buffer area added to Ludwig's Bustard and Karoo Korhaan observations, 100 m buffer area to quartz outcrops, prominent outcrops and watering points and 32 m buffer area to major watercourses).

9.4 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

No permits are required.

9.5 IDENTIFICATION OF KEY ISSUES

9.5.1 Key Issues and Potential Impacts/Risks Identified During the Scoping Phase

Potential impacts associated with the proposed solar farm facilities will include:

Construction impacts:

- Loss of extensive plains habitat (and subsequent loss of threatened species) and displacement of bird species during construction of the facilities; and
- Definite loss of daily movement corridors.

Operational impacts:

- Collision of birds with panels and overhead power lines. The surfaces of the PV panels often act as attractants for approaching birds since these surfaces may be confused for large waterbodies (the so-called “lake-effect”);
- Electrocution of birds caused by the proposed powerline structures;
- Secondary impacts related to the infrastructure attracting birds (nesting and roosting on structures, foraging underneath panels, bird pollution e.g. droppings and excretory products, especially by Sociable Weavers); and
- Indirect impacts associated with changes in the local community structure (e.g. competition with generalist species and a decline in species richness).

Cumulative impacts:

- Construction and planning of additional solar farms within proximity of the area are likely to increase the significance of the construction and operational impacts.

During the consultation process and review of the scoping process, BirdLife South Africa released a draft best practice guideline document for assessing and monitoring the impact of solar energy facilities on birds in South Africa (Jenkins *et al*., 2015). These guidelines, although drafted after the commissioning of this study, were considered during the current study. The Draft Guidelines were also discussed in detail under the section dealing with the study limitations and assumptions (section9.1.1.5).

Comment	Commenter	Response
To acknowledge the recent draft prepared by Jenkins et al. (2015)	BirdLife South Africa	To adhere and incorporate the guidelines, where possible, although the study was primarily performed in terms of the guidelines prepared by Smit (2012). Please see Section 9.1.1.5 for more information on this.

9.6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

9.6.1 Results of the Field Study

There is little information available on the impacts of solar energy plants on birds besides those discussed by Gunerhan *et al*. (2009), McCrary *et al*. (1986) and Tsoutsos *et al*. (2005). Birds are highly mobile, especially large bodied birds which also occupy large home ranges, they are more readily affected by solar facilities than other animals. Birds are also vulnerable to impacts caused by other types of energy facilities such as power lines and wind farms. For example, McCrary *et al*. (1986) found 70 dead birds comprising of 26 species over a period of two years. It clearly shows that direct impacts of solar facilities on birds are minimal and not excessively significant (an average rate of mortality of 1.9-2.2 birds per week affecting 0.6-0.7 % of the local bird population). However, their observations are probably slightly underestimated since 10-30 % of dead birds are removed by scavengers before being noted. Approximately 81 % of these mortalities were caused by collisions.

The main impacts associated with solar farm facilities include the loss of habitat and displacement of bird species due to the ecological footprint required by the panel infrastructure during construction and direct interaction by birds with the surface infrastructure required during the operational phase (e.g. the possible collision with power lines). It should be noted that the vegetation will not be cleared during construction to reduce the ecological footprint.

For this project, seven sites are proposed ranging in size from 275 ha (the smallest surface area being the proposed Gemsbok Solar PV5 and Gemsbok Solar PV6 project) to as much as 491 ha (the largest surface area being the proposed Boven Solar PV2 project). Considering that only approximately 220 ha on each site is proposed for each 75 MW of infrastructure (c. the total footprint for all seven sites is 1 540 ha), which means that approximately 50 % of each proposed site is likely to be covered by the panels, although only 10 % will be occupied by foundation infrastructure. Even though only 50% of each site is anticipated to be occupied by infrastructure, it is possible that populations of Threatened and Near threatened bird taxa could be become displaced if sensitive features (e.g. outcrops, gravel plains and open shrubveld) are likely to be impacted (in a direct way through the covering by PV panels). The displacement of bird species will most likely affect large bodied birds such as bustards and korhaans and habitat specialists with localized distribution ranges such as the Red and Sclater's Larks.

Note that the impact assessment relies on the results of data collected on site during a single sampling session (eight consecutive days) along with published information, citizen science datasets and the author's personal experience. Therefore, the precautionary principle was applied without having the knowledge during a series of independent sampling sessions spanning different seasons. Therefore the impacts described are only potential impacts that can only be acquired with an inherent risk ascribed to each of them based on available knowledge. The findings should not be interpreted as definitive, as such an assessment requires at least 6 to 12 months of data collection (to be quantified over a period of four seasons). Therefore, the current assessment only highlights potential impacts and is the result of the initial phase of data collection.

9.6.2 Loss of habitat, habitat transformation and displacement of bird taxa (Construction Phase)

The loss of habitat and subsequent displacement of bird taxa is probably the single most significant impact likely to occur. Seven sites are proposed, which are all geographically widely spaced from each other. However, only 220 ha (50 %) of the proposed site is likely to be occupied, of which 10 % will be occupied by foundation infrastructure. Although the physical impact is small (based on the foundation infrastructure), the surface area covered by the panels is likely to contribute towards the displacement of large bird species and habitat specialists. Also, the potential "shade-out" effect created by the panels (thereby minimizing the amount to sunlight available to plants during the day) could result in habitat modification and displacement of habitat specialists if no careful consideration is given to the placement of the panels (in terms of the type of habitat and its sensitivity).

The majority of proposed solar farms will coincide with areas of high and medium-high sensitivities (Table 9.7). In general, the construction of the proposed solar facilities will result partly in a loss of natural shrubveld, outcrops and gravel plains (including azonal habitat such artificial watering points). The subsequent loss of habitat will displace bird species from site, especially large bodied species that require large home ranges and habitat specialists. These species occur naturally at low densities and many are also Threatened or Near-threatened. Of all the sites, the displacement of bird species is likely to be the highest at Boven Solar PV2 given the complex spatial arrangement of watering points, quartz outcrops and watercourses.

Table 9.7: A comparison of the proposed avifaunal sensitivity of each site and its predicted impact significance (pre-mitigation) due to the loss of habitat/habitat transformation.

Site	Mean avifaunal sensitivity	Predicted impact significance
Boven Solar PV2	High	Very High
Gemsbok Solar PV5	High	High
Gemsbok Solar PV6	High	High
Boven Solar PV4	Medium-High	High
Boven Solar PV3	Medium-High	Medium-High
Gemsbok Solar PV3	Medium-High	Medium-High
Gemsbok Solar PV4	Medium	Medium

Ludwig's Bustard and the Red Lark, both Threatened species and have experienced rapid declines across their entire range due to habitat loss, interaction with power lines and intensive grazing. Both have declined over most of their geographic distribution ranges, and reporting rates clearly show that these species were historically more common in large rural areas where anthropogenic activities were low. This explains why reporting rates are relatively low (or even absent) from areas that are not statutorily conserved and where livestock farming has intensified.

It should be stressed that the presence of large-bodied bird species and habitat specialists (e.g. Red Lark and Sclater's Lark) in the study area is probably a function of habitat loss or unfavorable environmental conditions that occurred elsewhere in the region and the presence of extensive, intact suitable habitat in the study area. Many terrestrial bird species have shown widespread declines in numbers, primarily due to large-scale loss of habitat (see introductory chapters of Taylor *et al*., 2015). It is postulated that this steady decline of suitable habitat has forced these species to utilise other suitable areas that are often in close proximity to human activities.

Those species likely to be affected by the loss of habitat and displacement include:

- Large-bodied terrestrial birds that occupy large home ranges (Ludwig's Bustard, Northern Black Korhaan, Karoo Korhaan and Martial Eagle);
- Small passeriform habitat specialists (Red Lark and Sclater's Lark); and

- Falconiform species (e.g. Lesser Kestrel, Greater Kestrel and Rock Kestrel) that rely on open shrubveld as foraging habitat during the non-breeding season.

Mitigation

- A conceptual layout of each proposed solar site should allow for the preservation of sensitive habitat features, thereby implying that the entire site will not be utilised.
- Development on habitat with high ecological sensitivity should be avoided.
- Make use of manual techniques and labour during the fitment of the foundation/ piles to minimize the possible trampling and destruction of surrounding vegetation and the use of drilling equipment should be avoided.
- The proposed sites are widely spaced from each other – it is suggested that the impact would be minimised if these sites are placed in close proximity to each other and concentrated on a single area consisting of habitat with medium ecological sensitivity.
- Opportunities should be sought to replace lost artificial dams and watering points (if occurring).

9.6.3 Disturbances and displacement of bird taxa due to construction noise (Construction Phase)

It is inevitable that disturbance during the construction (moving vehicles, and people working on site and moving between sites), operation and maintenance phase will occur. These will be especially significant near or in close proximity to breeding or roosting birds, or where large congregations of birds occur (e.g. at watering points). Although it is not anticipated to pose a significant impact, special care should be exercised to avoid areas where surface water is prominent (dams and watering points or at nesting sites of birds of prey). This is also true for habitat with high sensitivity. Disturbances during the construction phase of this type of development are generally believed to be of moderate to low ambient noise levels, although activities related to the construction, operation and maintenance of the infrastructure are likely to temporarily displace larger terrestrial species from the area.

Mitigation

- Minimise area cleared for construction activities. This includes the area used by personnel and labour during construction.
- Where possible, construction activities should be located in areas with low-medium ecological sensitivity.
- Linear features (watercourses) must be retained irrespective of their floristic condition or composition to facilitate the movement of fauna.
- Appropriate buffer zones must be implemented around key habitat types (watering points, dams, prominent outcrops, quartz outcrops and dolerite gravel plains) to alleviate the effect of habitat fragmentation and edge effects. Prominent quartz outcrops, koppies, watering points and dams must be buffered by 100 m. If any breeding or nesting bird of prey is encountered during the construction phase, it must be buffered by at least 500 m. All major watercourses should be buffered by 32 m and all bustard/Korhaan observations should be buffered by 250 m.
- Limit construction activities to daytime.
- Minimise the use of earthmoving equipment that results in noise generation.
- Construction personnel must be restricted to the construction area.
- Minimise exterior lighting. Some migratory birds flying at night are attracted to lights, and these should be kept to a minimum. If possible, outside lighting should make use of longer wave lengths (550 nm) and preferably should contain green or blue hues (see Sheppard, 2011). Exterior lighting should not make use of fluorescent lights since these emit significant amounts of UV, which will attract invertebrates (insects) and possibly also birds.

- Intentional killing of birds should be avoided by means of awareness programmes presented to the labour force. The labour force should be made aware of the conservation issues pertaining to the animals occurring in the study area. Any person found deliberately harassing any animal in any way should face disciplinary measures, followed by the possible dismissal from the site.
- Delay construction activities at or in close proximity to prominent outcrops, quartz outcrops and dolerite gravel plains (including optimal forging habitat used by threatened and near threatened species as explained in this document) during the months of August – November when most korhaan, bustard and lark species are breeding.

9.6.4 Collision with PV panels (Operational Phase)

The surfaces of the PV panels could act as attractants for approaching birds. From a distance the surfaces of the panels could be mistaken as waterbodies by birds and could cause disorientation to migratory birds (known as the "lake-effect"). Collisions are expected to be higher in areas where surface water is scarce where large numbers of birds are expected to congregate. Therefore, the rate of collision is expected to be higher if solar facilities are located near large waterbodies. McCrary et al. (1986), based on studies conducted in the Mojave Desert, concluded that most of bird mortalities/collisions involved waterbird species (e.g. duck, coots) due to the proximal location of a large evaporation pond near the solar facility.

The significance of the impact is not clear and more data are needed to make informed decisions regarding the severity and consequences of the impact (by means of post-construction monitoring over two seasons).

Typical bird species likely to be affected include:

- Swallows, martins and swifts;
- Possibly bee-eaters, such as the European Bee-eater *Merops apiaster;*
- Scolopacid waders and shorebirds (considered to be rare in the study area);
- Waterbirds such as ducks, geese, coots, grebes, and possibly also storks (rare in the study site); and
- Kestrels and falcons.
-

Mitigation

- The applicant will use SunPower's PV systems which incorporate stippled and light-trapping technology to reduce reflectance and glare. However, it remains uncertain whether the reduced reflectance and glare from the panels will significance decrease the impact to acceptable levels. Information and experience are lacking regarding the interaction of birds with PV panels and this could only be established by means of quantifying bird mortalities at the panel arrays during post-construction monitoring (at least during the dry and wet season).
- It is highly recommended that the solar facilities be placed away (100 m or more) from dams, watering points and 32 m from major watercourses (e.g. *Prosopis glandulosa* watercourses) where waterbirds could congregate when surface water is present.
- Other possible mitigation measures could include appropriate bird deterrent devices installed at strategic positions to reduce the probability of collisions – proposed devices could include small rotating devices with highly reflective or contrasting surfaces and bird flappers.

9.6.5 Exterior lighting and potential collision with infrastructure (Operational Phase)

Nocturnal migrating birds (e.g. certain warbler and crepuscular insectivorous species) often can be attracted to and disorientated by outside lighting with the subsequent risk of colliding with infrastructure.

Mitigation

- Minimise exterior lighting and implement operational strategies to reduce light spill. Outside features should be illuminated by using down-lighting rather than up-lighting.
- Lights should be of longer wave lengths (550 nm) and preferably should contain green or blue hues (see Sheppard, 2011). Outside lighting should not make use of fluorescent lights since these emit significant amounts of UV, which will attract insects and possibly also birds.
- In addition, internal lights should be shielded by blinds/curtains.

9.6.6 Potential localised chemical pollution of surface and groundwater resources (Operational Phase)

The PV panels are likely to gather substantial amounts of dust. Nevertheless, the panel structures are likely to attract certain opportunistic bird species (for reasons such as shelter, foraging and nesting purposes) which, based on their daily activities will cause pollution through faeces and nest building material. In the past this necessitates the use of chemicals to wash and clean the panels resulting in water run-off containing chemicals which could pollute or contaminate nearby waterbodies and ground water reservoirs. However, the applicant has indicated that only water will be used for cleaning of the panels after being filtered by reverse osmosis – no treatment will be required.

Mitigation

- Avoid the placement of panels near dams, watercourses or watering points.
- If required, make use of environmentally friendly cleaners that are biodegradable and install soap traps to collect greywater run-off.
- Washing of the facility should be minimized and should be done twice annually to minimise disturbances.

9.6.7 Secondary impacts related to the infrastructure attracting birds (nesting and roosting on structures, foraging underneath panels, bird pollution) (Operational Phase)

It is possible that the PV infrastructure could attract birds for reasons such as nesting space, foraging habitat and roosting sites. Certain tall structures (e.g. pylons) are often used as roosting or nesting platforms, especially in a landscape where trees are scarce. Nesting on the PV infrastructure and pylons could affect the performance of the infrastructure, or it could pose a fire hazard (e.g. Sociable Weaver nests). On the other hand, roosting could lead to excessive accumulation of faeces on the surfaces of the panels or the build-up of excreta on power line insulators that could cause various electrical faults.

Typical bird species likely to roost and breed on the proposed infrastructure are:

- Nests: Sociable Weaver, Cape Sparrow, White-browed Sparrow-Weaver, Speckled Pigeon, Pied Crow.
- Roosting/hunting: Egyptian Goose, Lanner Falcon, Rock Kestrel, Pale Chanting Goshawk, Barn Owl and Spotted Eagle Owl.

Mitigation

- Install appropriate deterrent devices to prevent birds from nesting on important structures.

- Monitor nest-building activities and remove/trim nests that pose a risk (fire risk or affecting the operations of the solar facilities) with the consent of the Northern Cape Conservation Department. Trimming should only be conducted during the non-breeding season.
- Install nest boxes for owls along the perimeter of the facilities to assist with rodent control.
- Ensure appropriate spacing between the consecutive panel arrays (3 m or more) to allow for sunlight to reach the underlying vegetation. Allow for single-axis tracking of the sun by the arrays to maximize the amount of sunlight reaching the ground between the arrays.

9.6.8 Collision with power lines (Operational Phase)

A number of distribution power lines (132 kV) are proposed to link up the PV facilities with the nearby Nieuwehoop Substation. Based on the proposed alignments, the impact of the 132 kV lines is considered significant since most of these lines will cross habitat units comprising drainage lines and open plains and shrubveld containing large terrestrial bird species.

Collisions with power lines have probably accounted for most bird-power line interactions in South Africa. In general, the earth wires are much thinner in diameter when compared to the live components, and therefore less visible to approaching birds. The same applies to small voltage lines where the live components are often not readably visible to approaching birds. Many of the species likely to be affected include heavy, large-bodied terrestrial species such as the Ludwig's Bustard, Karoo Korhaan and Northern Black Korhaan that are not very agile or manoeuvrable once airborne. These species, especially those with the habit of flying with outstretched necks find it difficult to make a sudden change of direction while flying – resulting in the bird flying into the lines.

Bird collisions could be minimised by marking the lines with bird devices such as bird diverters and flappers to increase the visibility of the lines (APLIC, 1994). Many studies have proved that bird diverters can reduce mortalities by up to 60 % (Alonso and Alonso, 1999) and if installed correctly (e.g. utilising large devices spaced at least 5 m apart), they appear to be very effective. However, exceptions do occur and some birds (e.g. bustards) appear to be virtually "blind" in level flight. A case example is the Ludwig's Bustard which is highly susceptible to collisions with power lines.

The following bird species potentially could collide with the proposed power lines:

- Ludwig's Bustard, Northern Black Korhaan, Karoo Korhaan, Martial Eagle and possibly also Lanner Falcon.
- To a lesser extent also Egyptian Goose, Jackal Buzzard and Black-headed Heron.

Mitigation

- Nearly all the powerline alignments traverse land that is considered to be suitable foraging and breeding habitat for the Endangered Ludwig's Bustard – it is highly recommended that the entire proposed alignment be marked with appropriate bird diverters (see specification below);
- Wherever the proposed powerlines cross or run alongside any of the following habitat types, it is deemed compulsory that suitable bird deterrent/marking devices should be fitted to the earth wires to increase the visibility of the overhead cables/wires:
    - Large watercourses (e.g. *Prosopis* and *Morgsana*-dominated watercourses and floodplains – irrespective of their non-perennial status.
    - Dams and watering points in close proximity to the alignment (usually within 100 m from the alignment).
    - Any prominent outcrop or extensive plains area.
- Where possible, hotspot areas or suitable habitat where a high concentration of Ludwig's Bustards are expected should be avoided;

- The placement of the road alongside existing railway will greatly increase the visibility of the alignment. In addition, many bird species have already become accustomed to the existing railway line and its electrical infrastructure which will reduce collisions;
- The Double Loop Bird Flight Diverter (BFD) is recommended as a marking device on the earth wires (pers. comm. C. van Rooyen) (Figure 9.18). The installation should meet the following criteria:
    - Diverters should make use of the largest available spirals that can be fitted to the powerline. (see http://www.preformedsa.co.za).
    - Diverters should be preformed PVC that are UV resistant.
    - Diverters should be applied to all earth wires in a staggered fashion, alternating between black and white diverters.
    - Diverters should be fitted to the entire span (not the conventional fitment to the middle 60 % of the span) – fitment of BFDs to the entire span is essential since Ludwig's Bustards often detect the BFDs during their approach, and then deviate their course only to collide with unmarked spans near their edges (see Shaw, 2013).
    - All diverters should be spaced at 10 m intervals from each other.
- It is highly recommended that the proposed (most feasible) alignment be surveyed monthly by the Environmental Officer (EO) for at least five years after construction to document the frequency of mortalities caused by collision and the taxa involved. The data could provide predictive information on flyways used by the bird community in the region and where specific mitigation will be required. Areas with a high incidence of mortalities, for example watercourse crossings, in close proximity to watering points should be prioritised.

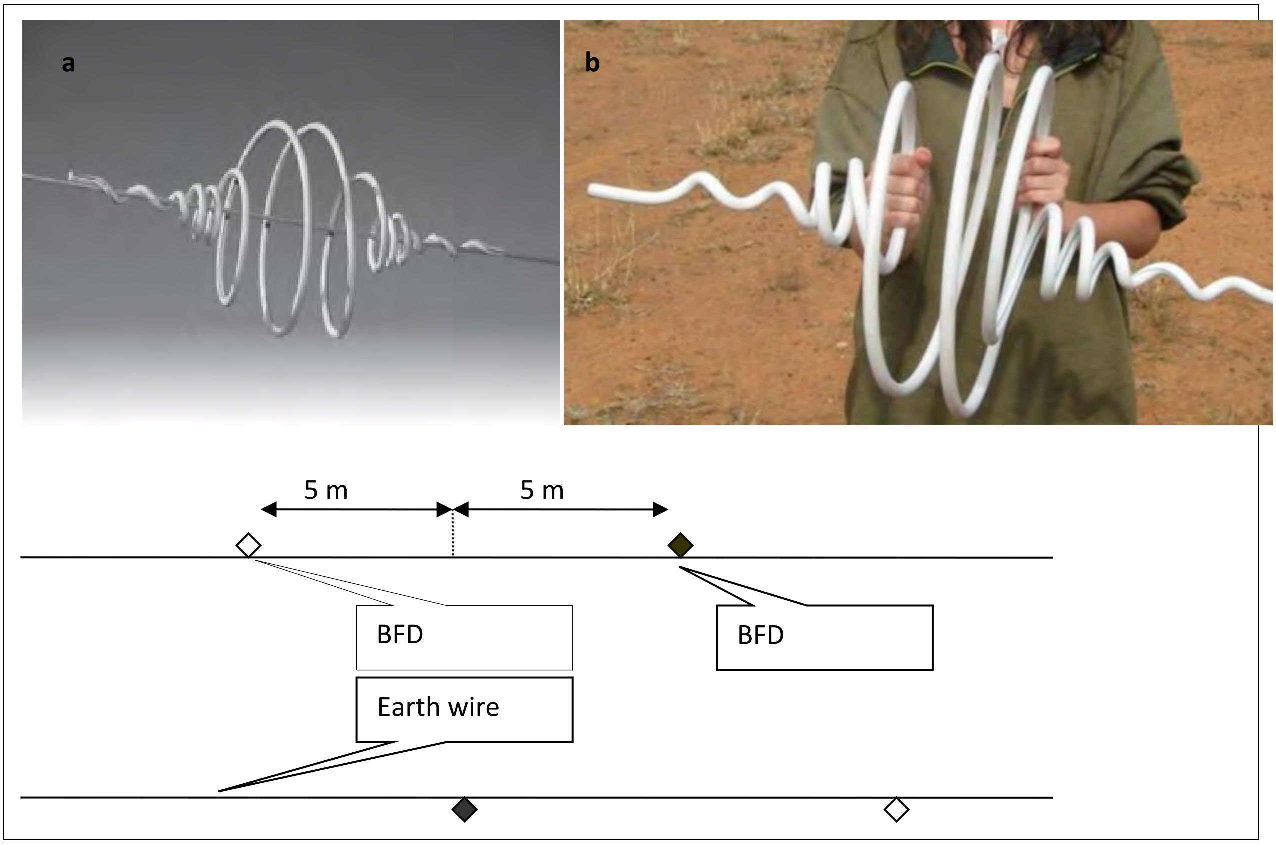

Figure 9.18: The recommended bird diverter to be used and installation guidelines: (a) the Double Loop Bird Flight Diverter (BFD) (copyright Preformed Line Products, www. preformedsa.co.za), (b) an example of the recommended size of the BFD (image copyright and courtesy of Shaw, 2013) and (c) – installation procedures (kindly provided by C. van Rooyen).

9.6.9 Electrocution of birds caused by the proposed power line structures (Operational Phase)

Electrocution happens when a bird bridges the gap between the live components or a combination of a live and earth component of a power line, thereby creating a short circuit. This happens when a bird, mainly a species with a fairly large wingspan attempts to perch on a tower, or attempts to fly off a tower. Many of these species include large birds of prey (e.g. vultures and the Martial Eagle) (Ledger and Annegarn, 1981; Kruger, 1999; Van Rooyen, 2000). These species will attempt to roost and even breed on the pylons if available nesting platforms are a scarce commodity, e.g. in the treeless Karoo.

Other types of electrocutions happen by means of so-called bird-streamers. This happens when a bird, especially when taking off, excretes and thereby causing a short-circuit through the fluid excreta (Van Rooyen and Taylor, 1999). Examples of species likely to be affected are those roosting on towers such as the large species of geese, and the Black-headed Heron *Ardea melanocephala*.

Large transmission lines (from 220 kV to 765 kV) seldom pose a risk of electrocution. However, smaller distribution lines (88 – 132kV) pose a higher risk of electrocution. Additional threats include network breakers and pole transformers.

The following bird species are prone to electrocution and are the main contributors of streamers:

- Martial Eagle, Steppe Buzzard, Jackal Buzzard, Sociable Weaver (when nests are constructed above conductors), Pied Crow, Black-headed Heron, Cattle Egret, Spotted Eagle-owl, Barn Owl, Southern Pale-chanting Goshawk, Egyptian Goose and to a lesser extent Lanner Falcon.

Mitigation

- The proposed power line alignment accepts the shortest possible route to the substation, thereby reducing the area of open shrubveld (utilised by bustards) to be crossed.
- The proposed alignments should run alongside the railway line wherever possible.
- For this project the design of the tower is an important consideration in preventing bird electrocutions and must incorporate the following design parameters:
  - The clearances between the live components should exceed the wingspan of any bird species;
  - The height of the tower should allow for unrestricted movement of terrestrial birds between successive pylons;
  - The live components should be bundled to increase the visibility for approaching birds;
  - Bird streamers should be eliminated by discouraging birds from perching above the conductors.

It is therefore recommended that the Monopole design as illustrated in Figure 9.19 be used for the project.

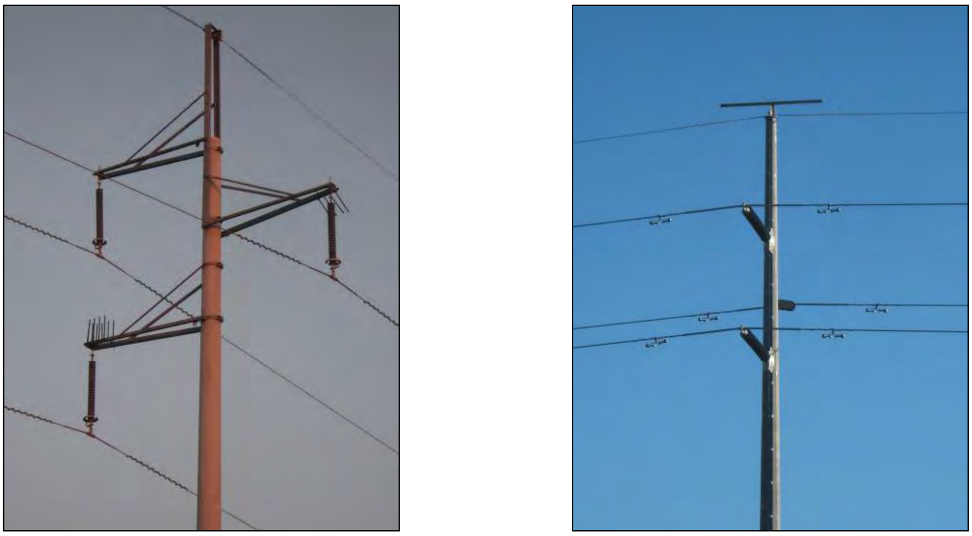

Figure 9.19: Two bird-friendly tower designs to monopoles be used for the current project (as opposed to the proposed design).

Both designs allow for enough clearance between the live conductors (being positioned in an off-set manner to each other) to eliminate the risk of electrocution. In addition, perching of large bird species is discouraged by the addition of diagonal crossbars or by doing away with the crossbars that holds the conductors in place. Bird streamers are also eliminated by fitting the poles with bird guards/spikes above the conductors. However, safe perching is facilitated by the fitment of a horizontal bar on top of the pole structure without the risk of electrocution (due to the perpendicular orientation of the bar relative to the conductors).

9.6.10 Indirect impacts associated with changes in the local community structure (Decommissioning Phase)

It is likely that the bird species composition will change once the PV panels are removed and habitat succession is initiated. However, considering the long recovery periods experienced after transformation of arid systems, it is predicted that the floristic structure and composition will mirror that of a pioneer community. Therefore, generalist bird species could dominate the study area. As mentioned above, it is believed that the densities of certain opportunistic species could increase. These species could easily out-compete other less resilient conspesific taxa in the area.

Mitigation

- Conduct annual seasonal bird surveys to determine the bird species composition and successional patterns for at least five years after decommissioning. Compare site data with those obtained from similar untransformed habitat. Adjust rehabilitation strategy when the bird successional trends are not conforming to benchmark compositions (e.g. compositions on untransformed habitat).

9.6.11 Cumulative Impacts - Indirect impacts related to anthropogenic encroachment

The proposed solar facilities, especially during construction will provide employment for the local community as well as people from afield. Unfortunately, such an activity will impact negatively on the surrounding habitat types by facilitating urban-sprawl and consequential plundering of natural resources (e.g. fire-wood collection, snaring and poaching).

Human environments are often magnets for alien and invader taxa which include feral dogs and cats (see discussion above). The domestic cats are specifically a problem since they could prey on the local native bird taxa.

Mitigation

It is difficult to manage or control urban sprawl in an economic environment where jobs are scarce and nearly unobtainable in rural areas. It is recommended that the local community be used during the construction phase or that the labour force be housed at Kenhardt. Illegal "squatting should be prohibited on the study area. During construction, employment will be temporary and construction camps should not be allowed to become permanent squatter camps.

9.6.12 Cumulative Impacts – "Congestion" of other planned and approved solar projects on the study region

Considering the interest in and rapid expansion of solar farm energy plants in South Africa, especially in the Northern Cape, it is anticipated that these structures could cumulatively have an impact on the surrounding ecological integrity, including bird populations.

The Nieuwehoop Solar Park Project is not the only project of this kind planned for the Kenhardt area. Scatec Solar SA (Pty) Ltd is also proposing to construct and operate three additional 75 megawatt (MW) Solar Photovoltaic (PV) power generation plants in the area. These plants will be constructed on the Farm Onder Rugzeer 168, which is situated adjacent to the Farm Boven Rugzeer (Remaining Extent of Farm 169) and the Eskom Nieuwehoop Substation. Each 75 MW plant (and associated infrastructure) will cover an approximate area/footprint of 250 ha (i.e. total area of approximately 750 ha).

Therefore, it is anticipated that an increase in surface activity and infrastructure, herewith composed of solar energy infrastructure could result in additional ecological impacts. These will be the same as those described earlier, although the magnitude and severity of the impacts are elevated (or enhanced) due to the addition of these structures to the landscape. Therefore, more surface area will become lost and further loss of habitat affecting bird species with large home range size are likely to be affected should their ranges overlap with these activities (e.g. large terrestrial bird species). In addition, a cumulative increase in the surface area of PV panels could also increase the risk of bird collisions with the panels and overhead power lines.

9.7 IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in Table 9.8 to Table 9.11 below.

Table 9.8: Impact assessment summary table for the Construction Phase

Construction Phase													
Direct Impacts													
Site/Area.	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplace ability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Gemsbok Solar PV5 Gemsbok Solar PV6	Habitat loss, fragmentation and displacement of threatened and near threatened species and species loss	Negative	Local	Long-Term	Substantial	Definite	Low	High	Avoid development on habitat with High sensitivity or align along existing infrastructure Apply appropriate buffer zones	High	Moderate	3	Medium
All sites in particular: Boven Solar PV2 Gemsbok Solar PV5 Gemsbok Solar PV6	Displacement and disturbances caused to birds due to noise generation and construction, operational and maintenance activities	Negative	Site	Medium-Term	Moderate	Highly probable	Moderate	Moderat e	Avoid development on habitat with High sensitivity or align along existing infrastructure Apply appropriate buffer zones Apply appropriate buffer zones	High	Moderate	3	Medium

Table 9.9: Impact assessment summary table for the Operational Phase

Operational Phase													
Direct Impacts													
Site/Area	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplace ability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
All sites	Increased bird mortalities due to collision with panels	Negative	Local	Long-term	Moderate	Probable	Low	High	Conduct post-construction monitoring Apply bird deterrent devices Avoid construction near surface water.	Moderate	Moderate	3	Low
All sites	Disorientation of bird species due to exterior lighting and increased bird mortalities (due to collision with infrastructure)	Negative	Local	Long-term	Moderate	Probable	Moderate	Moderate	See section 9.6.1.5 on mitigation	Moderate	Low	4	High
All sites	Cleaning of panels could result in chemical pollution of water resources	Negative	Local	Long-term	Slight	Probable	High	Low	Avoid placement of panels near waterbodies Make use of filtered water	Low	Low	4	High
All sites	Secondary impacts related to the infrastructure attracting birds: nest –building activities and roosting bird taxa	Negative	Site	Long-term	Slight	Definite	High	Low	See section 9.6.1.7 on mitigation	Moderate	Low	4	High

Operational Phase													
Direct Impacts													
Site/Area	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplace ability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
All power lines	Collision with power lines resulting in bird mortalities, especially threatened species	Negative	Region al	Long-term	Severe	Definite	Low	High	See section 9.6.1.8 on mitigation	Very High	High	2	Low
All power lines	Electrocution by power lines resulting in bird mortalities, especially threatened species	Negative	Region al	Long-term	Substantial	Probable	Low	High	See section 9.6.1.9 on mitigation	High	Moderate	3	Low

Table 9.10: Impact assessment summary table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Site/Area	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
All sites	Increased competition and decline in species richness during rehabilitation events	Negative	Local	Long-term	Moderate	Probable	Moderate	Moderate	See section 9.6.1.10 mitigation	Moderate	Low	4	Medium

Table 9.11: Cumulative impact assessment summary table

Cumulative Impacts													
Site/Area	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
All sites	Indirect impacts related to anthropogenic encroachment and exploitation of natural resources	Negative	Regional	Long-term	Substantial	Probable	Low	Moderate	See section 9.6.1.11 on mitigation	High	Moderate	3	Medium
Region	"Congestion" of other planned and approved solar projects on the study region AND increased bird mortalities (power lines) and displacement (solar panels) on a regional scale	Negative	Regional	Long-term	Severe	Definite	Low	High	N/a	Very High	High	2	Medium

9.8 INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

The following monitoring and management plans are required during the pre-construction phase (please note that pre-construction monitoring is mandatory and essential to conduct an informed and decisive impact assessment):

- The implementation of pre-construction monitoring to obtain additional long term data on the distribution and abundance of birds across different seasons. At least two independent sampling sessions are required during the dry cool and wet season (*pers. comm*., Samantha Ralston-Paton of EWT). The specialist recommends 8-10 days per session. The next data collection session should coincide with the peak wet season (late March – April).
- Implement vantage point surveys to identify and quantify bird flyways in the region. At least two surveys are required (on two prominent outcrops/koppies located on the eastern and western section of the study area). A minimum of 12 hours should be accumulated at each vantage point and coverage should include all the times of day (morning, midday and afternoon).

9.9 CONCLUSION AND RECOMMENDATIONS

As per Appendix 6 of the Environmental Impact Regulations of 2014 (No. R. 982) of the National Environmental Management Act (Act No. 107 of 1998) a reasoned opinion should be provided as to whether the proposed activity or portions thereof should be authorised.

- According to the results, areas identified with high avifaunal sensitivity are sensitive habitats
- All key habitat types (watering points, dams, prominent outcrops, quartz outcrops and dolerite gravel plains) should be buffered by at least 100 m to minimize any induced ecological edge-effects and associated fragmentation during the construction and operation phases of the project. In addition, all major watercourses should be buffered by at least 32 m;
- Boven Solar PV2, Gemsbok Solar PV5 and Gemsbok Solar PV6 contain the largest surface area of sensitive habitat (mainly outcrops and plain habitat) which are important areas for habitat specialists and Threatened and/ or Near-threatened species; and
- The remaining sites are dominated by habitat (mainly shrubveld) with medium - high ecological sensitivity (Boven Solar PV3, Boven Solar PV4 and Gemsbok Solar PV3) or medium ecological sensitivities (Gemsbok Solar PV4).

Development in areas corresponding to habitat of high sensitivity is likely to result in impacts (herewith referring to the loss of habitat and displacement of bird species) with a very high (Boven Solar PV2) or high significance (Boven Solar PV4, Gemsbok Solar PV5 and Gemsbok Solar PV6). Development at these sites is justifiable once *sufficient data* has been collected on the distribution and abundance of Threatened and Near-threatened bird taxa (*sensu* Jenkins *et al*., 2015) and only if the aforementioned buffer zones are applied to ensure that the ecological integrity and function of key habitats are maintained.

The more preferred sites for development include Gemsbok Solar PV3, and Gemsbok Solar PV4.

The sensitivity analysis was based on the outcome of a single instantaneous sampling session (04-11 December 2015) and refinement thereof is highly recommended by means of long term pre-construction monitoring (*sensu* Jenkins *et al*., 2015) of passerine abundance values and the distribution and abundance of Threatened and Near-Threatened bird species. It is also argued that habitat of medium ecological sensitivity provides suitable habitat for large terrestrial bird species, e.g. Ludwigs' Bustards, and caution is advised during development of these areas. As mentioned, all key habitat types (watering points, dams, prominent outcrops, quartz outcrops and dolerite gravel plains) should be buffered by at least 100 m and all major watercourses should be buffered by at least 32 m.

It is evident that the sensitivity classification is in need of validation and refinement based on the following recommendations:

- The implementation of pre-construction monitoring to obtain additional long term data on the distribution and abundance of birds across different seasons. At least two independent sampling sessions are required during the dry cool and wet season (*pers. comm*., Samantha Ralston-Paton of EWT). The specialist recommends that the sampling or monitoring sessions should last 8-10 days each. The next data collection session should coincide with the peak wet season (late March – April).
- Refinement and mapping of the distribution ranges of large terrestrial birds (e.g. Ludwig's Bustard and Karoo Korhaan) and habitat specialists (Sclater's Lark and Red Lark).
- The survey of 04 – 11 December 2015 coincided with very dry and unfavourable environmental conditions, and justifies a follow-up survey during the wet season (preferably after the area has received rains).

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9.11 APPENDICES

Appendix 9.1: A matrix of bird species numbers observed at each point count.

Species	anie 01	anie 02	anie 03	anie 04	anie 05	anie 06	anie 07	anie 08	anie 09	anie 10	anie 11	abie 12	anie 13	anie 14	anie 15	anie 16	anie 17	anie 18	anie 19	anie 20	anie 21	anie 22	anie 23	anie 24	anie 25	anie 26	anie 27	anie 28	anie 29	anie 30	anie 31	anie 32	anie 33	anie 34	anie 35	anie 36	anie 37	anie 38	anie 39	Anie 40	anie 41	anie 42	anie 43	anie 44	anie 45	anie 46	anie 47	anie 48	anie 49
Southern Ant-eating Chat	2	1	0	0	0	0	0	0	2	0	1	0	0	0	0	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Black-chested Prinia	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	2	2	0	1	0	2	2	0	1	2	0	0	0	0	0	2	2	0	0	0	0	0	0	0
Black-eared Sparrowlark	0	0	2	1	0	0	0	0	0	0	0	0	3	0	4	0	7	0	0	0	0	0	7	5	0	0	4	7	0	2	0	7	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Black-cheeked Waxbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Bokmakierie	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Black-throated Canary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Fiscal	0	0	0	0	2	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Chat Flycatcher	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chestnut-vented Tit-babbler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Cape Penduline Tit	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0
Cape Sparrow	16	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	2	0	2	0	0	0	2	0	0	0	0	0	0	0	4	0	0	0	0	0
Cape Turtle Dove	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Double-banded Courser	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-bellied Eremomela	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Familiar Chat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fawn-coloured Lark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Grey-backed Sparrowlark	30	5	0	0	0	0	0	0	0	0	0	23	0	0	4	38	0	0	0	0	0	0	4	0	0	0	19	0	0	10	0	2	0	0	0	0	0	0	0	0	0	0	0	10	2	0	0	0	0
Grey Tit	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kalahari Scrub-Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Karoo Prinia	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Karoo Korhaan	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Karoo Scrub-Robin	1	0	0	0	0	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Karoo Thrush	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Laughing Dove	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0
Lark-like Bunting	2	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	4	0	0	0	0	16	0	0	2	1	33	0	0	9	0	4	0	0	7	0	0	0	0	0	0	0	1	20	4	0	0	0	0
Mountain Wheatear	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Namaqua Dove	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

Species	anie 01	anie 02	anie 03	anie 04	anie 05	anie 06	anie 07	anie 08	anie 09	anie 10	anie 11	abie 12	anie 13	anie 14	anie 15	anie 16	anie 17	anie 18	anie 19	anie 20	anie 21	anie 22	anie 23	anie 24	anie 25	anie 26	anie 27	anie 28	anie 29	anie 30	anie 31	anie 32	anie 33	anie 34	anie 35	anie 36	anie 37	anie 38	anie 39	Anie 40	anie 41	anie 42	anie 43	anie 44	anie 45	anie 46	anie 47	anie 48	anie 49
Namaqua Sandgrouse	0	0	0	0	0	0	0	0	1	0	0	60	0	0	0	10	0	0	0	0	0	3	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	2	1	0	0	0
Northern Black Korhaan	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Acacia Pied Barbet	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Crow	12	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pale-chanting Goshawk	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pririt Batis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
African Red-eyed Bulbul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Red Lark	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous-eared Warbler	1	2	1	0	0	0	1	0	0	0	2	0	2	0	0	0	1	2	0	1	0	0	0	0	1	3	1	1	0	0	1	1	2	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0
Sabota Lark	0	2	1	0	3	0	0	4	3	1	4	2	6	2	1	0	2	0	2	0	2	3	1	1	3	3	0	2	0	0	1	3	0	1	0	1	0	1	0	0	3	1	0	0	1	2	0	0	0
Scaly-feathered Finch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spike-heeled Lark	10	5	2	0	4	4	2	19	2	0	0	0	0	0	0	7	0	2	3	0	2	4	0	0	3	2	0	0	0	5	0	3	0	2	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0
Sclater's Lark	0	0	4	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	1	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0
Southern Masked Weaver	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sociable Weaver	0	0	0	0	0	0	0	0	0	0	0	15	0	15	0	26	0	0	0	0	0	0	0	0	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Red Bishop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Stark's Lark	4	1	0	0	12	5	6	4	12	7	11	1	23	3	9	2	7	1	0	5	8	2	12	6	10	14	4	19	1	6	0	40	7	6	5	1	3	11	8	0	7	6	2	0	1	12	1	2	5
Sickle-winged Chat	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Sparrow-weaver	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
White-throated Canary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Yellow Canary	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	2	1	2	0	0	0	0	0	0	0	0	5	0	0	0	4	1	0	0	0	0

Appendix 2: A preliminary shortlist of bird species observed from the study area, their conservation and endemic status and habitat preference during 04 - 11 December 2015.

Common Name	Species	Global Conservation Status (IUCN, 2015)	National Conservation Status (Taylor et al., 2015)	Endemism	Habitat (broad categories)					
					Shrubveld	Gravel plains/ low outcrops	Koppies	Water courses	Dams/ watering points	Infrastructure/ pylons
ANSERIFORMES: Anatidae										
Egyptian Goose	*Alopochen aegyptiaca*								1	
PELECANIFORMES: Ardeidae										
Western Cattle Egret	*Bubulcus ibis*								1	
Black-headed Heron	*Ardea melanocephala*								1	
ACCIPITRIFORMES: Accipitridae										
Black-winged Kite	*Elanus caeruleus*								1	
Black-chested Snake Eagle	*Circaetus pectoralis*				1					
Martial Eagle	*Polemaetus bellicosus*	Vulnerable	Endangered			1				
Pale Chanting Goshawk	*Melierax canorus*			Near-endemic	1		1	1	1	
Jackal Buzzard	*Buteo rufofuscus*			Endemic			1			
Common ("Steppe") Buzzard	*Buteo vulpinus*				1					
OTIDIFORMES: Otididae										
Ludwig's Bustard	*Neotis ludwigii*	Endangered	Endangered	Near-endemic	1	1				
Karoo Korhaan	*Eupodotis vigorsii*		Near threatened	Endemic	1	1				
Northern Black Korhaan	*Afrotis afraoides*			Endemic	1	1				
CHARADRIIFORMES: Burhinidae										
Spotted Thick-knee	*Burhinus capensis*								1	

Common Name	Species	Global Conservation Status (IUCN, 2015)	National Conservation Status (Taylor et al., 2015)	Endemism	Habitat (broad categories)					
					Shrubveld	Gravel plains/ low outcrops	Koppies	Water courses	Dams/ watering points	Infrastructure/ pylons
CHARADRIIFORMES: Charadriidae										
Crowned Lapwing	*Vanellus coronatus*				1	1				1
CHARADRIIFORMES: Glareolidae										
Double-banded Courser	*Rhinoptilus africanus*		Near threatened		1	1				
PTEROCLIFORMES: Pteroclidae										
Namaqua Sandgrouse	*Pterocles namaqua*			Near-endemic	1	1			1	
COLUMBIFORMES: Columbidae										
Speckled Pigeon	*Columba guinea*									1
Cape Turtle Dove	*Streptopelia capicola*							1	1	1
Laughing Dove	*Spilopelia senegalensis*							1	1	1
Namaqua Dove	*Oena capensis*							1	1	1
STRIGIFORMES: Tytonidae										
Western Barn Owl	*Tyto alba*								1	1
STRIGIFORMES: Strigidae										
Spotted Eagle-Owl	*Bubo africanus*						1			
CAPRIMULGIFORMES: Caprimulgidae										
Rufous-cheeked Nightjar	*Caprimulgus rufigena*				1	1			1	
APODIFORMES: Apodidae										

Common Name	Species	Global Conservation Status (IUCN, 2015)	National Conservation Status (Taylor et al., 2015)	Endemism	Habitat (broad categories)					
					Shrubveld	**Gravel plains/ low outcrops**	**Koppies**	**Water courses**	**Dams/ watering points**	**Infrastructure/ pylons**
African Palm Swift	*Cypsiurus parvus*								1	1
Little Swift	*Apus affinis*								1	1
White-rumped Swift	*Apus caffer*								1	1
COLIIFORMES: Coliidae										
White-backed Mousebird	*Colius colius*			Endemic						1
BUCEROTIFORMES: Phoeniculidae										
Common Scimitarbill	*Rhinopomastus cyanomelas*							1		
PICIFORMES: Lybiidae										
Acacia Pied Barbet	*Tricholaema leucomelas*			Near-endemic				1	1	
FALCONIFORMES: Falconidae										
Lesser Kestrel	*Falco naumanni*									1
Rock Kestrel	*Falco rupicolus*						1			1
Greater Kestrel	*Falco rupicoloides*									1
PASSERIFORMES: Platysteiridae										
Pririt Batis	*Batis pririt*			Near-endemic				1		
PASSERIFORMES: Malaconotidae										
Bokmakierie	*Telophorus zeylonus*			Near-endemic				1	1	
PASSERIFORMES: Laniidae										
Southern Fiscal	*Lanius collaris*				1		1	1	1	1

Common Name	Species	Global Conservation Status (IUCN, 2015)	National Conservation Status (Taylor et al., 2015)	Endemism	Habitat (broad categories)					
					Shrubveld	Gravel plains/ low outcrops	Koppies	Water courses	Dams/ watering points	Infrastruc ture/ pylons
PASSERIFORMES: Corvidae										
Pied Crow	*Corvus albus*				1	1	1	1	1	1
PASSERIFORMES: Stenostiridae										
Fairy Flycatcher	*Stenostira scita*			Endemic				1		
PASSERIFORMES: Paridae										
Grey Tit	*Melaniparus afer*			Endemic			1	1		
PASSERIFORMES: Remizidae										
Cape Penduline Tit	*Anthoscopus minutus*			Near-endemic	1	1	1		1	
PASSERIFORMES: Alaudidae										
Spike-heeled Lark	*Chersomanes albofasciata*				1	1			1	
Karoo Long-billed Lark	*Certhilauda subcoronata*			Endemic		1				
Black-eared Sparrow-Lark	*Eremopterix australis*			Endemic	1	1			1	
Grey-backed Sparrow-Lark	*Eremopterix verticalis*			Near-endemic	1	1			1	
Sabota Lark	*Calendulauda sabota*				1	1	1	1	1	
Fawn-colored Lark	*Calendulauda africanoides*			Near-endemic				1		
Red Lark	*Calendulauda burra*	Vulnerable	Vulnerable	Endemic	1		1			
Sclater's Lark	*Spizocorys sclateri*		Near threatened	Endemic	1	1			1	
Stark's Lark	*Spizocorys starki*			Near-endemic	1	1	1		1	
Red-capped Lark	*Calandrella cinerea*				1					
PASSERIFORMES: Pycnonotidae										
African Red-eyed Bulbul	*Pycnonotus nigricans*			Near-endemic				1	1	

Common Name	Species	Global Conservation Status (IUCN, 2015)	National Conservation Status (Taylor et al., 2015)	Endemism	Habitat (broad categories)					
					Shrubveld	Gravel plains/ low outcrops	Koppies	Water courses	Dams/ watering points	Infrastructure/ pylons
PASSERIFORMES: Hirundinidae										
Barn Swallow	*Hirundo rustica*				1	1	1	1	1	1
Pearl-breasted Swallow	*Hirundo dimidiata*				1					
Rock Martin	*Ptyonoprogne fuligula*						1			
Greater Striped Swallow	*Cecropis cucullata*				1	1	1	1	1	1
PASSERIFORMES: Phylloscopidae										
Willow Warbler	*Phylloscopus trochilus*							1		
PASSERIFORMES: Cisticolidae										
Grey-backed Cisticola	*Cisticola subruficapilla*			Near-endemic	1	1				
Black-chested Prinia	*Prinia flavicans*				1	1		1	1	
Karoo Prinia	*Prinia maculosa*			Endemic	1	1		1	1	
Rufous-eared Warbler	*Malcorus pectoralis*			Endemic	1	1		1	1	
Yellow-bellied Eremomela	*Eremomela icteropygialis*				1	1		1		
PASSERIFORMES: Sylviidae										
Chestnut-vented Warbler	*Sylvia subcaerulea*			Near-endemic				1		
PASSERIFORMES: Zosteropidae										
Cape White-eye	*Zosterops virens*			Endemic				1		
PASSERIFORMES: Sturnidae										
Pale-winged Starling	*Onychognathus nabouroup*						1	1		1
PASSERIFORMES: Turdidae										

Common Name	Species	Global Conservation Status (IUCN, 2015)	National Conservation Status (Taylor et al., 2015)	Endemism	Habitat (broad categories)					
					Shrubveld	Gravel plains/ low outcrops	Koppies	Water courses	Dams/ watering points	Infrastructure/ pylons
Karoo Thrush	*Turdus smithi*			Endemic				1		
PASSERIFORMES: Muscicapidae										
Karoo Scrub Robin	*Cercotrichas coryphoeus*			Endemic	1			1		
Kalahari Scrub Robin	*Cercotrichas paena*			Near-endemic	1			1	1	
Chat Flycatcher	*Melaenornis infuscatus*			Near-endemic	1	1				
Sickle-winged Chat	*Emarginata sinuata*			Endemic	1					
Ant-eating Chat	*Myrmecocichla formicivora*			Endemic	1	1	1		1	
Mountain Wheatear	*Myrmecocichla monticola*			Near-endemic			1			
Familiar Chat	*Oenanthe familiaris*						1			
PASSERIFORMES: Nectariniidae										
Dusky Sunbird	*Cinnyris fuscus*			Near-endemic				1		
PASSERIFORMES: Passeridae										
White-browed Sparrow-Weaver	*Plocepasser mahali*							1	1	
Sociable Weaver	*Philetairus socius*			Endemic	1	1		1	1	1
House Sparrow	*Passer domesticus*									1
Cape Sparrow	*Passer melanurus*			Near-endemic				1	1	
PASSERIFORMES: Ploceidae										
Scaly-feathered Weaver	*Sporopipes squamifrons*			Near-endemic				1	1	
Southern Masked Weaver	*Ploceus velatus*							1	1	1
Southern Red Bishop	*Euplectes orix*								1	

Common Name	Species	Global Conservation Status (IUCN, 2015)	National Conservation Status (Taylor et al., 2015)	Endemism	Habitat (broad categories)					
					Shrubveld	Gravel plains/ low outcrops	Koppies	Water courses	Dams/ watering points	Infrastructure/ pylons
PASSERIFORMES: Estrildidae										
Red-headed Finch	*Amadina erythrocephala*			Near-endemic					1	1
Black-faced Waxbill	*Estrilda erythronotos*								1	
PASSERIFORMES: Viduidae										
Pin-tailed Whydah	*Vidua macroura*								1	
PASSERIFORMES: Motacillidae										
Cape Wagtail	*Motacilla capensis*								1	
African Pipit	*Anthus cinnamomeus*				1					
PASSERIFORMES: Fringillidae										
Black-throated Canary	*Crithagra atrogularis*				1			1	1	
Yellow Canary	*Crithagra flaviventris*			Near-endemic				1	1	
White-throated Canary	*Crithagra albogularis*			Near-endemic				1	1	
PASSERIFORMES: Emberizidae										
Lark-like Bunting	*Emberiza impetuani*			Near-endemic	1	1	1	1	1	1
					38	**28**	**19**	**38**	**48**	**23**

Scoping and Environmental Impact Assessment for the proposed Development of a 75 MW Solar Photovoltaic Facility (GEMSBOK SOLAR PV6) on Portion 8 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape Province

EIA REPORT

CHAPTER 10:

Terrestrial Faunal Impact Assessment

CONTENTS

TABLES

FIGURES

LIST OF ABBREVIATIONS

ADU	Animal Demography Unit
DEA	Department of Environmental Affairs
EBA	Endemic Bird Area
EIA	Environmental Impact Assessment
IBA	Important Bird Area
QDC	Quarter-degree grid cell
SA	Secondary Area

GLOSSARY

Definitions	
Acute effect value	The concentration at and above which statistically significant acute adverse effects are expected to occur.
Aquifer	A geological formation that has structures or textures that hold water or permit appreciable water movement through them.
Aquitard	A formation or group of geological formations with low permeability that retards the flow of groundwater.
Azonal habitat	A habitat type that is small and imbedded within larger habitat units. It is often not possible to map azonal habitat types.
Crepuscular	An animal with peak activity periods (mainly during foraging) during dawn and dusk.
Chronic effect value	The concentration limit that is safe for all or most populations even during continuous exposure.
Myrmecophagous	An animal that eats mainly ants
Rupicolous	Rock-loving, a species confined to outcrops.
Stenotopic	Pertaining to a animal species that are specialised or requires specialised habitat during part of its life-cycle (e.g. rocks, sandy soils).

EXECUTIVE SUMMARY

The information provided in this report was obtained from relevant literature and observations obtained during a site investigation (04 – 11 December 2015).

The following key considerations were identified and noted:

- Various sampling techniques (including trapping methods) were used to evaluate fauna mammals and herpetofauna) richness and composition on the proposed study area;
- Ten habitat types were identified based on the presence of the dominant vegetation communities. These ranged from *Salsola* – *Stipagrostis* short shrubveld, quartz and *Aloe dichotoma*-dominated outcrops, calcrete plains to *Prosopis glandulosa* watercourses and artificial livestock watering points. The shrubveld and artificial watering points contain high faunal diversities, although most of these have widespread distribution ranges within the Nama-Karoo Biome. However, the *Aloe dichotoma* outcrops, quartz outcrops and all prominent koppies provided habitat for habitat specialists, mainly rock-loving taxa;
- A total of 24 mammal species was confirmed during the investigation. Important ecological considerations pertaining to the mammal composition include:
  - The open *Salsola* – *Stipagrostis* shrubveld was capable of sustaining a high mammal richness consisting of a diversity of different guilds – it also sustained high densities of myrmecophagous (ant- eating) species such as aardwolf *Proteles cristatus* and aardvark *Orycteropus afer*. In addition, this is one of a few habitat types with a graminoid grass cover (dominated by *Stipagrostis*) which provides an ephemeral foraging habitat (due to the seed bank) for rodent taxa.
  - The calcrete soils provide an additional habitat for mammal taxa with a preference for hard substrates (e.g. Large-eared Mouse *Malacothrix typica*, Cape Short-tailed Gerbil *Desmodillus auricularis* and Bat-eared Fox *Otocyon megalotis*).
  - The watercourses are important dispersal corridors for foraging mammal species, while the artificial watering points provide essential surface drinking water, thereby augmenting the mammal richness and abundance.
  - The koppies and prominent outcrops sustain a unique, albeit species poor composition of rupicolous (rock-loving) taxa – thereby augmenting local richness (e.g. Namaqua Rock Mouse *Micaelamys namaquensis*, Western Rock Sengi *Elephantulus rupestris* and Rock Hyrax *Procavia capensis)*.
- The study area is poorly represented by amphibians, with four species expected to be present;
- Thirty five reptile species are expected to be present, of which 12 were confirmed during the survey. High species richness was observed on the *Aloe dichotoma* outcrops;
- No threatened or near threatened taxa was observed on the study site;
- Gemsbok Solar PV4 contains the largest area of continuous sensitive habitat which pertains to the *Aloe dichotoma* – *Tetradenia retrofracta* outcrops, an important area for habitat specialists;
- The remaining habitat of high ecological sensitivity (all major watercourses, artificial watering points, dams, prominent and quartz outcrops) is fragmented and of patchy occurrence. These are prominent on Boven Solar PV2, Boven Solar PV3 and Boven Solar PV4; and
- The majority of sites are dominated by habitat (mainly shrubveld and *Salsola* outcrops) with medium - high ecological sensitivity (Boven Solar PV2) or medium ecological sensitivities.

A list of impacts and the pre-mitigation significance of these impacts that could occur during the different phases of the project are detailed below:

Construction phase impacts:

- Habitat loss, fragmentation and displacement of animals and species loss – The significance is High to Moderate (before mitigation) and Moderate to Low (after mitigation)
- Displacement and disturbances caused to animals due to noise – The significance is Moderate (before mitigation) and Low (after mitigation).
- Displacement of foraging taxa and loss of genetic cohesion between populations – The significance is Moderate (before mitigation) and Low (after mitigation).

Operation phase impacts:

- Disorientation of nocturnal animals and increased frequency of predation of insects by insectivore mammal taxa – The significance is Moderate (before mitigation) and Low (after mitigation).
- Cleaning of panels could result in water pollution – The significance is Low (before mitigation) and Low (after mitigation).
- Nest building and roosting activities and interference with infrastructure – The significance is Moderate (before mitigation) and Low (after mitigation).
- Increased composition, loss of local diversity and potential increase in pest species such as mice and rats – The significance is Moderate (before mitigation) and Low (after mitigation).

Decommissioning phase impacts:'

- Increased competition due to shifts in the dominant composition and subsequent decline in species richness – The significance is Moderate (before mitigation) and Low (after mitigation).

Cumulative impacts:

- Exploitation of natural resources – significance is High (before mitigation) and Moderate (after mitigation).
- Increased loss of habitat on a regional scale – significance is High (before mitigation) and Moderate (after mitigation).

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R982	Addressed in the 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;**	Appendix A of the EIA Report
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix B of the EIA Report
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 10.1.1.1.
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 10.1.1.3. and Section 10.1.1.5.
e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	Section 10.1.1.3.
f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	Section 10.3.1.5.
g) an identification of any areas to be avoided, including buffers;	Section 10.3.1.5. and Section 10.6.1.3 (also Section 10.8)
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;	Layout maps of the proposed footprint of the sites were provided.
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 10.1.1.5.
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 10.3
k) any mitigation measures for inclusion in the EMPr;	Section 10.6
l) any conditions for inclusion in the environmental authorisation;	Section 10.8 and Section 10.9
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 10.8
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 10.9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Consultation took place between the project applicant and the EAP to discuss e.g. buffers and sensitivities on the sites.
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None received
q) any other information requested by the competent authority.	Yes

10 TERRESTRIAL FAUNA ASSESSMENT

10.1 INTRODUCTION AND METHODOLOGY

This chapter presents the Faunal Impact Assessment that was prepared by Mr. Lukas Niemand (of Pachnoda Consulting cc) as part of the EIA for the proposed solar PV facility of the Phase 2 Nieuwehoop Solar Park near Kenhardt in the Northern Cape Province.

10.1.1 Scope and Objectives

The scope of work and objectives for the study are:

- To describe the baseline conditions relating to the faunal assemblages in the study area;
- To provide a database of faunal assemblages/species/taxa confirmed from the area of investigation;
- An indication of important habitat and protected areas on or near the study area;
- To provide an indication of the occurrence of globally and nationally threatened and near threatened faunal species on the study area;
- To describe the anticipated impacts of the proposed development on the terrestrial fauna during construction and operation;
- To provide recommendations and a description on how the negative environmental impacts described above will be mitigated and managed; and
- To consider the cumulative impacts of the proposed development on the fauna of the area.

10.1.2 Terms of Reference

The terms of reference include the following:

- A description of the dominant species occurring in the area, including migratory species and their habitat associations;
- A description of the different micro-habitat types and important foraging and roosting sites on the study area;
- A description of threatened, rare, endemic and species of conservation importance in the area; and
- A description of the relative ecological importance of the specific habitat types in the area under investigation.

10.1.3 Approach and Methodology

Literature review and information base

A desktop and literature review of the area under investigation was commissioned to collate as much information as possible prior to fieldwork and data collection. The following literature was consulted:

Mammals

- The occurrence and conservation status of mammal taxa were based on the IUCN Red List (2015) and Friedmann and Daly (2004), while mammalian nomenclature was based on Skinner and Chimimba (2005) unless otherwise specified.

Herpetofauna

- Red List categories used were according to the recent conservation assessment conducted by Bates *et al.* (2014);
- Red List categories and listings of amphibian taxa follow Measey (2010); and
- The distribution of reptile and amphibian species was verified against the ADU's database consisting of ReptileMap and FrogMap.

Field surveys, data collection and analyses
Field surveys were performed during the latter part of the austral wet season i.e. the study area was investigated during 04 - 11 December 2015. However, the area was experiencing exceptionally hot and dry conditions due to late rains. In order to describe the baseline conditions and the avifaunal assemblages in the study area, it was necessary to obtain information on the local distribution and presence/absence of species by applying the following techniques:

Mammals

- Mammals were identified by visual sightings during *ad hoc* transect walks. In addition, mammals were also identified by means of spoor, droppings, roosting sites or likely habitat types;
- Mammal species (meso-carnivores and small mammals such as rodents) with predominant nocturnal or crepuscular habits were monitored by means of a four-day small mammal trapping session. Four trapping stations (see Figure 10.1) consisting of 20 traps each were placed respectively within open shrubveld, along the base of a prominent outcrop, along a watercourse and on calcrete plains. The traps, based on the 'Sherman Trap' design, were baited with a mixture of peanut butter, raisins and rolled oats;
- Nocturnal or crepuscular mammal species were also monitored by means of remote infrared wildlife cameras/trail cameras (n=6; Figure 10.2). The cameras were baited with fish and chicken livers.
- A rapid bat (Chiroptera) assessment was conducted during two consecutive nights (09-10 December 2015) using the ultrasonic microphone and recorded, Echo Meter Touch developed by Wildlife Acoustics.

Herpetofauna

- Possible burrows, or likely reptile habitat (termitaria, stumps or rocks) were inspected for any inhabitants. Amphibians were also identified by their vocalizations (if any) and through likely habitat types (e.g. water features, drainage lines, etc.). However, the herpetofaunal assessment focused largely on a desktop review.

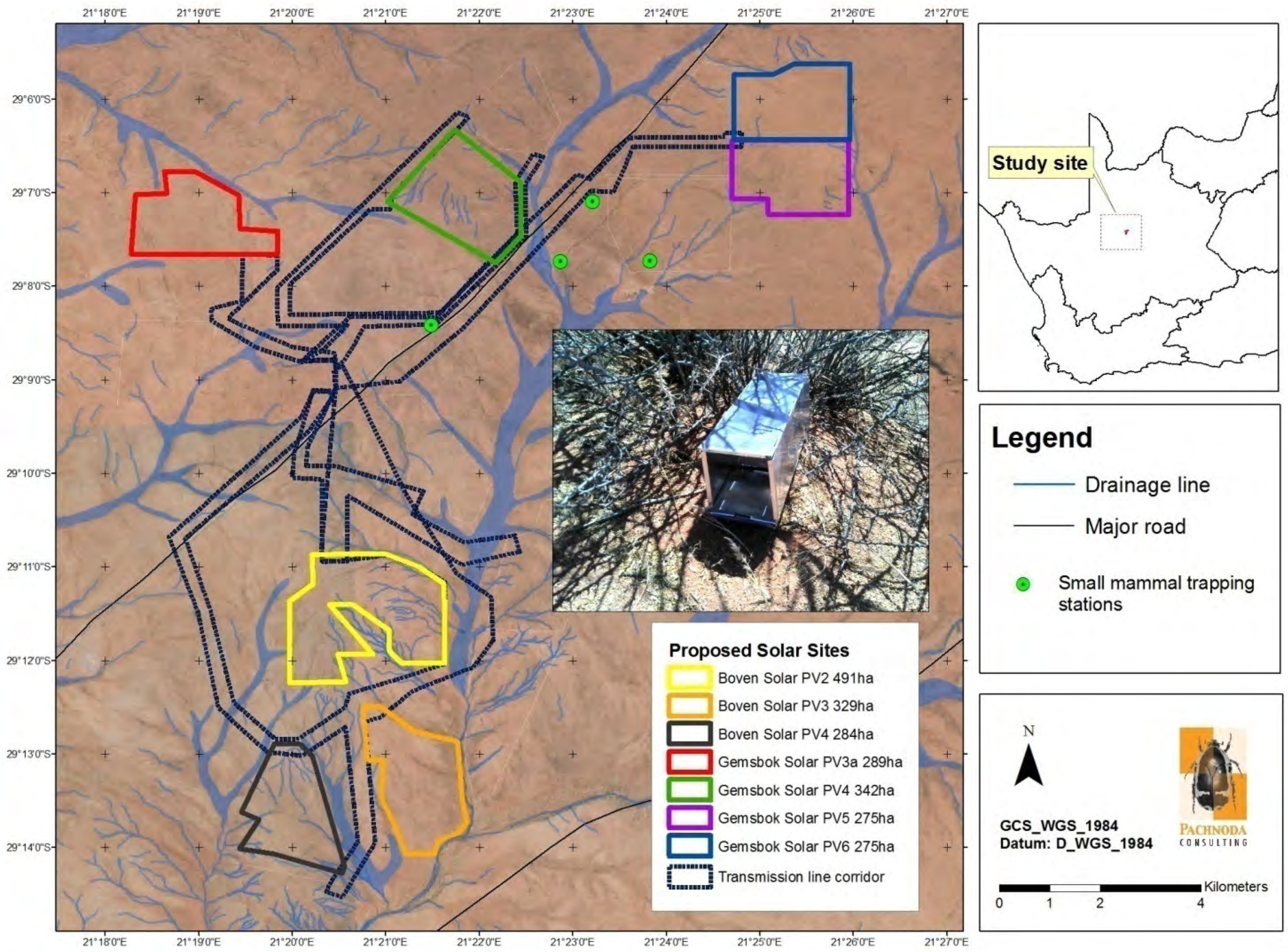

Figure 10.1: A satellite image illustrating the geographic localities of the small mammal trapping stations on the study area.

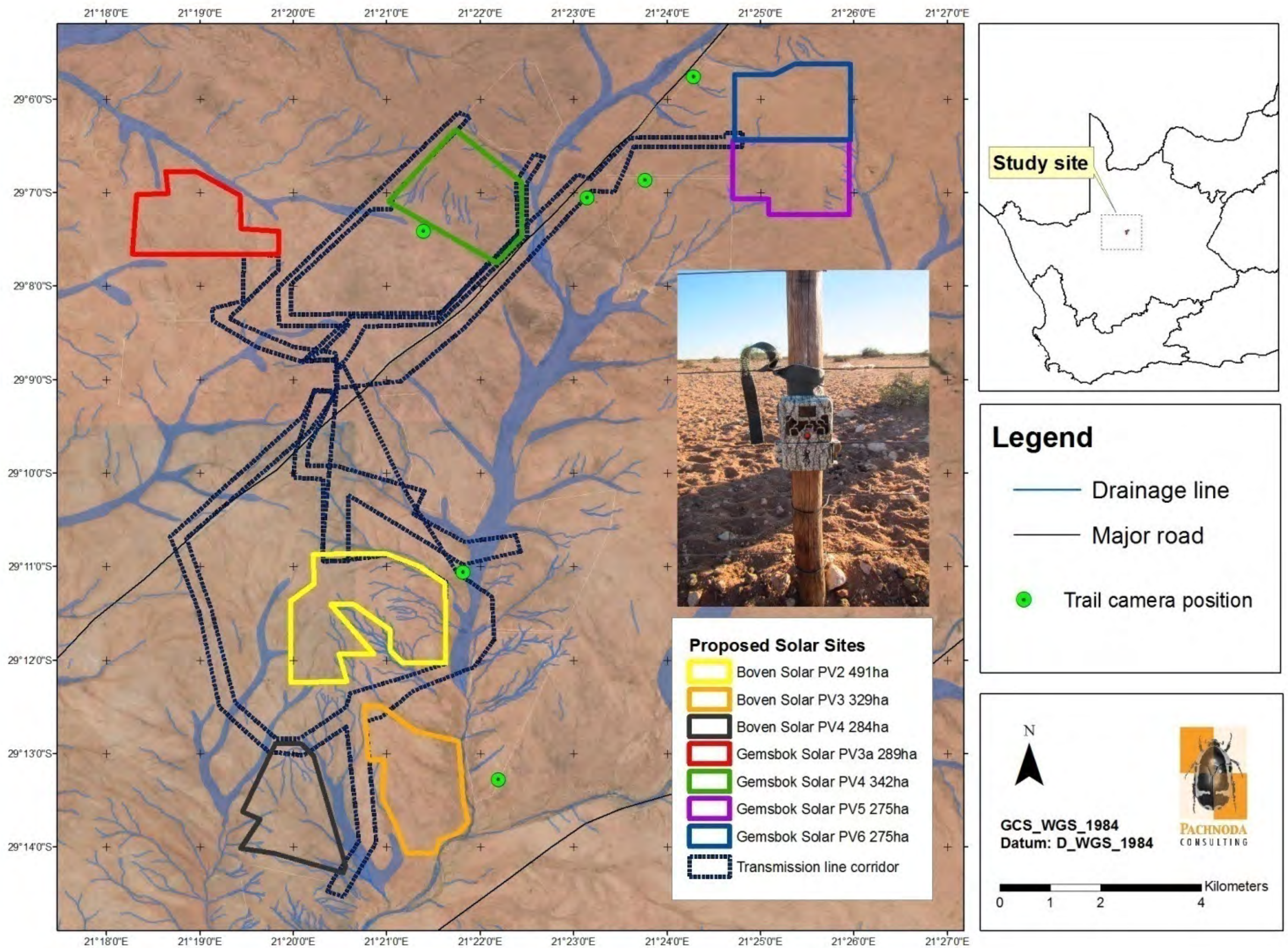

Figure 10.2: A satellite image illustrating the geographic localities of the trail cameras on the study area.

10.1.4 Ecological sensitivity

The ecological sensitivity of any piece of land is based on its inherent ecosystem service (e.g. wetlands) and overall preservation of biodiversity. In addition, the sensitivity of any piece of land is a key consideration when identifying impacts.

Ecological Function & Connectivity

The extent to which a site is ecologically connected to surrounding areas is an important determinant of its sensitivity. Systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to better ecosystem service (e.g. wetlands) or overall preservation of biodiversity. Therefore, any environmental management plan must include mitigation measures to ensure that negative environmental impacts do not interfere with the natural ecological process of the area.

Biodiversity Importance

Biodiversity importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.

Sensitivity Scale

- High – Sensitive ecosystems with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems OR with high species diversity and usually provide suitable habitat for a number of threatened or rare species. These areas should be protected;
- Medium – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems OR ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species; and
- Low – Degraded and highly disturbed/transformed systems with little ecological function and are generally very poor in species diversity (many species are exotic or weeds).

10.1.5 Assumptions and Limitations

Third-party information and citizen science datasets

- It is assumed that third party information (obtained from government, academic/research institutions, non-governmental organizations) is accurate and true;
- Some of the datasets/information are dated (out of date) and extant distribution ranges may have shifted although these datasets still provide insight into historical distribution ranges of relevant species;
- The datasets/information bases are mainly small-scale and could not always consider azonal habitat types (small habitat type which is imbedded within larger habitat units) that may be present on the study area (e.g. artificial livestock watering points). In addition, these datasets encompass surface areas larger than the study area, which could include habitat types and species that are not present on the study area itself. Therefore, the potential to overestimate species richness is highly likely while it is also possible that certain cryptic or specialist species could have been be overlooked in the past; and

- Some of the datasets (e.g. MammalMap, FrogMap and ReptileMap managed by the Animal Demography Unit of the University of Cape Town) are still in progress and are planned to run indefinitely.

Access and coverage

- The study area is under private ownership and managed as a livestock (sheep) farm. The study area is in a rather remote part of the country and not always accessible to the general public. Since most of the species distribution ranges contained in the relevant datasets are to the result of observations made by the public, it is likely that many species have been overlooked or not catalogued for the area (e.g. the area has not been surveyed before); and
- Some parts of the study area could not be accessed due to the absence of roads.

Temporal and spatial scale of surveys

- In order to obtain a comprehensive understanding of the dynamics of the faunal communities in the study area, as well as, the status of endemic, rare or threatened species, assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, due to time constraints such long-term studies are not feasible and were based on instantaneous (a "snapshot") sampling surveys;
- The inventories in this document are by no means complete, and are a reflection of the dominant taxa in the study area obtained during series of instantaneous sampling sessions. A comprehensive inventory, irrespective of the taxon or group of taxa could only be achieved by long-term temporal sampling; and
- The information presented in this document only has reference to the investigated study area(s) and cannot be applied to any other area without prior investigation.

Climate and seasonality

- The survey was conducted during early December 2015, thereby corresponding to the austral summer season. The study area coincides with the Bushmanland Arid Grassland, a regional vegetation type with a bimodal rainfall pattern. It receives part of its annual rainfall during December and again during late summer and early autumn (peak in March; Mucina & Rutherford, 2006);
- The current survey was undertakes during the early summer rainfall period. It should therefore be interpreted as a early summer season survey; and
- Unfortunately, the survey corresponded to hot, dry conditions, and the combined absence of precipitation (with late rainfall) induced dormancy in most of the higher vascular plant species. This obviously affected faunal abundance and behavior and the detection of animal species in the landscape (e.g. underestimate richness and abundance).

Integrated fauna report

- A holistic approach was followed during the assessment whereby a single standard report was produced summarizing the faunal attributes on the study area instead of seven independent reports; and
- Ecological systems are complex (not closed systems) and are invariably interconnected with each other. Similarly, habitat types are often not defined by discreet boundaries and the fauna that inhibits them often occur over large areas. On the other hand, many habitat specialists will remain in a particular habitat, and if this habitat is repeatedly encountered, it is possible that these species will also be present (if the habitat coincides with the species distribution range). Therefore, by sampling a variety of different habitat types in the study area, it will often be

possible to relate the fauna richness of a particular habitat type on a particular site to a similar habitat type on a different site within the study area.
- It is therefore justifiable that one integrated faunal report was prepared for all seven solar PV facilities (assessment tables have been prepared for each specific project-see Table 10.5-10.8).

10.1.6 Sources of Information

Please refer to section 10.1.3.

10.2 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE Terrestrial Fauna

10.2.1 Background

Pachnoda Consulting cc was contracted by the CSIR Environmental Management Services on behalf of Mulilo Renewable Project Developments ("Mulilo") to provide a faunal assessment report for Phase 2 of the proposed Nieuwehoop Solar Park near Kenhardt in the Northern Cape. The project entails the proposed design, construction and operation of seven 75 megawatt (MW) Solar Photovoltaic (PV) power generation plants to be located on Portion 3 of Gemsbok Bult Farm 120, Portion 8 of Gemsbok Bult Farm120 and the Remaining extent of the Boven Rugzeer Farm 169 (Figure 10.3). The surface extent of the proposed solar sites ranges from 275 ha to 491 ha in extent.

The project entails the following PV plants:

1. Gemsbok Solar PV3 on Portion 3 of Gemsbok Bult Farm 120 (289 ha);
2. Gemsbok Solar PV4 on Portion 3 of Gemsbok Bult Farm 120 (342 ha)
3. Gemsbok Solar PV5 on Portion 8 of Gemsbok Bult Farm 120 (275 ha);
4. Gemsbok Solar PV6 on Portion 8 of Gemsbok Bult Farm 120 (275 ha);
5. Boven Solar PV2 on Remaining Extent of Boven Rugzeer Farm 169 (491 ha);
6. Boven Solar PV3 on Remaining Extent of Boven Rugzeer Farm 169 (329 ha); and
7. Boven Solar PV4 on Remaining Extent of Boven Rugzeer Farm169 (284 ha).

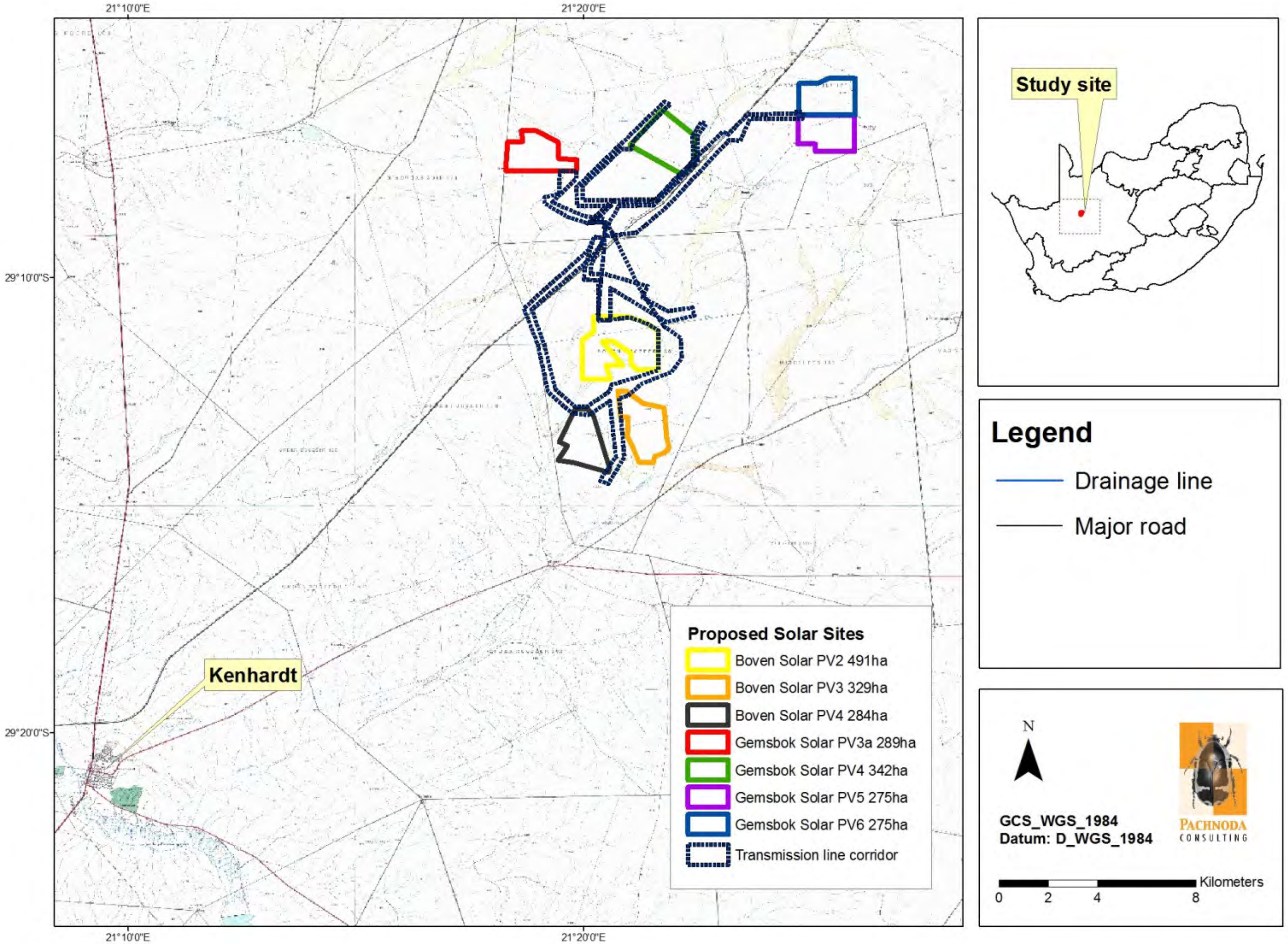

Figure 10.3 A topo-cadastral image illustrating the geographic position of seven PV plants forming part of Phase 2 of the Nieuwehoop Solar Park Project near Kenhardt.

10.2.2 Regional vegetation type

The study area lies in the Nama-Karoo Biome and more particularly in the Bushmanland Bioregion as defined by Mucina & Rutherford (2006). It comprises two ecological types: Bushmanland Arid Grassland and an azonal habitat comprising of inland saline vegetation known as Bushmanland Vloere (Figure 10.4).

1. *Bushmanland Arid Grassland* – This ecological type is prominent in the study area and comprises of extensive plains with a slightly sloping plateau that are sparsely dominated by “white” grasses such as *Stipagrostis* spp. and *Salsola* shrub.

It conforms to the habitat requirements of many plains species, including game species such as Springbok *Antidorcas masupialis*. In general, this vegetation type supports to extensive sheep farms, with some areas heavily encroached with dense shrub (e.g. *Rhigozum trichotomum*) due to overgrazing.

2. *Bushmanland Vloere* – This ecological type is prominent along the major drainage lines where it is present as small ephemeral pans. It plays an important role in connecting many of the smaller pans and ancient tributaries with each other.

The centre of these features is often devoid of vegetation although its edges are characterised by the presence of non-succulent forbs such as *Rhigozum trichotomum* and species of *Salsola* and *Lycium*. Some areas form thickets of *Parkinsonia africana, Lebeckia lineariifolia* and *Vachellia (=Acacia) karroo*.

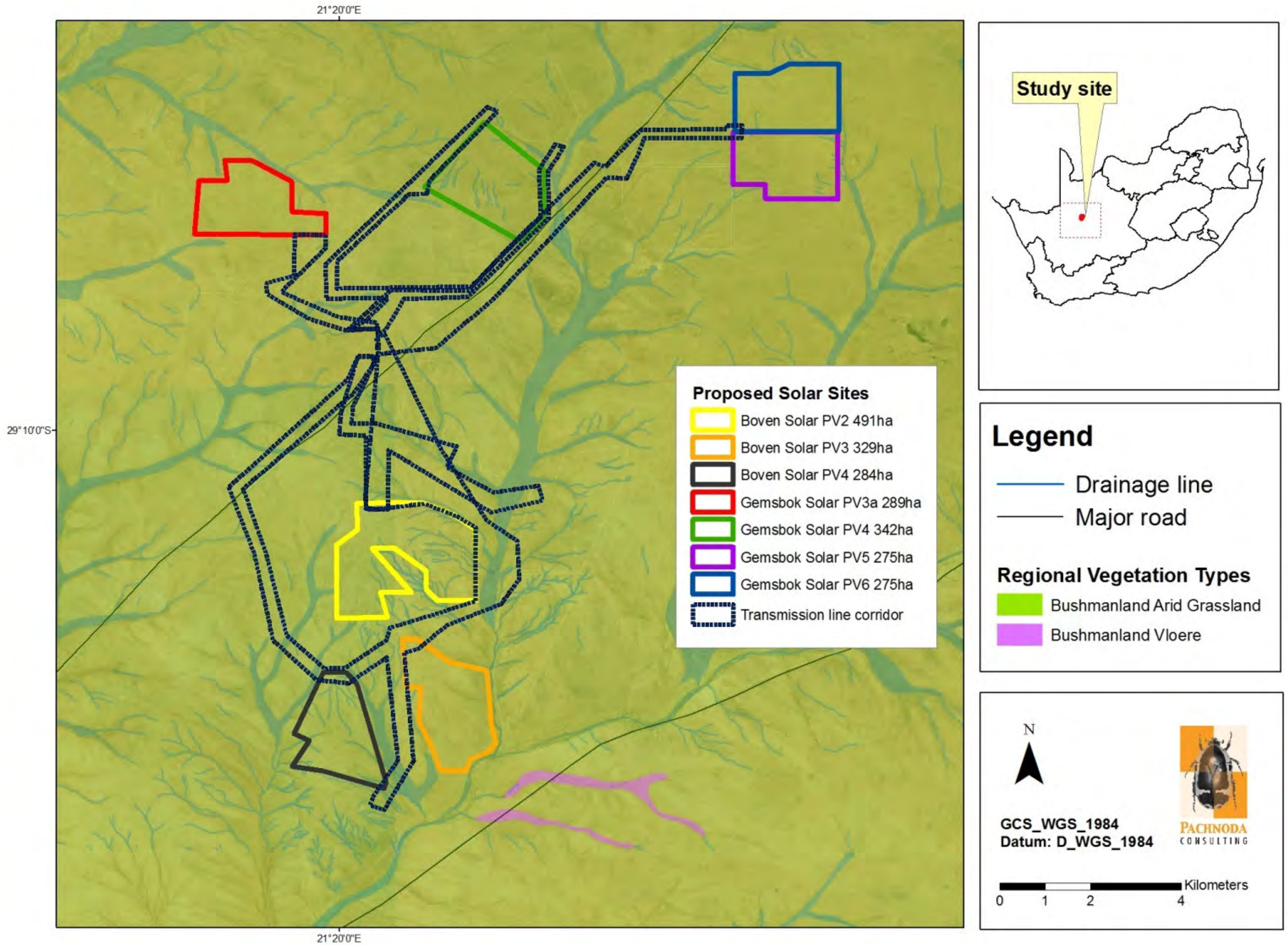

Figure 10.4: A satellite image (Google Earth) illustrating the regional vegetation types traversed by the proposed corridors. Vegetation type categories were chosen according to Mucina & Rutherford (2006).

10.2.3 Land Cover

According to the South African National dataset of 2013-2014 (Geoterrainimage, 2015), the study area comprises the following land cover categories (Figure 10.5):

Natural areas:

- Bare non-vegetated areas confined to gravel and calcrete plains;
- Low shrubland; and
- Woodland/open bush confined to the Bushmanland Vloere.

Transformed areas:

- Linear infrastructure (roads); and
- Bare soils confined to localised mining activities.

From the land cover dataset it is evident most of the study area is covered by natural vegetation (mainly low shrubland) with few infrastructure development has taking place in the area. However, the spatial heterogeneity of the landscape is monotonous and rather uniform.

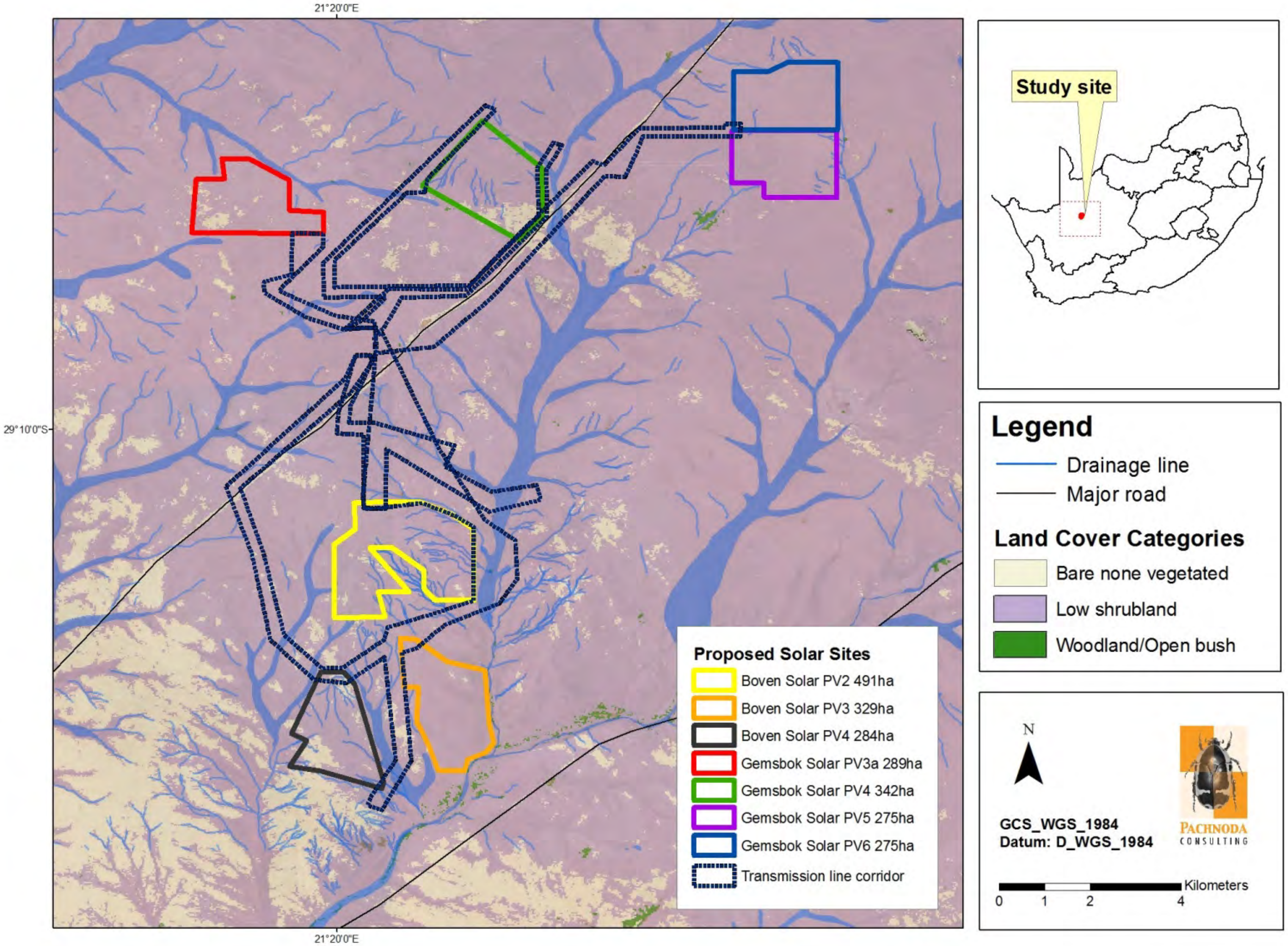

Figure 10.5: A map illustrating the land cover classes (Geoterrainimage, 2015) corresponding to the study area.

10.2.4 Conservation Areas and Important Bird and Biodiversity Areas

There is no conservation or protected areas in the immediate vicinity of the study area. The nearest protected areas are Augrabies Falls National Park and Witsand Nature Reserve, which are located respectively 110 km north-west and 120 km north-east of the study area.

The biodiversity importance of a particular area is often analysed based on BirdLife International's criteria to evaluate and identify Important Bird and Biodiversity Areas:

- *Category A1*: the regular presence of significant numbers of globally threatened species. In general only IUCN species listed as Critically Endangered, Endangered or Vulnerable are considered. The regular presence of a Critical or Endangered species, irrespective of population size, at a site may be sufficient for a site to qualify as an Important Bird Area (IBA). For Vulnerable species, the presence of more than threshold numbers at a site is necessary to trigger selection;
- *Category A2*: the area holds a significant component of a group of species whose breeding distributions is restricted to an Endemic Bird Area (EBA) or Secondary Area. In other words, an EBA provides habitat for two or more species with restricted ranges co-occur and have global distributions of less than 50 000km2. It is noteworthy that 70% of these species are also globally threatened. A Secondary Area (SA) holds one or more restricted-range species, but does not qualify as an EBA because less than two species are entirely confined to it. A typical SA includes a single restricted-range species which does not overlap in distribution with any other restricted-range species. For SAs, species occur where there are disjunct records of one or more restricted-range species, which are clearly geographically separate from any of the EBAs;
- *Category A3*: the area holds significant numbers of species whose distributions are largely confined to one biome. These species have shared distributions greater than 50 000km2.
- *Category A4*: the area may qualify on any one or more of the four criteria listed below:
- The area is known to hold on a regular basis more or less1% of a biogeographic population of a congregatory waterbird species;
    - The area is known to hold on a regular basis more or less 1% of the global population of a congregatory seabird or terrestrial species;
    - The area is known or thought to hold on a regular basis more or less 20 000 waterbirds or more or less 10,000 pairs of seabirds of one or more species; and
    - The area is known or thought to exceed thresholds set for migratory species at bottleneck sites.

The study area is not coincidal with any important bird and biodiversity areas. The nearest of these to the study area are the Augrabies Falls National Park (SA029; located 110 km north-west of the study site) and the Mattheus-Gat Conservation Area (SA034; located 144 km west of the study area) (Marnewick *et al*., 2015).

10.3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

10.3.1 Macro-habitat types

Apart from the regional vegetation types, the local composition and distribution of the vegetation communities in the study area are a consequence of a combination of factors including soil texture, geology, topography (plains vs. drainage systems), and grazing disturbance (presence of livestock). These have culminated in a number of habitat types that deserve further discussion (please refer to Figure 10.6 and Figure 10.7):

1. Aloe dichotoma – Tetradenia retrofracta outcrops
This unit is mainly confined to the Gemsbok Solar PV4 site where it is restricted to granite surface rock. It is characterized by the high density of *Aloe dichotoma* trees on very shallow rocky soils. However, the topography is undulating, with most of the unit occurring on mid- and upper slopes. Therefore, it does not conform to the open flat gravels plains so typical of the surrounding landscape, but is littered with large bounders. .

It is an important habitat and refuge for rupicolous (rock-dwelling) reptiles and small mammals which live in the exfoliating sheet rock and crannies.

2. Salsola – Stipagrostis short shrubveld
This habitat type is dominant in the study area and occurs on relatively flat terrain consisting of shallow sandy soils. The floristic structure consists of short shrubs which are evenly spaced permitting the free movement of large non-passerine terrestrial bird species. The occurrence of *Stipagrostis* spp. is important since it provides essential foraging habitat for a variety of grain-eating small mammal species such as mice. It is an important habitat type for fauna that require large home range sizes and appears to be the focal foraging habitat for medium-sized carnivores and plains game.

In addition, the habitat often consists of open patches of structured loam-sandy soils. The functional value of the substrate in many areas of the shrubveld is important since it provides an food resource for specialised, myrmecophagous (ant-eating) mammal taxa (e.g. aardvark *Orycteropus afer* and aardwolf *Proteles cristatus*), while disused aardvark burrows are often colonized by other burrowing animals.

3. Zygophyllum microphyllum – Pteronia calcrete plains
This habitat type is widely scattered and patchy (azonal and could not be accurately delineated) where it conforms to white gravelly soils on open plains with undulating topographies and a sparse basal cover of dwarf shrubs. It is therefore part of the *Salsola – Stipagrostis* short shrubveld where it occurs on rocky calcrete soils.

Calcrete soils are favored sites for mammals that live in dens or burrows, and are often occupied by large colonies of the South African ground squirrel *Xerus inauris*.

4. Salsola outcrops
This habitat type is prominent on the Boven Solar PV2 site. It is essentially confined to gravelly plains with shallow rocky soils dominated by a stunted shrub layer consisting of *Salsola spp*. The floristic structure of this habitat is transitional between the *Zygophyllum microphyllum – Pteronia calcrete* plains and the *Salsola – Stipagrostis* short shrubveld.

This unit also contains many smaller azonal habitats which include quartz outcrops and smaller patches of dark gravel plains which provide potential habitat for reptiles.

5. *Tetradenia retrofracta* quartz outcrops
These consist of scattered patches of white quartz plains, which are mainly located on the upper slopes of the southern solar sites. Although not regarded as an important habitat for animals due to the small surface areas of the respective patches of outcrops, it is often utilized during the heat of the day as habitat refuge since the ambient ground temperature is much lower than on the adjacent habitat (due to the highly reflective surfaces of the rock pebbles).

6. *Rhigozum trichotomum* watercourses
These are small drainage lines seldom wider than 5 m and often strongly dominated by the shrub *Rhigozum trichotomum*, a secondary species which tends to proliferate as a result of soil disturbance or overgrazing. The dominance by *Rhizogum* is best explained by episodic disturbance events caused by surface water runoff during peak rainfall events, thereby resulting in superficial scarring of the soil profile and the transport of sediment.

These drainage lines are important dispersal corridors for smaller mammals allowing them to colonise other habitats consisting of shrubveld.

7. *Prosopis glandulosa* watercourse and *Roepera morgsana* floodplains
These habitat types are restricted to large highly seasonal and ephemeral watercourses which are wider than 5 m. They are critically important since they act as important dispersal corridors in the region.

8. Koppies and prominent dolerite outcrops
These units represent prominent landscape features which include small dolerite inselbergs. They are mainly located outside any of the proposed solar sites, although providing potential refuge for rupicolous (rock-loving) animals with stenotopic habitat requirements (e.g. certain lizards and mammals of the genera *Cordylus* and *Elephantulus* respectively).

9. Artificial impoundments/dams
These represent small ephemeral waterbodies which provide surface drinking water to livestock and free-roaming game when inundated (they were all dry during the current survey). These were thinly scattered in the study area and comprised of open, trampled vegetation that were in most instances surrounded by *Rhigozum trichotomum*.

10. Artificial livestock drinking holes
These are artificial watering points providing drinking water to livestock (mainly sheep). However, the availability of surface water also attracts many mammals to this habitat.

Figure 10.6 (a-b): Images illustrating the dominant habitat types on the study site: *Aloe dichotoma – Tetradenia retrofracta* outcrops.

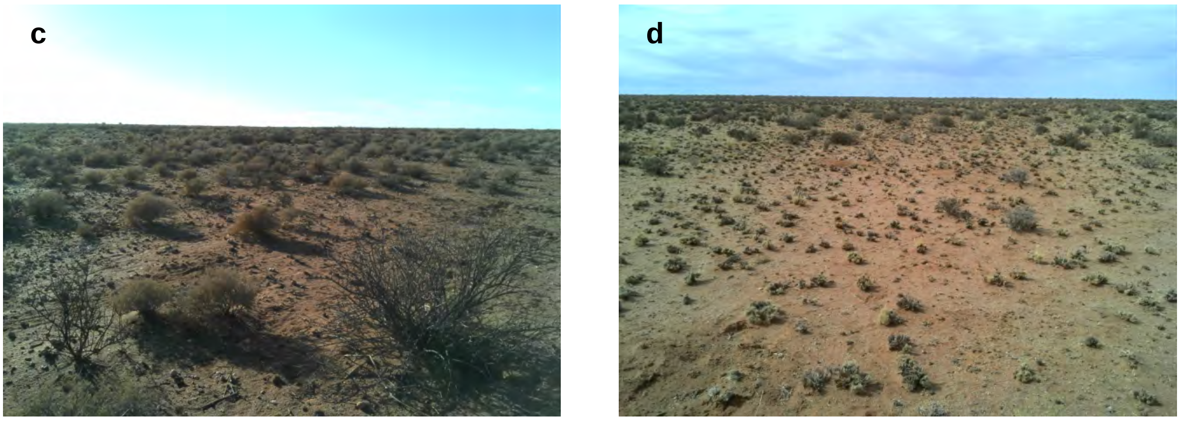

Figure 10.6 (c-d): Images illustrating the dominant habitat types on the study site: *Salsola – Stipagrostis* short shrubveld.

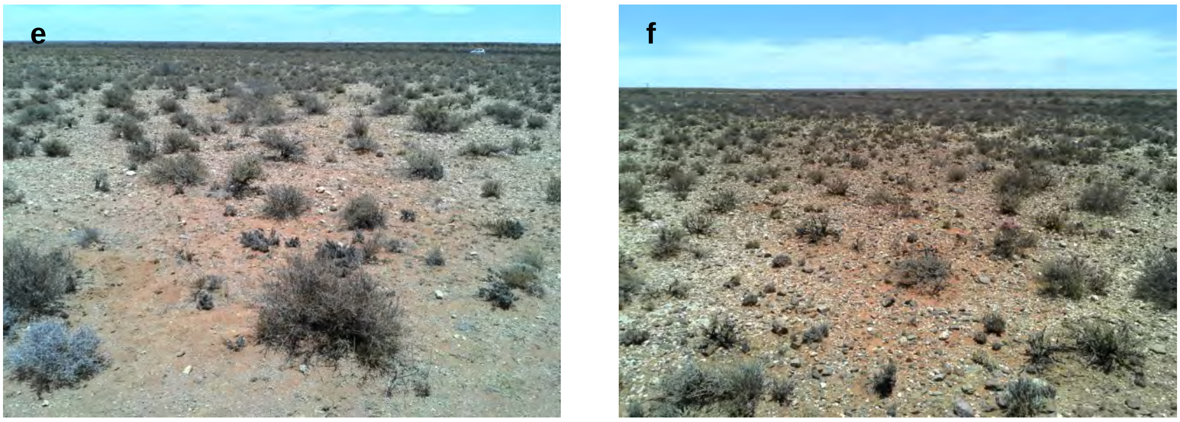

Figure 10.6 (e-f): Images illustrating the dominant habitat types on the study site: *Zygophyllum microphyllum – Pteronia* calcrete plains.

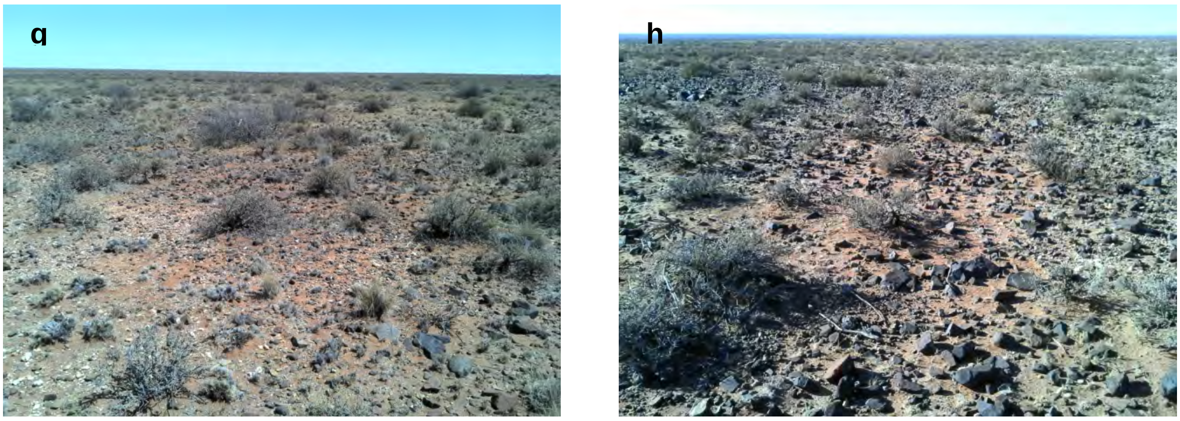

Figure 10.6 (g-h): Images illustrating the dominant habitat types on the study site: *Salsola* outcrops (mainly dark dolerite plains).

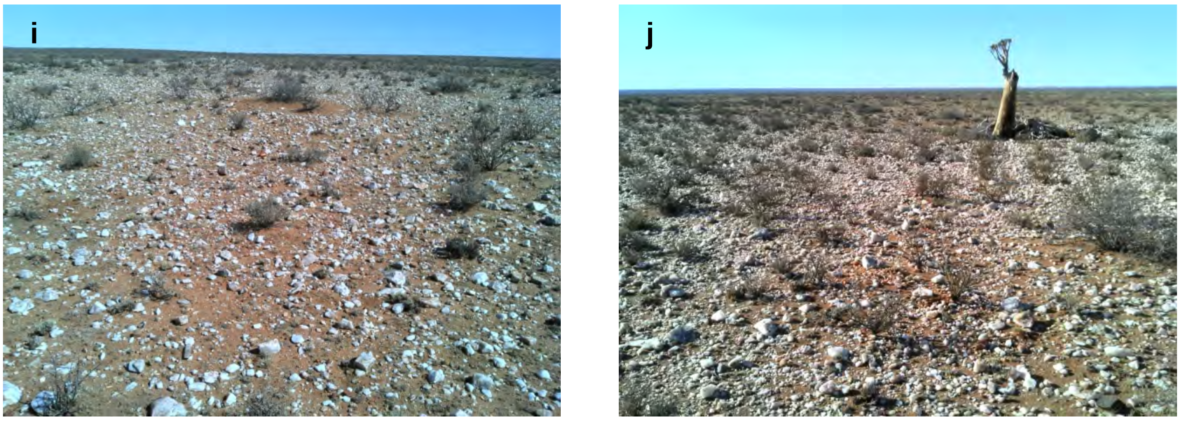

Figure 10.6 (i-j): Images illustrating the dominant habitat types on the study site: *Tetradenia retrofracta* quartz outcrops.

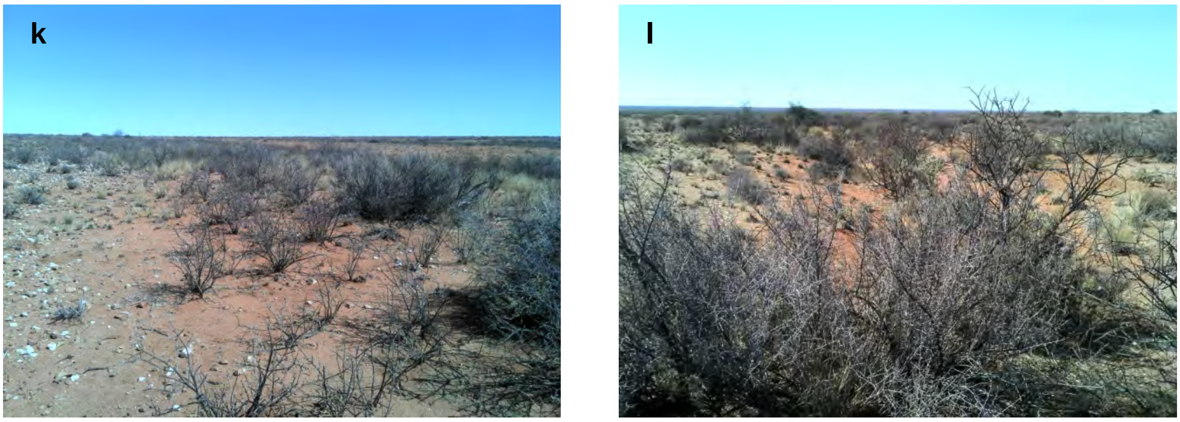

Figure 10.6 (k-l): Images illustrating the dominant habitat types on the study site: *Rhigozum trichotomum* watercourse.

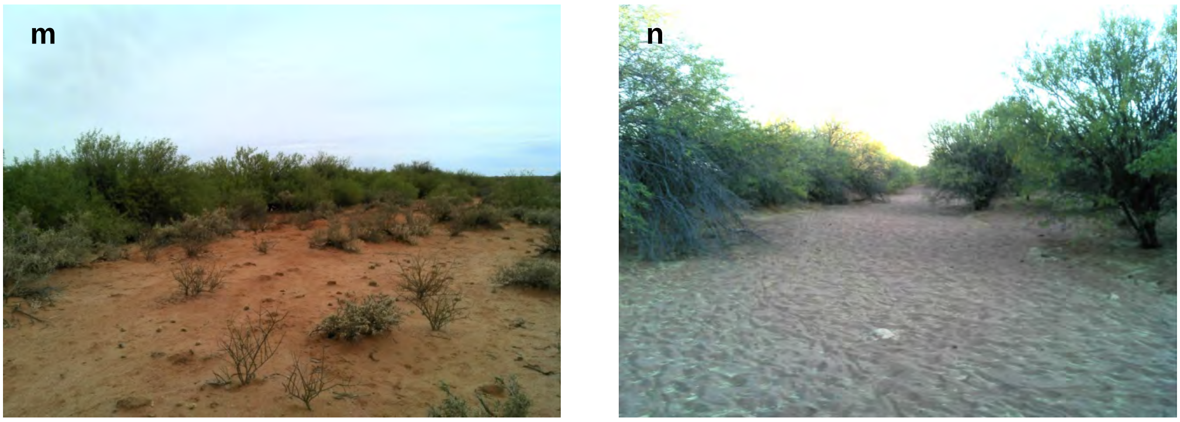

Figure 10.6 (m-n): Images illustrating the dominant habitat types on the study site: *Rhigozum trichotomum* watercourse.

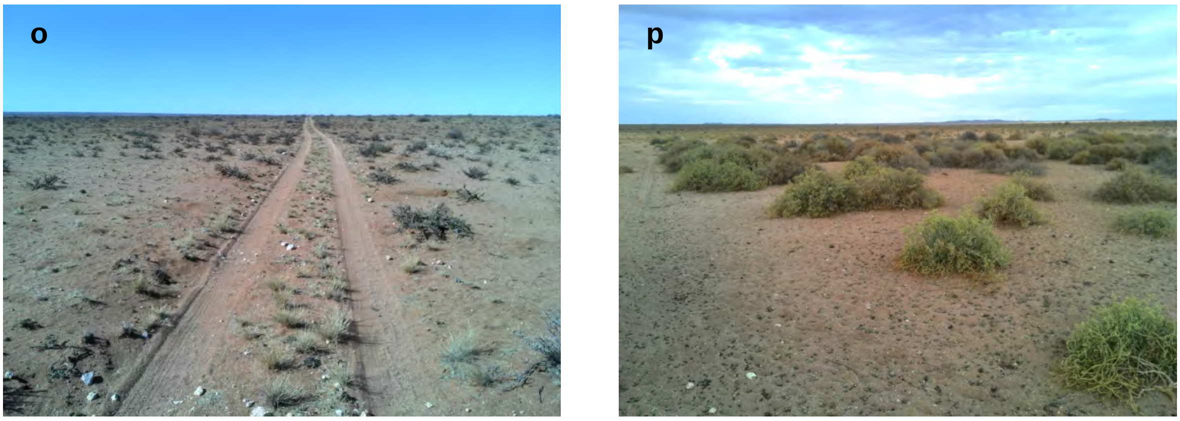

Figure 10.6 (o-p): Images illustrating the dominant habitat types on the study site: *Roepera morgsana* floodplain.

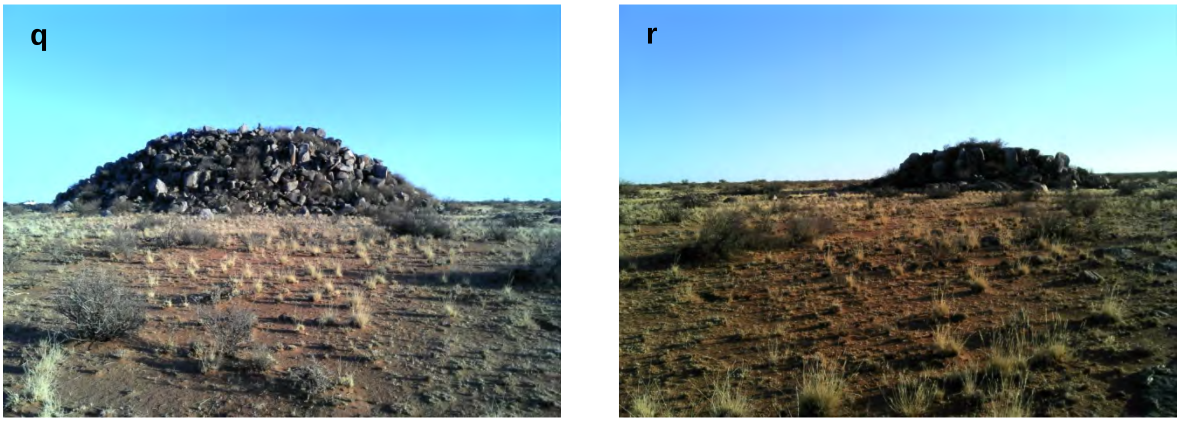

Figure 10.6 (q-r): Images illustrating the dominant habitat types on the study site: Koppies and prominent outcrops.

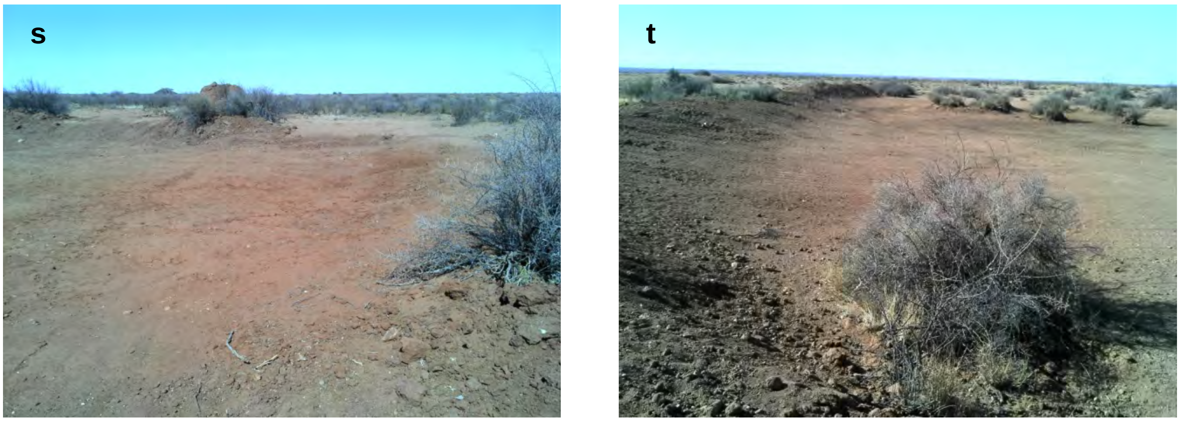

Figure 10.6 (s-t): Images illustrating the dominant habitat types on the study site: Artificial dams.

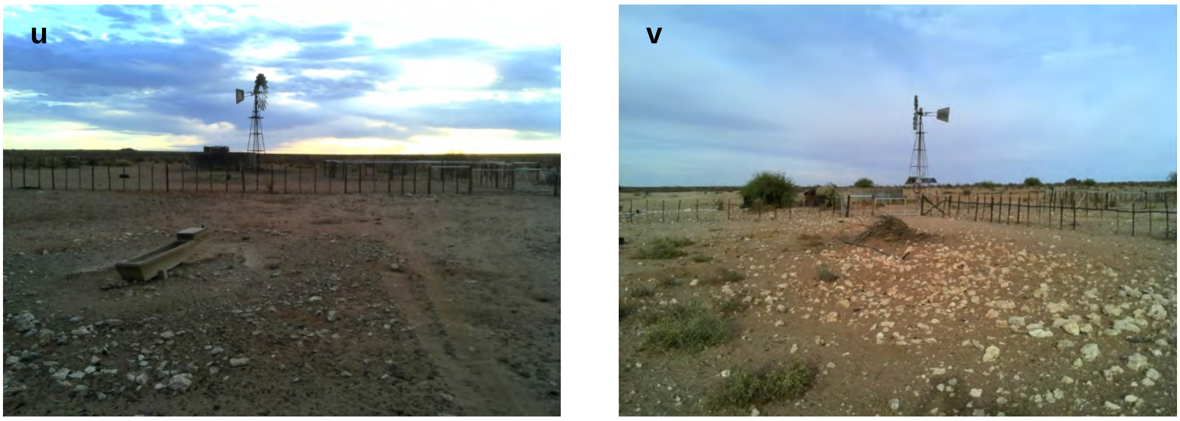

Figure 10.6 (u-v): Images illustrating the dominant habitat types on the study site: Artificial livestock watering points.

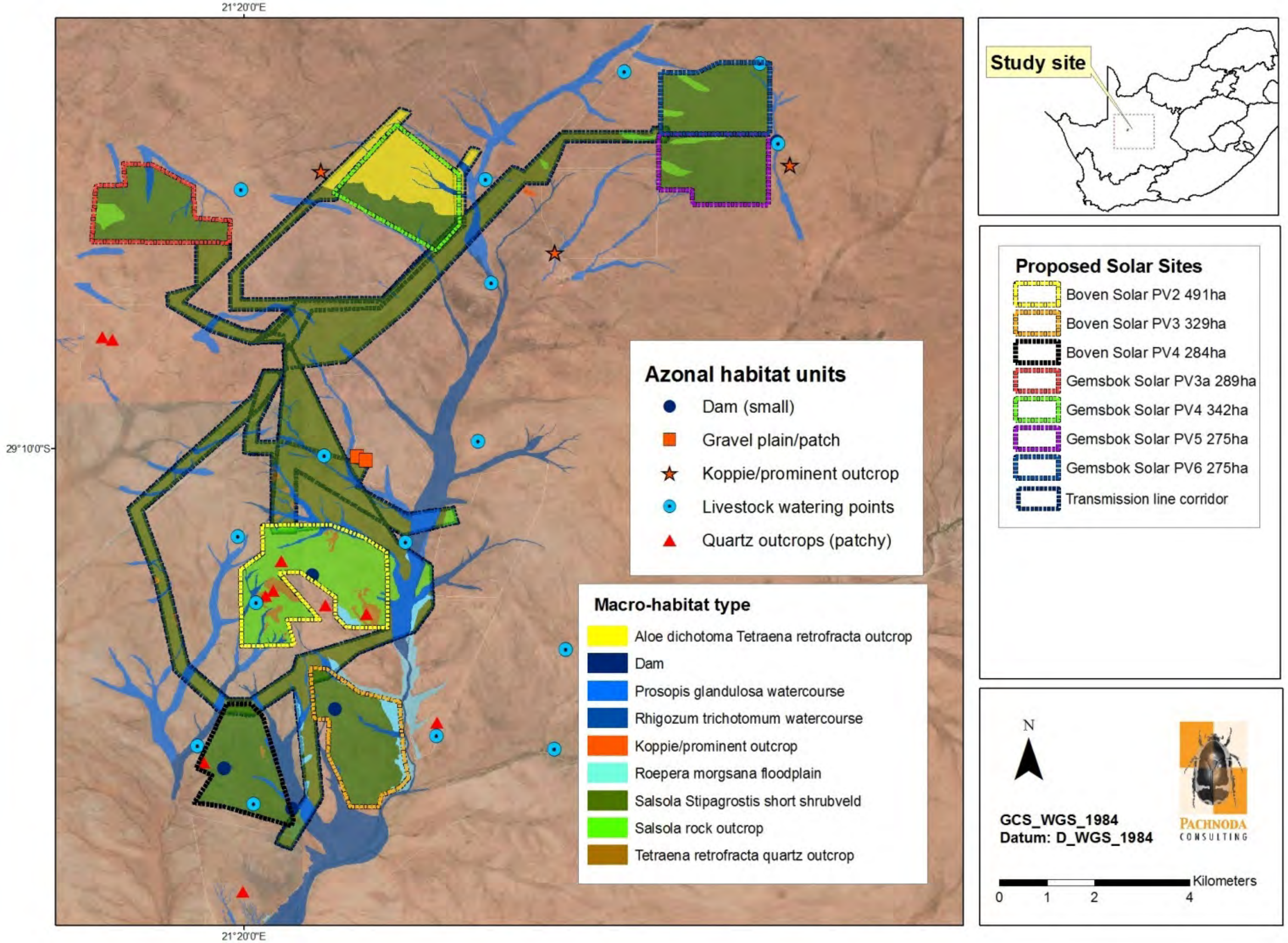

Figure 10.7: A satellite image illustrating the macro- habitat types in the study area (including proposed power line alignments).

10.3.2 Mammals

Species richness and composition

The study area is located in a remote region of South Africa as evidenced by the paucity of records for QDC 2921AB & 2921AD (Table 10.1). Only 11 species are currently known to occur in QDC 2921AB & 2921AD, of which one, the Reddish-gray Musk Shrew *Crocidura cyanea*, is included that is data deficient (Table 10.1). Most of the documented animals are small-bodied murids and elephant shrews.

Table 10.1: The observed mammal taxa confirmed from two quarter-degree grid cells 2921AB and 2921AD (source: MammalMap, ADU).

Family	Genus	Species	Common name	Red list category
Macroscelididae	*Elephantulus*	*rupestris*	Western Rock Elephant Shrew	Least Concern
Macroscelididae	*Macroscelides*	*proboscideus*	Short-eared Elephant Shrew	Least Concern
Molossidae	*Tadarida*	*aegyptiaca*	Egyptian Free-tailed Bat	Least Concern
Muridae	*Aethomys*	*namaquensis*	Namaqua Rock Mouse	Least Concern
Muridae	*Desmodillus*	*auricularis*	Cape Short-tailed Gerbil	Least Concern
Muridae	*Gerbilliscus*	*brantsii*	Highveld Gerbil	Least Concern
Muridae	*Gerbilliscus*	*paeba*	Paeba Hairy-footed Gerbil	Least Concern
Muridae	*Gerbilliscus*	*vallinus*	Brush-tailed Hairy-footed Gerbil	Least Concern
Muridae	*Rhabdomys*	*pumilio*	Xeric Four-striped Grass Rat	Least Concern
Nesomyidae	*Malacothrix*	*typica*	Large-eared African Desert Mouse	Least Concern
Soricidae	*Crocidura*	*cyanea*	Reddish-gray Musk Shrew	Data Deficient

The low richness as documented by MammalMap is an artifact of the remoteness of the study area. However, more surveys in the area are likely to show that approximately 45 mammal species is expected to occur (Appendix 1), of which 24 (53.3 %) species were confirmed during the current survey (Table 10.2 and Figure 10.8). However, six of the species expected to be present (Appendix 1) show distribution ranges peripheral to the region and are probably rare in the area. Among those confirmed were three antelopes, six rodents, three canines (jackals), one specialised hyaenid, one leporid (hare), one elephant-shrew, three herpestids (mongoose), aardvark, two chiropterans (bats), one felid (cat), one viverrid (genet) and one hyrax.

Results obtained from the survey showed that the study area sustains a high mammal richness. In addition, the observed richness is encouraged by a gradient in soil texture (e.g. sand, loam and calcrete soils), the presence of outcrops (which also increase spatial heterogeneity and small mammal diversity) and the compactness of the soils. However, part of the high species richness is also explained by the low density of the human population in the area that often contributes to persecution and local extirpation of selected species (mainly "problem" taxa such as scavengers). However, part of the mammal composition is unfortunately skewed by sheep farming practices (e.g. the fences) which have reduced the populations size of medium-sized scavengers.

Table 10.2: Inventory of mammals observed in the study area during 04 – 11 December 2015 (see Appendix 1).

Scientific Name	Vernacular Name	Observed Indicator	Observed Habitat
Antidorcas marsupialis	Cape Springbok	Visual sightings/camera trapped	Open shrubveld, in particular on the southern sites near the large *Roepera morgsana* floodplain.
Canis mesomelas	Black-backed Jackal	Visual sightings	Widespread, although occurring at low densities, probably as a result of sheep farming practice..
Cynictis penicillata	Yellow Mongoose	Visual sightings/camera trapped	Widespread.
Elephantulus rupestris	Western Rock Sengi	Visual sightings	Localised, restricted to prominent outcrops.
Felis cf. sylvestris lybica	African Wild Cat	Spoor/scats	Localised.
Galerella pulverulenta	Small Grey Mongoose	Visual sightings/camera trapped	Widespread.
Genetta genetta	Small-Spotted Genet	Spoor	Widespread.
Hystrix africaeaustralis	Cape Porcupine	Burrows/quills/visual sightings/camera trapped	Widespread and abundant.
Lepus capensis	Cape Hare	Dropping/ visual sightings/camera trapped	Widespread.
Micaelamys namaquensis	Namaqua Rock Mouse	Trapped	Common on outcrops.
Nycterus thebaica	Egyptian Slit-faced Bat	Ultrasonic detection	Localised at prominent outcrops.
Neoromicia capensis	Cape Serotine Bat	Ultrasonic detection	Widespread, roost in roofs of farm buildings and in infrastructure at artificial watering points.
Orycterus afer	Aardvark	Burrows/camera trapped	Widespread on shrubveld plains with sandy soils.
Otocyon megalotis	Bat-eared Fox	Visual sightings/camera trapped	Widespread, mainly on shrubveld.
Parotomys brantsii	Brants' Whistling Rat	Dens	Widespread and abundant.
Pedetes capensis	Springhare	Visual sightings/burrows	Widespread, mainly on open shrubveld with sandy soils.
Procavia capensis	Rock Hyrax	Visual sightings	Localised at prominent outcrops.
Proteles cristatus	Aardwolf	Visual sightings	Localised, occur in low densities.
Raphicerus	Steenbok	Visual	Widespread.

Scientific Name	Vernacular Name	Observed Indicator	Observed Habitat
campestris		sightings/camera trapped	
Rhabdomys pumilio	Xeric Four-striped Grass Mouse	Visual sightings (a diurnal species)	Widespread.
Suricata suricatta	Suricate	Visual sightings/dens	Confined to overgrazed areas and calcrete plains.
Sylvicapra grimmia	Common Duiker	Spoor/droppings	Widespread.
Vulpes chama	Cape Fox	Spoor/visual sightings/camera trapped	Widespread and abundant.
Xerus inaurus	South African Ground Squirrel	Visual sightings/dens	Widespread on calcrete and disturbed areas.

Figure 10.8: Images illustrating some of the mammal species recorded on the study area based on observed indicators: (a) Springbok *Antidorcas marsupialis*, (b) Bat-eared Fox *Otocyon megalotis.*

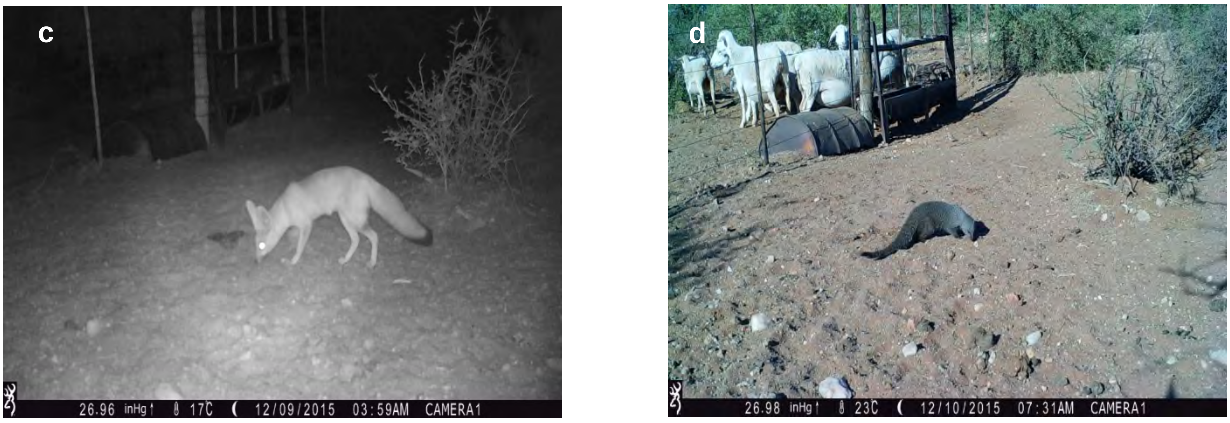

Figure 10.9: Images illustrating some of the mammal species recorded on the study area based on observed indicators: (c) Cape Fox *Vulpes chama*, (d) Small Grey Mongoose *Galerella pulverulenta.*

Figure 10.10: Images illustrating some of the mammal species recorded on the study area based on observed indicators: (e) Cape Hare *Lepus capensis*, (f) Steenbok *Raphicerus campestris.*

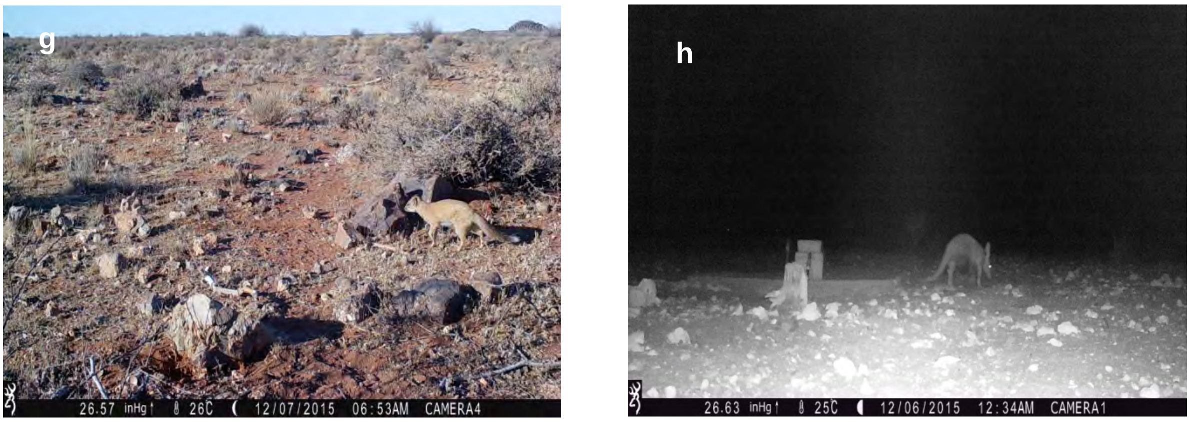

Figure 10.11: Images illustrating some of the mammal species recorded on the study area based on observed indicators: (g) Yellow Mongoose *Cynictis penicillata*, (h) Aardvark *Orycteropus afer.*

Figure 10.12: Images illustrating some of the mammal species recorded on the study area based on observed indicators: (i) Cape Porcupine *Hystrix africaeaustralis*, (j) Aardwolf *Proteles cristatus.*

Figure 10.13: Images illustrating some of the mammal species recorded on the study area based on observed indicators: *(*k) Brants' Whistling Rat *Parotomys brantsii*, (l) South African Ground Squirrel *Xerus inaurus.*

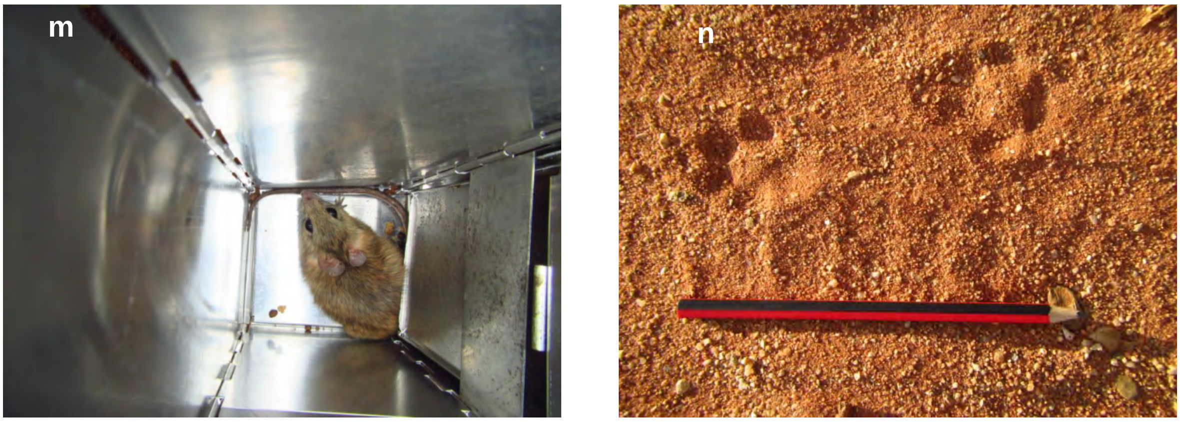

Figure 10.14: Images illustrating some of the mammal species recorded on the study area based on observed indicators: (m) Namaqua Rock Mouse *Micaelamys namaquensis*, (n) Small-Spotted Genet *Genetta genetta.*

Figure 10.15: Images illustrating some of the mammal species recorded on the study area based on observed indicators: (o) Common Duiker *Sylvicapra grimmia*, and (p) possible African Wild Cat *Felis cf. silvestris lybica*.

Biodiversity value and ecological considerations

- The open *Salsola – Stipagrostis* shrubveld is capable of sustaining a high mammal richness consisting of a diversity of different guilds it also sustains high densities of ant-eating species such as aardwolf *Proteles cristatus* and aardvark *Orycteropus afer*. In addition, this is one of a few habitats with a grass cover (dominated by *Stipagrostis*) which provide ephemeral foraging habitat (due to the seed bank) for rodents.
- The calcrete soils provide an additional habitat for mammals with a preference for hard substrates (e.g. Large-eared Mouse *Malacothrix typica*, Cape Short-tailed Gerbil *Desmodillus auricularis* and Bat-eared Fox *Otocyon megalotis*).
- The watercourses are important dispersal corridors for foraging mammal species (mainly ungulates and small to medium sized carnivores, while the artificial watering points provide essential surface drinking water, thereby augmenting the mammal richness and abundance (e.g. many different animals species are dependent on these for drinking water).
- The koppies and prominent outcrops sustain a unique, albeit species poor composition of rupicolous taxa – thereby augmenting local richness (e.g. Namaqua Rock Mouse *Micaelamys namaquensis*, Western Rock Sengi *Elephantulus rupestris* and Rock Hyrax *Procavia capensis)*.

Species of conservation concern

The study area is likely to support habitat for three regionally Near Threatened (Honey Badger *Mellivora capensis,* Littledale's Whistling Rat *Parotomys littledalei* and Lesueur's Wing-gland Bat *Cistugo lesueuri*) and two Data Deficient species (Reddish-Grey Musk Shrew *Crocidura cyanea* and Lesser Red Musk Shrew *C. hirta* (according to Friedmann and Daly, 2004). However, three of these are peripheral and probably absent (Littledale's Whistling Rat, *Parotomys littledalei*, Lesueur's Wing-gland Bat, *Cistugo lesueuri* and Lesser Red Musk Shrew, *Crocidura hirta*, while two have a high probability of occurrence:

<u>Honey Badger *(Mellivora capensis)*</u>

The honey badger is listed as "Least Concern" on the global IUCN Red List although Friedmann and Daly (2004) have listed it as "Near-Threatened".

Honey badgers are widespread and generally very catholic in their habitat requirements. They are predominately nocturnal, solitary, and generally very unobtrusive in behavior (Skinner and Chimimba, 2005). This species is expected to be present in the study area due to its unobtrusiveness and tolerance for human-modified habitat types. Based on its opportunistic behavior, it is likely to occur in all of the habitat types present.

Please note that the regional conservation status of *M. capensis* is currently under revision, with supporting evidence suggests that it will be downgraded from Near Threatened to Least Concern (pers. comm., M. Child of EWT).

<u>*"Data Deficient" species"*</u>

All shrew species of the genus *Crocidura* are regionally "Data Deficient" of which *C. cyanea* (which is known to be present in the QDS that overlaps with the study area) is considered to be widespread in the study area. Most shrew species are perceived to be relatively abundant, but modifications of suitable habitat (due to agricultural intensification and anthropogenic development) in combination with the paucity of scientific information on meta-population demographics place these species in the "Data Deficient" category.

10.3.3 Amphibians

No amphibians have been recently observed in the study area (*sensu* FrogMap and Minter *et al*., 2004). The observed absence and very low expected richness is best explained by the absence of any permanent and discrete seasonal habitat features holding surface water. The only species that could peripherally be present are Southern Pygmy Toad *Poyntonophrynus vertebralis*, Karoo Toad *Vandijkophrynus gariepensis gariepensis*, Boettger's Caco *Cacosternum boettger* and possibly also Tandy's Sand Frog *Tomopterna tandyi*.

Currently, none of the frog species with distribution ranges peripheral to the study area is Threatened or Near Threatened (Measey, 2010) and the area is not considered as an important zoographic region for amphibian diversity.

10.3.4 Reptiles

The relatively location position of the study area is responsible for the paucity of observed reptile taxa. Only five species are currently known to occur to the study area (according to QDC 2921AB & 2921AD; Table 10.3). However, this richness should be higher, and additional surveys in the area are likely to produce 35 expected species (inferred from distribution ranges in Bates *et al.,* 2015), of which 12 species were confirmed during the current survey (Appendix 2 and Figure 10.9):

- Leopard Tortoise *Stigmochelys pardalis* – widespread in study area;
- Verrox's Tent Tortoise *Psammobates tentorius verroxii* – localized and observed from the *Aloe dichotoma* granite outcrops;
- Karoo Sand snake *Psammophis notostictus* – widespread;
- Spotted Desert Lizard *Meroles suborbitalis* – widespread and abundant;
- Western Sandveld Lizard *Nucras tesselata* – localized on northern area consisting of *Aloe dichotoma* granite outcrops;
- Common Sand Lizard *Pedioplanis lineoocellata pulchella* – widespread;
- Karoo Girdled Lizard *Karusasaurus polyzonus* – confined to granite outcrops with exfoliating sheet-rock;
- Western Rock Skink *Trachylepis sulcata sulcata* – common on outcrops;
- Variegated Skink *Trachylepis variegata* – mainly confined to low outcrops;
- Ground Agama *Agama aculeata aculeata* – widespread on calcrete and shrubveld with compacted soils;
- Common Giant Gecko *Chondrodactylus angulifer angulifer* – widespread; and
- Spotted Barking Gecko *Ptenopus garullus maculatus* – uncommon on sandy areas.

According to a recent conservation assessment (Bates *et al*., 2014), none of the expected or observed reptile species are threatened or near threatened.

Table 10.3: The observed reptile taxa confirmed from two quarter-degree grid cells 2921AB and 2921AD that occur in the study area (data courtesy of ReptileMap, ADU).

Family	Genus	Species	Subspecies	Common name	Red list category
Agamidae	*Agama*	*aculeata*	*aculeata*	Common Ground Agama	Least Concern
Elapidae	*Naja*	*nigricincta*	*woodi*	Black Spitting Cobra	Least Concern
Gekkonidae	*Chondrodactylus*	*bibronii*	-	Bibron's Gecko	Least Concern
Scincidae	*Trachylepis*	*sulcata*	*sulcata*	Western Rock Skink	Least Concern
Testudinidae	*Psammobates*	*tentorius*	*verroxii*	Verrox's Tent Tortoise	Not listed

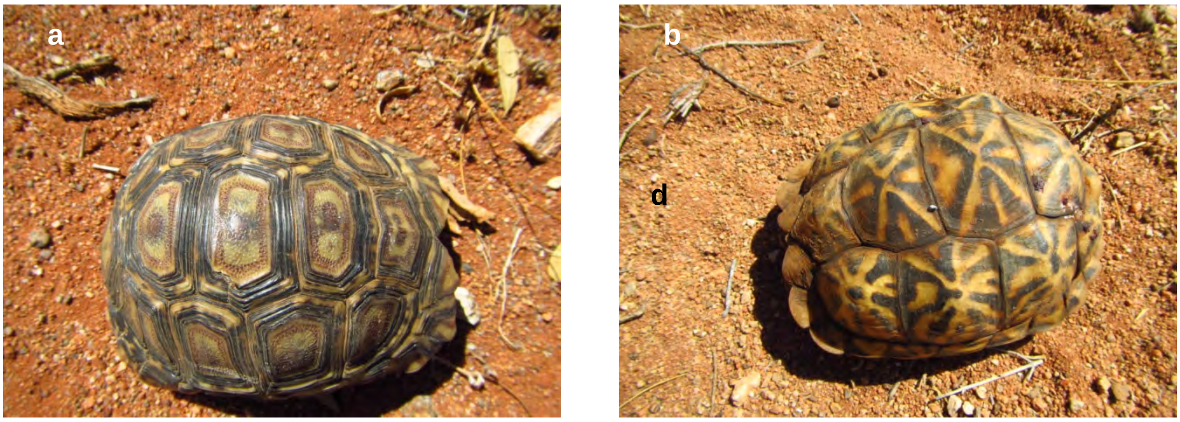

Figure 10.16: Images illustrating some of the reptile species recorded on the study area: (a) Leopard Tortoise *Stigmochelys pardalis*, (b) Verrox's Tent Tortoise *Psammobates tentorius veroxii*

Figure 10.17: Images illustrating some of the reptile species recorded on the study area: (c) Common Giant Gecko *Chondrodactylus angulifer angulifer*, (d) Karoo Girdled Lizard *Karusasaurus polyzonus.*

Figure 10.18: Images illustrating some of the reptile species recorded on the study area: (e) Spotted Desert Lizard *Meroles suborbitalis* and (f) Western Rock Skink *Trachylepis sulcata sulcata*.

10.3.5 Ecological Sensitivity analysis

A composite ecological sensitivity map based on the presence of habitat with a high probability to sustain threatened and near threatened fauna species and areas of high faunal richness is presented in Figure 10.10.

Areas of high ecological sensitivity
It is evident that the artificial livestock watering holes, artificial dams, all quartz and calcrete plains, *Aloe dichotoma – Tetradenia retrofracta* outcrops and prominent outcrops are identified with high faunal sensitivities (see Figure 10.10). The outcrops provide habitat for >50 % of the expected reptile composition, of which the granite sheet-rock of the *Aloe dichotoma – Tetradenia retrofracta* outcrops provide habitat for nearly all obligate rupicolous taxa.

In addition, the dams and watering points hold high faunal diversities, since they provide (drinking water to game and meso-predators in a water-scarce environment. Also, the major watercourses (*Roepera morgsana* floodplains and *Prosopis glandulosa* watercourse) are equally important movement corridors for a variety of mammals. Lastly, the calcrete plains provide a specialised niche for burrowing animals with localised distribution patterns in the study area which invariably prefer compacted soil substrates.

Areas of medium to high ecological sensitivity
These areas are represented by the low *Salsola* outcrops and the smaller *Rhigozum trichotomum* watercourses. The animal assemblages in these habitat types are widespread species, although observations suggest that the *Salsola* outcrops support more reptile species (when compared to neighboring shrubveld areas). In addition, the *Salsola* outcrops were found to be poorly represented by threatened and near threatened species, even though it provides ephemeral foraging habitat for many smaller taxa.

Although *R. trichotomum* watercourses are generally regarded as important, especially since they act as movement corridors for a variety of smaller mammals, they only marginally contribute towards the daily dispersal of large-bodied species. However, they are still regarded as important based on their ecological connectivity with the larger watercourses.

Areas of medium ecological sensitivity
These habitat types are dominant in the study area and represent an extensive area of open shrubland and plains network which provide ephemeral foraging habitat for many mammals. However, the faunal compositions of this unit comprises of widespread species typical of arid environments, and are fairly widespread and abundant in the region

Areas of low ecological sensitivity
Currently none of the habitat types are regarded to be of low ecological sensitivity.

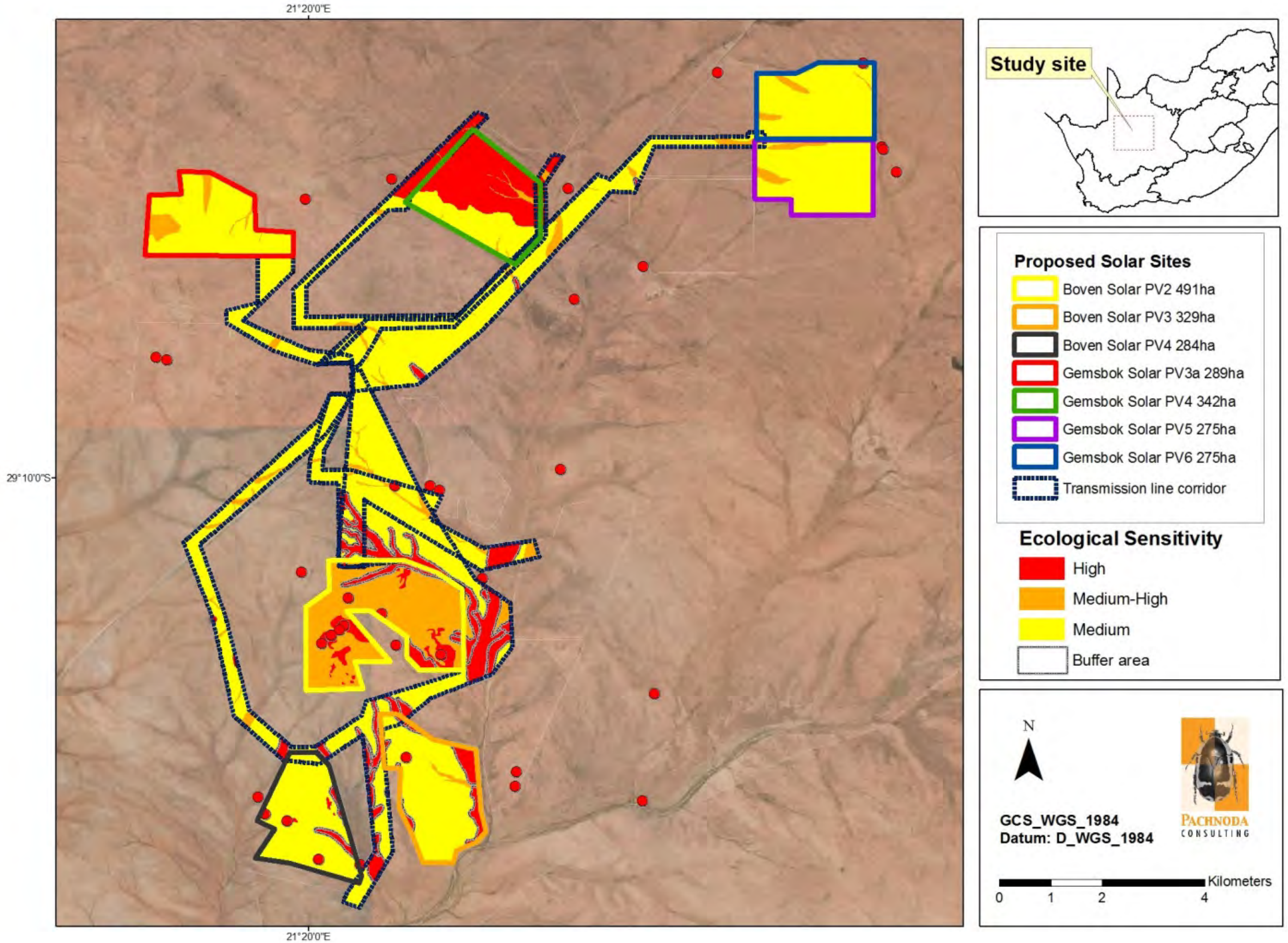

Figure 10.19: A composite ecological sensitivity map based the presence of habitat with a high probability to sustain Threatened and Near Threatened fauna species, and areas of high faunal richness (all watercourses are buffered by 32 meters and key habitat features such as outcrops, dams and watering points by 100 meters).

10.4 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

Not applicable to the faunal assessment.

10.5 IDENTIFICATION OF KEY ISSUES

10.5.1 Key Issues and Potential Impacts/Risks Identified During the Scoping Phase

Potential impacts associated with the proposed solar farm facilities include:

Construction impacts:

- Loss of extensive plains and calcrete habitat (and subsequent loss of threatened taxa) and displacement of taxa during construction of the facilities; and
- Potential loss of dispersal corridors.

Operational impacts:

- Secondary impacts related to the infrastructure attracting animals (nesting and roosting on structures, foraging underneath panels); and
- Indirect impacts associated with changes in the local community structure.

Cumulative impacts:

- Construction and planning of additional solar farms within proximity of the area are likely to increase the significance of the construction and operational impacts.

10.6 Assessment of Impacts and Identification of Management Actions

10.6.1 Results of the Field Study

There is little information available on the impacts of solar energy plants on animals besides those discussed by Gunerhan *et al*. (2009) and Tsoutsos *et al*. (2005). However, the impacts on the resident fauna are less severe when compared to birds which are highly mobile and are more readily affected by solar infrastructure (e.g. attraction by the reflective surfaces of the PV panels) than other taxonomic groups (e.g. mammals which often roost underneath the panels).

The main impacts associated with solar farm facilities are two-fold and include the loss of habitat and displacement of fauna species due to the large ecological footprint required during construction, and direct interaction of animals with the surface infrastructure required during the operational phase.

For this project, seven sites are proposed ranging in size from 275 ha (the smallest surface area being the proposed Gemsbok Solar PV5 and PV6 project) to as much as 491 ha (the largest surface area being the proposed Boven Solar PV2 project). Considering that only approximately 220 ha on each site is proposed for each 75 MW of infrastructure, which means that only 50 % of each proposed site is likely to be covered by the panels and only 10 % will be occupied by foundation infrastructure. It is possible that sensitive features could be impacted in a direct way through the loss of habitat during an overspill of construction activities and by the “shade-out” effect of the panel infrastructure itself. The sensitive features at risk include the outcrops and gravels plains, the calcrete plains and also part of the drainage lines (in the absence of a layout plan). In many instances, drilling will be required to secure the foundation/piles of the panels to the outcrops, which requires the use of drilling machinery which could lead to excessive trampling of the surrounding vegetation and habitat types.

10.6.2 Loss of habitat, habitat transformation and displacement of fauna (Construction Phase)

The loss of habitat and subsequent displacement of fauna is probably the only impact that could have a significant effect on the vegetation during the construction of the PV facilities. This will result in the potential alteration of vegetation and habitat units, although it is also possible that construction activities could overspill into neighboring areas. In addition, the transformation of habitat is also evident through the potential "shade-out" effect created by the panels, thereby minimizing the amount to sunlight available to plants during the day. Seven sites are proposed, which are all geographically widely spaced from each other. Only 220 ha (50 %) of the proposed site is likely to be occupied or covered, of which 10 % will be occupied by foundation infrastructure.

The majority of the proposed solar farms coincide with areas of high and medium-high sensitivity (Table 10.4). In general, the impact during the construction of the proposed solar facilities will be more severe on natural outcrops, calcrete and gravel plains (including azonal habitat such artificial watering points) and proximal to large watercourses where high faunal richness is expected and where mechanical drilling equipment is necessary. The watercourses, for example, also support vegetation that is higher than the infrastructure which would require pruning or clearing of vegetation. The subsequent alteration of outcrop and watercourse habitat will displace fauna, mainly substrate specialists and rupicolous species from the footprint site, as well as large bodied species that requires large home ranges.

Table 10.4: A comparison of the proposed faunal sensitivity of each site and its predicted impact significance (pre-mitigation) due to the loss of habitat/habitat transformation.

Site	Mean sensitivity	Predicted impact significance
Gemsbok Solar PV4	High	High
Boven Solar PV2	High	High
Boven Solar PV4	Medium-High	Moderate
Boven Solar PV3	Medium-High	Moderate
Gemsbok Solar PV3	Medium	Moderate
Gemsbok Solar PV5	Medium	Moderate
Gemsbok Solar PV6	Medium	Moderate

Those species likely to be affected by the loss of habitat and displacement include:

- Rupicolous reptile and mammal taxa,
- Mymecophagous species such as aardvark, bat-eared fox and aardwolf and those sheltering in burrows and dens,
- Large-bodied mammals (e.g. springbok) confined to open plains,
- Colonial mammal species living in structured dens and burrow systems.

Mitigation

- A conceptual layout of each proposed solar site should allow for the preservation of sensitive habitat features, thereby implying that the entire site will not be utilised.
- Development on habitat with high ecological sensitivity should be avoided.

- Make use of manual techniques and labour during the fitment of the foundation/ piles to minimize the possible trampling and destruction of surrounding vegetation and the use of drilling equipment should be avoided;
- Buffer all natural linear dispersal corridors (e.g. *P. glandulosa* and *M. roepera* watercourses) by at least 32 m and all *Aloe dichotoma* outcrops, quartz outcrops and prominent outcrops by at least 100 m.
- Opportunities should be sought to replace lost artificial dams and watering points.
- Where possible (depending on the sensitivity of the habitat and the surface area of the habitat), increase the distance between neighbouring arrays (currently 3 m) which will increase the amount and frequency of sunlight made available to the vegetation underneath the panels (thereby decreasing the “shade-out” effect).

10.6.3 Disturbance and displacement of animal taxa due to construction noise (Construction Phase)

It is inevitable that disturbance during the construction, operation and maintenance phases will occur. These will be especially significant near or in close proximity to roosting or breeding animals, or where congregations of animals are likely to occur (e.g. at watering points). Although it is not anticipated to pose a significant impact, special care should be exercised to avoid areas where surface water is prominent (dams and watering points) or where outcrops occur (e.g. during drilling into rock substrate). This is also true for habitats with high sensitivity. In most instances larger terrestrial species will temporarily vacate the area.

Mitigation

- Minimize area cleared for construction activities. This includes the area used by personnel and labour during construction.
- Make use of manual techniques and labour during the fitment of the foundation/ piles to minimize the possible trampling and destruction of surrounding vegetation and the use of drilling equipment should be avoided.
- Construction activities should correspond to areas with low-medium ecological sensitivity.
- Linear features (watercourses) must be retained irrespective of their floristic condition or composition to facilitate the movement of fauna.
- Appropriate buffer zones must be implemented around key habitat types (watering points, dams, prominent outcrops, quartz outcrops and *Aloe dichotoma* outcrops) to alleviate the effect of habitat fragmentation and edge effects. These features should be buffered by at least 100 m.
- Limit construction activities to daytime.
- Minimize the use of earthmoving and drilling equipment that results in noise generation.
- Construction personnel must be restricted to the construction area.
- Minimize external lighting. Some taxa dispersing at night could be attracted to lights, and these should be kept to a minimum. If possible, external lighting should make use of longer wave lengths (550 nm) and should contain preferably green or yellow hues. External lighting should not make use of fluorescent lights since these emit significant amounts of UV, which will attract invertebrates and possibly also insectivorous mammals, invertebrates and reptiles.
- Intentional killing of animals (especially snakes) should be avoided by means of awareness programmes presented to the labour force. The labour force should be made aware of the conservation issues pertaining to the animals occurring in the study area. Any person found deliberately harassing any animal in any way should face disciplinary measures, followed by possible dismissal from the site.
- Hunting and snaring are prohibited and labour personnel are not allowed to venture away from any designated construction site. Construction camps should preferably be situated near the town of Kenhardt.

10.6.4 Loss of dispersal corridors used by fauna species (Construction Phase)

The watercourses and drainage lines are identified as important movement corridors for mammal taxa to gain access between foraging habitat (e.g. dams and nearby shrubveld habitat) and roosting habitat. It is also instrumental in gene cohesion between different populations of the same species and to facilitate dispersal of emigrating individuals.

A number of the proposed solar sites correspond to *R. trichotomum* watercourses and are positioned in close proximity to some of the larger watercourses and floodplains. Any disruption or loss of watercourses and subsequent daily movement corridors could lead to increased intra- and inter-specific competition for resources. Similarly, those species with superior competitive abilities (mainly unspecialised species with widespread distributions) will displace specialist taxa leading to taxonomic impoverishment (e.g. over-dominance of certain species).

Mitigation

- Roads should avoid crossing major watercourses and dams, where possible.
- Minimise the number of vehicles using access roads.
- Existing roads should be used.
- The width of roads should be kept to a minimum.
- Implement traffic calming structures to limit the speed of vehicles (e.g. speed humps).
- Run-off control measures on either side of roads must be constructed so that small terrestrial animals can cross them. Ditches/trenches should have slopes of less than 45° rather than vertical sides.

10.6.5 Exterior lighting and potential collision with infrastructure (Operational Phase)

It is often possible for nocturnal animals (e.g. invertebrates and certain insectivorous predators) to be attracted to and disorientated by exterior lighting.

Mitigation

- Minimize exterior lighting and implement operational strategies to reduce "light spill". Outside features should be illuminated by using down-lighting rather than "up-lighting".
- Lights should be of longer wave lengths (550 nm) and preferably should contain green or yellow hues. Exterior lighting should not make use of fluorescent lights since these emit significant amounts of UV, which will attract invertebrates and possibly also birds.
- In addition, internal lights should be shielded by blinds/curtains.

10.6.6 Potential localised chemical pollution of surface and groundwater resources (Operational Phase)

The PV panels are likely to gather substantial amounts of dust. Nevertheless, the panel structures are likely to attract certain opportunistic animal species (for reasons such as shelter, foraging and nesting purposes) which, based on their daily activities, will cause pollution through excrement and nest building material. In most instances this will necessitate the use of chemicals to wash and clean the panels resulting in water run-off containing chemicals which could pollute or contaminate nearby waterbodies and ground water reservoirs. However, the applicant has indicated that only water for cleaning of the panels after being filtered by reverse osmosis – no chemicals or treatment will be required.

Mitigation

- Avoid the placement of panels near dams, watercourses or watering points.
- Only water should be used to clean the panels.
- Washing of the facility should be minimized and should be done once or twice annually to minimise disturbances.

10.6.7 Secondary impacts related to the infrastructure attracting birds (nesting and roosting on structures, foraging underneath panels, bird pollution) (Operational Phase)

(a) The shade created by the overhead PV panels could attract different mammals for reasons such as refuge and roosting sites. This in turn could affect the successful re-establishment of vegetation underneath the panels (especially if the species involved are herbivorous) and could lead to increased potential for soil erosion.
(b) In addition, when PV panels are tightly spaced together the shade-out effect caused by the panels will prevent the successful natural regeneration of vegetation. It is believed that a species-poor, albeit pioneer plant community will establish underneath the structures. This in turn could attract opportunistic and invader species (e.g. Multimammate Mouse *Mastomys coucha*) and possibly also Brown Rat *Rattus rattus* and House Mouse *Mus musculus* which could be introduced to the area during the import of construction material. Increased rodent populations will attract rodent predators, with the possibility of abnormal influxes of carnivorous mammals of to the genera *Felis* and *Canis.*

Mitigation

- Monitor nest-building or roosting activities and remove/trim nesting/roosting that is a risk to the solar infrastructure with the consent of the Northern Cape Conservation Department.
- Install nest boxes for owls along the perimeter of the facilities to assist with rodent control.

10.6.8 Indirect impacts associated with changes in the local community structure (Operational Phase)

It is probable that the species composition will change in areas that are cleared of vegetation. In addition, it is predicted that more generalist species will dominate the study area. As mentioned above, it is believed that the densities of certain opportunistic species (mainly rodents) could increase. These animals could easily out-compete other less resilient species in the area.

Areas cleared of vegetation provide the ideal habitat for pioneer or introduced mammals. These areas and the infrastructure provide the ideal nucleus for the proliferation of invader species such as House Mouse *Mus musculus* and Brown Rat *Rattus rattus* (these species could be brought to the area during the transport of construction material), and even domestic dogs and cats. In addition, many of these species could be a host to a number of parasites or vectors of foreign diseases that could spread to the local indigenous mammal population – sometimes with disastrous consequences. In addition, these species compete with the indigenous fauna for resources or they could even prey on the indigenous animals. Although many of these species are only able to survive in close association with humans, some are known to take up residence in the field. Also, domestic cats could interbreed with the local African Wild Cat *Felis sylvestris* population, thereby resulting in genetic contamination.

Mitigation

- Ensure appropriate spacing between the consecutive panel arrays (3 m or more) to allow for sunlight to reach the underlying vegetation.
- Conduct monthly screens to determine the occurrence/density of invasive species. If detected, a specialist in the field of pest control should be appointed to rectify the problem with the consent of the Northern Cape Conservation Department.
- No pets should be allowed on the premises.

10.6.9 Indirect impacts associated with changes in the local community structure (Decommissioning Phase)

It is likely that the vertebrate species composition will shift once the PV panels are removed and habitat succession is initiated. However, considering the long recovery periods experienced after transformation of arid systems, it is predicted that the floristic structure and composition will mirror that of a pioneer community. Therefore, generalist mammal species will dominate the study area. It is believed that the density of certain opportunistic species could increase in the area. These taxa could easily out-compete other less resilient conspesific taxa in the area and remove (through consumption) rehabilitating seedlings/seed bank.

Mitigation

- Ensure appropriate spacing between the consecutive panel arrays (3 m or more) to allow for sunlight to reach the underlying vegetation.
- Conduct montly surveys to determine the occurrence/density of invader taxa. If detected, a specialist in the field of pest or alien control should be appointed to rectify the problem with the consent of the Northern Cape Conservation Department.

10.6.10 Cumulative Impacts - Indirect impacts related to anthropogenic encroachment

The proposed solar facilities, especially during construction will provide employment for the local community as well as people from abroad. Unfortunately, such an activity could impact negatively on the surrounding habitat types by facilitating urban-sprawl and the consequent plundering of natural resources (e.g. fire-wood collection, snaring and poaching). Human environments are magnets for alien and invader taxa which include feral dogs and cats (see discussion above). Domestic cats specifically are a problem since they will prey on local native bird population. In addition, domestic cats are specifically a problem since they will hybridise with the African Wild Cat *Felis sylvestris*, resulting in genetic contamination of the natural population.

Mitigation

It is difficult to manage or control urban sprawl during an economic environment where jobs are scarce and nearly unobtainable in rural areas. It is recommended that the local community be used during construction or that the labour force be housed at Kenhardt. Illegal squatting should be prohibited on the study area. Where possible, construction camps on site should be properly organized and should be of short duration. The client confirmed that illegal squatting will not be allowed on site. The people who will be accommodated on site are minimal (less than 10). It will only be the security staff and a few management staff members.

10.6.11 Cumulative Impacts – ''Congestion" of other planned and approved solar projects on the study region

Considering the interest in, and rapid expansion of, solar farm energy plants in South Africa, especially in the Northern Cape, it is anticipated that these structures could cumulatively have an impact on the surrounding ecological integrity.

The Nieuwehoop Solar Park Project (Phase 1 consisting of three approved projects and Phase 2-subject of this assessment, consisting of seven solar PV projects) is not the only project of this kind planned for the Kenhardt area. Scatec Solar SA (Pty) Ltd is also proposing to operate three 75 megawatt (MW) Solar Photovoltaic (PV) power generation plants in the area. These proposed plants will be constructed on the Farm Onder Rugzeer 168, which is situated alongside the Farm Boven Rugzeer (Remaining Extent of Farm 169) and the proposed Eskom Nieuwehoop Substation. Each 75 MW plant (and associated infrastructure) of Scatec will cover an approximate area/footprint of 250 Ha (i.e. total area of approximately 750 Ha).

Therefore, it is anticipated that an increase in surface infrastructure could result in additional ecological impacts. These will be the same as those described earlier, although the magnitude and severity of the impacts are elevated (or enhanced) due to the addition of these structures to the landscape. Therefore, surface area will be lost, entailing the loss of vegetation communities and the additional loss of habitat.

10.7 IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in Table 10.5 to Table 10.8 below.

Table 10.5: Impact assessment summary table for the Construction Phase

Construction Phase													
Direct Impacts													
Site	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Gemsbok Solar PV3 Gemsbok Solar PV5 Gemsbok Solar PV6	Habitat loss, fragmentation and displacement of Near Threatened species and species loss due to the clearing of habitat/vegetation	Negative	Local	Long-Term	Moderate	Highly probable	Low	Moderate	Concentrate or cluster sites in close proximity to each other Develop on habitat with medium sensitivity Avoid development on sensitive habitat	Moderate	Low	4	Medium
All sites, but in particular: Gemsbok Solar PV4 (drilling) Boven Solar PV2	Displacement and disturbances caused to animals due to noise generation	Negative	Site	Medium-Term	Moderate	Highly probable	Moderate	Moderate	Develop on habitat with medium sensitivity Apply appropriate buffer zones	Moderate	Low	2	Medium

Construction Phase													
Direct Impacts													
Site	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
	Displacement of foraging taxa and loss of genetic cohesion between populations	Negative	Regional	Medium-Term	Moderate	Probable	Moderate	Low	Apply appropriate buffer zones Avoid crossing or interference with watercourses	Moderate	Low	4	Medium

Table 10.6: Impact assessment summary table for the Operational Phase

Operational Phase													
Direct Impacts													
Site	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
All sites	Disorientation of nocturnal animals and increased predation by insectivores caused by exterior lighting	Negative	Local	Long-term	Moderate	Probable	Moderate	Moderate	See section 1.6.1.5 on mitigation	Moderate	Low	4	High
All sites	Cleaning of panels could result in chemical pollution of water resources	Negative	Local	Long-term	Slight	Probable	High	Low	Avoid placement of panels near waterbodies Make use of filtered water	Low	Low	4	High
All sites	Nest – building and roosting activities and interference with infrastructure - secondary impacts related to the infrastructure attracting animals	Negative	Site	Long-term	Slight	Definite	High	Low	See section 1.6.1.7 on mitigation	Moderate	Low	4	High

Operational Phase													
Direct Impacts													
Site	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
All sites	Increased composition, loss of local diversity and potential increase in pest species due to habitat chance and associated change to local community composition and abundance (under infrastructure)	Negative	Local	Long-term	Moderate	Definite	Moderate	Moderate	See section 1.6.1.8 on mitigation	Moderate	Low	4	Medium

Table 10.7: Impact assessment summary table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Site	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
All sites	Increased competition and decline in species richness - indirect impacts associated with changes in the local community structure	Negative	Local	Long-term	Moderate	Definite	Moderate	Moderate	See section 1.6.1.9 on mitigation	Moderate	Low	4	Medium

Table 10.8: Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
All sites	Exploitation of natural resources and indirect impacts related to anthropogenic encroachment	Negative	Regional	Long-term	Substantial	Probable	Low	Moderate	See section 1.6.1.10 on mitigation	High	Moderate	3	Medium
Entire study region	Increased loss of habitat and mortalities on a regional scale caused by "congestion" of other planned and approved solar projects on the study region	Negative	Regional	Long-term	Substantial	Definite	Low	High	N/a	High	Moderate	3	Medium

10.8 INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

The following key management procedures are required during the construction and operational phases:

- Avoid and minimize development on habitat of high ecological sensitivity by means of:
  - Site selection should focus on habitat with medium ecological sensitivity; and
  - Apply buffer zones (100m from the edge of the key habitat features) to habitat with high ecological sensitivity.
- Educate personnel and staff members about the biodiversity importance of the area by means of environmental awareness programmes.
- Make use of manual techniques and labour during the fitment of the foundation/ piles to minimize the possible trampling and destruction of surrounding vegetation.
- Apply “best practice management” procedures during construction activities (e.g. minimize the area cleared for construction activities, contain workforce within construction site, and limit construction activities to daytime).
- Minimize exterior lighting, use lights/globes of appropriate wavelength and make use of down-lighting.
- Monitor areas around construction camps for signs of illegal hunting or resource utilisation. If detected take remedial action (removal of snares, remote security cameras and awareness programmes).
- Minimise the use of construction and operational vehicles and apply road calming structures.
- Apply appropriate space between consecutive PV panels to allow for sunlight to reach the basal vegetation and monitor ecological succession and animal re-colonisation.
- Conduct regular screens to determine the occurrence/density of invader taxa and rectify if required.

10.9 CONCLUSION AND RECOMMENDATIONS

As per Appendix 6 of the Environmental Impact Assessment Regulations of 2014 (No. R. 982) of the National Environmental Management Act (Act No. 107 of 1998) a reasoned opinion should be provided as to whether the proposed activity or portions thereof should be authorised:

- According to the results, areas identified with high faunal sensitivity should be perceived as sensitive habitat and development activities should preferably refrain from these areas.
- All key habitat features should have a buffer of at least 100 m and all major watercourses by at least 32 m to minimize any induced ecological edge-effects and associated fragmentation during the construction and operation of the project;
- The site for Gemsbok Solar PV4 contains the largest area of continuous sensitive habitat which pertains to the *Aloe dichotoma – Tetradenia retrofracta* outcrops, an important habitat for rupicolous animals. It also supports a high faunal richness;
- The remaining habitat of high ecological sensitivity (all major watercourses, artificial watering points, dams, prominent and quartz outcrops) is fragmented and patchy. These are prominent on Boven Solar PV2, Boven Solar PV3 and Boven Solar PV4; and
- The majority of sites is dominated by habitat (mainly shrubveld and *Salsola* outcrops) with medium - high ecological sensitivity (Boven Solar PV2) or medium ecological sensitivities.

Development on areas corresponding to habitat of high sensitivity is likely to result in impacts (herewith referring to the loss of habitat and displacement of animal species) with a very high to high significance (Gemsbok Solar PV4) or high significance (Boven Solar PV2 – PV4). Development on these sites is only justifiable if the aforementioned buffer zones are applied to ensure that the ecological integrity and function of key habitat are maintained. The more preferred sites for development include Gemsbok Solar PV3, Gemsbok Solar PV5 and Gemsbok Solar PV6.

10.10 REFERENCES

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10.11 APPENDICES

Appendix 1: A shortlist of mammal species with distribution ranges sympatric to that of the study area and their probability of occurrence. The regional conservation status of species was chosen according to Friedmann & Daly (2004) and the global conservation status of species is indicated in brackets (IUCN, 2015). Nomenclature was chosen according to Skinner & Chimimba (2005), unless otherwise indicated.

Scientific Name	Vernacular Name	Probability of Occurrence	Habitat	Conservation Status
Macroscelidea: Macroscelididae				
Elephantulus rupestris	Western Rock Sengi	High, confirmed from prominent outcrops.	Outcrops in savanna and grassland.	Least Concern
Macroscelides proboscideus	Round-eared Elephant-shrew	High, could occur on the low outcrops and calcrete plains.	Confined to semi-arid outcrops and gravel plains	Least Concern
Eulipotyphla: Soricidae				
Crocidura cyanea	Reddish-Grey Musk Shrew	High, likely to occur.	Dry terrain among rocks in dense scrub and grass, in moist places and in hedges.	Data Deficient
Crocidura hirta	Lesser Red Musk Shrew	Peripheral to study site.	Varied, from moist savanna to Kalahari thornveld.	Data Deficient
Chiroptera: Nycteridae				
Nycterus thebaica	Egyptian Slit-faced Bat	High, confirmed foraging at the base of a prominent outcrop.	Varied, roost in buildings and trees.	Least Concern
Chiroptera: Vespertilionidae				
Cistugo lesueuri	Lesueur's Wing-gland Bat	Status uncertain (not detected by means of ultrasonic detectors).	Varied, roost in rock crevices.	Near Threatened
Neoromicia capensis	Cape Serotine Bat	High, a widespread and confirmed (by means of ultrasonic detectors).	Variable. Commonly enters houses and readily visits lights.	Least Concern
Chiroptera: Molossidae				
Tadarida aegyptiaca	Egyptian Free-Tailed Bat	High, a widespread species likely to occur.	Cosmopolitan, occurring in all vegetation types.	Least Concern
Lagomorpha: Leporidae				
Lepus capensis	Cape Hare	High, confirmed.	Dry open woodland and scrub.	Least Concern
Lepus saxatilis	Scrub Hare	Moderate, a widespread species likely to occur.	Woodland and scrub with some grass cover.	Least Concern
Rodentia: Sciuridae				
Xerus inaurus	South African Ground Squirrel	A very common and widespread Species - confirmed	Open areas with sparse cover on hard substrate.	Least Concern
Rodentia: Myoxidae				
Graphiurus ocularis	Spectacled Dormouse	Could occur, mainly associated with areas containing outcrops.	Outcrops.	Least Concern
Rodentia: Pedetidae				
Pedetes capensis	Springhare	High, widespread and confirmed.	Sandy compacted soils.	Least Concern
Rodentia: Hystricidae				

Scientific Name	Vernacular Name	Probability of Occurrence	Habitat	Conservation Status
Hystrix africaeaustralis	Cape Porcupine	High, a widespread species confirmed from the study site.	Catholic, but prefers broken country with hills and rocks.	Least Concern
Rodentia: Muridae				
Malacothrix typica	Large-eared Mouse	High, a widespread species likely to occur, especially on calcrete soils.	Short grassy areas on hard soils.	Least Concern
Desmodillus auricularis	Cape Short-tailed Gerbil	High, likely to occur (especially on calcrete plains).	Compact soils with grass cover.	Least Concern
Gerbillurus paeba	Hairy-footed Gerbil	High, likely to occur on open shrubveld	Varied, although partial to sandy soils with cover.	Least Concern
Gerbillurus vallinus	Brush-tailed Hairy-footed Gerbil	High, could occur on the calcrete plains	Semi-arid shrubland on hard substrates.	Least Concern
Gerbilliscus brantsii	Highveld Gerbil	Could occur.	Sandy soils with some cover of grass, scrub or open woodland.	Least Concern
Micaelamys namaquensis	Namaqua Rock Mouse	High, confirmed from the habitat containing outcrops.	Rocky habitats.	Least Concern
Rhabdomys pumilio	Xeric Four-striped Grass Rat	High, a widespread species likely to occur - confirmed	Grassland with good grass cover.	Least Concern
Mastomys coucha	Multimammate Mouse	High, a widespread species likely to occur.	Wide habitat tolerance, including human habitation. A pioneer species.	Least Concern
Otomys unisulcatus	Karoo Bush Rat	High could occur.	Nama-Karoo shrub	Least Concern
Parotomys brantsii	Brants' Whistling Rat	Confirmed, a widespread species on the study site.	Present in large colonies at the base of shrubs in sandy soils.	Least Concern
Parotomys littledalei	Littledale's Whistling Rat	Status uncertain, difficult to access based on morphological characters alone	Sandy gravel and open plains of the Karoo	Near Threatened
Carnivora: Canidae				
Vulpes chama	Cape Fox	High, widespread and confirmed	Savanna, shrubland and grassland.	Least Concern
Otocyon megalotis	Bat-eared Fox	High, widespread and confirmed..	Open savanna with short shrub and grass cover.	Least Concern
Canis mesomelas	Black-Backed Jackal	High, a widespread species likely to occur - confirmed	Wide habitat tolerance; arid, savanna and well watered regions. Absent from forests.	Least Concern
Carnivora: Mustelidae				
Mellivora capensis	Honey Badger	High, could occur	Varied.	Near Threatened
Ictonyx striatus	Striped Polecat	High, likely to occur.	Varied, from forest to grassland.	Least Concern
Carnivora: Herpestidae				
Galerella pulverulenta	Small Grey Mongoose	High, likely to occur - confirmed	Varied, from rocky shoreline to arid grassland and Desert.	Least Concern
Galerella sanguinea	Slender Mongoose	Peripheral, could occur.	Catholic habitat requirements, arid to more mesic regions. Cover in the form of holes in the ground, hollow logs or rocks are essential.	Least Concern
Cynictis penicillata	Yellow Mongoose	High, widespread species likely to occur - confirmed	Open areas such as vleis and open grassland around waterholes.	Least Concern
Suricata suricatta	Suricate	High, likely to occur - confirmed	Open savanna and grassland.	Least Concern
Carnivora: Viverridae				

Scientific Name	Vernacular Name	Probability of Occurrence	Habitat	Conservation Status
Genetta genetta	Small-Spotted Genet	High, a widespread species – confirmed	Savanna, adapts well to rural gardens and urban areas.	Least Concern
Carnivora: Hyaenidae				
Proteles cristatus	Aardwolf	High, likely to occur - confirmed	Wide habitat tolerance but prefers open areas with a high density of food (termites)	Least Concern
Carnivora: Felidae				
Felis silvestris lybica	African Wild Cat	High, likely to occur - confirmed	Varied, although cover is essential.	Least Concern
Caracal caracal	Caracal	High, could occur (mainly on areas consisting of outcrops).	Savanna, grassland and semi-arid areas.	Least Concern
Tubulidentata: Orycteropodidae				
Orycterus afer	Aardvark	High, confirmed. An important species in the landscape providing roosting and refuge for other mammal taxa.	Wide range of habitat although partial to termitaria.	Least Concern
Hyracoidea: Procavidae				
Procavia capensis	Rock Hyrax	High, localised on prominent Outcrops/koppies - confirmed	Open grassy plains and open woodland.	Least Concern
Ruminantia: Bovidae				
Oryx gazella	Gemsbok	Could occur .	Dry, open areas, including arid woodland.	Least Concern
Raphicerus campestris	Steenbok	High, widespread and conifrmed	Drier savanna, grassland and shrublands.	Least Concern
Antidorcas marsupialis	(Cape) Springbok	High, widespread on study area – confirmed	Open arid plains.	Least Concern
Sylvicapra grimmia	Common Duiker	High, a widespread species – confirmed	Varied, all major biomes.	Least Concern

Appendix 2: A shortlist of reptile species with distribution ranges sympatric or peripheral to study area and their probability of occurrence.

Scientific Name	Common Name	Occurrence	Habitat Description
Testudinidae			
Stigmochelys pardalis	Leopard Tortoise	Likely to occur – confirmed	Varied, from arid to mesic savanna.
Psammobates tentorius veroxii	Verrox's Tent Tortoise	Likely to occur – confirmed.	Arid savanna and semi-desert.
Elapidae			
Aspidelaps lubricus lubricus	Coral Shield Cobra	Could occur	Outcrops.
Naja nigricincta woodi	Black Spitting Cobra	Could occur	Outcrops.
Naja nivea	Cape Cobra	Could occur	Varied.
Colubridae			
Telescopus beetzii	Beetz's Tiger Snake	Could occur	Mainly outcrops.
Viperidae			
Bitis arietans arietans	Puff Adder	Could occur	Absent only from desert, dense forest and mountains.
Bitis caudalis	Horned Adder	High, likely to occur.	Hot, dry open areas.
Lamprophiidae			
Boaedon capensis	Common House Snake	Could occur	Varied.
Dipsina multimaculata	Dwarf Beaked Snake	Peripheral	Arid sandy areas and dry watercourses.
Psammophis notostictus	Karoo Sand Snake	High - confirmed	Karroid and arid shrub.
Psammophis trinasalis	Fork-marked Sand Snake	Peripheral.	Arid savanna and desert.
Typhlopidae			
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	Peripheral.	Varied, semi-desert, coastal bush, fynbos and savanna.
Lacertidae			
Meroles suborbitalis	Spotted Desert Lizard	High, confirmed	Open sparsely vegetated areas.
Nucras tesselata	Western Sandveld Lizard	High, confirmed	Outcrops and open karroid veld.
Pedioplanis laticeps	Karoo Sand Lizard	Could occur	Compacted well-vegetated soils in areas with stones.
Pedioplanis lineoocellata pulchella	Common Sand Lizard	High, likely to occur - confirmed	Varied, along broken, rocky terrain.
Pedioplanis namaquensis	Namaqua Sand Lizard	Could occur.	Open sparsely vegetation plains and calcrete plats.
Cordylidae			
Karusasaurus polyzonus	Karoo Girdled Lizard	High, confirmed	Outcrops with exfoliating rock sheet.
Scincidae			
Acontias lineatus	Striped Dwarf Legless Skink	Peripheral	Sandy soils with debris.
Trachylepis occidentalis	Western Three-striped Skink	High, could occur	Arid shrub and karroid veld.
Trachylepis sulcata sulcata	Western Rock Skink	High, confirmed.	Arid rock outcrops.
Trachylepis variegata	Variegated Skink	High - confirmed	Varied, associates with small outcrops.
Agamidae			
Agama aculeata aculeata	Ground Agama	High - confirmed	Semi-desert to savanna.
Agama anchietae	Anchieta's Agama	High, could occur	Outcrops.
Agama atra	Southern Rock Agama	High, likely to occur.	Outcrops in grassland and savanna.
Gekkonidae			
Chondrodactylus angulifer angulifer	Common Giant Gecko	High, likely to occur - confirmed	Terrestrial burrowing species of sandy open plains

Scientific Name	Common Name	Occurrence	Habitat Description
Chondrodactylus bibronii	Bibron's Gecko	Likely to occur.	Karroo veld and arid areas.
Nucras intertexta	Spotted Sandveld Lizard	Likely to occur	Arid savanna.
Pachydactylus capensis	Cape Gecko	Likely to occur.	Varied, partial to refugia such as outcrops, temitaria and debris.
Pachydactylus latirostris	Quartz Gecko	High, likely to occur.	Sandy and sparsely vegetated plains.
Pachydactylus mariquensis	Common Banded Gecko	Peripheral.	Sandy soils and plains, often in dry riverbeds.
Pachydactylus purchelli	Purchell's Gecko	Could occur.	Rocky habitat and outcrops.
Ptenopus garullus maculatus	Spotted Barking Gecko	High, likely to occur - confirmed	Sandy flats or duneveld.

Scoping and Environmental Impact Assessment for the proposed Development of a 75 MW Solar Photovoltaic Facility (GEMSBOK SOLAR PV6) on Portion 8 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape Province

EIA REPORT

CHAPTER 11:

Soils and Agricultural Potential Assessment

CONTENTS

TABLES

FIGURES

LIST OF ABBREVIATIONS

AGIS	Agricultural Geo-Referenced Information System
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
EIA	Environmental Impact Assessment
PET	Potential evapotranspiration

EXECUTIVE SUMMARY

The proposed development is located on land zoned and used for agriculture. South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable for cultivation. This assessment has found that the proposed site is on land which is of very low agricultural potential and is not suitable for cultivation.

The key findings of this study are:

- The development of the proposed solar energy facility will have very low significance negative impacts on agricultural resources and productivity, and it will also deliver low significance positive impacts on agriculture.
- The significance of all potential agricultural impacts is influenced by the fact that the site has low agricultural potential, limited by severe climatic moisture availability constraints and shallow, rocky soils. It is only suitable for low intensity grazing.
- The negative cumulative impact on loss of agricultural land in the area as a result of a number of other close developments is assessed as having moderate significance. However, it is still agriculturally strategic from a national perspective to steer as much of the country's renewable energy development as possible to regions such as this one. It is preferable to incur a higher cumulative loss in such a region, than to lose agricultural land with a higher production potential elsewhere in the country.
- Soils are shallow, red sandy soils on underlying rock and hard-pan carbonate, predominantly of the Coega and Mispah soil forms.
- The land capability is classified as Class 7 - non-arable, low potential grazing land.
- The site has a low grazing capacity of 31 - 40 hectares per large stock unit.
- Five potential negative impacts of the proposed development on agricultural resources and productivity were identified as:
  - Loss of agricultural land use caused by direct occupation of the land by the proposed solar energy facility footprint.
  - Loss of topsoil in disturbed areas causing a decline in the capacity of the soil to support vegetation.
  - Soil erosion caused by alteration of the surface characteristics.
  - Degradation of veld vegetation beyond the direct footprint of the proposed facility.
  - Cumulative regional loss of agricultural land use as a result of several other developments in the area.
- One potential positive impact of the proposed development on agricultural resources and productivity was identified as:
  - Generation of additional land use income through rental for the proposed solar energy facility. This will provide the farming enterprise with increased cash flow and rural livelihood, and thereby improve its financial sustainability.
- All impacts apart from the cumulative impact (as discussed above) were assessed as having a very low or low significance, and the overall agricultural impact for all phases of the development was assessed as being of a low significance.
- The following mitigation measures were recommended:
  - Implement an effective system of stormwater run-off control;

- Control dust generation during construction and decommissioning activities through implementing standard construction site control methods (i.e. dampening with water) where required;
- Strip and stockpile topsoil before disturbance and re-spread it on the surface as soon as possible after disturbance;
- Manage any sub-surface spoils from excavations in such a manner that it will not impact on agricultural land; and
- Minimise road footprint and control vehicle access on designated roads only.

- Because of the low agricultural potential of the site, the development should, from an agricultural impact perspective, be authorised. Environmental Authorisation is promoted by the fact that the site falls within a proposed renewable energy development zone (i.e. REDZ), where such land use has been assessed as very suitable in terms of a number of factors, including agricultural impact. It is preferable to incur a loss of agricultural land in such a region, without cultivation potential, than to lose agricultural land that has a higher potential, to renewable energy development elsewhere in the country.
- No agriculturally sensitive areas occur within the site and no part of it is therefore required to be set aside from the development.
- The site has uniformly low potential, therefore from an agricultural point of view, there is no preferred location or layout within the preferred site.
- There are no conditions resulting from this assessment that should be included in the environmental authorisation.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R982	Addressed in the 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;	Yes
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Yes
c) an indication of the scope of, and the purpose for which, the report was prepared;	Sections 11.1.1 & 11.1.2
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 11.1.3
e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	Section 11.1.3
f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	Section 11.3.8
g) an identification of any areas to be avoided, including buffers;	Section 11.3.8
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;	Figure 11.2
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 11.1.4
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 11.6
k) any mitigation measures for inclusion in the EMPr;	Section 11.6
l) any conditions for inclusion in the environmental authorisation;	Not applicable
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 11.8
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 11.9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 11.1.3
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not applicable
q) any other information requested by the competent authority.	Not applicable

11 SOILS AND AGRICULTURAL POTENTIAL ASSESSMENT

11.1 INTRODUCTION AND METHODOLOGY

This report presents the Soil and Agricultural Potential Assessment undertaken by Mr. Johann Lanz (an independent consultant), under appointment to the CSIR, as part of the Environmental Impact Assessment (EIA) for the proposed Gemsbok PV5 Solar Energy Facility including its associated power lines, near Kenhardt in the Northern Cape Province (Figure 11.1).

Figure 11.1: Location map of the proposed site, north east of the town of Kenhardt

11.1.1 Objectives of the Specialist Study

The objectives of the study are to identify and assess all potential impacts of the proposed development on agricultural resources including soils and agricultural production potential, and to provide recommended mitigation measures, monitoring requirements, and rehabilitation guidelines for all identified impacts.

The scope of work is captured and listed under the terms of reference below.

11.1.2 Scope of Work and Terms of Reference

The following terms of reference apply to this study:

The report will fulfil the terms of reference for an agricultural study as set out in the National Department of Agriculture's document, *Regulations for the evaluation and review of applications pertaining to renewable energy on agricultural land*, dated September 2011, with an appropriate level of detail for the agricultural suitability and soil variation on site (which may therefore be less than the standardised level of detail stipulated in the above regulations).

The above requirements together with requirements for an EIA specialist report may be summarised as follows:

- Research and describe the existing environment in terms of its soils and agricultural potential. Identify any significant soils and agricultural features or disturbances, as well as any sensitive features and receptors within the proposed project area.
- Undertake a desktop assessment to compile a baseline description, including an assessment of the existing soil and agricultural potential data for the site.
- Provide a sensitivity map indicating the presence of sensitive features and receptors (i.e. sensitive soil and agricultural features), “no-go” areas, setbacks/buffers, as well as any red flags or risks associated with soil and agricultural impacts.
- Define the environmental risks to the soils and agricultural land and potential, as well as the consequences thereto.
- Highlight any gaps in baseline data.
- Conduct a site visit and a field investigation of soils and agricultural conditions across the site and identify any areas that have potential for cultivation.
- Describe and map soil types (soil forms) and characteristics (soil depth, soil colour, limiting factors, and clay content of the top and sub soil layers).
- Describe the topography of the site and map soil survey points.
- Summarise available water sources for agriculture.
- Describe historical and current land use, agricultural infrastructure, as well as possible alternative land use options.
- Describe the erosion, vegetation and degradation status of the land.
- Determine and map, if there is variation, the agricultural potential across the site.
- Determine and map the agricultural sensitivity to development across the site.
- Identify relevant protocols, legal and permit requirements relating to soil and agricultural potential impacts likely to be generated as a result of the proposed project.
- Identify and assess all potential impacts (direct, indirect and cumulative) of the construction, operational and decommissioning phases of the proposed development on soils and agricultural potential, and note the economic consequences of the proposed development on soils and agricultural potential.
- Provide recommended mitigation measures, management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts (for inclusion into the EMPr as well).

11.1.3 Approach and Methodology

The pre-fieldwork assessment was based on the existing Agricultural Geo-Referenced Information System (AGIS) data, as well as satellite imagery for the site. This was supplemented by a field investigation that aimed at ground-proofing the AGIS data and assessing specific field conditions and the variation of these across the site. It did not comprise a detailed soil mapping exercise, but was based on an overview assessment, which involved driving and walking across the site, assessing topography and surface conditions, investigating existing cuttings in numerous excavations along the railway, and in animal burrows. Because of the shallow soils and the existing burrows and excavations, it was not necessary to auger additional holes. The field investigation also included a visual assessment of erosion and erosion potential on site, taking into account the proposed development layout. The field assessment was completed on 25 July 2014. An additional field assessment on the same land type (and same soils) on the neighbouring farm portion was completed for another project on 18 November 2015. Because of the identical field conditions it informs this assessment as well. An assessment of soils (soil mapping) and long term agricultural potential is in no way affected by the season in which the assessment is made, and therefore the fact that the assessment was done in winter (with the additional one done in summer) has no bearing on its results. The conducted soil investigation is considered completely adequate for the purposes of this study (i.e. for the purposes of determining the impact of the proposed development on agricultural resources and productivity). Detailed soil mapping has no relevance to an assessment of agricultural potential in this environment, as the limitations are overwhelmingly climatic and therefore even where soils suitable for cultivation may occur, they cannot be cultivated because of the aridity constraints.

Soils were classified according to the South African soil classification system.

Telephonic consultation was done with the current farmer of the land, Mr Sarel Strauss, to get details of current farming practices on the farm.

The impacts have been assessed in line with the methodology indicated in Chapter 4 of this EIA Report. The developments listed in Table 6.1 of Chapter 6 of the EIA Report, which are located within a 20 km radius of the proposed project, have been considered in the assessment of cumulative impacts.

11.1.4 Assumptions and Limitations

The following assumption was used in this specialist study:
It was assumed that water is not available anywhere on the farm for irrigation. Given the very severe moisture constraints of the environment and that no suitable water has ever been identified by farmers in the area, this is a fair assumption.

The following limitations were identified in this study:

- Soils were not mapped in detail for the study. However detailed soil mapping has no relevance to an assessment of agricultural potential in this environment, as the limitations are overwhelmingly climatic and therefore even where soils suitable for cultivation may occur, they cannot be cultivated because of the aridity constraints. More detailed soil mapping would add no value to the assessment. The study had more than sufficient information on the soils to make an assessment on the impacts of the development on agriculture, and so this is not seen as a limitation.
- The assessment rating of impacts is not an absolute measure. It is based on the subjective considerations and experience of the specialist, but is done with due regard and as accurately as possible within these constraints.

There are no other specific constraints and limitations for this study.

11.1.5 Information Sources

All data on land types, land capability, grazing capacity etc. was sourced from the online Agricultural Geo-Referenced Information System (AGIS), produced by the Institute of Soil, Climate and Water (Agricultural Research Council, undated). Satellite imagery of the site available on Google Earth was also used for evaluation.

Information on farming practices was obtained through consultation with the farmer, Mr Sarel Strauss.

11.1.6 Declaration of Independence of Specialists

Refer to Appendix A of this EIA Report for the Curriculum Vitae of Mr. Johann Lanz, which highlights his experience and expertise. The declaration of independence by the specialist is provided in Box 11.1 below and included in Appendix B of this EIA Report.

BOX 11.1: DECLARATION OF INDEPENDENCE

I, Johann Lanz, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed Gemsbok Solar PV6 Project, application or appeal in respect of which I was appointed, other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

JOHANN LANZ

11.2 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO SOILS AND AGRICULTURAL POTENTIAL IMPACTS

The components of the project that can impact on agricultural resources and productivity are:

1. Occupation of the site by the footprint of the solar PV facility's infrastructure and roads and its associated power lines.
2. Constructional activities that denude the surface cover of vegetation, for example for lay down areas, and/or disturb the soil below surface, for example for levelling, excavations, etc.
3. Vehicle traffic on site.

It is important to note that a detailed project description is included in Chapter 2 of the EIA Report.

11.3 DESCRIPTION OF THE SOILS AND AGRICULTURAL CAPABILITY OF THE AFFECTED ENVIRONMENT

The information in this section is considered entirely adequate for the purposes of this assessment and there are therefore no gaps in the baseline data.

A satellite image of the site including the development layout is given in Figure 11.2. Photographs of site conditions are given in Figures 11.3 to 11.6.

11.3.1 Climate and Water Availability

Rainfall for the immediate area is given as a very low 183 mm per annum, with a standard deviation of 71 mm according to the South African Rain Atlas (Water Research Commission, undated). The average monthly distribution of rainfall is shown in Table 11.1. One of the most important climate parameters for agriculture in a South African context is moisture availability, which is the ratio of rainfall to evapotranspiration. Moisture availability is classified into six categories across the country (as shown in Table 11.2). The proposed development site falls within Class 6, which is described as a very severe limitation to agriculture.

Table 11.1: Average monthly rainfall for the site (29° 10' S; and 21° 21' E) in mm (Water Research Commission, undated)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
25	33	38	24	11	5	3	4	5	8	11	16	183

Table 11.2: The classification of moisture availability climate classes for summer rainfall areas across South Africa (Agricultural Research Council, Undated)

Climate Class	Moisture Availability (Rainfall/0.25 PET)	Description of Agricultural Limitation
C1	>34	None to slight
C2	27-34	Slight
C3	19-26	Moderate
C4	12-18	Moderate to severe
C5	6-12	Severe
C6	<6	Very severe

Water for stock is obtained from wind pumps on the farm. There is insufficient water available for any form of irrigation.

11.3.2 Terrain, Topography and Drainage

The proposed development is located on a terrain unit of level plains with some relief in the Northern Cape interior at an altitude of 960 meters. Slopes across the site are less than 2%.

The underlying geology is migmatite, gneiss and granite of the Namaqualand Metamorphic Complex with abundant calcrete.

There are no perennial drainage courses within the project footprint. There are temporary drainage courses, typical of arid environments, where surface run-off would accumulate and flow, but this would only occur very occasionally, immediately after high rainfall events.

11.3.3 Soils

The land type classification is a nationwide survey that groups areas of similar soil, terrain and climatic conditions into different land types. The proposed development is located on a single land type, Ag5. This land type comprises predominantly shallow, red sands to loamy sands on underlying rock, hard-pan carbonate, or hard-pan dorbank. The soils fall into the arid Silicic, Calcic, and Lithic soil groups according to the classification of Fey (2010). A summary detailing soil data for the land type is provided in Table 11.A1 in Appendix 11.1 of this chapter. The field investigation confirmed that the soils on site are shallow, red sandy soils on underlying rock and hard-pan carbonate. Actual soil forms vary within short distances depending on rock ridges that run across the area and the extent of calcrete formation. There are numerous outcrops of rocky ridges at the soil surface across the entire area. All investigated sample points across the area were one of four soil forms: Coega, Mispah, Plooysberg or Hutton. However there is very little practical difference between these different soil forms. All have a clay content of approximately 7%, are shallow and are underlain by a hard impenetrable layer (either rock or hard-pan carbonate).

The land has low to moderate water erosion hazard, mainly due to the low slope, but is susceptible to wind erosion because of the sandy texture of the soil.

11.3.4 Agricultural Capability

Land capability is the combination of soil suitability and climate factors. The area has a land capability classification, on the eight category scale, of Class 7 - non-arable, low potential grazing land. The limitations to agriculture are aridity and lack of access to water in addition to the shallow soil depth and rockiness. Because of these constraints, agricultural land use is restricted to low intensity grazing only. The natural grazing capacity is low, at mostly 31 - 40 hectares per animal unit. The current farmer uses an average stocking rate of 10 hectares per sheep.

11.3.5 Land Use and Development on and Surrounding the Site

The farm is located within a sheep farming agricultural region and land use for the farm and surrounding area is sheep farming only. There is no cultivation or any history of cultivation on the farm. There is no farmstead or buildings on the farm portion. The only agricultural infrastructure on the farm is fencing into camps and stock watering points, supplied by wind pumps. There are no wind pumps on the proposed PV site.

The Sishen-Saldanha railway line with its associated infrastructure runs through the farm to the north of the proposed PV site.

A new access road is proposed from the railway line road to the development.

11.3.6 Status of the Land

The biome classification for the site is Bushmanland Arid Grassland. The natural vegetation is grazed and veld conditions are very sparse but there is no evidence of accelerated erosion or other land degradation on the site.

11.3.7 Possible Land Use Options for the Site

Because of both the climate and soil limitations, the site is not suitable for any agricultural land use other than low intensity grazing.

The site is within one of South Africa's eight proposed renewable energy development zones, and has therefore been identified as one of the most suitable areas in the country for renewable energy development, in terms of a number of environmental impacts, economic and infrastructural factors.

These factors include an assessment of the significance of the loss of agricultural land. Renewable energy development is therefore a very suitable land use option for the site.

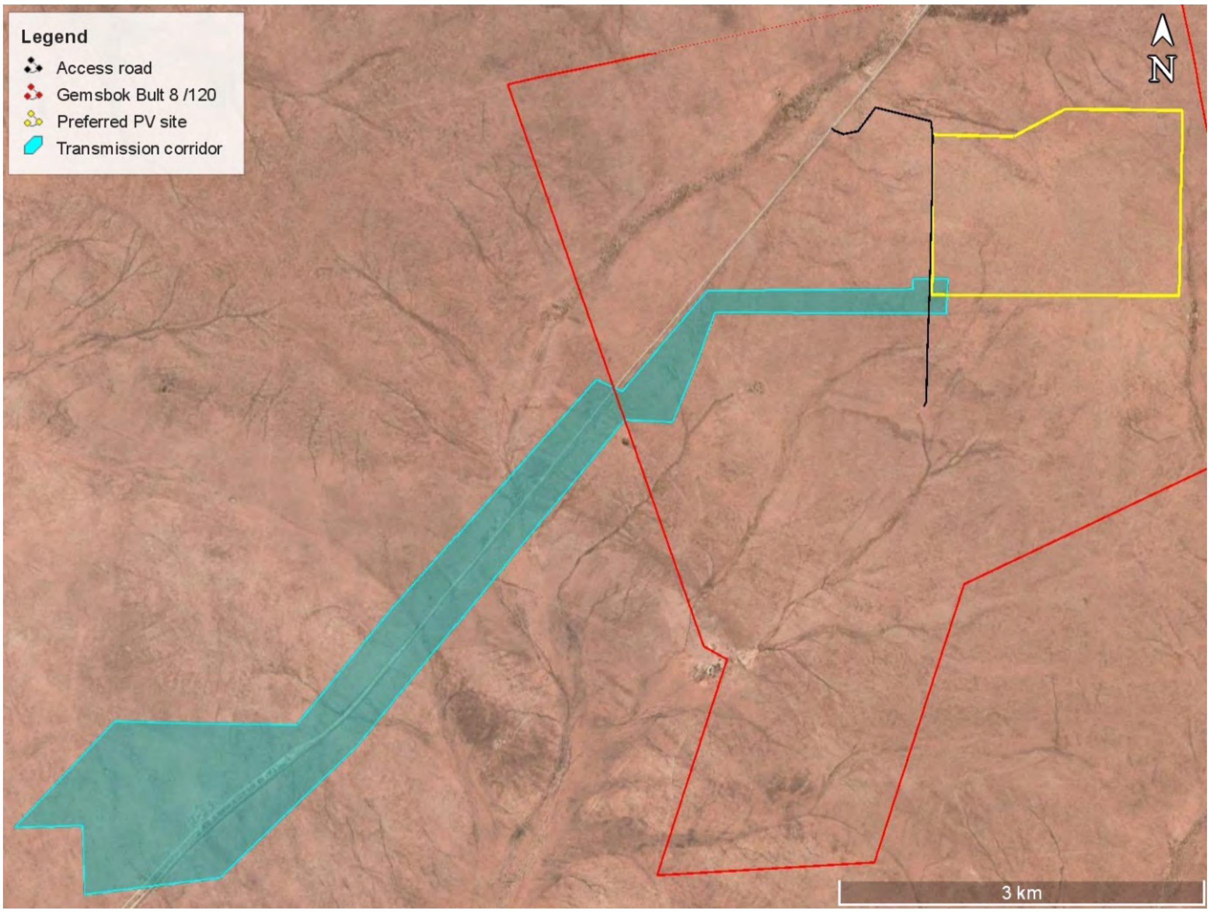

Figure 11.2: Satellite image of the site showing the farm boundary (total farm portion size is 5,059 ha); the preferred site (289 ha of which 220 ha will be utilised); the proposed transmission corridor for the Eskom connection; and the proposed access roads.

Figure 11.3: Photograph showing typical site conditions across the area.

Figure 11.4: Photograph showing the railway and road running through the farm and the typical site conditions.

Figure 11.5: Photograph from the area of typical soil profile on the side of an excavation showing shallow hard-pan carbonate horizon (Coega soil form).

Figure 11.6: Photograph from the area of typically occurring, shallow hard-pan carbonate horizon (Coega soil form).

Figure 11.7: Photograph from the area of typical soil profile in a railway cutting showing shallow bed rock (Mispah soil form).

Figure 11.8: Photograph from the area of typically occurring, red sandy soil overlying shallow rock (Hutton soil form).

Figure 11.9: Photograph from the area showing one of the many occurring ridges of hard rock outcropped on the surface, that occur across the area.

11.3.8 Agricultural Sensitivity

Agricultural potential is uniformly low across the entire farm and the choice of placement of the solar PV facility on the farm (and within the preferred site) therefore has no influence on the significance of agricultural impacts. No agriculturally sensitive areas occur within the preferred site and so no parts of it (or in fact of the entire farm) need to be avoided by the development. No buffers are required around any agricultural features.

11.4 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

A change of land use (re-zoning) for the development on agricultural land needs to be approved in terms of the Subdivision of Agricultural Land Act (Act 70 of 1970) (SALA). This is required for long term lease, even if no subdivision is required. Rehabilitation after disturbance to agricultural land is managed by the Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA). The Department of Agriculture, Forestry and Fisheries reviews and approves applications in terms of these Acts according to their *Guidelines for the evaluation and review of applications pertaining to renewable energy on agricultural land*, dated September 2011.

11.5 IDENTIFICATION OF KEY ISSUES AND POTENTIAL IMPACTS

The following have been identified by the specialist as potential impacts on agricultural resources and productivity.

11.5.1 Construction and Decommissioning Phases only

1. Degradation of veld vegetation beyond the direct footprint of the proposed PV facility due to trampling by vehicles.
2. Loss of topsoil due to poor topsoil management (burial, erosion, etc.) during construction and decommissioning related soil profile disturbance (levelling, excavations, road surfacing etc.) and resultant decrease in that soil's capability for supporting vegetation.

11.5.2 All Phases – Construction, Operation and Decommissioning

1. Loss of agricultural land use due to direct occupation by the infrastructural footprint of the proposed development for the duration of the project (all phases). This will take affected portions of land out of agricultural production.
2. Soil erosion by wind or water due to alteration of the land surface characteristics. Alteration of surface characteristics may be caused by construction related land surface disturbance, vegetation removal, and the establishment of hard standing areas, surfaces and roads. Erosion will cause loss and deterioration of soil resources and may occur during all phases of the project.
3. Generation of additional land use income through the rental of the land for the proposed solar energy facility. This will provide the farming enterprise with increased cash flow and rural livelihood, and thereby improve its financial sustainability. This is rated as a positive impact.

11.5.3 Cumulative Impacts

1. Cumulative impacts due to the regional loss of agricultural land resources as a result of other developments on agricultural land in the region.

Consultation process

The Scoping Report was released for a 30-day comment period which extended from 23 October to 24 November 2015.

The National DEA has accepted the Scoping Report in a letter dated 28 January 2016. The letter of acceptance includes requirements for Agricultural studies that need to be included in the EIA Report. These requirements are listed in Table 11.3 below. These requirements are taken verbatim from a DAFF document, *Regulations for the evaluation and review of applications pertaining to renewable energy on agricultural land.* Unfortunately however, DEA still uses an earlier draft of this document, which was since updated by DAFF in September 2011.

Table 11.3. National DEA Requirements for the Soils and Agricultural Potential Assessment

DEA Requirement	Feedback from Specialist
Detailed soil assessment of the site in question, incorporating a radius of 50 m surrounding the site, on a scale of 1:10 000 or finer. The soil assessment should include the following: Identification of the soil forms present on site; The size of the area where a particular soil form is found; GPS readings of soil survey points; The depth of the soil at each survey point; Soil colour; Limiting factors; Clay content; Slope of the site; A detailed map indicating the locality of the soil forms within the specified area; and Size of the site.	Detailed soil mapping has no relevance to an assessment of agricultural potential in this environment, where cultivation is not possible, soil conditions are generally poor and the agricultural limitations are overwhelmingly climatic. In such an environment, even where soils suitable for cultivation may occur, they cannot be cultivated because of the aridity constraints. The level of detail in the DEA (and DAFF) requirement is appropriate for arable land only. It is not appropriate for this site. Conducting a soil assessment at the required level of detail would be very time consuming and be a complete waste of that time. It would add absolutely no value to the assessment. The level of soil assessment that was conducted for this report is considered more than adequate for a thorough assessment of all agricultural impacts. The assessment did include identification of soil forms, soil depth, colour, limiting factors and clay content, and the slope and size of the site.
Exact locality of the site	See Figure 11.1.
Current activities on the site, including developments or buildings.	Section 11.3.5
Surrounding developments/land uses and activities in a radius of 500 m of the site.	Section 11.3.5
Access routes and the condition thereof.	Section 11.3.6
Current status of the land (including erosion, vegetation, and a degradation assessment).	Section 11.3.6
Possible land use options for the site.	Section 11.3.7
Water availability, source and quality (if available).	Section 11.3.1
Detailed descriptions of why agriculture should or should not be the land use of choice.	Section 11.9
Impact of the change of land use on the surrounding area.	Section 11.6
A shape file containing the soil forms and relevant attribute data as depicted on the map.	A shapefile containing soil forms is not relevant - see first point above

11.6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

The six potential impacts identified in Section 11.5 are assessed in Tables 11.4 and 11.5 below.

The proposed development is located on land zoned and used for agriculture. South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable and important for agricultural production. The proposed site is however on land which has very low agricultural potential and is only suitable for low intensity grazing.

All impacts are evaluated in terms of their consequence for agricultural production, not in terms of the impact *per se*. This is because it is agricultural production that must be the focus of an agricultural assessment. Because the undisturbed site already has extremely limited agricultural potential, it means that the consequence of any impact for agricultural production is limited, with the result that the consequence and significance of agricultural impacts is low.

Furthermore, the poor, very shallow soil conditions reduce the significance of loss of topsoil and the low slope gradients reduce the significance of potential erosion impacts.

Irreplaceability of impacts is considered low because the resource that is being impacted is non-arable, low potential grazing land, which is not a scarce resource in the country. The confidence level of the assessment is considered high because there is certainty about the low agricultural potential of the land and the impacts are fairly easy to understand and predict.
The impacts of the associated power line are negligible because the actual footprint of disturbance is confined to the pylon bases. All grazing can continue undisturbed below the lines themselves. The footprint is therefore minuscule in relation to available grazing land.

There are a large number of other potential projects in the area that will also lead to a loss of agricultural land. Although the loss of individual project portions of land has low significance, as discussed above, the cumulative impacts of land loss regionally becomes more significant. However, despite this cumulative impact, it is still agriculturally strategic from a national perspective to steer as much of the country's renewable energy development as possible to regions such as this one, with very low agricultural potential. It is preferable to incur a higher cumulative loss in such a region, than to lose agricultural land with a higher production potential elsewhere in the country.

The economic consequences of the proposed project are positive for agriculture. Rentals payable to farmers for lease of land for renewable energy are far in excess of the income that can be generated from farming the land. The leasing of portions of a farming enterprise's land therefore provides increased cash flow and rural livelihood to the enterprise, and thereby improve its financial sustainability.

Mitigation measures are also included in Table 11.4. Recommendations for the monitoring and review of all identified mitigation measures are described in Section 11.8 and 11.9 of this chapter, as well as the EMPr (Part B of this EIA Report).

11.6.1 Degradation of veld vegetation beyond the direct footprint of the proposed PV facility due to constructional disturbance and potential trampling by vehicles

The potential impact of degradation of veld vegetation beyond the direct footprint of the proposed PV facility is rated as negative, direct impact that is predicted to occur as a result of disturbance during activities undertaken during the construction and decommissioning phases. The impact is rated with a site specific spatial extent and medium-term duration (i.e. the impact and risk will be experienced between 1 and 10 years). The consequence and probability of the impact is respectively rated as slight and likely. The reversibility and irreplaceability of the impact is respectively rated as moderate and low. The significance of the impact without the implementation of mitigation measures is rated as very low.

The following mitigation measures have been recommended during the construction and decommissioning phases in order to reduce the significance of veld degradation:

- Minimize the footprint of disturbance during construction and decommissioning activities.
- Confine vehicle access to roads only.

- Control dust generation during construction and decommissioning activities by implementing standard construction site dust control measures (dampening with water) where required. Because of water scarcity, this should only be done where and when dust generation is a significant problem.

With effective implementation of these mitigation actions, the impact of the project on veld degradation is predicted to be of very low significance.

11.6.2 Loss of Topsoil due to Poor Topsoil Management

The potential impact of loss of topsoil due to poor topsoil management (burial, erosion, etc.) during construction and decommissioning related soil profile disturbance (such as levelling, excavations, road surfacing etc.) and the resultant decrease in the capability of the soil to support vegetation is rated as a negative, direct impact. The impact is rated with a site specific spatial extent and medium-term duration (i.e. the impact and risk will be experienced between 1 and 10 years). The consequence and probability of the impact is respectively rated as slight and likely. The reversibility and irreplaceability of the impact is respectively rated as moderate and low. The significance of the impact without the implementation of mitigation measures is rated as very low.

The following mitigation measures have been recommended during the construction and decommissioning phases in order to reduce the loss of topsoil:

- Strip and stockpile topsoil from all areas where soil will be disturbed. Stripping should be done to a depth of 15 cm. There are no important requirements for stockpile management and it can therefore be done in the way that is most practical for the operation.
- After cessation of disturbance, re-spread topsoil evenly over the entire disturbed surface. The depth and surface cover should be monitored during spreading to ensure that it is even.
- Dispose of any sub-surface spoil material, generated from excavations, where they will not impact on land that supports vegetation, or where they can be effectively covered with topsoil.

With effective implementation of these mitigation actions, the impact of the project on topsoil is predicted to be of very low significance.

11.6.3 Loss of Agricultural Land Use

The potential impact of loss of agricultural land use due to the direct footprint of the proposed project for the construction, operational and decommissioning phases is predicted to be a negative, direct impact. The impact is rated with a site specific spatial extent and long-term duration (i.e. the impact and risk will be experienced for the duration of the proposed project). The consequence and probability of the impact is respectively rated as slight and very likely. The reversibility and irreplaceability of the impact is respectively rated as high and low. The significance of the impact without the implementation of mitigation measures is rated as very low. No mitigation measures are recommended.

The loss of 220 hectares of grazing land should be seen in the context of the total farming enterprise. Mr Sarel Strauss reports that his total sheep farming enterprise takes place on four adjacent farms totalling about 38,000 hectares and the loss of agricultural land therefore represents only 0.58% of the total available farm area. Mr Strauss is of the opinion that the loss will have a negligible impact on his farming enterprise.

11.6.4 Soil Erosion due to Alteration of the Land Surface Characteristics

The potential impact of soil erosion by wind or water due to alteration of the land surface characteristics is predicted to be a negative, direct impact. As noted above, alteration of surface characteristics may be caused by construction related land surface disturbance, vegetation removal, and the establishment of hard standing areas, surfaces and roads. The impact is rated with a site specific spatial extent and long-term duration (i.e. the impact and risk will be experienced for the duration of the proposed project). The consequence and probability of the impact is respectively rated as slight and likely. The reversibility and irreplaceability of the impact are rated as low. The significance of the impact without the implementation of mitigation measures is rated as very low.

The following mitigation measures have been recommended during the construction, operational and decommissioning phases in order to reduce soil erosion:

- Implement an effective system of run-off control, where it is required, that collects and safely disseminates run-off water from all hardened surfaces and prevents potential down slope erosion.

With effective implementation of these mitigation actions, the impact of increased soil erosion is predicted to be of very low significance.

11.6.5 Additional Land Use Income Generation

As noted above, the additional income generated during the construction, operational and decommissioning phases as a result of the leasing of the land to the solar facility is predicted to be a direct, positive impact. This will provide the increased cash flow and thereby improve the financial sustainability of the farming enterprise. The impact is rated with a site specific spatial extent and long-term duration (i.e. the impact and risk will be experienced for the duration of the proposed project). The consequence and probability of the impact is respectively rated as slight and very likely. The reversibility and irreplaceability of the impact is respectively rated as high and low. The significance of the impact without the implementation of enhancement measures is rated as very low. No enhancement measures are recommended.

11.6.6 Cumulative Impact: Regional Loss of Agricultural Land Resources

As mentioned above, the implementation of various other developments (See Chapter 4 of the EIA Report) in conjunction with this proposed project are expected to result in a cumulative impact in terms of the loss of agricultural land resources on a regional scale. The impact is rated with a regional spatial extent and long-term duration (i.e. the impact and risk will be experienced for the duration of the proposed project). The consequence and probability of the impact is respectively rated as moderate and very likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as moderate. No mitigation measures are recommended.

11.7 IMPACT ASSESSMENT SUMMARY

The potential impacts of the proposed project on soils and agricultural potential is summarised in Tables 11.4 and 11.5.

Table 11.4: Impact assessment summary table.

Aspect/ Impact pathway	Nature of Impact	Status	Spatial Extent	Duration	Conse-quence	Proba-bility	Reversi-bility	Irreplace ability	Mitigation / Management Actions	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Construction and Decommissioning Phases (Direct Impacts)													
Vehicle traffic and dust generation	Veld degra-dation	Negative	Site	Medium term	Slight	Likely	Moderate (i.e. Partially)	Low	1. Minimize footprint of disturbance. 2. Confine vehicle access on roads only. 3. Control dust generation during construction and decommissioning activities by adopting standard construction site dust control methods (such as dampening surfaces with water), where required	Very Low	Very Low	5	High
Construc-tion and decommiss ioning activities that disturb the soil profile.	Loss of topsoil	Negative	Site	Medium term	Slight	Likely	Moderate (i.e. Partially)	Low	1. Strip and stockpile topsoil from all areas where soil will be disturbed. 2. After cessation of disturbance, re-spread topsoil over the surface. 3. Dispose of any sub-surface spoils from excavations where they will not impact on land that supports vegetation, or where they can be effectively covered with topsoil.	Very Low	Very Low	5	High
Construction, Operational and Decommissioning Phases (Direct Impacts)													
Occupation of the land by the project infrastruct ure	Loss of agricul-tural land use	Negative	Site	Long term	Slight	Very Likely	High	Low	None	Very Low	Not applicable	5	High
Change in surface characteris tics and surface cover.	Erosion	Negative	Site	Long term	Slight	Likely	Low	Low	Implement an effective system of run-off control, where it is required, that collects and safely disseminates run-off water from all hardened surfaces and prevents potential down slope erosion.	Low	Very Low	5	High
Project rental	Additio-nal land use income	Positive	Site	Long term	Slight	Very Likely	High	Low	None	Very Low	Not applicable	5	High

Table 11.5: Cumulative impact assessment summary table

Aspect/ Impact pathway	Nature of Impact	Status	Spatial Extent	Duration	Conse-quence	Proba-bility	Reversi-bility	Irreplaceability	Mitigation / Management Actions	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Occupation of the land by a number of different projects	Regional loss of agricultural land	Negative	Regional	Long term	Substantial	Very Likely	Moderate (i.e. Partially)	Moderate	None	Moderate	Not Applicable	3	High

11.8 INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

The following main mitigation measures and monitoring requirements are proposed for inclusion in the EMPr:

- Minimize the footprint of disturbance during construction and decommissioning activities.
- Confine vehicle access to roads only.
- Control dust generation during construction and decommissioning activities by implementing suitable, standard construction site dust control measures.
- Strip and stockpile topsoil from all areas where soil will be disturbed.
- After cessation of disturbance, re-spread topsoil over the surface.
- Dispose of any sub-surface spoil material, generated from excavations, where they will not impact on land that supports vegetation, or where they can be effectively covered with topsoil.
- Implement an effective system of run-off control, where it is required, that collects and safely disseminates run-off water from all hardened surfaces and prevents potential down slope erosion.

The following main monitoring requirements are proposed for inclusion in the EMPr:

- Undertake a periodic site inspection to verify the occurrence of off-road vehicle tracks surrounding the site.
- Establish an effective record keeping system for each area where soil is disturbed for construction and decommissioning purposes. Recommendations for the recording system are included in the EMPr (Part B of the EIA Report).
- Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.

11.9 CONCLUSION AND RECOMMENDATIONS

The proposed development is on land zoned and used for agriculture. South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable for cultivation. This assessment has found that the investigated site is on land which is of very low agricultural potential and is not suitable for cultivation.

Because of the low agricultural potential of the site, the development should, from an agricultural impact perspective, be authorised. Environmental Authorisation is promoted by the fact that the site falls within a proposed renewable energy development zone (i.e. REDZ), where such land use has been assessed as very suitable in terms of a number of factors, including agricultural impact. It is preferable to incur a loss of agricultural land in such a region, without cultivation potential, than to lose agricultural land that has a higher potential, to renewable energy development elsewhere in the country.

No agriculturally sensitive areas occur within the proposed site and no part of it is therefore required to be set aside from the development. Because the site is uniformly low potential, from an agricultural point of view, there is no preferred location or layout within the preferred site. There are no conditions resulting from this assessment that need to be included in the environmental authorisation.

11.10 REFERENCES

Agricultural Research Council. Undated. AGIS Agricultural Geo-Referenced Information System available at http://www.agis.agric.za/.

Fey, M. 2010. Soils of South Africa. Cambridge University Press, Cape Town.

Water Research Commission. Undated. South African Rain Atlas available at http://134.76.173.220/rainfall/index.html.

APPENDIX 11.1: SOIL DATA

Table 11.A1: Land type soil data for the proposed site.

Land type	Land capability class	Soil series (forms)	Depth (cm)	Clay % A horizon	Clay % B horizon	Depth limiting layer	% of land type
Ag5	7	Hutton	10-35	5-12	6-15	ca, so, db	43
		Mispah	5-15	4-12		R	14
		Mispah	5-15	4-12		ca	12
		Hutton	45->120	6-12	7-15	ca, so, R	10
		Hutton	10-35	10-20	15-25	ca, so, db	9
		Rock outcrop	0			R	8

Land capability classes: 7 = non-arable, low potential grazing land.
Depth limiting layers: R = hard rock; so = partially weathered bedrock; ca = hardpan carbonate; db = dorbank hardpan.

Scoping and Environmental Impact Assessment for the proposed Development of a 75 MW Solar Photovoltaic Facility (GEMSBOK SOLAR PV6) on Portion 8 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape Province

EIA REPORT

CHAPTER 12:

Heritage Impact Assessment (Archaeology and Cultural Landscape)

CONTENTS

TABLES

FIGURES

LIST OF ABBREVIATIONS

ASAPA	Association of Southern African Professional Archaeologists
CCS	Crypto-crystalline silica
CRM	Cultural Resources Management
CSIR	Council for Scientific and Industrial Research
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ESA	Early Stone Age
GPS	global positioning system
HIA	Heritage Impact Assessment
In situ	In its original location or context.
LSA	Later Stone Age
MSA	Middle Stone Age
NEMA	National Environmental Management Act (No. 107 of 1998)
NHRA	National Heritage Resources Act (No. 25) of 1999
NID	Notification of Intent to Develop
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

GLOSSARY

Background scatter	Artefacts whose spatial position is conditioned more by natural forces than by human agency
Early Stone Age	Period of the Stone Age extending approximately between 2 million and 200 000 years ago.
Hand-axe	A bifacially flaked, pointed stone tool type typical of the Early Stone Age.
Holocene	The geological period spanning the last approximately 10-12 000 years.
Later Stone Age	Period of the Stone Age extending over the last approximately 20 000 years.
Middle Stone Age	Period of the Stone Age extending approximately between 200 000 and 20 000 years ago.
Patinated	Chemically altered surface.
Pleistocene	The geological period beginning approximately 2.5 million years ago and preceding the Holocene.

EXECUTIVE SUMMARY

ASHA Consulting (Pty) Ltd was appointed by the Council for Scientific and Industrial Research (CSIR) to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction, operation and decommissioning of the 75 Megawatt (MW) Gemsbok Solar PV6 solar energy facility on Portion 8 of the farm Gemsbok Bult 120, near Kenhardt, Northern Cape. A 132 kV transmission line will link the facility with the Nieuwehoop Substation presently under construction on Gemsbok Bult 120/3.

A field survey of the preferred site, the alternative sites and the transmission corridors revealed archaeological material to be very thinly scattered throughout. However, more significant artefacts scatters were located around pans and rocky outcrops. The scatters are of low-medium significance and all are likely to be easily avoided.

There will also be impacts to the cultural landscape, but these would be of low significance. Mitigation would serve to slightly reduce the contrast of the built elements in the landscape.

There are no fatal flaws and overall the heritage impacts are considered to be of low significance for all phases. Mitigation would reduce the significance of impacts to archaeology and graves to very low, while impacts to the landscape will remain of low significance. Cumulative impacts to archaeology are insignificant because no important heritage sites would be lost during implementation of the proposed development. The clustering of this development with the many others proposed in the area means that the cumulative impacts to the landscape are considered to be acceptable and of low significance.

Because the potential impacts are quite limited and fairly easily avoidable it is recommended that the proposed Gemsbok PV6 facility and its associated transmission lines be authorised subject to the following conditions:

- Should it not be possible to avoid the significant archaeological sites with a minimum buffer of 20 m from the waypoints, then they should be excavated;
- The possible grave should be avoided with a buffer of at least 5 m or else tested and, if necessary, exhumed prior to construction with approval from SAHRA;
- The construction team should be made aware of the potential to locate graves and be instructed to report any suspicious stone features to SAHRA prior to disturbance;
- Where technically feasible, the built elements of the facility should be painted in an earthy colour to minimise visual contrast in the landscape; and
- If any archaeological material or human burials are uncovered during the course of construction then work in the immediate area should be halted. The find would need to be reported to SAHRA and may require inspection by an archaeologist. Such a heritage resource is the property of the state and may require excavation and curation in an approved institution.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R982	Addressed in the 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;	Appendix A of this EIA Report
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix B of this EIA Report
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 12.1.4
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section12. 3.2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	Section 12.3
f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	Section 12.6.2
g) an identification of any areas to be avoided, including buffers;	Sections12.7 & 12.11
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 12.11
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 12.3.5
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;	Sections 12.7 & 8
k) any mitigation measures for inclusion in the EMPr;	Section 12.11
l) any conditions for inclusion in the environmental authorisation;	Sections 12.11 & 12.13
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 12.11
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;	Sections 12.12 & 12.13
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 12.6.1
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 12.6.1
q) any other information requested by the competent authority.	n/a

12 HERITAGE IMPACT ASSESSMENT

12.1 INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by the Council for Scientific and Industrial Research (CSIR) to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction, operation and decommissioning of the 75 Megawatt (MW) Gemsbok Solar PV6 solar energy facility on Portion 8 of farm Gemsbok Bult 120, near Kenhardt, Northern Cape. A 132 kV transmission line will link the facility with the Nieuwehoop Substation presently under construction on Portion 3 of Gemsbok Bult Farm 120.

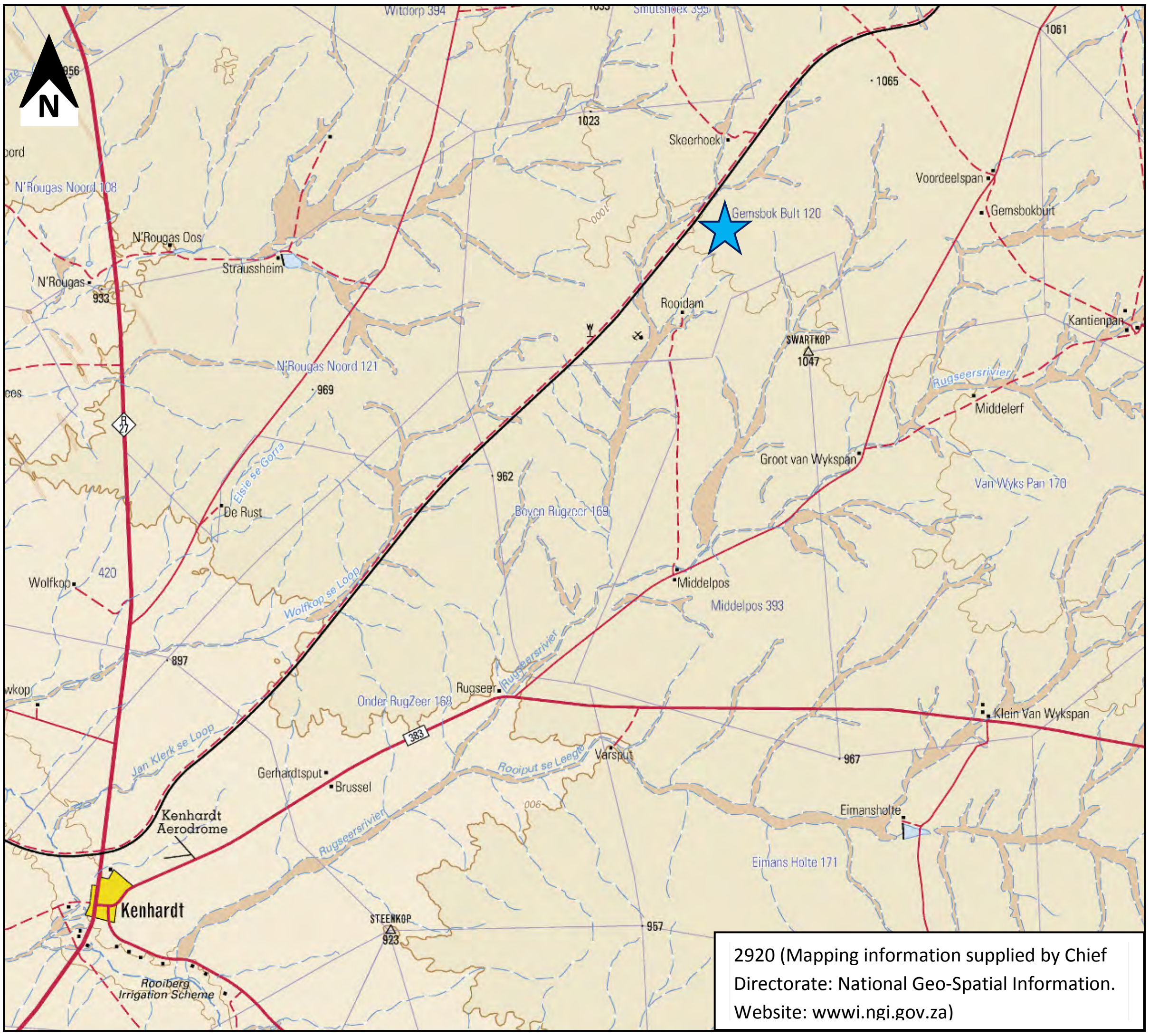

Figure 12.1: Map showing the location of the Gemsbok Solar PV6 site (blue star) along the Sishen-Saldanha railway line.

12.1.1 Project Description

This project, referred to as Gemsbok Solar PV6, is one of seven solar projects being proposed on three neighbouring land parcels (Figure 12.2). It will entail construction of the following components:

- Single Axis Tracking structures (aligned north-south) and Fixed Axis Mounting structures (aligned east-west);
- Solar module mounting structures comprised of galvanised steel and aluminium;
- Foundations which will likely be drilled and concreted into the ground; and a
- Solar measuring station.

- Building Infrastructure:
  - Offices;
  - Operational and maintenance control centre;
  - Warehouse/workshop;
  - Ablution facilities;
  - Converter station;
  - On-site substation building;
  - On-site workers accommodation camp; and a
  - Guard House.

Associated Infrastructure

- 132 kV overhead transmission line (Steel Monopole design);
- On-site substation;
- Additional feeder bay and Busbar at the Eskom Nieuwehoop Substation or extensions of the existing infrastructure;
- A new 400/132kV transformer bay at the Eskom Nieuwehoop Substation;
- 400/132kV Transformer at the Eskom Nieuwehoop Substation;
- Extension of the 400kV busbar;
- Extension of the 132kV Busbar;
- 22/33 kV internal transmission lines/underground cables;
- Solar resource measuring station;
- Access road;
- Internal gravel roads;
- Fencing;
- Panel maintenance and cleaning area;
- Stormwater channels; and a
- Temporary work area during the construction phase (i.e. laydown area).

12.1.2 Project Aspects Relevant to Heritage Impacts

Any aspect of the development as proposed might have a negative impact on heritage resources and thus the entire project is relevant to the heritage assessment. Aspects that disturb the ground (e.g. foundations, roads, trenches) may affect archaeology, palaeontology and graves, while all superstructure (e.g. solar panels, buildings, fences) would introduce impacts to the cultural landscape.

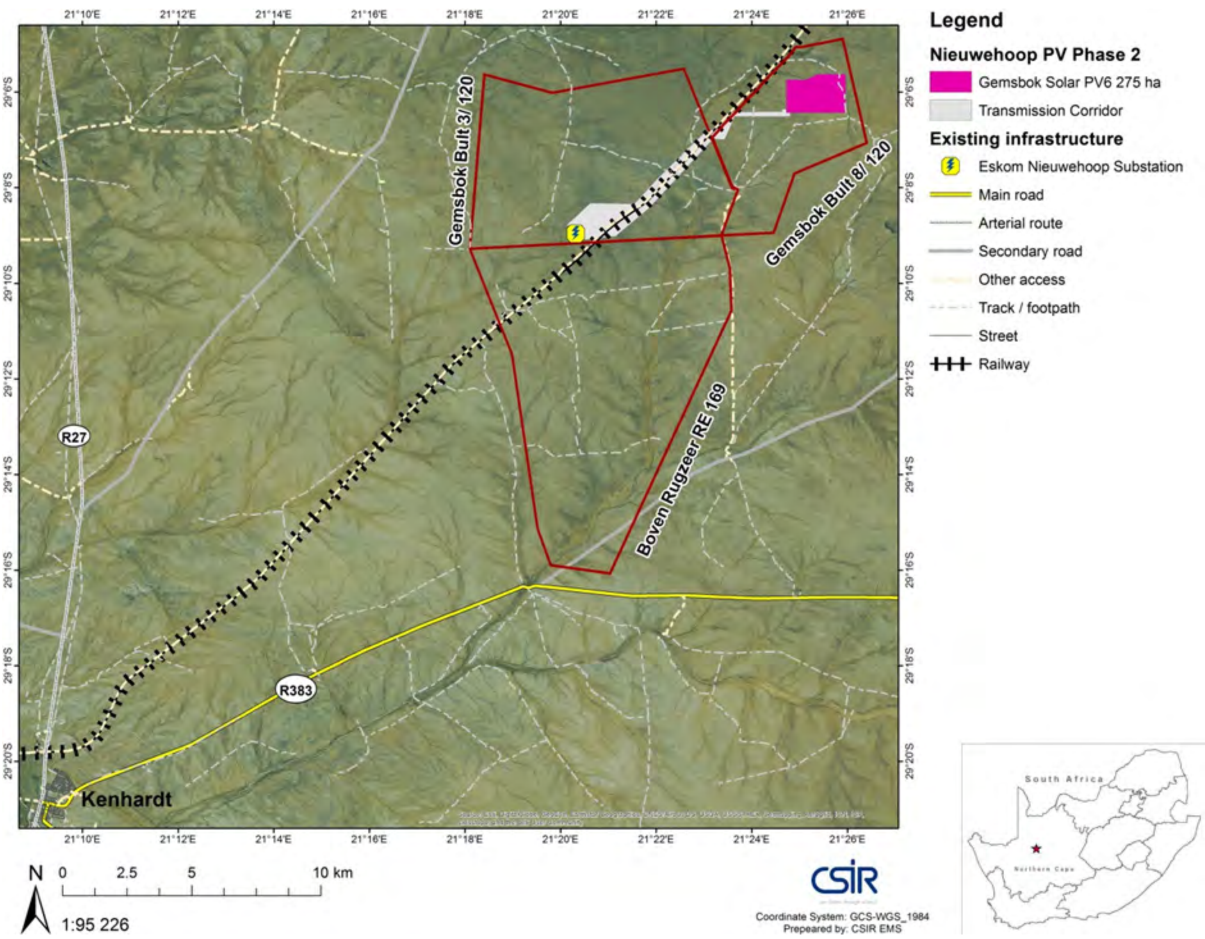

Figure 12.2: Map showing the location of the proposed Gemsbok Solar PV6 facility (dark pink) that was considered during the EIA phase.

12.1.3 Terms of reference

ASHA Consulting (Pty) Ltd was requested to conduct a field study and produce a heritage impact assessment (HIA) that would meet the requirements of the heritage authorities.

The HIA was based on the following broad Terms of Reference:

- Prepare and undertake a desktop study on the fossil heritage, archaeology, and heritage sites within the proposed project area.
- Undertake a detailed field examination of the archaeological sites and heritage features within or in the region of the development area.
- Describe the type and location of known archaeological sites and in the study area, and characterize all heritage items that may be affected by the proposed project.
- Describe the baseline environment and determine the status quo in relation to the specialist study.
- Record sites of archaeological relevance (photos, maps, aerial or satellite images, GPS co-ordinates, and stratigraphic columns).
- Evaluate the potential for occurrence of archaeological features within the study area.

- Identify and rate potential direct, indirect and cumulative impacts of the proposed project on the archaeological heritage for the construction, operational and decommissioning phases of the project. Study the cumulative impacts of the project by considering the impacts of proposed solar facility, together with the impact of other similar or related projects in the area (or being proposed);
- A Heritage Impact Assessment (HIA) report will be produced detailing the findings of the impact assessment. The report will cover all aspects of heritage (including archaeology, graves, built environment and the cultural landscape) as required by the National Heritage Resources Act (No 25 of 1999) (NHRA); and
- Identify suitable measures to avoid, reverse, mitigate or manage identified impacts and to determine the extent of the residual risks that need to be managed and monitored (these measures should be included in the EMPr); and
- Provide input to the EMPr, including mitigation measures and monitoring requirements to ensure that the impacts on the archaeology are limited.

Note that fossil heritage (palaeontology) is excluded from the present report because it has been handled by a separate specialist.

12.1.4 Scope and objectives of the report

An HIA is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued for consideration by the National Department of Environmental Affairs (DEA) who will review the Environmental Impact Assessment (EIA) and grant or refuse Environmental Authorisation (EA). The HIA report will outline any mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the conditions of EA should this be granted.

12.1.5 The Author

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting HIAs and archaeological specialist studies in the Western Cape and Northern Cape provinces of South Africa since 2004 (Please refer to the Curriculum Vitae included in Appendix A of this EIA Report). He has also conducted research on aspects of the Later Stone Age in these provinces and published widely on the topic. He is accredited with the Association of Southern African Professional Archaeologists (ASAPA) Cultural Resources Management (CRM) section (Member #233) as follows:

- Principal Investigator: Stone Age, Shell Middens & Grave Relocation; and
- Field Director: Colonial Period & Rock Art.

12.1.6 Declaration of Independence

ASHA Consulting (Pty) Ltd and its consultants have no financial or other interest in the proposed development and will derive no benefits other than fair remuneration for consulting services provided. A full declaration is provided in Appendix B of this EIA Report.

12.2 HERITAGE LEGISLATION

The National Heritage Resources Act (NHRA) No. 25 of 1999 protects a variety of heritage resources as follows:

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old;
- Section 36: graves and human remains older than 60 years and located outside of a formal cemetery administered by a local authority; and
- Section 37: public monuments and memorials.

Following Section 2, the definitions applicable to the above protections are as follows:

- Structures: “any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith”;
- Palaeontological material: “any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace”;
- Archaeological material: a) “material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures”; b) “rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation”; c) “wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation”; and d) “features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found”;
- Grave: “means a place of interment and includes the contents, headstone or other marker of such a place and any other structure on or associated with such place”; and
- Public monuments and memorials: “all monuments and memorials a) “erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government”; or b) “which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual.”

While landscapes with cultural significance do not have a dedicated Section in the NHRA, they are protected under the definition of the National Estate (Section 3). Section 3(2)(c) and (d) list “historical settlements and townscapes” and “landscapes and natural features of cultural significance” as part of the National Estate. Furthermore, Section 3(3) describes the reasons a place or object may have cultural heritage value; some of these speak directly to cultural landscapes.

Section 38 (2a) states that if there is reason to believe that heritage resources will be affected then an impact assessment report must be submitted. This report fulfils that requirement.
Under the National Environmental Management Act (No. 107 of 1998; NEMA), as amended, the project is subject to an EIA. Ngwao-Boswa Ya Kapa Bokoni (Heritage Northern Cape; for built environment and cultural landscapes) and SAHRA (for archaeology and palaeontology) are required to provide comment on the proposed project in order to facilitate final decision making by the DEA.

12.3 METHODS

12.3.1 Literature survey and information sources

A survey of available literature was carried out to assess the general heritage context into which the development would be set. This literature included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS). The 1:250 000 map was sourced from the Chief Directorate: National Geo-Spatial Information.

12.3.2 Field survey

The fieldwork for all seven proposed projects was undertaken simultaneously. The Gemsbok PV5 study area and its alternative study area were surveyed on 01 and 02 November 2015. The site visit took place in winter, although in this dry area seasonality has no effect on the visibility of heritage resources – visibility was excellent. The survey sought to conduct a landscape survey where certain landscape features known to be more sensitive were located and searched. Transects through all areas of the site were carried out to ensure that consistent results were being obtained and that the survey methodology was reliable. During the survey the positions of finds were recorded on a hand-held GPS receiver set to the WGS84 datum. Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

The survey was conducted by the author and Mr Matthew Shaw, an archaeology Masters student. Although both the preferred and alternative sites were surveyed, the present impact assessment report assesses only the preferred option.

12.3.3 Impact assessment

For consistency, the impact assessment was conducted through application of a scale supplied by the CSIR.

12.3.4 Grading

Section 7 of the NHRA provides for the grading of heritage resources into those of National (Grade 1), Provincial (Grade 2) and Local (Grade 3) significance. Grading is intended to allow for the identification of the appropriate level of management for any given heritage resource. Grade 1 and 2 resources are intended to be managed by the national and provincial heritage resources authorities, while Grade 3 resources would be managed by the relevant local planning authority. These bodies are responsible for grading, but anyone may make recommendations for grading.

It is intended that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. Heritage Western Cape (2012), however, uses a system in which resources of local significance are divided into Grade 3A, 3B and 3C. These approximately equate to high, medium and medium-low local significance, while sites of low or very low significance (and generally not requiring mitigation or other interventions) are referred to as ungradable. For convenience, the Heritage Western Cape system is employed here.

12.3.5 Assumptions and limitations

The study is carried out at the surface only and hence any completely buried archaeological sites will not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. Given the nature of the surface geology with bedrock frequently protruding through the gravel, neither of these limitations is likely to have affected the outcome of the report.

With regards to cumulative impacts, various other solar energy facilities and electrical transmission lines have been proposed in the immediate area. A new substation is presently under construction on Portion 3 of Gemsbok Bult Farm 120, while three solar energy facilities have received EA, although it is unknown when/if they will be built. The full list of developments considered in the cumulative impact assessment can be found in Table 6.1 of Chapter 6 of the EIA Report.

12.4 PHYSICAL ENVIRONMENTAL CONTEXT

12.4.1 Site context

The preferred site is located in a remote area between 35 and 37.5 km northeast of Kenhardt. It is located approximately 1 km to the southeast of the Sishen-Saldanha Railway Line and its gravel service road. Although major power lines are not currently present in the area, a large substation is currently under construction just north of the site and the railway line – this is the Eskom Nieuwehoop Substation (Figure 12.3). Three other PV facilities have already been granted authorisation in close proximity to the substation setting a precedent for electrical development in the area. The land is otherwise generally undeveloped and used for small stock grazing. Farm tracks and fences criss-cross the general area and occasional wind pumps occur.

12.4.2 Site description

The broader study area is very flat with topography limited to a few low rises and a few rocky outcrops, the nearest outcrops being 700 m southwest of the Alternative site and 800 m southeast of the preferred site. Low surface outcrops of rock also occur in places. Ephemeral stream beds are present, but generally rare in this area, and are evident largely by the slightly denser vegetation occurring along their courses. A fairly large pan occurs within the transmission corridor but is somewhat atypical with vegetation growing in it (Figure 12.4). Several smaller pans occur in the area as well: one lies at the southern edge of the Alternative site, one lies in its centre and a third lies within the north-eastern corner of the Preferred site. Overall, the surface is flat, coated in sand and gravel and has very sparse vegetation (Figure 12.5).

Figure 12.3: View across the sandy area alongside the large pan in the transmission corridor. The vegetation growing in the pan is visible in the background.

Figure 12.4: View across the Alternative study area showing one of the typical gravel patches in the area.

12.5 CULTURAL HERITAGE CONTEXT

This section of the report contains the desktop study and establishes what is already known about heritage resources in the vicinity of the study area. What is found during the field survey may then be compared with what is already known in order to gain an improved understanding of the significance of the newly reported resources.

12.5.1 Archaeological aspects

Bushmanland is well known for the vast expanses of gravel that occur in places and which frequently contain stone artefacts in varying densities (Beaumont 1995). Such material is referred to as 'background scatter' and is invariably of very limited significance. At times, however, the scatter can become very dense and mitigation work is occasionally called for. The artefacts located in these contexts are largely Early Stone Age (ESA) and Middle Stone Age (MSA) and are not associated with any other archaeological materials – these would have long since decomposed and disappeared. Previous experience immediately east of the present site suggests that such dense accumulations of artefacts are unlikely to occur in this area.

Of potentially more significance, however, are Later Stone Age (LSA) sites which are commonly located along the margins of water features in Bushmanland. These features include both pans and ephemeral drainage lines. Such sites were identified to the east of the present study area in association with pans but artefact scatters associated with drainage lines were rare (Orton 2014a, 2014b, 2014c). The drainage lines on the present site, however, are more prominent and perhaps more likely to reveal LSA camp sites. These sites would typically contain mostly stone artefacts, but fragments of ostrich eggshell (used as water containers and also as a food source) and pottery are also found at times, while bone is rare and likely confined to sites that are very recent. Similar LSA sites can also be found in association with rocky outcrops but none appear to occur within the present study area. Because of their positions along water courses and adjacent to rocky areas, such sites are often avoided by development proposals because of the need to avoid the relevant natural features. Despite the increased likelihood of locating archaeology along streams, Morris (2009) noted that a search along the banks of the Hartebeest River close to Kenhardt, where he expected elevated frequencies of archaeological material, revealed virtually nothing.

Another kind of archaeological site fairly commonly encountered in Bushmanland is small rock outcrops that have been quarried as a source of stone material for making stone tools. Several such occurrences were noted to the east where quartz outcrops where frequently flaked (Orton 2014a, 2014b, 2014c).

Rock engravings are known from the broader area (Louw Roux Bushmanland 2013). From the limited information available, these appear to be naturalistic images produced by the Bushmen. Geometric images, produced by the Khoekhoen, are not well known from the area (Orton 2013), although David Morris (pers. comm. 2015) has seen examples in the region. Painted art is also very rare but again, examples are known, particularly on large granite boulders.

12.5.2 Historical aspects

The Anglo-Boer War was fought across the Northern Cape, but information on the role of Kenhardt appears difficult to locate. The town was occupied by the Boers in late February 1900 after they convinced the magistrate that they had a large gun and would fire on the town if it did not surrender. They later surrendered to the British who occupied the town on 31st March 1900. My mid-1900 there were perhaps 100 Cape Rebels detained in a camp outside of Kenhardt (Grobler 2004). The British raised a local force known as the Border Scouts in Upington in May 1900. Many were mixed-race individuals, some local farmers, others Kalahari hunters, but all disliked the Boers. The scouts were responsible for a large area of the north-western Cape Colony centred on Upington and Kenhardt. They eventually numbered 786 by January 1901 and were under the command of Major John Birbeck (AngloBoerWar.com 2015; Rodgers 2011). At the beginning of 1902 there were 150 Border Scouts stationed at Kenhardt. Two boers, H.L. Jacobs and A.C. Jooste, were accused of treason and executed in the town on 24 July 1901 (Grobler 2004). A memorial stands there to their honour (Green Kalahari n.d.).

No major action appears to have taken place around Kenhardt, although the Boers are known to have attacked a patrol on 17th May 1901, while the British attacked a Boer position on 25th June 1901 (AngloBoerWar.com 2015).

12.5.3 Built environment

The built environment is sparsely represented in Bushmanland because the farms tend to be so large. The vast majority of structures appear to be quite recent in age (20th century) and are of very limited heritage significance. In any case, the development will not affect any buildings. Graves are also very rare. Some older farms may have small graveyards located close to their farm buildings but, again, these are highly unlikely to be included within the areas proposed for development. Unmarked pre-colonial graves can, in theory, be located anywhere, although they are generally more common in sandy areas where excavation of graves was easier and in more productive areas where population densities would have been higher. It is highly unlikely that pre-colonial graves would be encountered in the study area.

12.5.4 Other aspects

The cultural and natural landscape is also of concern. However, the cultural landscape is very poorly developed in this area with fences, water troughs and wind pumps being the primary features. The natural landscape lacks visually interesting and sensitive features. In addition, the proposed site is a long distance from any important roads (it is 11 km from the R27) and is highly unlikely to be visible to anyone other than local residents making use of the gravel road along the railway line. Solar PV facilities are not very tall and, if an earthy coloured paint is used for the buildings (where technically feasible), they can be almost invisible from as little as 1 km away.

12.6 IDENTIFICATION OF KEY ISSUES

12.6.1 Key Issues Identified During the Scoping Phase

Only one potentially significant heritage issue was identified during the scoping phase of this EIA process. This was:

- The potential damage to or destruction of Stone Age archaeological sites occurring in proximity to water courses and pans.

No formal consultation was carried out specifically for the purposes of the heritage impact assessment because all studies were covered by the PPP. The CSIR conducted a joint PPP for all seven proposed PV developments.

12.6.2 Sensitivity of the site in relation to proposed activity

The site is sensitive for the many archaeological artefacts and sites on its surface that would be damaged or destroyed through construction related activities. These include site preparation and all works related to installation of the project components.

12.6.3 Identification of Potential Impacts

The potential impacts identified during the EIA assessment are:

12.6.3.1 Construction Phase

- Damage to or destruction of archaeological resources
- Impacts to the cultural and natural landscape

12.6.3.2 Operational Phase

- Impacts to the cultural and natural landscape

12.6.3.3 Decommissioning Phase

- Impacts to the cultural and natural landscape

12.6.3.4 Cumulative impacts

- Damage to or destruction of archaeological resources; and
- Impacts to the cultural and natural landscape.

12.7 FINDINGS OF THE HERITAGE STUDY

This section describes the heritage resources recorded in the study area during the course of the project. All are archaeological in nature and comprise largely of Stone Age remains. Table 1 lists and describes the findings, while Figure 12.5 maps them. Further discussion of certain finds is presented below.

Table 1: List of archaeological resources found during the survey. Note that, even though the alternative site is not formally assessed here, the resources found are still listed for the record. Where the project number appears in brackets this indicates that the resource is close to but not actually within the footprint area. A number of hours under mitigation is the suggested time required to carry out mitigation excavations.

Project	Way point	Co-ordinates	Description	Heritage significance	Suggested mitigation
Gemsbok PV6	241	S29 05 39.3 E21 25 52.5	LSA scatter of quartz, quartzite and CCS on the east side of a small pan.	Low-medium	Avoid with a buffer of at least 20 m or conduct archaeological excavations to rescue artefacts and data (2 hours).
Gemsbok PV6 Alt. (Gemsbok PV6 Tx)	240	S29 06 23.1 E21 24 20.3	LSA scatter of quartz, ostrich eggshell and one bone fragment on the west side of a small pan.	Low	-
Gemsbok PV6 Alt.	779	S29 06 48.9 E21 23 51.9	Quartz and quartzite LSA scatter on the north side of a pan. It hjas been disturbed by aardvark burrowing but part is intact.	Low-medium	Avoid with a buffer of at least 20 m or conduct archaeological excavations to rescue artefacts and data (1 hours).
(Gemsbok PV6 Alt.)	780	S29 06 51.4 E21 23 49.9	Probable grave. A rectangular area of loosely packed rocks in a sandy area to the southwest of a pan. There are no other rocks in the area at all. There are some fragments of ostrich eggshell as well as some quartz and CCS artefacts around it and an old tin can also lies nearby.	High	Avoid with a buffer of at least 5 m or test excavate to check for human remains then make decision to avoid or exhume with required process.

Project	Way point	Co-ordinates	Description	Heritage significance	Suggested mitigation
Gemsbok PV6 Alt. Gemsbok PV6 Tx	773	S29 06 47.5 E21 23 27.2	Large LSA site on the eastern edge of a wide, shallow pan area. Contains quartz, quartzite, CCS, banded iron formation. Hammer stone/upper grindstone and another upper grindstone seen. A part of the site is heavily damaged by aardvark burrows but at least one third of the dense area is intact.	Low-medium	Avoid with a buffer of at least 20 m or conduct archaeological excavations to rescue artefacts and data (4 hours).
Gemsbok PV6 Alt. Gemsbok PV6 Tx	774	S29 06 47.2 E21 23 28.6	Dense LSA quartz scatter on edge of wide, shallow pan area but about 40 m further east than 773. Quartzite and hornfels also present.	Low-medium	Avoid with a buffer of at least 20 m or conduct archaeological excavations to rescue artefacts and data (4 hours).
Gemsbok PV6 Alt. Gemsbok PV6 Tx	775	S29 06 48.3 E21 23 26.9	Small LSA artefacts scatter of quartz and quartzite on the eastern edge of a wide, shallow pan area.	Low-medium	Avoid with a buffer of at least 20 m or conduct archaeological excavations to rescue artefacts and data (2 hours).
Gemsbok PV6 Alt. Gemsbok PV6 Tx	776	S29 06 48.8 E21 23 26.7	Small LSA artefacts scatter of quartz, quartzite and CCS on the eastern edge of a wide, shallow pan area.	Low-medium	Avoid with a buffer of at least 20 m or conduct archaeological excavations to rescue artefacts and data (2 hours).
(Gemsbok PV6 Tx)	768	S29 07 03.9 E21 23 12.1	Dense quartz artefact scatter at the base of a rocky koppie.	Medium	Avoid or conduct archaeological excavations to rescue artefacts and data (8 hours).
(Gemsbok PV6 Tx)	769	S29 07 04.1 E21 23 12.8	Dense quartz artefact scatter at the base of a rocky koppie. Some quartzite also present. Two lightly ground patches on bedrock here.	Medium	Avoid or conduct archaeological excavations to rescue artefacts and data (8 hours).
(Gemsbok PV6 Tx)	770	S29 07 05.9 E21 23 13.7	Light quartz scatter and one lightly ground patch on bedrock at the base of the smaller rocky koppie. There appears to be light artefact scatter all around the small hill but no particular points of concentration.	Low	-
(Gemsbok PV6 Tx)	771	S29 07 04.8 E21 23 11.5	Dense quartz scatter on a terrace near the crest of the koppie. Just above it there is a possible rock gong (it rings nicely when struck).	Low-medium	Avoid or conduct archaeological excavations to rescue artefacts and data (2 hours).
(Gemsbok PV6 Tx)	772	S29 07 03.9 E21 23 11.2	A single lightly ground patch on bedrock. There is also some glass around here too.	Low	-

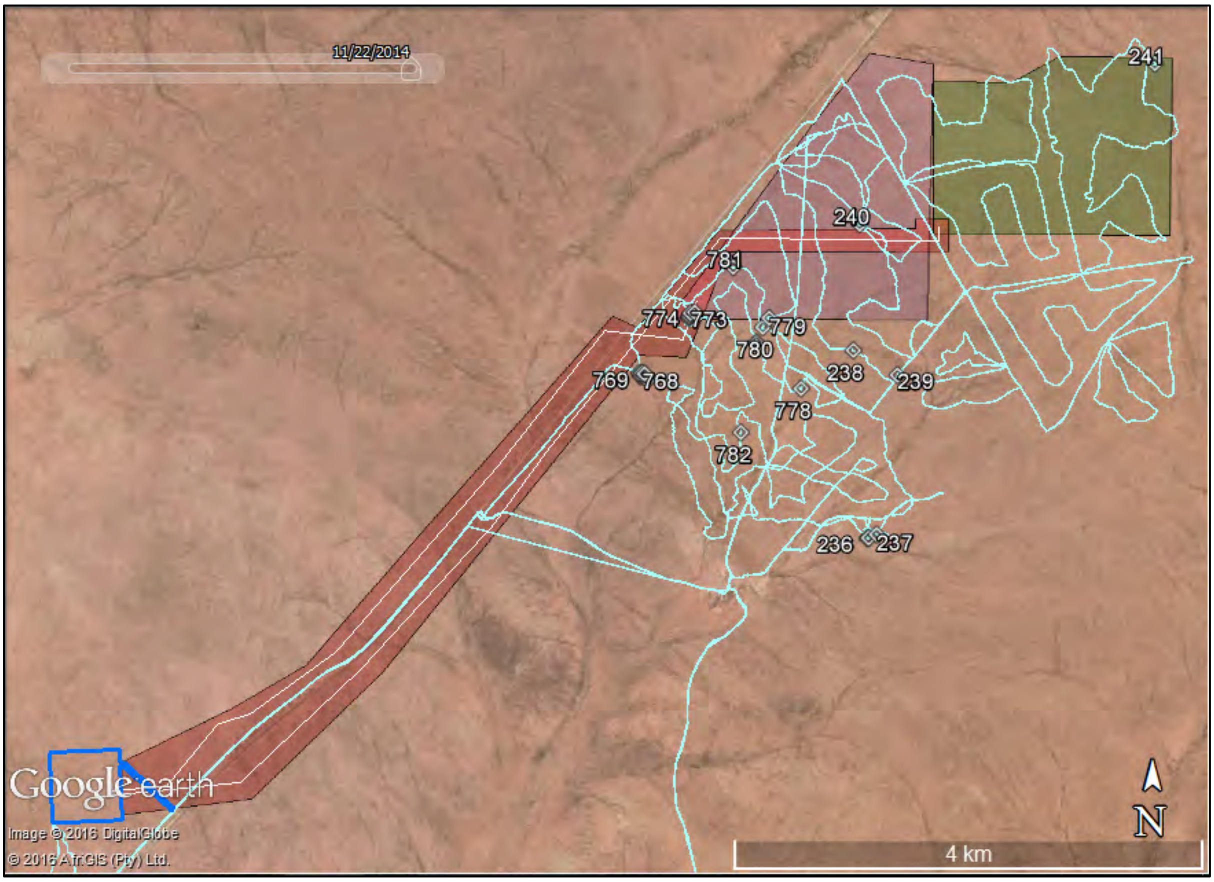

Figure 12.5: Aerial view of the study area showing the preferred site (green), transmission corridors (red) and alternative site (purple) with all finds superimposed. The Nieuwehoop Substation location is in blue in the southwest. The survey tracks are the thin light blue lines.

12.7.1 Archaeology

Archaeological material was found throughout the broader study area but in quite variable densities. The majority of the area contained only an extremely low density background scatter with occasional artefacts attributable to all three Stone Ages. Most archaeological material was located around the pan in the transmission corridor and the nearby rocky hill just outside the corridor, but one artefact scatter was found alongside a small pan within the preferred site. The survey showed that, with the exception of the pan in the northeast, water features were largely absent from the preferred site and this, along with the obvious rocky foci elsewhere, is likely the reason that so little was observed there.

Several LSA artefacts scatters with research potential were observed around the pans (e,g, Figure 12.6) and the rocky hill, while a scatter of larger ESA or MSA artefacts was found in the open close to a stone source (Figure 12.7).

Figure 12.6: LSA stone artefacts from the scatter alongside the pan at waypoint 771. On the left if a well used and presumably well-treasured hammer stone / upper grindstone. The scale is in cm.

Figure 12.7: *E*SA or MSA stone artefacts from the scatter at waypoint 781. The scale on the spine of the notebook is in cm.

12.7.2 Graves

No graves were recorded in the Preferred study area, but one possible grave was found just outside the southern margin of the Alternative site. It was a low mound of rocks in a gravel area (Figure 12.8).

Figure 12.8: Mound of stones though to be a grave at waypoint 238.

12.7.3 Cultural landscape

The cultural landscape in the area is fairly poorly developed with relatively little anthropogenic modification of the landscape being evident. What there is – farm tracks, wind pumps, reservoirs, fences – relates to a landscape of small stock farming but this has been compromised in the study area by the railway line and the new substation.

12.7.4 Statement of significance

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ''cultural significance'' means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

The majority of archaeological resources (and all those within the preferred site and transmission corridor) are deemed to have no more than low-medium cultural significance for their scientific value. The possible grave has high significance for its social value, while the cultural landscape has low cultural significance for its aesthetic and social values.

12.7.5 7.5. Summary of heritage indicators and provisional grading

The archaeological resources identified in the transmission corridor are considered to be grade 3C for their scientific value. The possible grave site is important because of the potential for human remains but its context suggests low-medium significance and a provisional grading of 3C to be appropriate for the site. Because of its low significance and the presence of other infrastructure within it, the landscape is also considered ungradable.

12.8 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

12.8.1 Damage to and Destruction of Archaeological Resources (Construction Phase)

It is anticipated that any archaeological sites located within the final development footprint of the PV facility would be physically damaged or, more likely, destroyed when the surface is levelled in preparation for construction. The chances of impacts through erection of the transmission lines are far smaller because of the very limited ground disturbance that would occur. All these impacts would be direct, negative impacts. The extent of the impacts would be site specific and their duration permanent. The consequence of the impacts is rated as moderate and the probability is very likely. The impacts are non-reversible and the resources cannot be replaced. Because the consequence of impacting the archaeological sites (alongside the pans at waypoints 773 to 776 and 241) found within the proposed transmission corridor and PV footprint is moderate, the significance of any potential impacts is likely to be low before mitigation. Mitigation would involve an archaeologist conducting excavations to rescue archaeological material from the relevant sites and, once this is complete, the significance of the potential impacts would be reduced to very low. Alternatively, the archaeological sites could be avoided with a minimum buffer of 20 m. Those in the transmission corridor are likely to be easily avoided.

12.8.2 Damage to and Destruction of Graves (Construction Phase)

It is anticipated that any graves located within the final development footprint would be physically damaged or, more likely, destroyed when the surface is levelled in preparation for construction. These impacts would be direct, negative impacts. The survey did not reveal any graves within the preferred development site but the chance still exists that one or more may be present. The extent of the impact would be site specific and its duration permanent. The consequence of the impact is rated as extreme and the probability is very unlikely. The impacts are non-reversible and the resource cannot be replaced. The consequence and probability combine to give an impact significance rated as low before mitigation. If any graves were found during construction then, if they cannot be protected and avoided, an archaeologist would need to exhume the grave with the permission of SAHRA. The only mitigation that can be suggested at present is to ensure that all works remain within the authorised footprint. This would reduce the significance of the impact to very low with mitigation.

12.8.3 Impacts to the Natural and Cultural Landscape (Construction, Operational and Decommissioning Phases)

The impact of the proposed project on the natural and cultural landscape is expected to occur during the construction, operational and decommissioning phases because of the presence of structures and equipment in the rural landscape. These impacts would be negative and direct, with a local spatial extent, and a long-term duration (for the lifetime of the facility). The consequence and probability of the impact are rated as moderate and very likely respectively and these combine to produce a potential impact of low significance. The reversibility of the impact and irreplaceability of the resource are rated as high and moderate respectively. Solar panels are not as visible from a distance as the built aspects of the proposed development would be, but with the use of earthy-coloured paint on the buildings (where technically feasible), the degree of visual intrusion would be slightly reduced but the impact significance is still rated as being low.

During the operational phase, the addition of solar panels to the landscape will result in a marked change in its character from a rural landscape to one characterized by electrical infrastructure. Given that the precedent has already been set for electrical development, the significance of these potential impacts is considered to be low. No mitigation measures are recommended for the operational and decommissioning phases.

12.8.4 Cumulative Impacts to Archaeological Resources

The development of multiple solar energy facilities will result in many archaeological artefacts and sites being disturbed and/or destroyed over a wide area. Few of the sites recorded in the region have high cultural significance and it is likely that the vast majority of those that do would be protected from harm because of their proximity to water courses and pans. Cumulative impacts would be negative and direct in nature. They would occur at the local level and would be permanent. Because no sites of high archaeological significance were found within the present study area, the cumulative impact consequence is rated as moderate with the probability of impacts being likely. These combine to provide a significance rating of low for this project. The impacts are irreversible and the irreplaceability of archaeological resources is high. With mitigation the impact significance is reduced to very low.

12.8.5 Cumulative Impacts to Graves

The development of multiple solar energy facilities may result in a number of graves being disturbed and/or destroyed over a wide area. However, because graves can be very difficult to identify and many may well continue to exist beneath any developments, it is difficult to evaluate any cumulative impacts. The nature of graves as individual and generally isolated heritage resources is such that, although each is significant, the disturbance of multiple examples will not result in a significant cumulative impact. Cumulative impacts would be negative and direct and occur at the local level. They would be permanent in duration. The moderate consequence and very unlikely probability combine to give an impact significance rating of low before mitigation. After mitigation it is expected to be very low. The only mitigation that can be suggested at present is to ensure that all works remain within the authorised footprint. If graves were found during construction then they should either be protected and avoided or exhumed with the permission of SAHRA. The post-mitigation impact significance would be very low.

12.8.6 Cumulative Impacts to the Natural and Cultural Landscape

The development of multiple solar energy facilities will result in significant visual degradation of the local environment. However, it is also worth noting that it is far better, from the cumulative impact point of view, to cluster the facilities rather than to have them spread out over the landscape. The present application is one of a number of applications for solar energy facilities in close proximity to the Nieuwehoop Substation and, because of this clustering, the cumulative impacts are more acceptable. The impacts would be direct and negative, occurring at the local level and with long term duration. The consequence is rated as moderate and, although the impact is very likely to occur, the significance of the impact is low. Although mitigation is suggested (i.e. use earthy-coloured paint on built elements where technically feasible), this will not have much effect overall, therefore the significance of the impact after mitigation is still rated as being low.

12.9 IMPACT ASSESSMENT SUMMARY

The assessment of potential impacts and recommendation of mitigation measures as discussed above are collated in Tables 12.2 to 12.5 below. Note that indirect impacts are not assessed because the nature of the identified heritage resources is such that significant indirect impacts are highly unlikely to occur

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Table 12.2: Impact assessment summary table for the Construction Phase.

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Clearing of site	Destruction of archaeological resources	Negative	Site	Permanent	Moderate	Very likely	Non-reversible	High	Archaeological excavation to be undertaken by a professional archaeologist or avoid sites with a buffer of 20 m; Ensure all works occur inside approved development footprint.	Low	Very low	5	High
Clearing of site	Destruction of graves	Negative	Site	Permanent	Extreme	Very unlikely	Non-reversible	High	Avoid grave with a buffer of at least 5 m or test and exhume as required	Low	Very low	5	Medium
Clearing of site and construction of the proposed facility	Impacts to the natural and cultural landscape	Negative	Local	Long term	Moderate	Very likely	High	Moderate	Use earthy-coloured paint on built elements where technically feasible	Low	Low	4	High

Table 12.3: Impact assessment summary table for the Operational Phase.

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
The presence of the proposed PV facility	Impacts to the natural and cultural landscape	Negative	Local	Long term	Moderate	Very likely	High	Moderate	None required	Low	Low	4	High

Table 12.4: Impact assessment summary table for the Decommissioning Phase.

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
The presence of constructio n vehicles	Impacts to the natural and cultural landscape	Negative	Local	Short term	Moderate	Very likely	High	Moderate	None required	Low	Low	4	High

Table 12.5: Cumulative impact assessment summary table.

Cumulative Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Clearing of site	Destruction of archaeological resources	Negative	Local	Permanent	Moderate	Unlikely	Non-reversible	High	Archaeological excavation to be undertaken by a professional archaeologist	Low	Very low	5	High
Clearing of site	Destruction of graves	Negative	Local	Permanent	Moderate	Very unlikely	Non-reversible	High	Avoid grave with a buffer of at least 5 m or test and exhume as required	Low	Very low	5	Low
Clearing of site and construction of the proposed facility	Impacts to the natural and cultural landscape	Negative	Local	Long term	Moderate	Very likely	High	Moderate	Use earthy-coloured paint on built elements where technically feasible	Low	Low	4	High

12.10 PERMIT REQUIREMENTS

The NHRA does not require the developer to obtain permits prior to construction. However, any archaeological mitigation work (i.e. test excavations, sampling etc.) that may be required (in the event of archaeological resources or graves of significance being found within the development footprint during construction) would need to be conducted under a permit issued to, and in the name of, the appointed archaeologist. The permit application process allows the heritage authorities to ensure that a suitably qualified and experienced archaeologist undertakes the work and that the proposed excavation/sampling methodology is acceptable.

12.11 INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

12.11.1 For inclusion in the EMPr

It should be noted that the monitoring that may be suggested in an HIA and requested by the heritage authorities is different to that commonly enforced in the EIA context:

- For heritage purposes monitoring would be to check for previously undiscovered (and generally buried) heritage resources in areas where the probability remains high despite nothing being found during assessment; while
- In the EIA context, monitoring serves to ensure that authorisation conditions have been met. These requirements have been included in the EMPr document.

For heritage purposes then, and based on present information, no monitoring is required.
Heritage mitigation requirements that should be incorporated into the EMPr are as follows:

- If the archaeological sites indicated in Figure 12.9 cannot be avoided (with a minimum buffer of 20 m) then provision should be made well in advance of the start of construction (preferably at least 6 months) for archaeological mitigation to be carried out. This will allow the archaeologist time to obtain a permit, conduct the work, analyse the material and obtain a positive comment from SAHRA. If the sites can be avoided then the Environmental Control Officer (ECO) should ensure that they are cordoned off and protected from harm.
- The ECO should meet with workers on site at the start of the construction phase to explain the possibility that previously unidentified graves might be present. The possible grave recorded during the survey could be pointed out as an example. During clearing of the surface, all personnel should be vigilant for any unusual stone features and these should be reported to the ECO, who should then report the find to an archaeologist. The find should be cordoned off and protected *in situ* until it can be evaluated by an archaeologist. Such a feature may need to be tested by an archaeologist to confirm whether they are graves or not. If they are graves then exhumation would be required prior to further work in the area.
- It should be ensured that all construction and operation activities take place within the authorised construction footprint so as to minimise damage to heritage resources that have not been mitigated;
- Where technically feasible, earthy-coloured paint should be used on the built elements of the project so as to reduce the visual contrast in the landscape.

12.11.2 For inclusion in the Environmental Authorisation

- Should it not be possible to avoid the significant archaeological sites with a minimum buffer of 20 m from the waypoints, then they should be excavated;
- The possible grave should be avoided with a buffer of at least 5 m or else tested and, if necessary, exhumed prior to construction with approval from SAHRA;
- The construction team should be made aware of the potential to locate graves and be instructed to report any suspicious stone features to SAHRA prior to disturbance;
- Where technically feasible, the built elements of the facility should be painted in an earthy colour to minimise visual contrast in the landscape; and
- If any archaeological material or human burials are uncovered during the course of construction then work in the immediate area should be halted. The find would need to be reported to SAHRA and may require inspection by an archaeologist. Such a heritage resource is the property of the state and may require excavation and curation in an approved institution.

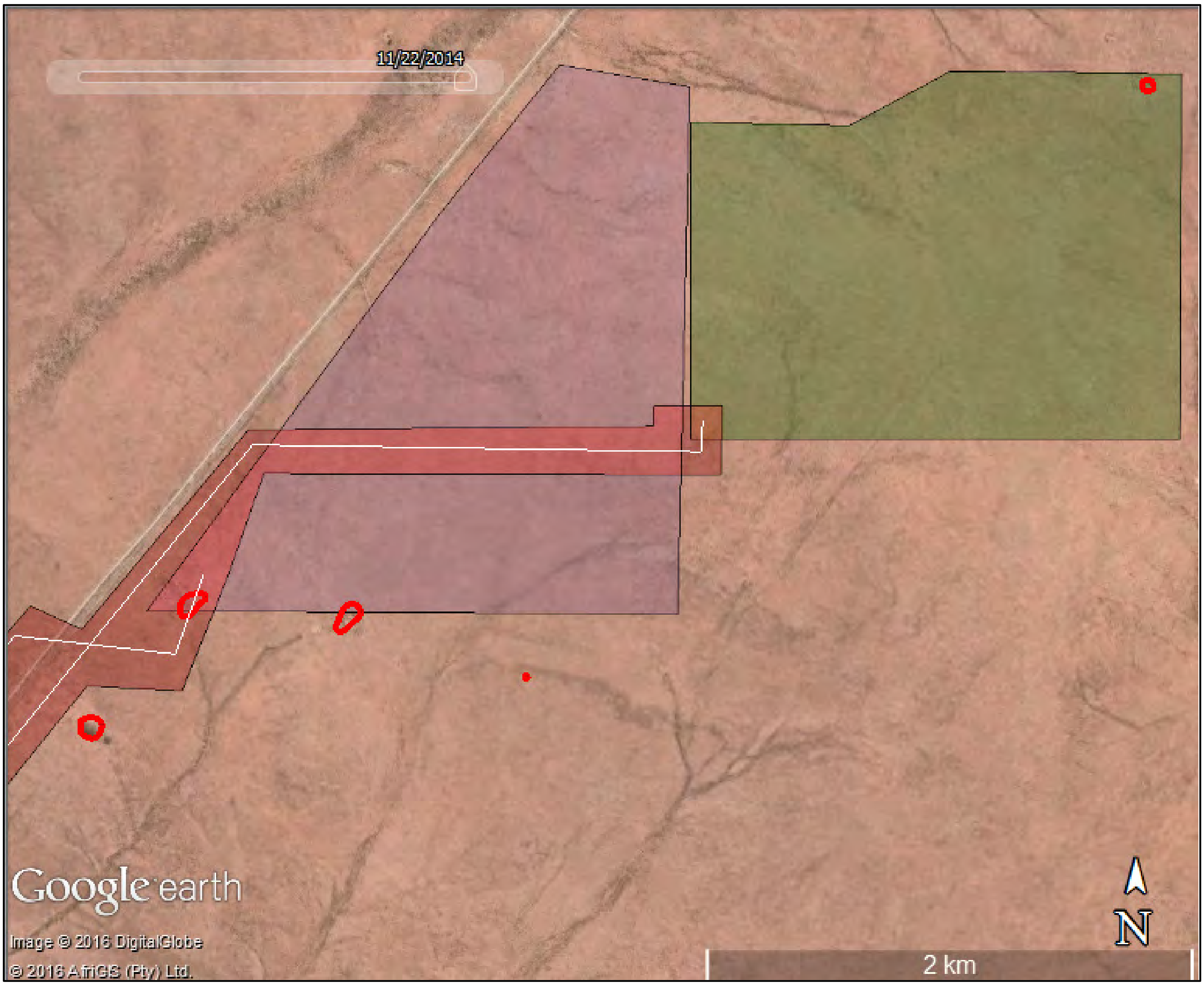

Figure 12.9: Aerial view of the preferred development site (green), alternative site (purple) and part of the transmission corridor (red) showing the locations of all the sensitive heritage sites (red outlines).

12.12 CONCLUSIONS

The Stone Age archaeological sites found in the transmission corridor and Preferred PV footprint area have low-medium significance and most should be easily avoided by the development. This makes the project area well-suited to development. Overall, impacts to heritage resources are of very low significance and will not influence the decision to proceed with the project. The development requires no heritage permits but if any archaeological mitigation becomes required then this would need to occur under a permit issued by SAHRA to the appointed archaeologist.

12.13 RECOMMENDATIONS

Because the potential impacts are quite limited and fairly easily avoidable it is recommended that the proposed Gemsbok PV6 facility and its associated transmission lines be authorised subject to the following conditions:

- Should it not be possible to avoid the significant archaeological sites with a minimum buffer of 20 m from the waypoints, then they should be excavated;
- The possible grave should be avoided with a buffer of at least 5 m or else tested and, if necessary, exhumed prior to construction with approval from SAHRA;
- The construction team should be made aware of the potential to locate graves and be instructed to report any suspicious stone features to SAHRA prior to disturbance;
- Where technically feasible, the built elements of the facility should be painted in an earthy colour to minimise visual contrast in the landscape; and
- If any archaeological material or human burials are uncovered during the course of construction then work in the immediate area should be halted. The find would need to be reported to SAHRA and may require inspection by an archaeologist. Such a heritage resource is the property of the state and may require excavation and curation in an approved institution.

12.14 REFERENCES

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MULILO
RENEWABLE PROJECT DEVELOPMENTS

Scoping and Environmental Impact Assessment for the proposed Development of a 75 MW Solar Photovoltaic Facility (GEMSBOK SOLAR PV6) on Portion 8 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape Province

EIA REPORT

CHAPTER 13:

Palaeonotological Impact Assessment

CONTENTS

TABLES

FIGURES

LIST OF ABBREVIATIONS

DEA	Department of Environmental Affairs
ECO	Environmental Control Officer
EMPr	Environmental Management Programme
EIA	Environmental Impact Assessment
HWC	Heritage Western Cape
PIA	Palaeontological Impact Assessment
PV	Photovoltaic
SAHRA	South African Heritage Resources Agency
Ma / mya	Million years ago

GLOSSARY

DEFINITIONS	
Basement Rocks	Ancient igneous and metamorphic rocks (usually unfossiliferous) underlying the sedimentary cover rocks in a given region
Calcrete	Pedogenic limestone (*i.e.* limestone generated by soil processes within soils and surface rock debris), generally associated with seasonally arid climates.
Fossiliferous	Containing fossil remains
Igneous Rocks	Rocks that have crystallised from a molten state (magma / lava); *e.g*. granite.
Metamorphic	Rocks that have recrystallized under conditions of altered (usually highly elevated) temperature and pressure; *e.g.* gneiss.
Precambrian	Older than 541 million years old (mya).
Pleistocene Epoch	Time period between *c*. 2.6 mya and 10 000 years ago (associated with a series of majo glaciations in the northern hemisphere).

EXECUTIVE SUMMARY

Gemsbok Solar PV6 (Pty) Ltd (a wholly owned Subsidiary of Mulilo Renewable Project Developments (PTY) LTD ("Mulilo")) is proposing to develop the Gemsbok Solar PV6 75 MW Solar Photovoltaic (PV) Facility on Portion 8 of Gemsbok Bult Farm 120, situated *c*. 36 km north-east of Kenhardt, Northern Cape Province. The study area (including preferred and alternative sites *plus* transmission lines) for the proposed PV facility is underlain at depth by Precambrian basement rocks (*c*. 1-2 billion years old) assigned to the Namaqua-Natal Province. These ancient igneous and high-grade metamorphic rocks - mainly granites and gneisses of the Keimoes Suite (granitoids) and Korannaland Supergroup (high grade metasediments) - crop out at surface in small areas and are entirely unfossiliferous. A large proportion of the basement rocks is mantled by a range of superficial sediments of Late Caenozoic age that may contain sparse fossil remains. These predominantly thin, unconsolidated deposits include small patches of calcretes, gravelly to sandy river alluvium, pan sediments, surface gravels, colluvium (scree) as well as Pleistocene to Recent wind-blown sands of the Gordonia Formation (Kalahari Group). Most of these younger rock units are of widespread occurrence and low palaeontological sensitivity. Scientifically important vertebrate fossil remains (*e.g.* Pleistocene mammalian bones and teeth) have been recorded within older stratified pan and river sediments elsewhere in the Bushmanland region where they are often associated with stone artefacts, while a limited range of trace fossils (*e.g.* plant root casts, termitaria and other invertebrate burrows) may be found within calcrete horizons

No previously recorded areas or sites of exceptional fossil heritage sensitivity or significance have been identified within the Nieuwehoop Solar Development project area near Kenhardt as a whole. Due to the inferred scarcity of scientifically important fossil remains within the Gemsbok Solar PV6 study area, the overall impact significance of the construction phase of the proposed solar energy project is assessed as VERY LOW (before and after mitigation). No significant impacts on fossil heritage are anticipated during the operational and decommissioning phases of the proposed solar energy facility. The potentially fossiliferous sedimentary rock units represented within the study area (*e.g.* Gordonia sands, calcrete, alluvium) are of widespread occurrence and this is also likely to apply to most of the fossils they contain. It is concluded that the cumulative impacts on fossil heritage resource posed by the known alternative energy and other infrastructural developments in the region (as explained in Chapter 4 of the EIA Report) is very low. There are no fatal flaws in the proposed Gemsbok Solar PV6 75 MW Solar PV Facility development, nor are there objections to its authorisation as far as fossil heritage conservation is concerned, since significant impacts on scientifically valuable fossils or fossil sites are not anticipated here. The no-go option (no solar developments) will have a neutral impact on local palaeontological heritage resources. The only proposed condition to accompany the Environmental Authorisation is that the recommendations for monitoring and mitigation included in the Environmental Management Programme (EMPr) are fully complied with.

Given the low palaeontological sensitivity of the eastern Bushmanland region, as determined from desktop and field-based studies, as well as the inferred very low impact significance of the Gemsbok Solar PV6 75 MW Solar PV Facility for fossil heritage conservation, no specialist palaeontological monitoring or mitigation is recommended here, pending the potential discovery of substantial new fossil remains during construction. During the construction phase all substantial bedrock excavations should be monitored for fossil material by the responsible Environmental Control Officer. Should significant fossil remains - such as vertebrate bones and teeth, plant-rich fossil lenses, petrified wood or dense fossil burrow assemblages - be exposed during construction, the responsible Environmental Control Officer should safeguard these, preferably *in situ*. The South African Heritage Resources Authority (SAHRA) should be alerted as soon as possible (Contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000, Tel: 021 462 4502, Email: cscheermeyer@sahra.org.za), so that appropriate action can be taken by a professional palaeontologist, at the developer's expense. Mitigation would normally involve the scientific recording and judicious sampling or collection of fossil material as well as associated geological data (*e.g.* stratigraphy, sedimentology, taphonomy) by a professional palaeontologist. The palaeontologist concerned with mitigation work will need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). These recommendations should be included within the EMPr for the proposed solar energy facility development.

In this report the entire site (preferred and alternative layouts *plus* transmission lines) for the proposed Gemsbok Solar PV6 75 MW Solar PV Facility on Portion 8 of Gemsbok Bult Farm 120 has been assessed based on the worst case scenario. From a palaeontological heritage impact point of view, the applicant can select any 250 ha area within the surveyed area to construct the PV plant, provided that the recommended mitigation measures are implemented as applicable.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R982	Addressed in the 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;	Appendix A of this EIA Report
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix B of this EIA Report
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 13.1
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Not Applicable
e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	Section 13.1
f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	Section 13.3
g) an identification of any areas to be avoided, including buffers;	Not Applicable
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 13.3
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 13.1.4
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;	Sections 13.5, 13.6, 13.7 and 13.8
k) any mitigation measures for inclusion in the EMPr;	Section 13.7 and 13.8
l) any conditions for inclusion in the environmental authorisation;	Not Applicable
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 13.8
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 13.9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not Applicable
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 13.5.1
q) any other information requested by the competent authority.	Not applicable

13 PALAEONTOLOGICAL IMPACT ASSESSMENT

This chapter presents the Palaeontological Impact Assessment that was prepared by Dr. John Almond (of Natura Viva cc) as part of the Environmental Impact Assessment (EIA) for the proposed solar PV facility for the Phase 2 Nieuwehoop Solar Park near Kenhardt in the Northern Cape Province.

13.1 INTRODUCTION AND METHODOLOGY

13.1.1 Scope and Objectives

The proposed Gemsbok Solar PV6 Solar Photovoltaic (PV) Facility (75 MW) project area overlies potentially fossiliferous sedimentary rocks.

This report provides a desktop assessment of potential impacts on local palaeontological (*i.e.* fossil) heritage within the study area for the proposed Gemsbok Solar PV6 (75 MW) Solar PV Facility on Portion 8 of Gemsbok Bult Farm 120, situated *c.* 36 km north-east of Kenhardt, Northern Cape Province. The report contributes to the EIA for this alternative energy development and includes recommendations for inclusion in the EMPr (Part B of the EIA Report).

The overall objectives of the specialist study are to:

- Determine the current conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured.
- Identify potential impacts that may occur during the construction, operational and decommissioning phases of the proposed development, as well as impacts associated with future environmental changes if the “no-go” option is implemented (both positive and negative).
- Assess the impacts in terms of direct, indirect and cumulative impacts.
- Provide recommendations with regards to potential monitoring programmes.
- Determine mitigation and/or management measures which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts.
- Incorporate and address all issues and concerns raised in relation to palaeontological impacts.

13.1.2 Terms of Reference

The Terms of Reference for the present study, as defined by the CSIR, are as follows:

1. Review detailed information relating to the project description and precisely define the environmental risks to palaeontological heritage, and consequences thereto.
2. Conduct a review of available information pertaining to the study area.
3. Draw on desktop information sources, the knowledge of local experts, information published in the scientific press and information derived from relevant EIAs and similar specialist studies previously conducted within the surrounding area.
4. Prepare and undertake a desktop study on the palaeontology and fossil heritage within the proposed project area, based on:
    - a review of all relevant palaeontological and geological literature, including geological maps and previous reports,

- location and examination of fossil collections from the study area (*e.g.* museums), and
- data on the proposed development (*e.g.* location of footprint, depth and volume of bedrock excavation envisaged).

5. Describe the type and location of known fossil heritage sites in the study area, and characterize all items that may be affected by the proposed project.
6. Describe the baseline environment and determine the *status quo* in terms of palaeontological heritage.
7. Note fossils and associated sedimentological features of palaeontological relevance (photos, maps, aerial or satellite images, and stratigraphic columns).
8. Analyse the stratigraphy, age and depositional setting of fossil-bearing units.
9. Evaluate the potential for occurrence of palaeontological heritage features within the study area.
10. Incorporate relevant information from other specialist reports/findings, if required.
11. Identify and rank the highlights and sensitivities to development of fossil heritage within study area.
12. Identify and rate potential direct, indirect and cumulative impacts of the proposed project on the palaeontology and fossil heritage during the construction, operational and decommissioning phases of the project. Study the cumulative impacts of the project by considering the impacts of existing industries / solar PV plants within the area (as well as those PV plants that are proposed), together with the impact of the proposed project.
13. Provide recommendations and suggestions regarding fossil heritage management on site, including conservation measures, as well as promotion of local fossil heritage (*e.g.* for public education, schools) to ensure that the impacts are limited.
14. Provide input to the EMPr, including mitigation and monitoring requirements to ensure that the impacts on the archaeological features and heritage features are limited.
15. Provide specific recommendations for further palaeontological mitigation (if any).
16. Compile an illustrated, fully-referenced review of palaeontological heritage within study area based on desktop study.

13.1.3 Approach and Methodology

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations etc.) represented within the study area are determined from geological maps and satellite images. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author's field experience and palaeontological database (consultation with professional colleagues as well as examination of institutional fossil collections may play a role here). This data is then used to assess the palaeontological sensitivity of each rock unit to development (provisional tabulations of palaeontological sensitivity of all formations in the Western, Eastern and Northern Cape have already been compiled by J. Almond and colleagues (*e.g.* Almond & Pether 2008). The likely impact of the proposed development on local fossil heritage is then determined on the basis of (1) the palaeontological sensitivity of the rock units concerned and (2) the nature and scale of the development itself, most significantly the extent of fresh bedrock excavation envisaged. When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a Phase 1 field assessment study by a professional palaeontologist is usually warranted to identify any palaeontological hotspots and make specific recommendations for any mitigation required before or during the construction phase of the development. However, due to the low palaeontological sensitivity of the present study area a Phase 1 field assessment is not required and a desktop assessment is being undertaken instead (i.e. this study).

On the basis of the desktop and Phase 1 field assessment studies, the likely impact of the proposed development on local fossil heritage and any need for specialist mitigation are then determined. Adverse palaeontological impacts normally occur during the construction rather than the operational or decommissioning phase. Phase 2 mitigation by a professional palaeontologist – normally involving the recording and sampling of fossil material and associated geological information (*e.g.* sedimentological data) may be required (a) in the pre-construction phase where important fossils are already exposed at or near the land surface and / or (b) during the construction phase when fresh fossiliferous bedrock has been exposed by excavations. To carry out mitigation, the palaeontologist involved will need to apply for a palaeontological collection permit from the relevant heritage management authorities for the Northern Cape, *i.e.* SAHRA (Contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000, Tel: 021 462 4502, Email: cscheermeyer@sahra.org.za). It should be emphasized that, providing appropriate mitigation is carried out, the majority of developments involving bedrock excavation can make a positive contribution to our understanding of local palaeontological heritage.

13.1.4 Assumptions and Limitations

The accuracy and reliability of palaeontological specialist studies as components of Heritage Impact Assessments are **generally** limited by the following constraints:

1. Inadequate database for fossil heritage for much of South Africa, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas – including the overall Nieuwehoop Solar Development project area - have never been surveyed by a palaeontologist.
2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant ("mappable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil etc.), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.
3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information.
4. The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (e.g. of commercial mining companies) - that is not readily available for desktop studies.
5. Absence of a comprehensive computerized database of fossil collections in major South African institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:

(a) underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or

(b) overestimation of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium *etc.*).

Since most areas of South Africa have not been studied palaeontologically, a palaeontological desktop study usually entails inferring the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist.

In the case of the Nieuwehoop Solar Park Development project area near Kenhardt in the Northern Cape, bedrock exposure is limited due to extensive cover by superficial deposits (*e.g.* alluvium, soils, surface gravels), especially in areas of low relief, as well as by pervasive *bossieveld* vegetation. For this reason, as well as the low palaeontological sensitivity of the sedimentary rocks mapped in the project area, a desktop-level rather than field-based assessment was considered appropriate for this study. Despite the lack of palaeontological field data from the project area itself, confidence levels in the conclusions reached in the desktop study are moderately high because of the author's field experience of the sedimentary rocks represented in the wider Bushmanland region (See reference list for previous palaeontological assessments in the area; *e.g.* Almond 2009, 2011, 2014a, 2014b, 2014c, 2014d). Recent palaeontological heritage assessments for several other alternative energy developments in the region have been taken into consideration (*e.g.* the Scatec Solar project area just to the west of the Nieuwehoop Solar Park Development project area).

In terms of the impact assessment, the methodology adopted is outlined in Chapter 4 of the EIA Report, which also notes the developments within a 20 km radius that have been considered in order to assess cumulative impacts.

13.1.5 Sources of Information

The information used in this desktop study was based on the following sources:

1. A detailed project outline supplied by the CSIR - Environmental Management Services.
2. Previous desktop palaeontological assessment reports for study areas in the Kenhardt region by the author (Almond 2009, 2011, 2014a, 2014b, 2014c, 2014d).
3. A review of the relevant scientific literature, including published geological maps (e.g. 1: 250 000 scale geological map sheet 2920 Kenhardt published by the Council for Geoscience, Pretoria) and accompanying sheet explanations (*e.g.* Slabbert *et al*. 1999)
4. The author's previous field experience with the formations concerned and their palaeontological heritage (*cf* Almond and Pether 2008; SAHRIS website).

13.1.6 Declaration of Independence of Specialists

Refer to Appendix A of this EIA Report for the Curriculum Vitae of Dr. John Almond, which highlights his experience and expertise. The declaration of independence by the specialist is provided in Box 13.1 below and included in Appendix B of this EIA Report.

BOX 13.1: DECLARATION OF INDEPENDENCE

I, John Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed Gemsbok Solar PV6 Project, application or appeal in respect of which I was appointed, other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

JOHN ALMOND

13.2 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO PALAEONTOLOGICAL HERITAGE IMPACTS

As noted above, the Gemsbok Solar PV6 project area near Kenhardt is located in a region of Bushmanland that is underlain by potentially fossiliferous sedimentary rocks of Late Tertiary or Quaternary age as well as by unfossiliferous basement rocks (as discussed in Section 1.3 of this chapter). The construction phase of the proposed development will entail substantial excavations into the superficial sediment cover and locally into the underlying bedrock as well. These include, for example, surface clearance operations, excavations for the solar array footings, underground cables, access and internal gravel roads, 132 kV transmission line towers, on-site substation, laydown areas, stormwater channels, water pipelines (if required) and foundations for buildings (offices, operational control centre, warehouse/workshop). All these developments may adversely affect potential, legally-protected fossil heritage resources within the study area by destroying, disturbing or permanently sealing-in fossils at or beneath the surface of the ground that are then no longer available for scientific research or other public good.

The planning, operational and decommissioning phases of the proposed solar energy facility are very unlikely to involve additional adverse impacts on local palaeontological heritage, however.

A detailed description of the proposed project is included in Chapter 2 of the EIA Report.

13.3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

In this section of the report an outline of the geology of the proposed Gemsbok Solar PV6 project area is first given, based on the relevant geological maps and scientific literature. This is followed by a brief review of fossil heritage that has previously been recorded from the sedimentary rock units that are represented within the project area.

13.3.1 Geological Context

The study area for the proposed Gemsbok Solar PV6 project, located on Portion 8 of Gemsbok Bult Farm 120, located some 36 km northeast of Kenhardt, Northern Cape, is situated in flat-lying terrain within the semi-arid Bushmanland region at elevations between *c*. 975 to 1120 m amsl. with a gentle slope to the southwest. It is drained by a dendritic network of shallow, southerly-flowing tributary streams of the Hartbeesrivier such as the Rugseersrivier system. The geology of the study area is shown on 1: 250 000 geology sheet 2920 Kenhardt (Council for Geoscience, Pretoria) (Figure 13.1). The entire area is underlain at depth by a variety of Precambrian basement rocks that are *c*. 2 billion years old and are assigned to the **Namaqua-Natal Province**. These ancient igneous and high-grade metamorphic rocks - mainly granites and gneisses of the **Keimoes Suite** (granitoids) and **Korannaland Supergroup** (high grade metasediments) – are listed in the legend to Figure 13.1. The various basement rock units are described in the Kenhardt 1: 250 000 sheet explanation by Slabbert et al. (1999) and placed in the context of the Namaqua-Natal Province by Cornell *et al*. (2006). They crop out at surface as small patches and are entirely unfossiliferous and so will not be discussed further here. The Precambrian crustal rocks are transected by the NW-SE trending Boven Rugzeer Shear Zone that crosses the study area. The shear zone separates two major crustal blocks in Bushmanland known as the Kakamas Terrane and Areachap Terrane (Cornell *et al.* 2006, their figure 18).

A large proportion of the basement rocks in the proposed project area are mantled by a range of superficial sediments of Late Caenozoic age, some of which are included within the **Kalahari Group**. These predominantly thin, unconsolidated deposits include small patches of calcretes (soil limestones), gravelly to sandy river alluvium, pan sediments along certain watercourses, surface gravels, colluvium (scree) as well as – especially – Quaternary to Recent aeolian (wind-blown) sands of the Gordonia Formation (Kalahari Group). The basement rocks in the Germsbok Solar PV6 study area are largely mantled by aeolian sands of the **Gordonia Formation** (“Kalahari sands”) as well as by Late Caenozoic alluvial deposits along shallow dendritic drainage lines.

The geology of the Late Cretaceous to Recent Kalahari Group is reviewed by Thomas (1981), Dingle *et al.* (1983), Thomas & Shaw (1991), Haddon (2000) and Partridge *et al.* (2006). The thickness of the unconsolidated Kalahari sands in the Bushmanland area is variable and often uncertain. The Gordonia Formation dune sands are considered to range in age from the Late Pliocene/Early Pleistocene to Recent, dated in part from enclosed Middle to Late Stone Age stone tools (Dingle *et al*., 1983, p. 291). Note that the recent extension of the Pliocene - Pleistocene boundary from 1.8 Ma back to 2.588 Ma would place the older Gordonia Formation sands entirely within the Pleistocene Epoch. A number of older Kalahari formations underlie the young wind-blown surface sands in the main Kalahari depository to the north of the study area. However, at the latitude of the study area near Kenhardt (*c*. 29° S) Gordonia Formation sands less than 30 m thick are likely to be the main or perhaps only Kalahari sediments present (*cf* isopach map of the Kalahari Group, Figure 6 *in* Partridge *et al*., 2006). These unconsolidated sands will be locally underlain by thin subsurface gravels along the buried palaeosurface and perhaps by calcretes of Pleistocene or younger age (*cf* Mokalanen Formation).

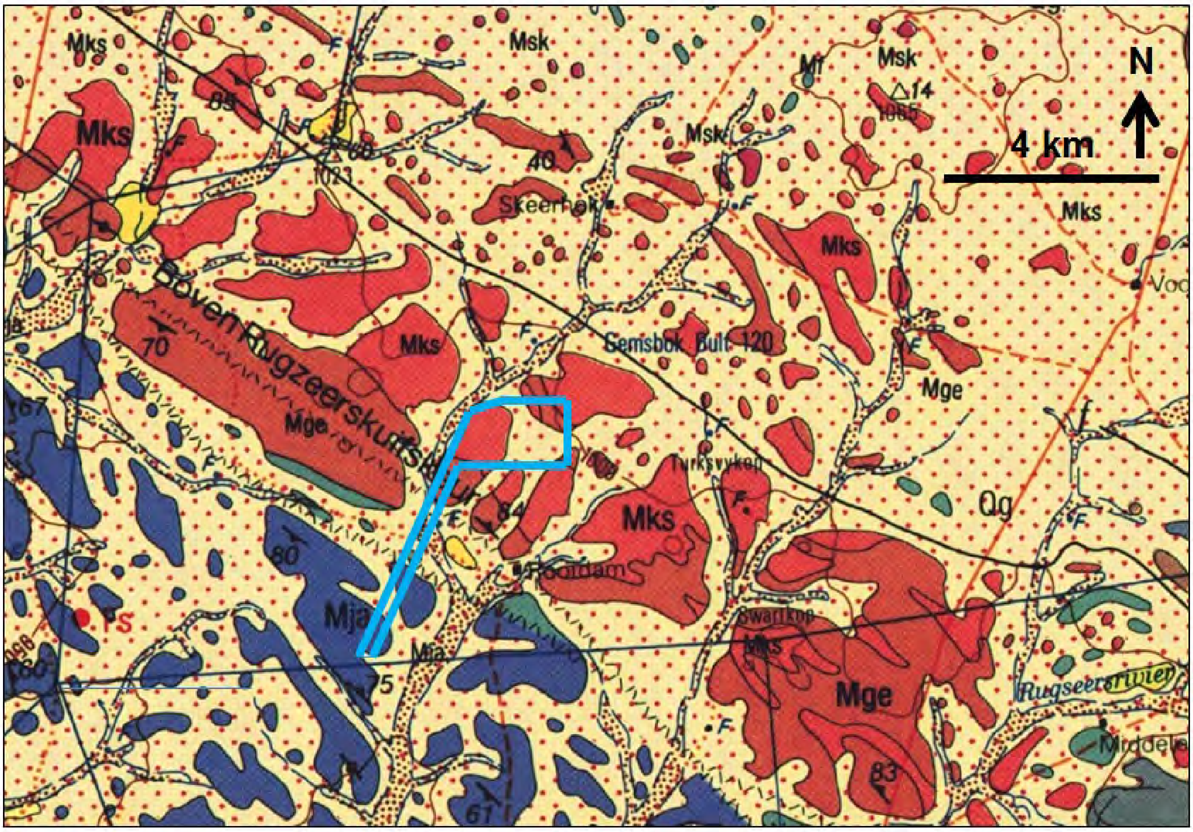

Figure 13.1: Extract from 1: 250 000 scale geological map sheet 2920 Kenhardt (Council for Geoscience, Pretoria) showing the geology of the Gemsbok Solar PV6 study area on the Portion 8 of Gemsbok Bult Farm 120, situated *c*. 36 km to the NE of Kenhardt, Northern Cape. The area - including the preferred and alternative sites as well as associated transmission lines - is *approximately* indicated by the pale blue polygon.

The main geological units represented within the Gemsbok Solar PV6 project area include:

PRECAMBRIAN BASEMENT ROCKS

KEIMOES SUITE

- Brown (Mge) = Gemsbokbult Granite
- Red (Mks) = Klipkoppies Granite
- Blue-green (Mf) =Friersdale Charnockite

KORANNALAND SUPERGROUP

- Dark blue (Mja) = Jacomynpan Group

LATE CAENOZOIC SUPERFICIAL SEDIMENTS

- Pale yellow with sparse red stipple (Qg) = aeolian sands of the Gordonia Formation (Kalahari Group)
- Pale yellow with dense black stipple = alluvial and pan sediments
- Dark yellow (Tec) = calcrete

13.3.2 Palaeontological Heritage

The Precambrian basement rocks represented within the study area are high grade metamorphic rocks that were last metamorphosed some 1 billion years ago and are entirely unfossiliferous. The sparse fossil record of Late Caenozoic superficial sediments in the Bushmanland region are briefly reviewed here (Refer also to Table 13.1). Note that, to the author's knowledge, there are no fossil records from the broader Nieuwehoop Solar Development project area itself and no palaeontological fieldwork has been undertaken here.

The diverse superficial deposits within the South African interior, including Bushmanland, have been comparatively neglected in palaeontological terms. However, sediments associated with ancient drainage systems, springs and pans may occasionally contain important fossil biotas, notably the bones, teeth and horn cores of mammals as well as remains of reptiles like tortoises (*e.g.* Skead 1980, Klein 1984, Brink 1987, Bousman *et al.* 1988, Bender & Brink 1992, Brink *et al.* 1995, MacRae 1999, Meadows & Watkeys 1999, Churchill *et al.* 2000, Partridge & Scott 2000, Brink & Rossouw 2000, Rossouw 2006, Almond *in* Macey *et al.* 2011). Other late Caenozoic fossil biotas that may occur within these superficial deposits include non-marine molluscs (bivalves, gastropods), ostrich egg shells, trace fossils (e.g. calcretised termitaria, coprolites, invertebrate burrows, rhizocretions), and plant material such as peats or palynomorphs (pollens) in organic-rich alluvial horizons (Scott 2000) and diatoms in pan sediments. In Quaternary deposits, fossil remains may be associated with human artefacts such as stone tools and are also of archaeological interest (*e.g*. Smith 1999 and references. therein). Ancient solution hollows within extensive calcrete hardpans may have acted as animal traps in the past. As with coastal and interior limestones, they might occasionally contain mammalian bones and teeth (perhaps associated with hyaena dens) or invertebrate remains such as snail shells.

Diverse fossils associated with the ancient Tertiary drainage systems of the Karoo and Bushmanland region have been summarized by Almond *in* Macey *et al.* (2011) (See also articles by Cooke 1949, Wells 1964, Butzer et al. 1973, Helgren 1977, Klein 1984, Macrae 1999). They include remains of fish, reptiles, mammals, freshwater molluscs, petrified wood and trace fossils (*e.g.* De Wit 1990, 1993, De Wit & Bamford 1993, Bamford 2000, Bamford & De Wit 1993, Senut *et al.* 1996).

In the Brandvlei area to the southwest of Kenhardt lies the north-south trending Geelvloer Palaeo-valley, a Mid Tertiary palaeodrainage system that links up with the Commissioners Pan – Koa Valley system to the northwest. Here calcretised basal alluvial facies contain bones of hippopotamus-like artiodactyls called anthracotherids indicating a Miocene age (De Wit 1993, 1999, De Wit *et al.* 2000). Anthracotherids are an extinct group of amphibious mammalian herbivores only distantly related to true hippos that were widespread in the Miocene of Africa (Schneider & Marais 2004). Early to Mid-Miocene silicified woods from Brandvlei are referable to a number of extant tree families, including the Dipterocarpaceae that mainly inhabit tropical forests in Africa and Asia today. The fossil woods and associated sediments indicate that warm, tropical to subtropical climates prevailed in the Mid-Miocene and that perennial, low-sinuousity braided river systems supported lush riparian forests (De Wit & Bamford 1993, Bamford & De Wit 1993, Bamford 2000). Wet, weakly seasonal climates are suggested by the structure (indistinct growth rings) and dimensions (trunk diameters of over 50 cm) of the fossil woods (Bamford 2000).

Abraded Plio-Pleistocene fossil woods from relict alluvial terraces of the Sak River just north of Brandvlei include members of the Family Polygalaceae and also indicate humid growth conditions (Bamford & De Wit 1993). These terraces were formed by meandering rivers during intermittent pluvial (*i.e.* wetter), but still semi-arid, episodes following the onset of generally arid conditions in the western portion of southern Africa towards the end of the Miocene. So far fossils have not been recorded from the Sakrivier system closer to Kenhardt.

Pan sediments in Bushmanland have also recently yielded interesting Pleistocene mammalian faunas in association with age-diagnostic archaeological material. Important fossil mammalian remains assigned to the Florisian Mammal Age (*c*. 300 000 – 12 000 BP; MacRae 1999) have recently been documented from stratigraphic units designated Group 4 to Group 6 (*i.e.* calcrete hardpan and below) at Bundu Pan, some 22 km northwest of Copperton (Kiberd 2006 and references therein). These are among very few Middle Pleistocene faunal records from stratified deposits in the southern Africa region (Klein 1980, 1984a, 1984b, 2000) and are therefore of high palaeontological significance. Characteristic extinct Pleistocene species recorded at Bundu Pan are the giant Cape Horse or Zebra (*Equus capensis*) and the Giant Hartebeest (*Megalotragus priscus*). Other extant to extinct taxa include species of warthog, blesbok, black wildebeest, springbok and baboon. There is additionally trace fossil evidence for hyaenids (tooth marks) as well as ostrich egg shell. Preliminary dating and the inferred ecology of the fossil taxa present suggests the presence of standing water within a grassy savanna setting during the 200 - 300 000 BP interval when the Bunda Pan faunal assemblage accumulated. A sequence of Earlier, Middle and Later Stone Age (ESA, MSA and LSA, respectively) artefact assemblages is also recorded from this site. Stratigraphic Groups 4 to 6 (*i.e.* calcrete hardpan and below) contain a Final Acheulian or transitional ESA/MSA artefact assemblage, while Groups 2 - 3 above the calcrete horizon contain a MSA artefact assemblage. Orton (2012) recorded a single fossil equid tooth associated with a rich MSA artefact assemblage from gravels overlying a calcrete hardpan on the farm Hoekplaas near Copperton. This horizon is probably equivalent to Group 3 of Kiberd's stratigraphy at Bundu Pan, and therefore somewhat younger than the Florisian mammal fauna reported there.

The fossil record of the Kalahari Group as a whole is generally sparse and low in diversity; no fossils are recorded here in the Kenhardt geology sheet explanation by Slabbert *et al.* (1999). The Gordonia Formation dune sands were mainly active during cold, drier intervals of the Pleistocene Epoch that were inimical to most forms of life, apart from hardy, desert-adapted species. Porous dune sands are not generally conducive to fossil preservation. However, mummification of soft tissues may play a role here and migrating lime-rich groundwaters derived from underlying lime-rich bedrocks may lead to the rapid calcretisation of organic structures such as burrows and root casts. Occasional terrestrial fossil remains that might be expected within this unit include calcretized rhizoliths (root casts) and termitaria (*e.g. Hodotermes*, the harvester termite), ostrich egg shells (*Struthio*), tortoise remains and shells of land snails (*e.g. Trigonephrus*) (Almond in Macey *et al.* 2011, Almond & Pether 2008). Other fossil groups such as freshwater bivalves and gastropods (*e.g. Corbula, Unio*), ostracods (seed shrimps), charophytes (stonewort algae), diatoms (microscopic algae within siliceous shells) and stromatolites (laminated microbial limestones) are associated with local watercourses and pans. Microfossils such as diatoms may be blown by wind into nearby dune sands (Du Toit 1954, Dingle *et al.,* 1983). These Kalahari fossils (or subfossils) can be expected to occur sporadically but widely, and the overall palaeontological sensitivity of the Gordonia Formation is therefore considered to be low. Underlying calcretes might also contain trace fossils such as rhizoliths, termite and other insect burrows, or even mammalian trackways. Mammalian bones, teeth and horn cores (also tortoise remains, and fish, amphibian or even crocodiles in wetter depositional settings) may be expected occasionally expected within Kalahari Group sediments and calcretes, notably those associated with ancient alluvial gravels (See Koa River Valley above). The younger (Pleistocene to Recent) fluvial and alluvial sands and gravels within the proposed development area are unlikely to contain many, if any, substantial fossil or subfossil remains.

Table 13.1: Fossil heritage recorded from the major rock units that are represented within the broader Nieuwehoop Solar Development study area near Kenhardt

GEOLOGICAL UNIT	ROCK TYPES AND AGE	FOSSIL HERITAGE	PALAEONT-OLOGICAL SENSITIVITY
LATE CAENOZOIC SUPERFICIAL SEDIMENTS, especially ALLUVIAL AND PAN SEDIMENTS	fluvial, pan, lake and terrestrial sediments, including diatomite (diatom deposits), pedocretes (*e.g.* calcrete), colluvium (slope deposits such as scree), aeolian sands (Gordonia Formation, Kalahari Group) LATE TERTIARY, PLEISTOCENE TO RECENT	bones and teeth of wide range of mammals (*e.g.* mastodont proboscideans, rhinos, bovids, horses, micromammals), fish, reptiles (crocodiles, tortoises), ostrich egg shells, fish, freshwater and terrestrial molluscs (unionid bivalves, gastropods), crabs, trace fossils (*e.g.* calcretised termitaria, horizontal invertebrate burrows, stone artefacts), petrified wood, leaves, rhizoliths, stromatolites, diatom floras, peats and palynomorphs.	GENERALLY LOW BUT LOCALLY HIGH (*e.g.* Tertiary alluvium associated with old river courses)
Basement granites and gneisses NAMAQUA-NATAL PROVINCE	Highly-metamorphosed sediments, intrusive granites MID-PROTEROZOIC (*c.*1- 2 billion years old)	None	ZERO

13.4 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

All South African fossil heritage, including palaeontological sites and specimens, is protected by law (National Heritage Resources Act (Act 25 of 1999) and fossils cannot be collected, damaged, destroyed or disturbed without a permit from SAHRA or the relevant Provincial Heritage Resources Agency.

As mentioned previously, where palaeontological mitigation of a development project is required, the palaeontologist concerned with mitigation work would need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies recently developed by SAHRA (2013).

The present palaeontological heritage assessment falls under Sections 35 and 38 (Heritage Resources Management) of the National Heritage Resources Act (Act 25 of 1999), and it will also inform the Environmental Management Programme for this project.

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites; and
- palaeontological objects and material, meteorites and rare geological specimens.

According to Section 35 of the National Heritage Resources Act (Act 25 of 1999), dealing with archaeology, palaeontology and meteorites:

1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
2) All archaeological objects, palaeontological material and meteorites are the property of the State.
3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.
4) No person may, without a permit issued by the responsible heritage resources authority—
   i. destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
   ii. destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
   iii. trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
   iv. bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—
   a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
   b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;
   c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
   d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

13.5 IDENTIFICATION OF KEY ISSUES

13.5.1 Key Issues Identified During the Scoping Phase

The only key issue identified by the specialist during the Scoping Phase is the potential loss of palaeontological heritage resources (fossils, fossil sites including their geological context) through surface clearance and excavations into sedimentary rocks during the construction phase of the project.

The Scoping Report was released for a 30-day comment period which extended from 23 October 2015 to 24 November 2015.

As noted above, based on the low palaeontological sensitivity of the area, this desktop Palaeontological Impact Assessment is being undertaken during the EIA Phase (*i.e.* prior to the commencement of construction of the Gemsbok Solar PV6 project (subject to the issuing of an Environmental Authorisation)). As mentioned above, this specialist assessment is conducted by Dr. John Almond in order to assess the significance of potential impacts of the proposed project on palaeontological resources (which is discussed in Section 13.6 of this chapter).

13.5.2 Identification of Potential Impacts

The potential impacts identified during the EIA Phase are:

13.5.3 Construction Phase

- Potential loss of palaeontological heritage resources through disturbance, damage or destruction of fossils and fossil sites (including associated geological contextual data) through surface clearance and excavation activities during the construction phase.

13.5.4 Operational Phase

No significant impacts on palaeontological heritage are anticipated during the operational phase of the development.

13.5.5 Decommissioning Phase

No significant impacts on palaeontological heritage are anticipated during the operational phase of the development.

13.5.6 Cumulative Impacts

- Potential cumulative loss of palaeontological heritage resources through disturbance, damage or destruction of fossils and fossil sites (including associated geological contextual data) through surface clearance and excavation activities during the construction phase of several alternative energy facilities within the broader Kenhardt region and other key electrical infrastructure developments within a 20 km radius of the proposed project site.

13.6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

In this section of the report potential impacts of the construction, operational and decommissioning phases of the proposed PV solar facility development on palaeontological heritage are outlined and recommendations for any necessary monitoring or mitigation are provided. Possible cumulative impacts in the light of other alternative energy development proposals in the Kenhardt region are also evaluated.

13.6.1 Potential Impact 1: Construction Phase

The construction phase of the proposed solar energy facility will entail substantial surface clearance and shallow excavations into the superficial sediment cover (aeolian sands, surface gravels, stream alluvium *etc.*), which may contain fossil remains, and in some cases also into the underlying unfossiliferous bedrock. These include, for example, surface clearance operations, excavations and foundations (which will likely be drilled and concreted into the ground) for the solar array footings, underground cables, access and internal gravel roads, 132 kV transmission line towers, on-site substation, laydown areas, stormwater channels, water pipelines and foundations for buildings (offices, operational control centre, warehouse/workshop). As a result, fossils at the ground surface or buried beneath it may be disturbed, damaged, destroyed or sealed-in while their scientifically informative sedimentary context will also be disturbed or destroyed.

Desktop analysis of the fossil records of the various rock units underlying the proposed project area indicates that the majority of these units are of zero to low palaeontological sensitivity (as discussed in Section 13.3.2 and Table 13.1 of this chapter). The basement rocks are entirely unfossiliferous while the overlying Late Caenozoic superficial sediments (wind-blown sands, alluvium, gravels *etc.*) are of low to very low palaeontological sensitivity. Construction of the solar panel arrays, overhead power lines, buildings and associated infrastructure is therefore unlikely to entail significant impacts on local fossil heritage resources.

The inferred impact of the proposed solar facility development on local fossil heritage is assessed in Table 13.2 below. This assessment applies only to the construction phase of the development since further impacts on fossil heritage during the operational and decommissioning phases of the solar energy facility are not anticipated.

The destruction, damage or disturbance out of context of fossils and fossil sites preserved at the ground surface or below ground represents a *direct negative* impact that is confined to the development footprint (*site specific*). Such impacts are made only during the construction period, and can usually be partially mitigated but cannot be fully rectified; *i.e.* they are *non-reversible* and of *permanent* duration. Since several of the sedimentary units represented within the study area do contain fossils of some sort, some level impact on fossil heritage is probable (*likely*). However, because of the generally very sparse occurrence of well-preserved, scientifically-valuable fossils within the superficial sediments, and because most of the fossils encountered are likely to be of widespread occurrence (low irreplaceability) the consequence of these impacts is rated as *slight*.

No previously recorded areas or sites of exceptional fossil heritage sensitivity or significance have been identified within the proposed project area as a whole. Due to the inferred scarcity of exceptional fossil remains within the study area, the overall impact significance of the construction phase of the proposed solar energy project is assessed as *VERY LOW* (without mitigation). Due to the paucity of palaeontological field studies within this part of Bushmanland, confidence levels for this desktop palaeontological heritage assessment are only moderate (medium).

Specialist palaeontological monitoring and mitigation for this project are not recommended, pending the discovery of new fossil sites during development, given its low impact significance. The Environmental Control Officer (ECO) responsible for the construction phase of the project should be aware of the necessity of conserving fossils and should monitor all substantial excavations into sedimentary rocks for fossil remains. Proposed mitigation of chance fossil finds during the construction phase involves safeguarding of the fossils (preferably *in situ*) by the responsible ECO, reporting of finds to the SAHRA and, where appropriate, judicious sampling and recording of fossil material and associated geological data by a qualified palaeontologist (as discussed in Section 13.8 of this chapter). Should these recommended mitigation measures be fully implemented, the impact significance of the development would remain *VERY LOW* but small residual negative impacts (*e.g.* loss of undetected fossils) would remain. However, these negative impacts would be partially offset through the improved scientific understanding of local palaeontological heritage in a hitherto poorly-studied region of South Africa which would be considered as a significant *positive* outcome.

There are no fatal flaws in the proposed development proposal as far as fossil heritage is concerned.

13.6.2 Potential Impacts (Operational and Decommissioning Phases)

No significant impacts on fossil heritage resources are anticipated during the operational and decommissioning phases of the proposed solar energy facility.

13.6.3 Cumulative Impacts

The palaeontological heritage impact significance of all seven solar energy developments and associated electrical infrastructure proposed for Phase 2 of the Nieuwehoop Solar Park Development, as well as other proposed solar facilities and electrical infrastructure (discussed in Chapter 4 of the EIA Report) near Kenhardt (within a 20 km radius of the proposed project) are rated equally as **very low**. The potentially fossiliferous sedimentary rock units represented within the broader project area are of widespread occurrence and this is also likely to apply to most of the fossils they contain. It is concluded that the cumulative impact on fossil heritage resources posed by the proposed seven projects of the Nieuwehoop Solar Park Development and associated electrical infrastructure to the northeast of Kenhardt is of a low significance.

Given the generally low palaeontological sensitivity of the basement and overlying sedimentary rocks in the broader eastern Bushmanland region, significant cumulative impacts on fossil heritage are not anticipated here as a result of the various alternative energy and other infrastructure developments that have been proposed here (refer to the several recent palaeontological impact assessments undertaken by the author for projects near Kenhardt that are listed in the references).

13.7 IMPACT ASSESSMENT SUMMARY

The assessment of impacts on palaeontological heritage resources as well as recommended mitigation and monitoring measures, as discussed above, are collated in Tables 13.2 and 13.3 below.

The no-go option (no solar developments) will have a neutral impact on local palaeontological heritage resources.

Table 13.2: Impact assessment summary table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Poten tial Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Conse quence**	**Proba bility**	**Reversi bility of Impact**	**Irreplace ability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Surface clearance and excava-tions into superficial sediments	Loss of fossil heritage at or beneath ground surface	Nega-tive	Site	Permane nt	Slight	Likely	Non-reversibl e	Low	• Undertake monitoring of all substantial excavations into sedimentary rocks for fossil remains and safeguard any finds in situ. • Appoint a professional palaeontologist to record and sample any chance fossil finds	Very low	Very low	5	Medium

Table 13.3: Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	**Nature of Poten tial Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Conse quence**	**Proba bility**	**Reversi bility of Impact**	**Irreplace ability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Surface clearance and excava-tions into superficial sediments	Loss of fossil heritage at or beneath ground surface	Nega-tive	Site	Perma-nent	Slight	Likely	Non-rever-sible	Low	• Undertake monitoring of all substantial excavations into sedimentary rocks for fossil remains and safeguard any finds in situ. • Appoint a professional palaeontologist to record and sample any chance fossil finds	Very low	Very low	5	Medium

13.8 INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

Given the low palaeontological sensitivity of the proposed project area, as determined from desktop analysis, as well as the inferred very low impact significance of the alternative energy projects for fossil heritage conservation, no specialist palaeontological monitoring or mitigation is recommended here, pending the potential discovery of substantial new fossil remains during construction.

During the construction phase all substantial bedrock excavations should be monitored for fossil material by the responsible ECO. Should significant fossil remains - such as vertebrate bones and teeth, plant-rich fossil lenses, petrified wood or dense fossil burrow assemblages - be exposed during construction, the responsible ECO should safeguard these, preferably *in situ*. The SAHRA should be alerted as soon as possible (Contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000, Tel: 021 462 4502, Email: cscheermeyer@sahra.org.za), so that appropriate action can be taken by a professional palaeontologist, at the developer's expense. Mitigation would normally involve the scientific recording and judicious sampling or collection of fossil material as well as associated geological data (*e.g.* stratigraphy, sedimentology, taphonomy) by a professional palaeontologist.

The palaeontologist concerned with mitigation work will need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies recently developed by SAHRA (2013).

No monitoring or mitigation is required during the operational and decommissioning phases of the development.

These mitigation recommendations (as summarised in Part B of the EIA Report) should be incorporated into the EMPr for each Solar PV energy facility proposed by Mulilo Renewable Project Developments.

13.9 CONCLUSION AND RECOMMENDATIONS

The study area for the Gemsbok Solar PV6 facility (including preferred and alternative sites as well as the associated 132 kV transmission line) is underlain at depth by Precambrian basement rocks (*c*. 1-2 billion years old) assigned to the Namaqua-Natal Province. These ancient igneous and high-grade metamorphic rocks - mainly granites and gneisses of the Keimoes Suite (granitoids) and Korannaland Supergroup (high grade metasediments) - crop out at surface in small areas and are entirely unfossiliferous. A large proportion of the basement rocks are mantled by a range of superficial sediments of Late Caenozoic age that may contain sparse fossil remains. These predominantly thin, unconsolidated deposits include small patches of calcretes, gravelly to sandy river alluvium, pan sediments, surface gravels, colluvium (scree) as well as Pleistocene to Recent wind-blown sands of the Gordonia Formation (Kalahari Group). Most of these younger rock units are of widespread occurrence and low palaeontological sensitivity. Scientifically important vertebrate fossil remains (*e.g.* Pleistocene mammalian bones and teeth) have been recorded within older stratified pan and river sediments elsewhere in the Bushmanland region where they are often associated with stone artefacts, while a limited range of trace fossils (*e.g.* plant root casts, termitaria and other invertebrate burrows) may be found within calcrete horizons.

No previously recorded areas or sites of exceptional fossil heritage sensitivity or significance have been identified within the Nieuwehoop Solar Development project area as a whole. Due to the inferred scarcity of scientifically important fossil remains within the Gemsbok Solar PV6 study area, the overall impact significance of the construction phase of the proposed solar energy project is assessed as VERY

LOW (before and after mitigation). No significant impacts on fossil heritage are anticipated during the operational and decommissioning phases of the proposed solar energy facility. The potentially fossiliferous sedimentary rock units represented within the study area (*e.g.* Gordonia sands, calcrete) are of widespread occurrence and this is also likely to apply to most of the fossils they contain. It is concluded that the cumulative impacts on fossil heritage resources posed by the known alternative energy and other infrastructural developments in the region (as explained in Chapter 4 of the EIA Report) is of very low significance. There are no fatal flaws in the proposed solar facility development, nor are there objections to its authorisation as far as fossil heritage conservation is concerned, since significant impacts on scientifically valuable fossils or fossil sites are not anticipated here. The only proposed condition to accompany environmental authorisation is that the recommendations for monitoring and mitigation included in the EMPr are fully complied with. The no-go option (no solar developments) will have a neutral impact on local palaeontological heritage resources.

Given the low palaeontological sensitivity of the broader eastern Bushmanland region, as determined from the desktop study, as well as the inferred very low impact significance of the Gemsbok Solar PV6 75 MW Solar PV Facility for fossil heritage conservation, no specialist palaeontological monitoring or mitigation is recommended here, pending the discovery of substantial new fossil remains during construction. Mitigation measures and monitoring recommendations for inclusion in the EMPr are discussed in Sections 1.6 and 1.8 of this report.

In this report the entire site (and transmission line) for the Gemsbok Solar PV6 75 MW Solar Photovoltaic (PV) Facility on Portion 8 of Gemsbok Bult Farm 120 has been assessed based on the worst case scenario. From a palaeontological heritage impact point of view, the applicant can select any 250 ha area within the surveyed area to build the PV plant, provided that the recommended mitigation measures are implemented as applicable.

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MULILO
RENEWABLE PROJECT DEVELOPMENTS

Scoping and Environmental Impact Assessment for the proposed Development of a 75 MW Solar Photovoltaic Facility (GEMSBOK SOLAR PV6) on Portion 8 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape Province

EIA REPORT

CHAPTER 14:

Socio-Economic Impact Assessment

CONTENTS

TABLES

FIGURES

LIST OF ABBREVIATIONS

CLD	Causal Loop Diagram
DEA	Department of Environmental Affairs
ECT	Equity Control Theory
EIA	Environmental Impact Assessment
IDP	Integrated Development Plan
MW	Megawatt
PAP	Project Affected People
PV	Photovoltaic
SIA	Social Impact Assessment
SES	Socio-ecological System

EXECUTIVE SUMMARY

Project Context

Mulilo Renewable Project Developments (PTY) LTD ("Mulilo") intends to develop seven Solar PV Facilities of 75 MW each and associated electrical infrastructure (132 kV transmission lines for each 75 MW facility) on Portions 3 and 8 of Gemsbok Bult Farm 120 and the Remaining Extent of Boven Rugzeer Farm 169 near Kenhardt in the Northern Cape (see Figure 14.1). The seven proposed 75 MW Solar PV facilities and associated transmission lines each require a separate EIA Process.

This Social Impact Assessment (SIA), compiled by Rudolph du Toit of the Council for Scientific and Industrial Research (CSIR) and externally reviewed by Ms. Liza van der Merwe (a private consultant), contributes to the abovementioned seven separate, requisite EIA processes. A single, integrative SIA has been compiled dealing with all seven sites based on the following reasons:

- The proposed project sites (as included in the official survey area) are located in very close proximity to each other and therefore present very similar baseline social conditions;
- The nature of the proposed development (i.e. solar PV electricity generation and transmission line development) is exactly the same for all the proposed projects sites. As such, the anticipated impacts resulting from the proposed developments will be similar regardless of its location; and
- Anticipated significant social impacts are expected to manifest in the urban node or sizeable human settlement in closest proximity to the proposed development (i.e. the town of Kenhardt) and not on the actual project sites. This is due to the extremely low population density of the relevant farms, its remote location and the relative absence of infrastructure and economic opportunity capable of attracting and sustaining agents of social change. Accordingly, it makes no difference on which land parcel or ERF the relative impacts originate, as the consequences resulting from such impacts are expected to manifest in Kenhardt, and can therefore be addressed in a single report.

The current land use of the proposed project areas, as well as the surrounding land parcels is zoned for agricultural development and use. The construction phase of each proposed solar PV facility would last approximately 15 months. Employment opportunities created during the construction phase for the PV projects equates to approximately 900-1 350 man months (for skilled opportunities) and approximately 1500 – 1 800 man months (for unskilled opportunities per project (i.e. seven 75 MW PV projects in total). Table 2.1 lists the anticipated number of skilled and unskilled employment associated with the solar PV plant developments as well as the associated transmission lines projects. It should be noted that the employment opportunities provided in this report are estimates and is dependent on the final engineering design and the REIPPPP Request for Proposal provisions at that point in time.

Employment opportunities to be created during the operational phase equate to 1 200 man months (for skilled opportunities) and approximately 1 680 man months (for unskilled opportunities) per project (i.e. seven 75 MW PV projects in total) over the 20 year plant lifespan.

Mulilo further proposes an Economic Development Plan which sets out to achieve the following:

- Create a local Community Trust to empower the communities-by buying them a stake in the renewable energy projects to promote economic transformation;
- Initiate a training strategy to facilitate employment from the local community; and
- Give preference to local suppliers of components for the construction of the facility.

It is important to note that a detailed project description is provided in Chapter 2 of the EIA Report. The study area is located within the ZF Mgcawu District Municipality (formerly known as the Siyanda District Municipality). The actual project footprints (on Portions 3 and 8 of Gemsbok Bult Farm 120 and the Remaining Extent of Boven Rugzeer Farm 169) are located in the !Kheis Local Municipality. However, the closest urban centre, Kenhardt, is located in the Kai !Garib Local Municipality. Given the proximity of the proposed projects to the town of Kenhardt (i.e. approximately 20 to 30 km north-east of Kenhardt); the focus of this SIA will be on the Kai !Garib Local Municipality.

Affected Socio-Economic Environment

The total population of the Kai !Garib municipal area is 65 869; of which 6 679 reside in the Kenhardt area. A total of 16 703 households are located in the Kai !Garib Local Municipality, with 35% of households being female headed. The total female population dominates the total male population by 8.5% (Kai !Garib Integrated Development Plan (IDP), 2014). The working age demographic (15 to 65 years) makes-up 70.5% of the population, whereas those below 15 years of age comprise 24.4% of the population. The +65 years age group makes-up 5.1% of the population. Accordingly, the dependency ratio (the economically active population versus the non-economically active population) is 41.9% (Stats SA, 2011).

The official unemployment rate of 10% has decreased by 6.1% since the 2011 Census measurement of 16.1%. The economic sector is dominated by agriculture which provides 51.8% of jobs, followed by the Community and Government Services sector with 15.9%.

Informants[1] in Kenhardt indicated that levels of unemployment in the town are particularly high (i.e. higher than reflected in the relevant census data). All informants indicated that the vast majority of the economically active population are dependent on some form of government subsidy[2] (reported to be approximately R 1300 per person per month). Subsequently, the local labour market appears to offer very limited absorption of the economically active population component (i.e. approximately 4675 employment opportunities, based on a 70.5% working age demographic for the Kai !Garib municipal area) of the 6679 inhabitants of the Kenhardt area.

Public infrastructure (public telephones, the public swimming pool and benches) was vandalised to an extent that will probably render future utilisation impossible without municipal upgrades. Acts of social disorder, such as loitering and vandalism, are regularly associated with poverty and elevated levels of distress within communities (Richardson & Shackleton, 2014). According to Fisher and Baron’s (1982) Equity-Control Theory (ECT), acts of vandalism are often triggered by a perceived violation of norms related to fairness in terms of social and environmental arrangements. According to the ECT, acts of vandalism can be understood as an attempt to reduce inequality.

Informants further indicated that teenage pregnancies and drug abuse were major social issues in Kenhardt, and that the prevalence of these issues is increasing. This claim is validated by secondary data contained in the Kai !Garib Draft IDP (2014), which lists teenage pregnancy and drug abuse as major social challenges within the larger municipal area. Both these issues elevate the local dependency ratio, thereby placing already stressed livelihood strategies under even more strain.

It is suggested that teenage pregnancy is positively related to elevated levels of poverty, associated idleness and inappropriate forms of recreation (Were, 2007). Poverty and limited recreation opportunities appear to be clear contributing factors to the high teenage pregnancy rate. However, poor sex education, limited understanding of and access to modern contraception and lack of parental guidance are likely exacerbating factors.

[1] Sociological research ethics dictates that the identity of informants (i.e. those being interviewed) should be protected if *any* possibility of physical, mental, emotional or legal harm exists. Accordingly, the identities of informants are not disclosed in this study.

[2] ‘Subsidy’ is used here to represent a variety of government subsidies.

Informants complained that informal shop owners and traders are generally foreign nationals and are not seen as members of the community. This outsider versus insider experience, coupled with a dependency of the local community on the services offered by outsiders, appears to generate feelings of distrust and vulnerability. This existing outsider versus insider phenomenon suggests that the local community could be sensitive to the influx of job seekers and other forms of in-migration into Kenhardt.

Informants further reported frustration regarding job creation expectations created by other developments in the area. Consequently, the Kenhardt community is likely to be particularly sensitive to similar expectation which could be created by the proposed developments.

Methods

Applied Anthropological Methods

Collection of primary data during the site visit was guided by a Participant Observation Methodology (Anderson & Taylor, 2002). Participant observation is an applied anthropological approach, whereby the researcher 'becomes' a resident in the community for a given period of time to observe the normal daily lives of community members and to conduct informal interviews with informants. The intention of interviews is to uncover the major livelihood strategies present in the study area, to understand the key socio-economic challenges, and gain insights into the 'constructed reality' of the Kenhardt community. Observation of community members' lives, routines and living environments help to gain insight into practices, patterns and processes which community members may not be consciously aware of.

Systems Theory

Conventional SIA reports generally describe the affected environment in terms of social and economic conditions, with only very cursory references to the biophysical environment. Due to the inherent complexity of human-nature interaction, and the profound impacts resulting from this interaction, a more holistic approach was adopted towards understanding and representing the affected environment. Accordingly, the receiving environment and subsequent impacts thereon were viewed and interpreted as a coupled socio-ecological system (SES). This approach is a radical departure from viewing the receiving environment as a loose collection of independent economic, social and environmental variables.

Vulnerability Context

Finally, an Asset Pentagon has been used to interpret the collected information. An Asset Pentagon is an assessment method developed within the discipline of Livelihoods Assessment, and aims to establish the vulnerability context of a given social grouping. People's access to productive assets (Human-, Social-, Natural-, Physical- and Financial capital) lies at the heart of their vulnerability context. Generally, the greater access people have to assets, the more livelihood strategies are available and the easier it is for them to switch from one strategy to the next. Conversely, limited access to assets results in reduced livelihood strategies and impaired ability to assume alternative strategies should the need arise.

Assessment of Impacts and Identification of Management Actions

Potential Impact 1: Influx of Jobseekers

Construction of the proposed projects (i.e. seven Solar PV facilities and associated transmission lines) is likely to attract job seekers to the town of Kenhardt. Such an influx generally causes a disturbance in the existing social order as prevailing leadership, kinship and social control mechanisms are challenged by new and alternative values, beliefs and practices. The impact is expected to be ***medium to long term*** in duration and ***local in extent***. Influx of job seekers into the study area is therefore rated as having a ***moderate significance (negative)*** rating before mitigation. Should the mitigation measures discussed below be implemented, this significance rating should reduce to ***low***.

- *Mitigation*

  The proponent must develop a Workforce Recruitment Policy. The proponent should also clearly define who is considered to be local (Kenhardt) residents; known as the Project Affected People

(PAP). It is also suggested that the proponent assembles a database of local residents and their relevant skills and experience well in advance of the construction phase of the proposed projects. Finally, the proponent should develop a Stakeholder Engagement Plan which sets-out the communication strategy to be followed with regards to the proposed solar development and transmission lines.

Potential Impact 2: Increases in Social Deviance

In-migration into the study area, particularly Kenhardt, is likely to increase the incidence of teenage pregnancies, drug abuse, prostitution and other social disorders. This impact is expected to be ***medium term*** in duration and ***local*** in extent. Increases in social deviance within the study area are therefore rated as having a ***moderate significance (negative)*** rating before mitigation which will drop to ***low significance*** with mitigation. Increases in social deviance are extremely difficult to control and often lie outside the exclusive control of the proponent as it is driven by complex socio-ecological conditions related to poverty and feelings of hopelessness.

- *Mitigation*
  The mitigation measures proposed for Potential Impact 1 must also be used to mitigate impacts resulting from increases in social deviance, as Potential Impact 1 is a precursor to Potential Impact 2. Furthermore, the proponent must be contractually bound to deliver on its Economic Development Plan for the area once the proposed project is successfully selected as a preferred bidder.

Potential Impact 3: Expectations regarding jobs

Informants in the Kenhardt area indicated a significant level of frustration with other proposed developments in the area due to expectations of possible employment. Unrealised expectations in a poor community could lead to feelings of desperation, disempowerment, anger and a general distrust in developers. In isolated cases, such frustration of expectations might lead to malicious damage of project property and intimidation of employees. The impact is expected to be ***short term*** in duration and ***local in extent***. Expectations regarding jobs are therefore rated as having a ***low significance (negative)*** rating before mitigation. Should the mitigation measures discussed below be implemented, this significance rating will be reduced to ***very low***.

- *Mitigation*
  Proper implementation of the Stakeholder Engagement Plan proposed for Potential Impact 1 should lead to realistic expectations of employment for most of the local community.

Potential Impact 4: Local Spending

Procurement of goods and services in the Kenhardt area during the construction and operational phase of the proposed project is likely to hold socio-economic benefits as a result of the multiplier effect (i.e. the increase in final income resulting from a new injection of spending). A secondary positive impact might result from entrepreneurial development in the project area especially in the service industry. The impact is expected to be ***medium to long term*** in duration and ***local in extent***. Local spending in the study area is therefore rated as having a ***low significance (positive)*** rating.

- *Enhancement*
  The proponent must procure goods and services, as far as practically possible, from within the project area (with a focus on Kenhardt). It is also suggested that regularly required goods and services (e.g. food and accommodation) be obtained from as large a selection of local service providers as possible to ensure distribution of project benefits.

Potential Impact 5: Local employment

The creation of short term employment for low skilled community members in the study area, though not ideal, does provide much needed temporary financial relief, while also contributing to a sense of empowerment and dignity. The limited number of long term employment offered by the proponent provides long term (small scale) socio-economic benefit to the affected community and may also contribute to the multiplier effect, as more income generally results in greater spending. The impact is expected to be ***long term*** in duration and ***local in extent***. Local employment is therefore rated as having a ***moderate significance (positive)*** rating.

- *Enhancement*
  As recommended for Potential Impact 1, the proponent must develop a Workforce Recruitment Policy. This policy must reserve employment, where practically possible, for local residents (particularly for vulnerable groups such as women and previously disadvantaged individuals). This requirement should be contractually binding on the proponent.

Potential Impact 6: Human Development via the proposed Economic Development Plan

Mulilo indicated that an Economic Development Plan is suggested for the study area, should the proposed project be successful. The positive impacts of this plan are self-evident and will relate to the creation of employment, local spending and human capacity development. The impact is expected to be ***long term*** in duration and ***local in extent***. Human development is therefore rated as having a ***moderate significance (positive)*** rating.

- *Enhancement*
  It is proposed that the proponent must engage with local Non-governmental Organisations (NGOs), Community Based Organisations (CBOs) and local government structures to identify and agree upon relevant skills and competencies required in the Kenhardt community. The proponent should also consider aligning economic development and skills development initiatives with the Kai !Garib Local Municipality's IDP objectives.

Potential Impact 7: Job losses

It is expected that the proposed projects could possibly be decommissioned after an operational lifespan of approximately 20 years. Decommissioning of the proposed developments will result in job losses. Secondary impacts might result from incorrect decommissioning of project infrastructure which might be used for inappropriate purposes. This in turn could result in health and safety impacts on the local community. This impact is expected to be ***long term*** in duration and ***local in extent***. Job losses resulting from decommissioning within the study area are therefore rated as having a ***moderate significance (negative)*** rating before mitigation and a ***low significance (negative)*** with mitigation. This impact is however considered to be acceptable in light of the local need for employment and development.

- *Mitigation*
  The proponent must comply with relevant South African labour legislation when retrenching employees. Mulilo should also consider appropriate succession training of locally employed staff earmarked for retrenchment during decommissioning. Such training could gradually equip workers to enter gainful employment in other locally viable sectors. Finally, all project infrastructures should be decommissioned appropriately and thoroughly to avoid misuse and disposed of or re-used according to relevant standards.

Cumulative impacts

Given the relative balance between cumulative benefits and impacts, the significance rating ascribed to the cumulative impact of the proposed development is expected to be of ***long term to medium term*** in duration, ***local*** in extent and of ***moderate significance*** (negative) rating in terms of exacerbated social disruption, and of ***moderate significance*** rating (positive) in terms of local economic development.

Overall significance rating

The overall significance rating of the *negative* socio-economic impacts associated with the proposed projects is ***low*** to ***moderate***; whereas the overall significance rating of the *positive* socio-economic impacts associated with the proposed development is ***moderate***. It is therefore concluded that the prospective socio-economic benefits of the proposed projects outweigh the socio-economic losses/impacts.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R982	Addressed in the 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;	Appendix A of the EIA Report
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix B of the EIA Report
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 14.1.1
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	30 July 2014. The season of the site visit is immaterial as social impacts likely to result from the proposed project are not seasonal in nature.
e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	Section 14.1.3
f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	Section 14.3
g) an identification of any areas to be avoided, including buffers;	Not applicable as the project is not proposed in an urban area where social impacts are expected to manifest.
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;	Not applicable as the project is not proposed in an urban area where social impacts are expected to manifest.
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 14.1.5
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;	Sections 14.4.3, 14.4.4, 14.4.5 and 14.4.6
k) any mitigation measures for inclusion in the EMPr;	Sections 14.5
l) any conditions for inclusion in the environmental authorisation;	No conditions identified or required.
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	No monitoring conditions identified or required.
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 14.5
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 14.3.3.1.2
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 14.4.1
q) any other information requested by the competent authority.	External Peer Review required by the DEA. This external review report is included as an appendix to this specialist report.

14 SOCIAL IMPACT ASSESSMENT

This Social Impact Assessment (SIA) was commissioned in response to the Environmental Impact Assessment (EIA) application processes initiated by Mulilo Renewable Project Developments (PTY) LTD (Mulilo). Mulilo intends to develop seven Solar PV Facilities of 75 MW each and associated electrical infrastructure (132 kV transmission lines for each 75 MW facility) on Portions 3 and 8 of Gemsbok Bult Farm 120 and the Remaining Extent of Boven Rugzeer Farm 169 near Kenhardt in the Northern Cape (see Figure 14.1). The seven projects are indicated in Table 14.1.

14.1 INTRODUCTION AND METHODOLOGY

Table 14.1: Seven Preferred Solar PV Facilities proposed by Mulilo near Kenhardt in the Northern Cape

No	Solar PV Project	Project Site
1.	Gemsbok Solar PV3	Portion 3 of Gemsbok Bult Farm 120
2.	Gemsbok Solar PV4	Portion 3 of Gemsbok Bult Farm 120
3.	Gemsbok Solar PV5	Portion 8 of Gemsbok Bult Farm 120
4.	Gemsbok Solar PV6	Portion 8 of Gemsbok Bult Farm 120
5.	Boven Solar PV2	Remaining Extent of Boven Rugzeer Farm 169
6.	Boven Solar PV3	Remaining Extent of Boven Rugzeer Farm 169
7.	Boven Solar PV4	Remaining Extent of Boven Rugzeer Farm 169

This SIA has been compiled by Rudolph du Toit of the Council for Scientific and Industrial Research (CSIR) and externally reviewed by Ms. Liza van der Merwe (a private consultant). As part of the acceptance of the Scoping Reports (letters dated 28 and 29 January 2016 of the Gemsbok and Boven PV projects respectively), the Department of Environmental Affairs (DEA) requested for an external review of the SIA to be conducted. The review report is included as Appendix 10.A of this report.

A single integrative SIA, dealing with all seven proposed sites, has been compiled based on the following reasons:

- The proposed project sites (as included in the official survey area) are located in very close proximity to each other and therefore present very similar baseline social conditions;
- The nature of the proposed development (i.e. solar PV electricity generation and transmission line development) is exactly the same for all the proposed project sites. As such, the anticipated impacts resulting from the proposed developments will be similar regardless of its location; and
- Anticipated significant social impacts are expected to manifest in the urban node or sizeable human settlement in closest proximity to the proposed development (i.e. the town of Kenhardt) and not on the actual project sites. This is due to the extremely low population density of the relevant farms, its remote location and the relative absence of infrastructure and economic opportunity capable of attracting and sustaining agents of social change. Accordingly, it makes no difference on which land parcel or ERF the relative impacts originate, as the consequences resulting from such impacts are expected to manifest in Kenhardt, and can therefore be addressed in a single report.

A SIA can be defined as the process of determining *"[t]he consequences to human populations of any public or private actions (these include policies, programmes, plans and/or projects) that alter the ways in which people live, work, play, relate to one another, organise to meet their needs and generally live and cope as members of society. These impacts are felt at various levels, including individual level, family or* *household level, community, organisation or society level. Some social impacts are felt by the body as a physical reality, while other social impacts are perceptual or emotional*" (Barbour, 2007).

Evidently, the realm of human experience is characterised by subjectivity; both in terms of affected community's experiences and the SIA practitioner's interpretation of such experiences. Such subjectivity is known as the "social construct of reality" (Anderson & Taylor, 2002). However, social well-being can largely be agreed upon regardless of ones worldview. Accordingly, the SIA process must be committed to the following objectives (Barbour, 2007):

- The principles of sustainable development and social sustainability;
- Vulnerable groups;
- Meeting basic needs and services;
- Livelihood strategies;
- Fairness and equity;
- Social justice;
- Openness and participation; and,
- Accountability.

In pursuit of these objectives, it is imperative that an SIA looks beyond the direct positive and negative impacts likely to result from proposed projects and looks at promoting the well-being of communities potentially affected by a project by addressing entrenched structural issues of empowerment, minority groups, gender issues and poverty reduction.

14.1.1 Scope and Objectives

This SIA Report investigates the potential social disruptors and associated social impacts likely to result from the development of the proposed seven 75 MW solar PV facilities and associated transmission lines proposed by Mulilio near Kenhardt in the Northern Cape Province. In this regard, the study focuses on the town of Kenhardt and not the individual land parcels on which the proposed projects will develop, as all of the significant anticipated social impacts will be experienced in the urban area nearest to the proposed developments (i.e. Kenhardt). Social disruptors and impacts under investigation are those which are most likely to significantly influence social and cultural concerns, values, consequences and benefits to communities.

The objective of this SIA is to assist with informed decision-making by the competent authority (DEA) as, as well as the development of appropriate management directives, as it relates to the consideration of social impact likely to result from the proposed development.

14.1.2 Terms of Reference

The SIA will include:

- A review of existing information, and collecting and reviewing baseline social information etc.
- Conducting interviews with key affected parties, including local communities, local landowners, key government officials (local and regional) etc.
- An identification and assessment of key social issues and potential impacts (negative and positive) associated with the construction, operational and decommissioning phases of the proposed projects.
- An identification of potential mitigation and enhancement measures.
- A specialist report which includes an assessment of the potential social impacts associated with the proposed projects.

- An outline of mitigatory measures and additional management or monitoring guidelines.
- Provide input to the Environmental Management Programme (EMPr), including mitigation and monitoring requirements to ensure that negative social impacts are limited.

14.1.3 Study Approach and Methodology

This SIA consulted secondary data sources (published documentation) to obtain basic socio-economic baseline demographics. This secondary data was then augmented with primary data generated by a site visit to the proposed project site as well as the town of Kenhardt and the surrounding areas.

14.1.3.1 Applied Anthropological Methods

Collection of primary data during the site visit was guided by a Participant Observation Methodology (Anderson & Taylor, 2002). Participant observation is an applied anthropological approach, whereby the researcher 'becomes' a resident in the community for a given period of time to observe the normal daily lives of community members and to conduct informal interviews with informants. The intention of interviews is to uncover the major livelihood strategies present in the study area, to understand the key socio-economic challenges, and gain insights into the 'constructed reality' of the Kenhardt community. Observation of community members' lives, routines and living environments help to gain insight into practices, patterns and processes which community members may not be consciously aware of.

14.1.3.2 Systems Theory

Conventional SIA reports generally describe the affected environment in terms of social and economic conditions, with only very cursory references to the biophysical environment. Due to the inherent complexity of human-nature interaction, and the profound impacts resulting from this interaction, a more holistic approach was adopted towards understanding and representing the affected environment. Accordingly, the receiving environment and subsequent impacts thereon were viewed and interpreted as a coupled socio-ecological system (SES). This approach is a radical departure from viewing the receiving environment as a loose collection of independent economic, social and environmental variables.

Systems theory provides insight into complex system relationships by interpreting a given system through the following set of principles:

- Complex systems **are open systems** (i.e. free interaction with other systems across systemic boundaries);
- Complex systems operate under conditions **not at equilibrium** (i.e. supply and demand of systemic services are not in balance, also known as redundancy in cases of over supply);
- Complex systems have an **asymmetrical structure** (i.e. structure is maintained, though component parts my change);
- Complex systems consist of **many** components;
- In a complex system, components on average **interact with many others** via numerous possible routes;
- Some sequences of interaction within complex systems will result in **feedback routes;**
- Parts of a complex system interact in non-linear ways to create properties and behaviours which is not inherent to the system's component parts; known as **emergence.**

Subsequently, typical socio-economic baseline data is then represented in a Causal Loop Diagram (CLD) to illustrate the systemic causal linkages between variables present in the SES in which the study area is located.

14.1.3.3 Vulnerability Context

Finally, an Asset Pentagon has been used to interpret the collected information. An Asset Pentagon is an assessment method developed within the discipline of Livelihoods Assessment, and aims to establish the vulnerability context of a given social grouping. People's access to productive assets (Human-, Social-, Natural-, Physical- and Financial capital) lies at the heart of their vulnerability context. Generally, the greater access people have to assets, the more livelihood strategies are available and the easier it is for them to switch from one strategy to the next. Conversely, limited access to assets results in reduced livelihood strategies and impaired ability to assume alternative strategies should the need arise.

As a result, the SIA research approach is descriptive in nature and uses indicative reasoning to reach its impact assessment findings. In terms of the impact assessment, the methodology adopted is outlined in Chapter 4 of the EIA Report.

14.1.4 Information Sources

The primary and secondary data sources used in the SIA include:

- Primary data generated through participant observation techniques;
- The South African Guideline for Involving Social Assessment Specialists in EIA (Barbour, 2007);
- The Kai !Garib Local Municipality Draft IDP of 2014;
- Orlight SA (Pty) Ltd's "Kenhardt Solar PV Power Plant"; BioTherm (Pty) Ltd's "Aries Solar PV Facility"; AES Solar Energy Limited's "Olvyn Kolk PV Power Plant" and the Eskom SOC's "Aries-Helios 765 kV transmission line upgrade");
- The 2011 Census report (Statistics South Africa (StatsSA), 2011); and
- Academic journal articles on the topics of vandalism, teenage pregnancy and poverty such as Ceccato and Haining (2005).

14.1.5 Assumptions and Limitations

Secondary data on the study area is very limited. The site visit was therefore intended to gather sufficient primary data to guide the SIA. However, information gathered during the site visit generally carries a medium level of confidence as the SIA is an applied research method, as opposed to a scientific research method. This means that much less time and resources are available for primary research and the subsequent verification of findings. As a result, the majority of significance ratings ascribed to both the potential positive and negative impacts resulting from the proposed solar PV facilities and associated transmission lines were given a ***medium*** confidence rating.

The SIA[3] assumes that the majority of socio-economic impacts will be experienced in the town of Kenhardt; due to its proximity to the project site. It is however possible for socio-economic impacts to be experienced in other urban nodes close to the project site. The project boundary, in terms of socio-economics, is therefore arbitrarily constructed.

Various energy-related developments are present in the general study (i.e. within a 50 km radius) area and were considered in this study (e.g. Mulilo Renewable Project Developments (Pty) Ltd's "Phase 1 and Phase 2- Nieuwehoop Solar PV Power Plants"; Orlight SA (Pty) Ltd's "Kenhardt Solar PV Power Plant"; BioTherm (Pty) Ltd's "Aries Solar PV Facility"; AES Solar Energy Limited's "Olvyn Kolk PV Power Plant",

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[3] This study is a SIA as per the definition contained in the *Guideline for Involving Social Assessment Specialists in the EIA Process* (Barbour, 2007): "*Social impacts can be defined as 'The consequences to human populations of any public or private actions (these include policies, programmes, plans and/or projects) that alter the ways in which people live, work, play, relate to one another, organise to meet their needs and generally live and cope as members of society'*".

Eskom SOC's "Aries-Helios 765 kV transmission line upgrade" and the Scatec Solar 163 (Pty) Ltd "Onder Rugzeer Kenhardt PV 1, 2 & 3 PV Power Plants"). However, when considering cumulative impacts, the combined impacts of *all* developments in a given area should be considered; not only the impacts resulting from *similar* activities/projects. Clearly, considering the possible socio-economic impacts likely to result from all development in an arbitrarily defined study area is not practically possible in the limited timeframe of the EIA process. However, this SIA attempts to identify and understand the cumulative socio-economic impacts likely to result from the interaction of similar (i.e. solar energy and electrical infrastructure developments) development activities within the general study area. Chapter 4 of the EIA Report notes the developments within a 20 km radius that have been considered in order to assess cumulative impacts.

In terms of the employment estimates, the man months noted in this study, which are also known as "person months", is the total number of employees in each of the Contract Months, within the Construction Measurement Period and the Operating Measurement Period, as applicable. It should be noted that the said "person months" are, at present, best estimates only and could well change once the project is initiated.

14.1.6 Declaration of Independence of Specialist

Refer to Appendix A of this EIA Report for the Curriculum Vitae of Rudolph du Toit, which highlights his experience and expertise. The declaration of independence by the specialist is provided in Box 13.1 below and included in Appendix B of this EIA Report.

BOX 13.1: DECLARATION OF INDEPENDENCE

I, Rudolph du Toit, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed Kenhardt PV Facilities and Transmission Lines Project, application or appeal in respect of which I was appointed, other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

RUDOLPH DU TOIT

14.2 PROJECT CONTEXT (SOCIO-ECONOMICS)

14.2.1 Project Information

As noted above, Mulilo intends to develop seven Solar PV Facilities of 75 MW each and associated electrical infrastructure (132 kV transmission lines for each 75 MW facility) on Portions 3 and 8 of Gemsbok Bult Farm 120 and the Remaining Extent of Boven Rugzeer Farm 169 near Kenhardt in the Northern Cape (see Figure 14.1). The seven proposed 75 MW Solar PV facilities and associated transmission lines each require a separate EIA Process.

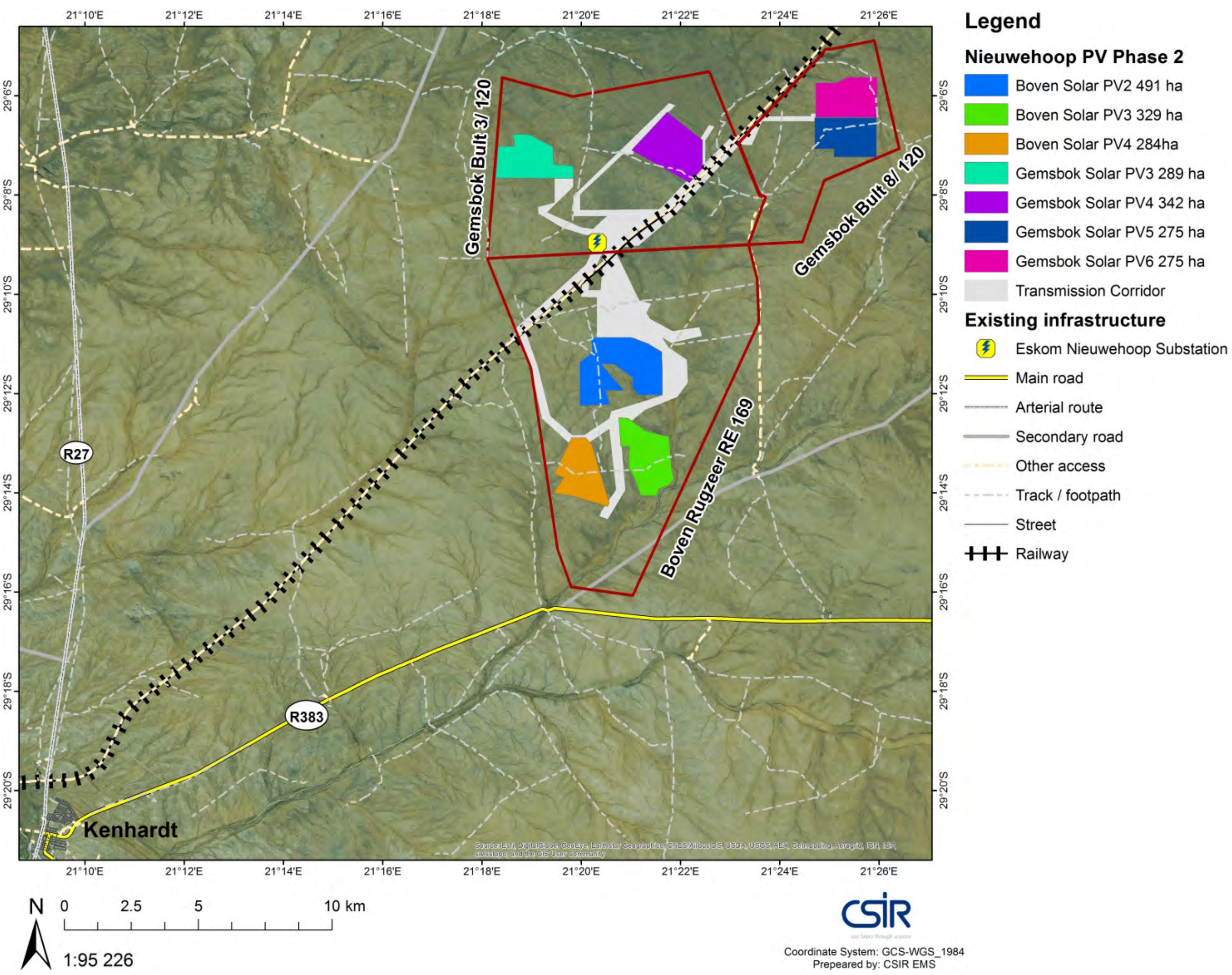

Figure 14.1: Preferred site locations of the seven proposed Photovoltaic Facilities near Kenhardt in the Northern Cape.

The current land use of the proposed project areas, as well as the surrounding land parcels is zoned for agricultural development and use. The construction phase of each proposed solar PV facility would last approximately 15 months. Employment opportunities created during the construction phase for the PV projects equates to approximately 900 -1 350 man months (for skilled opportunities) and approximately 1 500 – 1 800 man months (for unskilled opportunities per project (i.e. seven 75 MW PV projects in total). Table 14.2 lists the anticipated number of skilled and unskilled employment associated with the solar PV plant developments as well as the associated transmission lines projects. It should be noted that the employment opportunities provided in this report are estimates and is dependent on the final engineering design and the REIPPPP Request for Proposal provisions at that point in time.

Employment opportunities to be created during the operational phase equate to 1 200 man months (for skilled opportunities) and approximately 1 680 man months (for unskilled opportunities) per project (i.e. seven 75 MW PV projects in total) over the 20 year plant lifespan.

Mulilo further proposes an Economic Development Plan which sets out to achieve the following:

- Create a local Community Trust to empower the communities-by buying them a stake in the renewable energy projects to promote economic transformation;
- Initiate a training strategy to facilitate employment from the local community; and
- Give preference to local suppliers of components for the construction of the facility.

It is important to note that a detailed project description is provided in Chapter 2 of the EIA Report.

Table 14.2: Anticipated skilled and unskilled employment opportunities created during construction and operational phases of each project

MULILO'S SEVEN 75 MW SOLAR PV POWER PROJECTS (INCLUDING ASSOCIATED TRANSMISSION INFRASTRUCTURE):	
Construction phase	**Man Months (for each project)*** **Man months is also known as "Person Months": means the total number of Employees in each of the Contract Months, within the Construction Measurement Period and the Operating Measurement Period, as applicable, which are adjusted for the actual working time, compared to normal working time.**
PV project - between 60 and 90 skilled and 100 and 120 unskilled employment opportunities are expected be created during the construction phase.	Skilled: 60 * 15 months = 9 00 man months Skilled: 90 * 15 months = 1 350 man months Unskilled: 100 * 15 = 1 500 man months Unskilled: 120 * 15 = 1 800 man months
Operation phase	
PV Project - approximately 5 skilled and 7 unskilled employment opportunities will be created over the 20 year lifespan of the proposed facility	Skilled: 5 * 240 months = 1 200 man months Unskilled: 7 * 240 months = 1 680 man months

14.2.2 Legal, Policy and Planning Context

The Integrated Development Plan (IDP) (2015) for the Kai! Garib Local Municipality was considered in the drafting of this specialist study, due to its specific relevance to social and economic considerations related to proposed developments. Note that other key statutes were also considered in drafting this study (i.e. National Environmental Management Act (NEMA); National Heritage Act; and the Development Facilitation Act), but are discussed in greater detail in Chapter 4 of this EIA Report.

14.2.2.1 Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)

Section 24 of the Constitutional Act states that everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures, that –

i. Prevents pollution and ecological degradation;
ii. Promotes conservation; and
iii. Secures ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

In support of the above rights, the environmental management objectives of proposed projects are to protect ecologically sensitive areas and support sustainable development and the use of natural resources, whilst promoting justifiable socio-economic development in the towns nearest to the project sites.

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

The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) requires cooperative environmental governance by establishing principles for decision making on matters affecting the environment, institutions that will promote cooperative governance and procedures for coordinating environmental functions exercised by organs of state. NEMA also aims to achieve sustainable development. In this regard NEMA requires the integration of social, economic and environmental factors into planning, implementation and decision-making to ensure that development serves present and future generations.2.2.3 National Heritage Resources Act, 1999 (Act No. 25 of 1999)

The National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) transfers responsibility for the identification of local heritage resources and the inclusion of heritage areas to all municipalities in South Africa. Developers/proponents need to integrate the NHRA into relevant planned projects and obtain approval (if necessary) from the relevant heritage authorities or municipalities before commence of the project.

14.2.2.3 Integrated Development Plan, 2015 for the Kai !Garib Local Municipality

The objective of the IDP is to create an economically viable and maturely developed municipality, which enhances the standard of living of all the inhabitants and communities through good governance and excellent service. The IDP has identified key priority issues for the municipality.

14.2.2.4 Development Facilitation Act (Act 67 of 1995)

The Development Facilitation Act, 1995 (Act 67 of 1995) (DFA) sets out a number of key planning principles which have a bearing on assessing proposed developments in light of the national planning requirements. The planning principles most applicable to the study area include:

- Promoting the integration of the social, economic, institutional and physical aspects of land development;
- Promoting integrated land development in rural and urban areas in support of each other;
- Promoting the availability of residential and employment opportunities in close proximity to or integrated with each other;
- Optimising the use of existing resources including such resources relating to agriculture, land, minerals, bulk infrastructure, roads, transportation and social facilities;
- Contributing to the correction of the historically distorted spatial patterns of settlement in the Republic and to the optimum use of existing infrastructure in excess of current needs;
- Promoting the establishment of viable communities; and,
- Promoting sustained protection of the environment.

14.3 AFFECTED SOCIO-ECONOMIC ENVIRONMENT

The intention of this section is to provide background information of the socio-economic baseline conditions present in the study area. Information sources used to compile the socio-economic baseline consists of both primary (a site visit conducted on the 30 July 2014) and secondary research (relevant published literature and policy documents).

14.3.1 Socio-economic Baseline Data

14.3.1.1 Secondary Data

The study area is located within the ZF Mgcawu District Municipality (formally known as the Siyanda District Municipality). The actual project footprints (I.e. Portions 3 and 8 of Gemsbok Bult Farm 120 and the Remaining Extent of Boven Rugzeer Farm 169) are located in the !Kheis Local Municipality (part of the ZF Mgcawu District Municipality). However, the closest urban centre, Kenhardt, is located in the Kai !Garib Local Municipality. Given the proximity of the proposed projects to the town of Kenhardt; the focus of this SIA will be on the Kai !Garib Local Municipality (Figure 14.2), as this is where the vast majority of potential project impacts (both positive and negative) might manifest.

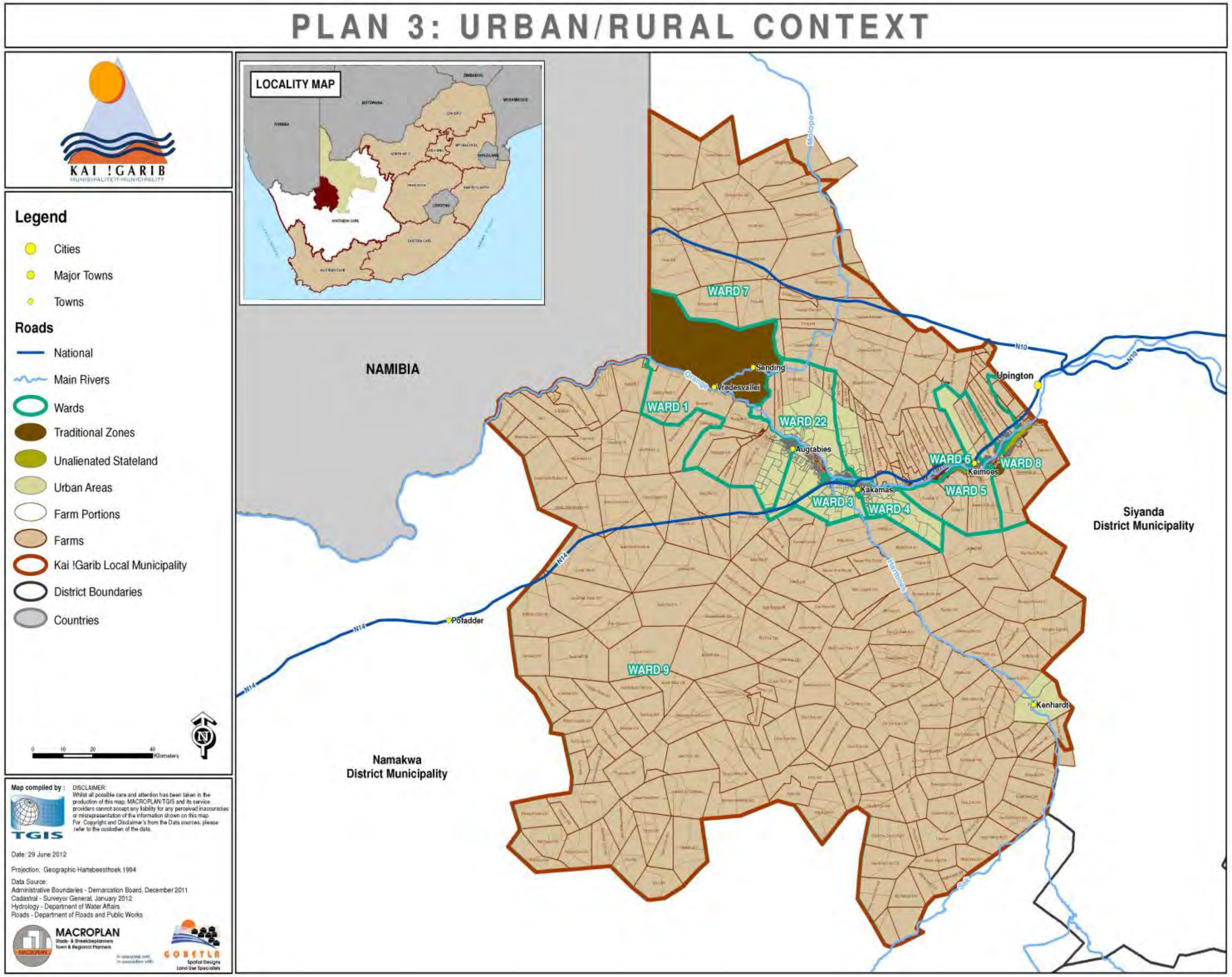

Figure 14.2: Kai !Garib Local Municipality

(Source: Kai !Garib IDP, 2015)

Regional Demographics

According to the Kai !Garib IDP (2015) and the Stats SA 2011 Census data, the total population of the Kai !Garib municipal area is 65 869; of which 6 679 resides in the Kenhardt area. A total of 16 703 households resides in the Kai !Garib Local Municipality, with 35% of households being female headed. The total female population dominates the total male population by 8.5% (Kai !Garib IDP, 2015). Population of the working age demographic (15 to 65 years) makes-up 70.5% of the population, whereas those below 15 years of age comprises 24.4% of the population; the + 65 years age group makes-up 5.1% of the population. Accordingly, the dependency ratio (the economically active population vs the non-economically active population) is 41.9% (Stats SA, 2011).

Regional economic status

Income distribution within the study area is extremely skewed, with a high percentage of the population living in extreme poverty. Approximately 60 % of ZF Mgcawu DM's population has an income of between R 0 to R 800 per month. Approximately 7.7% of the population of the !Kheis Local Municipality has no income, whereas the majority of the population (i.e. 28.30 %) earns between the R 19 601 – R 38 200 income bracket. The 2011 census indicates that 22 % and 34 % of the economically active population (between the ages of 15-34) in the ZF Mgcawu DM and the !Kheis Local Municipality, respectively, are unemployed. The !Kheis Local Municipality has the highest unemployment percentage of all the local municipalities falling within the ZF Mgcawu DM. Also, nearly a third of the population is economically inactive which suggests that individual and household incomes generated in the study area are being used to support a substantial amount of dependents. This in turn exacerbates the level of household vulnerability in the area.

The unemployment rate for the !Kheis Local Municipality in 2001 was 20 % and in 2011 was 28 % (Statistics SA, 2015). The official unemployment rate of 10 % (based on the 2011 Census) has decreased by 6.1 % since the 2001 Census measurement of 16.1 % for the Kai !Garib Local Municipality. The economic sector is dominated by agriculture which provides 51.8 % of jobs, followed by the Community and Government Services sector with 15.9 % (Figure 14.3). The number of jobs generated by the agricultural sector needs to be interpreted within the context of the Kai !Garib Municipality. The vast majority of the land area occupied by the Kai !Garib Municipality consists of agricultural land, accordingly, it is unsurprising that agriculture would register as the major employer at municipal (i.e. regional) level.

However, the distribution of jobs within urban centres, like Kenhardt, does not necessarily follow this agriculturally dominated pattern. If the prevailing practice of predominantly male-oriented employment within the agricultural sector (specifically in terms of sheep farming) is assumed, the 51.8 % of jobs generated by the agricultural sector could in fact be heavily skewed towards men. This in turn is suggestive of a female dominated population (dominating the male population by a ratio of 8.5%) which is heavily dependent on other economic sectors (i.e. non-agricultural sectors) for their income, and could very well imply that socio-economic impacts on urban centres, from which the majority of non-agricultural work opportunities originate, could be of more significance than farm-based impacts.

Regional educational status

In terms of education, 9.5 % of the total population of ZF Mgcawu DM has no formal schooling, while 13.5 % of the !Kheis Local Municipality's population is unschooled. Based on the 2011 Census, 3.1 % of the population of the !Kheis Local Municipality has no form of education, 55 % has some primary schooling, 7.5 % completed primary school, 5.7 % completed secondary school and 0.5 % has higher education

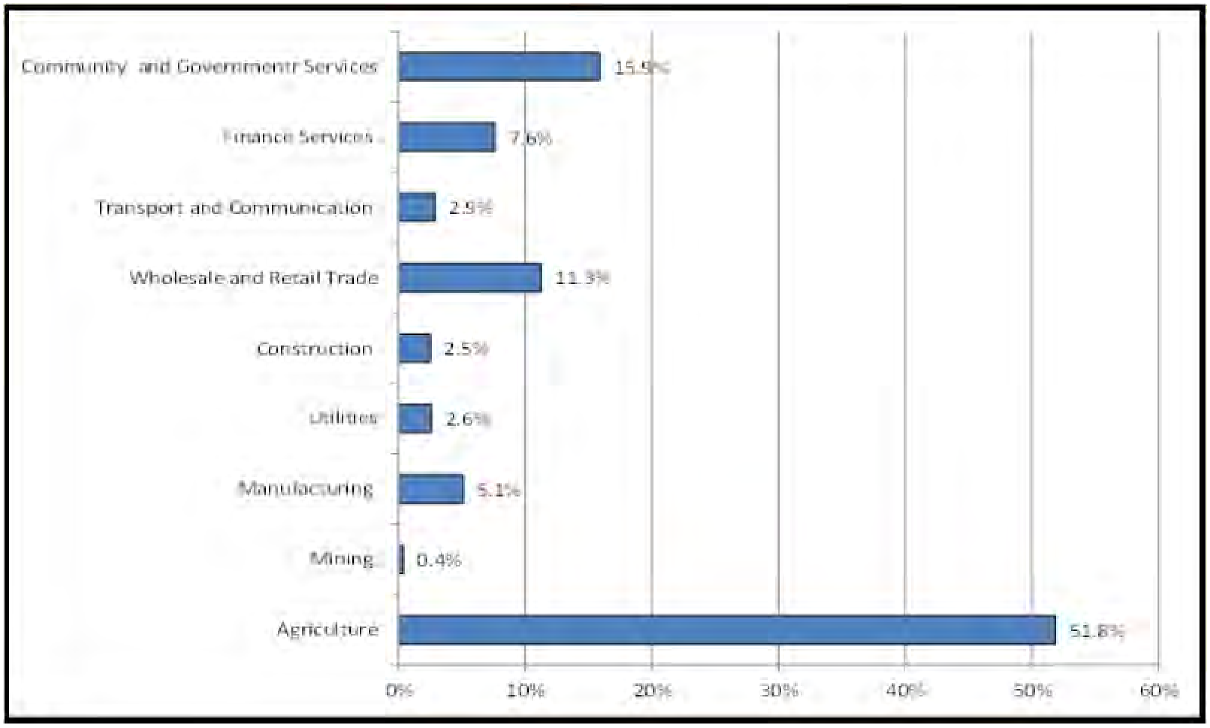

Figure 14.3: Most active economic sectors within the Kai !Garib Local Municipality

(Source Kai !Garib IDP, 2015)

Significant regional social challenges

The major social challenges faced in the Kai !Garib Municipal area include (Kai !Garib IDP, 2015):

- Increases in drug abuse;
- Increases in children under 10 years abusing alcohol;
- Increases in teenage pregnancies;
- Increased crime linked to alcohol and drug abuse;
- High youth unemployment rates; and
- Increased prevalence of HIV & AIDS.

14.3.1.2 Fieldwork

Clearly, the above mentioned figures and findings relate to the larger municipal area and subsequently provide limited detailed information regarding the actual study area (i.e. Kenhardt and surrounding areas). Furthermore, a dramatic difference in landscape character and environmental features occurs throughout the Kai !Garib municipal area that are due to the availability of irrigation water along the areas immediately adjacent to the Orange River. For example, due to the higher productivity of areas under irrigation, the total employment opportunities in the municipal area (especially in the agricultural and support services sector) tend to be limited to the banks of the Orange River. It is therefore safe to assume that Kenhardt, being located approximately 70 km away from the Orange River, has a different profile in terms of employment figures, as well as the various socio-economic impacts resulting from gainful employment. Consequently, it was deemed necessary to supplement the limited secondary data with a site visit to Kenhardt and the surrounding area to try and obtain useful data relating to socio-economic conditions.

Informants[4] in Kenhardt indicated that levels of unemployment in the town are particularly high. All informants interviewed indicated that the vast majority of the economically active population is dependent on some form of government subsidy (reported to be approximately R 1300 per person per month). These statements appear to be reliable given the very limited amount of businesses operating within Kenhardt. Businesses generally consist of liquor stores, restaurants and accommodation (Bed and Breakfast), with only one observed clothing store (PEP) and one general dealer (KLK). Employment figures for these businesses appear to range from a minimum of one to a maximum of four employees. Agriculture in the Kenhardt area is dominated by sheep farming which requires particularly low levels of labour (approximately 2-4 labours per farm) (R. Grobbelaar, personal communication, 31 July 2014), with limited seasonal increases in labour requirements during the shearing season. Larger employers in Kenhardt include the local high school, the Kai !Garib municipal offices, the Department of Social Development satellite office and the local police station.

Subsequently, the local labour market appears to offer very limited absorption of the economically active component (i.e. approximately 4675 employment opportunities, based on a 70.5% working age demographic for the Kai !Garib municipal area) of the 6679 inhabitants of the Kenhardt area.

Participant observation further supports the claim of high unemployment. Groups of young men (approximately 16 to 30 years of age) where observed loitering on various street corners during the normal working hours of both days of the site visit (a Wednesday and Thursday during the weekday). Furthermore, public infrastructure (public telephones, the public swimming pool and benches) where vandalised to such an extent that further use of these facilities is impossible. Acts of social disorder, such as loitering and vandalism, are regularly associated with poverty and elevated levels of distress within communities (Richardson & Shackleton, 2014). According to Fisher and Baron's (1982) Equity-Control Theory (ECT), acts of vandalism are often triggered by a perceived violation of norms related to fairness in terms of social and environmental arrangements. From this perspective, acts of vandalism can be understood as an attempt to reduce inequality.

Ceccato and Haining (2005) report that vandalism is particularly obvious in areas with low social integration and organisation; whereas Nowak *et. al.* (1990) reports higher levels of vandalism in areas with high unemployment rates and low private property ownership. A possible alternative interpretation of social disorder could be the "Broken Windows" theory put forward by Wilson and Keeling (1982). According to this theory, the presence of vandalism (or social disorder), however minor, creates a condition in which further vandalism is sanctioned; thereby increasing its frequency. However, acts of vandalism in Kenhardt were perpetrated in the formal, well maintained precinct of the town, as well as in the informal, poorly maintained precinct. This suggests that the "Broken Windows" theory does not apply to the observed social disorder in Kenhardt.

Informants further indicated that teenage pregnancies and drug abuse were major social issues in Kenhardt, and that the prevalence of these issues is increasing. This claim is validated by secondary data contained in the Kai !Garib IDP (2015), which lists teenage pregnancy and drug abuse as major social challenges within the larger municipal area. Both these issues elevate the local dependency ratio, thereby placing already stressed livelihood strategies under even more strain.

Teenage pregnancy may be positively related to elevated levels of poverty, associated idleness and inappropriate forms or recreation (Were, 2007). Recreational opportunities in Kenhardt are extremely limited. A public rugby field and an oval racing track just outside of town are the only public recreational facilities offered. Informants identified an informal nightclub on the north-eastern outskirts of Kenhardt,

[4] Sociological research ethics dictates that the identity of informants (i.e. those being interviewed) should be protected if *any* possibility of physical, mental, emotional or legal harm exists. Accordingly, the identities of informants are not disclosed in this study.

which is associated (according to informants) with alcohol abuse and other forms of inappropriate recreation. Informants further confirmed that no internet cafes or public internet facilities are available in Kenhardt, which contributes to the overall lack of recreation/entertainment opportunities. Poverty and limited recreation opportunities may be contributing factors to the high teenage pregnancy rate. However, poor sex education, limited understanding of and access to modern contraception and lack of parental guidance are likely exacerbating factors.

With regards to teenage pregnancy; interviewed parents communicated disappointment and indignation, rather than concern about the practical implications of teenage pregnancy. This suggests a violation of existing cultural norms. It is therefore assumed that further escalation of teenage pregnancies (and/or teenage sexual activity) would continue to disrupt the Kenhardt community not only in terms of livelihoods, but also in terms of family relations. The relative lack of employment in and around Kenhardt is suggestive of a community heavily reliant on kinship and reciprocity for its economic survival. Accordingly, further deterioration of kinship ties as a result of cultural taboos might jeopardize the already precarious livelihood strategies of young mothers and their children.

A study of Kenhardt's urban form is revealing. The town displays typical apartheid planning structure, with a distinct poorer urban node (previously a coloured township) to the north and a wealthier urban node (previously white urban node) to the south. A clear buffer zone (*cordon sanitaire)* separates the two areas (Figure 14.4). The poorer urban node to the north is characterised by small ERF sizes, erratic street patterns, a significant informal housing component and no business nodes.

Conversely, the wealthier urban node to the south is characterised by larger ERF sizes, a clear grid patterned road infrastructure, a complete absence of informal structures and a business node in the shape of a ribbon development along the R 27. Furthermore, the secondary school, municipal offices, and local clinic are all located within the wealthier southern node. During fieldwork, it was also observed that informal traders are located throughout the poorer northern node, but are virtually absent from the wealthier southern node. Informants complained that informal shop owners and traders are generally foreign nationals and are not seen as 'members' of the community. This outsider versus insider experience, coupled with a dependency of the local community on the services offered by outsiders appears to generate feelings of distrust and vulnerability. A secondary issue might also be the potential "leakage" of investment from the local economy due to foreign nationals not reinvesting in Kenhardt, but rather evacuating their funds to friends and family abroad or residing elsewhere. This existing outsider versus insider phenomenon suggests that the local community could be sensitive to the influx of job seekers and other forms of in-migration into Kenhardt.

Interestingly, the poorer northern node is expanding, while the wealthier southern node remains unchanged. Figure 14.5 indicate the expansion of the northern urban node through satellite imagery from 2005 and 2013, respectively. The yellow polygons indicate new informal residential units and the orange polygons indicate densification of informal units. These images show a potentially significant residential growth in the poorer community of Kenhardt.

Figure 14.6 indicate the wealthier southern node in 2005 and 2013, respectively. No discernible growth in the formal residential housing stock can be observed. Fieldwork also revealed that some houses in the southern node are for sale. This suggests that the southern urban node may be shrinking.

The growth of informal housing in Kenhardt is difficult to explain as the town does not appear to offer any significant social or economic pull factors. Recent declines in local rainfall and subsequent knock-on effects on agriculture are unlikely to fully account for increased urbanisation, as sheep farming does not generate significant employment opportunities. It therefore seems reasonable to assume that the increase can, to a large degree, be attributed to natural growth. This would suggest that wealthier residents (residing in the south) have the ability to 'escape' from the area, should they wish to; whereas the poorer residents (residing in the north) are 'trapped' in the area, thereby causing a natural growth in population numbers. The general trend of declining birth rates among white South Africans might also be a contributing factor. This increase in population is bound to add additional strain on the livelihoods of the poor community.

The fastest growing industry in Kenhardt appears to be Bed and Breakfast (B&B) establishments. Observations during fieldwork indicated that B&Bs were the single largest industry (in terms of number of establishments, not turnover) in the town. This observation is supported by local informants who suggested that the growth in the industry is attributable to the recent increases in energy–related projects (solar energy and Eskom transmission lines) proposed in the area.

Informants further reported frustration regarding job creation expectations created by other developments in the area. Apparently, other energy-related developments in the Kenhardt area, for which EIA processes are currently underway, communicated to the community that employment opportunities will be offered to local residents. When residents established that these jobs would only materialise in 5 to 10 years' time; considerable frustration and anger was (and is) experienced. According to Barbour (2007), the expectation of an occurrence (in social terms) should be considered as an impact resulting from a planned development. Consequently, the Kenhardt community is likely to be particularly sensitive to similar expectation which could be created by the proposed development.

14.3.2 Vulnerability Context

According to the Department for International Development (DFID) (1999), a community's vulnerability context is a product of *trends*, *shocks* and *seasonality* within the context of the community being researched. Informants indicated that very little seasonal variation is experience in income levels and livelihood strategies; therefore seasonality is of negligible interest in the vulnerability context of the Kenhardt community. Shocks, interpreted as an impact of sudden occurrence which directly destroy assets or livelihood strategies, also appears to have a limited role in the Kenhardt community. Trends do however seem to have a significant impact on those living in the area. Of particular importance are the increasing trends in unemployment and social deviance (teenage pregnancies and drug abuse), as well as the decreasing trend in the relative contribution of agriculture to job creation in Kenhardt.

Figure 14.4: Urban form of Kenhardt, with the (i) red polygon indicating the historical coloured township, (ii) the yellow polygon indicating the historical white urban node; and (iii) the green arrow indicating the cordon sanitaire

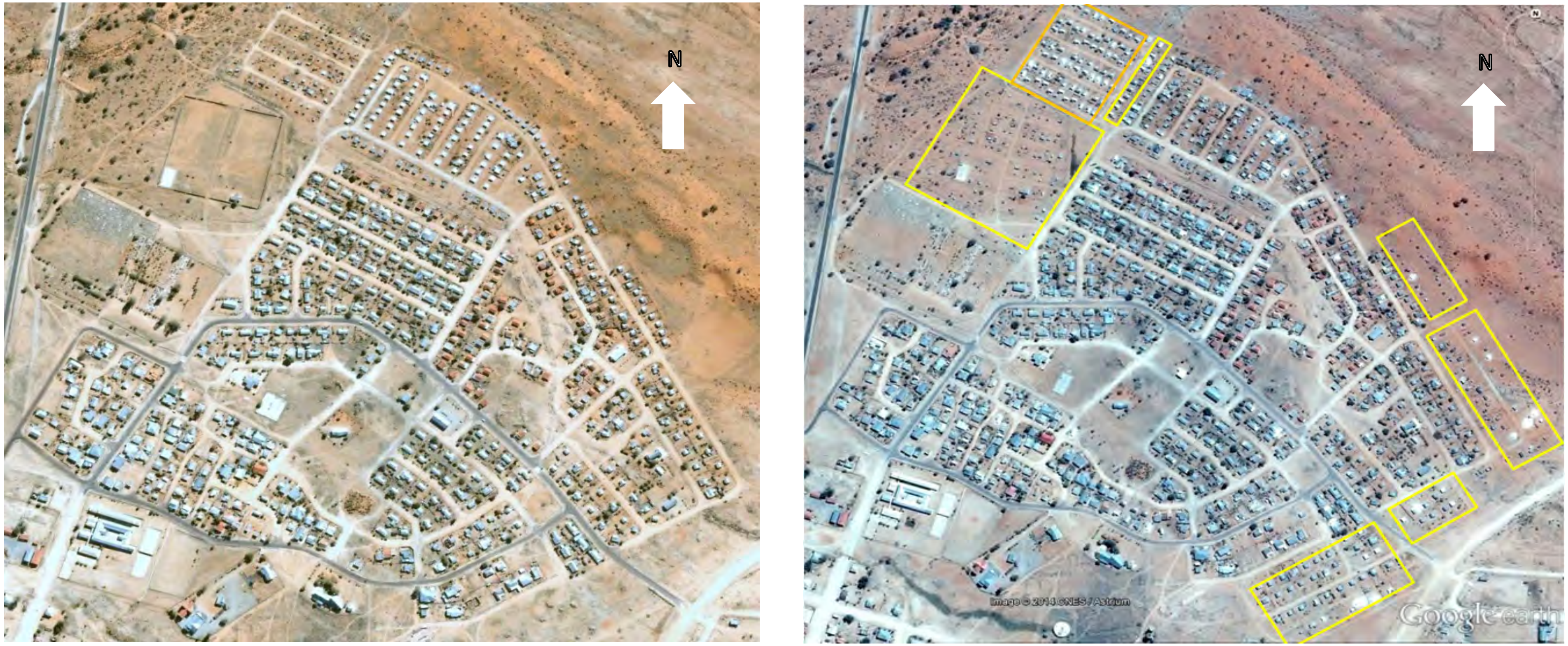

Figure 14.5: Satellite image of the poorer (northern) urban node of Kenhardt in 2005 on the left, and a satellite image of the same node in 2013 on the right; with (i) the yellow polygons indicating urban expansion; and (ii) the orange polygon indicating densification.

Figure 14.6: Satellite image of the wealthier (southern) urban node of Kenhardt in 2005 on the left, and satellite image of the same node of Kenhardt in 2013 on the right; indicating no discernible expansion or densification

People's access to productive assets (Human-, Social-, Natural-, Physical- and Financial capital) lie at the heart of their vulnerability context. Table 14.3 provides a brief explanation of the various forms of capital. Generally, the greater access people have to assets, the more livelihood strategies they have available and the easier it is for them to 'switch' from one strategy to the next. An effective way to assess access to assets is by using an Asset Pentagon (Figure 14.7).

The Asset Pentagon schematically represents variations in people's access to assets. The centre of the pentagon represents zero access to assets. Consequently, a resilient[5] community will have a pentagon characterised by a relative balance between all 5 forms of capital. Conversely, a pentagon wherein one or two capital classes dominate could be indicative of a vulnerable community.

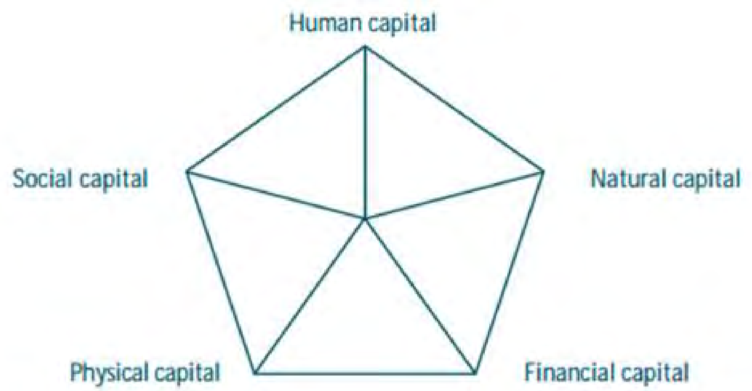

Figure 14.7: Example of an Asset Pentagon with 100% access to all 5 forms of capital

Table 14.3: Brief definition of the 5 capital forms

Capital class	Description
Human capital	Human capital signifies the ability to perform labour, skills-set, knowledge and health that empowers people to pursue different livelihood strategies and attain their livelihood objectives.
Social capital	These are the social resources available to people in the pursuit of their livelihood strategies. These include: networks and social connectedness, membership of formalised groups and/or relationships of trust reciprocity and exchange.
Natural capital	Natural capital refers to the natural resource stocks, flows and services which are beneficial for livelihoods. There are numerous natural resources that make up natural capital, from intangible services such as the atmosphere, to divisible assets used directly for production.
Physical capital	Physical capital is the basic infrastructure and producer goods, necessary for people to pursue their relevant livelihood strategies. Such capital includes; inexpensive transport, affordable energy, secure shelter, adequate and safe potable water supply, and access to information.
Financial capital	Financial capital simply refers to the financial resources people use to achieve their livelihood strategies. Generally financial capital consists of available stocks (savings, livestock, jewellery, etc.) or, regular inflows (pensions, remittances, government subsidies, etc.).
Source: DFID (1999)	

[5] The use of the term 'resilient' in this context should not be confused with 'resilience theory' (i.e. the ability of a system to accommodate change while still maintaining its core function structure and identity), but is here merely used to refer to adaptability and robustness.

The Kenhardt community appears to have acceptable access to both Human and Social capital. Informants reported that community members are generally in very good health and that most young adults have a secondary education. The high level of unemployment and the increasing number of teenage pregnancies present in Kennard requires robust social capital to prevent affected community members from falling into abject poverty. The relative success of the local community in preventing this, suggests that access to Social capital is satisfactory.

Access to Physical capital in Kenhardt seems average to low. The community has access to bulk services (water, electricity and waste collection), and a range of housing types ranging from formal to informal. Transport is not a significant factor within Kenhardt, due to its very small size; however, access to other urban areas (e.g. Keimoes, Kakemas and Upington) is limited to private transport. Informants also indicated that access to information and awareness of basic rights and public services are very low. Natural capital in Kenhardt is limited due to the harsh climatic conditions and general lack of irrigation water. As a result, community members appear to have limited access to productive natural assets. Finally, access to financial capital is very limited as the bulk of the vulnerable section of the Kenhardt community seems to be dependent on government subsidies and pensions.

Represented as an Asset Pentagon; the Kenhardt community's access to assets is indicated in Figure 14.8.

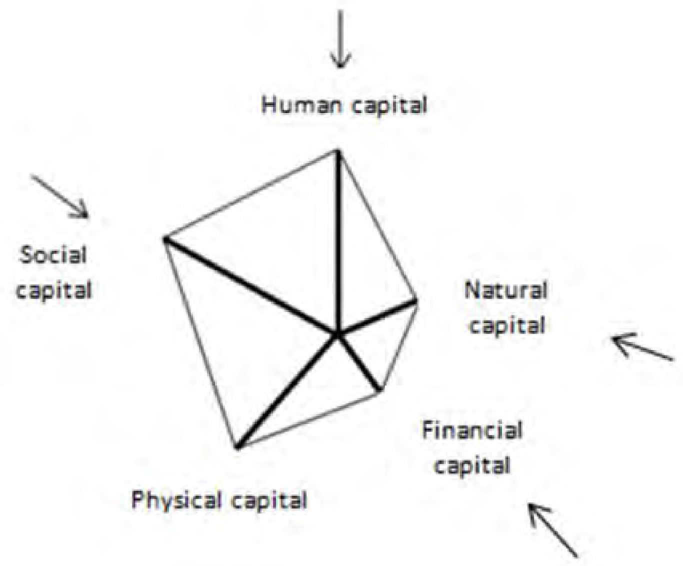

Figure 14.8: Kenhardt Asset Pentagon

The Kenhardt community appears to be vulnerable in terms of its livelihood strategies due to a relative imbalance in access to assets classes, with Human and Social capital dominating the pentagon. The arrows (Figure 14.8) indicate downward pressure (or trends) on the various asset classes. Climate change is expected to continue to deteriorate Natural capital; while high levels of unemployment coupled with a growth in population size is likely to weaken Human, Social and Financial capital. Future development in the Kenhardt area needs to take cognisance of the community's current vulnerability context. In this context, the proposed solar energy development could offer much need relief in terms of Human, Social and Financial capital through the creation of employment (even short-term employment) and local spending. Accordingly, the receiving social environment is not deemed to be sensitive (in a negative sense) to the proposed development, its structures and associated infrastructure.

14.3.3 Systems Analysis

A systemic analysis of the SES of Kenhardt is informed by the discipline of Systems thinking. According to Systems thinking, development (as proposed by Mulilo) is introduced in complex systems of human-nature interaction. Such systems are open, functions in non-linear ways, are characterised by feedback loops and display emergence. Emergence is simply the creation of system characteristics which are not present in the individual variables constituting the system. Put differently, the sum of the individual parts does not necessarily equal the whole.

Systems thinking has been applied in this SIA for its ability to engage with complexity and uncertainty; something conventional reductionist and empirical research methods fails to do effectively. Of particular interest are the unintended consequences or causal relationships of the proposed development (indirect impacts), as well as the cumulative impacts likely to result from it. Such impacts are systemic consequences and are therefore complex in nature.

The CLD presented in Figure 14.9 is a simplified representation of the SES of which Kenhardt is part. The CLD contains system variables (i.e. goods, services and stocks of capital) displayed as boxes; linking relationships indicating the causal flow of goods, services and/or impacts which are displayed as arrows; and the polarity of causal flows (i.e. is the causal flow reinforcing or diminishing a subsequent variable), indicated by a “+” or “-“ at the head of each arrow (reinforcing relationships are depicted in blue and diminishing relationships are depicted in red). Linking relationships represented by dashed arrows indicate weak causality, while solid arrows show strong causality (the thicker the arrow, the stronger the causal relationship). Together, these attributes of the CLD enables a more holistic understanding of causality and the relative impact of causal relationships.

Figure 14.9 consists of 27 causal relationships. However, of greatest importance to this study are relationships 9, 11 and 12. Relationship 9 indicates a strong causal relation between “Government subsidies” and “Livelihoods”, wherein subsidies are heavily contributing to the livelihoods of the local community. Relationship 11 explains a strong causal link between “Energy sector developments” in the study area with “Livelihoods”. Accordingly, new energy-related developments in the area are contributing significantly to livelihoods. Relationship 12 indicates that “Sheep farming” has a weak causal link with “Livelihoods”, as it has a limited contribution to local livelihood strategies.

Both “Government subsidies” and “Energy sector developments” are variables which are sustained by exogenous capital flows (i.e. it is *not* generated and maintained by the Kenhardt SES); however, both contribute significantly to local livelihood strategies. “Sheep farming” is endogenous to the SES (i.e. it *is* generated and maintained by the Kenhardt SES), but it is suggested that it only contributes weakly to local livelihoods. This suggests that the Kenhardt SES is vulnerable to exogenous shocks. Any proposed developments within the Kenhardt SES should therefore aim to reduce this vulnerability by growing the number of alternative endogenous livelihood strategies. The ability to choose from a variety of income streams (redundancy[6]) enables adaptive capacity within the system.

A second observation relates to relationships 21 and 22. Relationship 21 indicates a diminishing causal relationship between “Energy sector developments’ and “Biodiversity”. Similarly, relationship 22 explains a diminishing causal link between “Energy sector developments and “Tourism”. These relationships demonstrate that energy related developments in the study area will ultimately reduce biodiversity and could also negatively impact on tourism. Clearly, this could impact negatively on livelihood strategies

[6] Redundancy is used here in a systems perspective, and aims to indicate that the SES under consideration does not necessarily function at equilibrium levels (i.e. a balance between supply and demand of goods, services and functions). Accordingly, an oversupply of income generating options, though not resulting in equilibrium, does cause greater adaptive capacity by allowing people to change from one option to the next as needed.

related to biodiversity and tourism. However, the significant vulnerability of the SES to exogenous shocks and the subsequent need to transform exogenous capital flows into endogenous adaptive capacity; suggests that *limited* loss of biodiversity, tourism and subsequent income is acceptable in order to achieve greater *systemic* resilience.

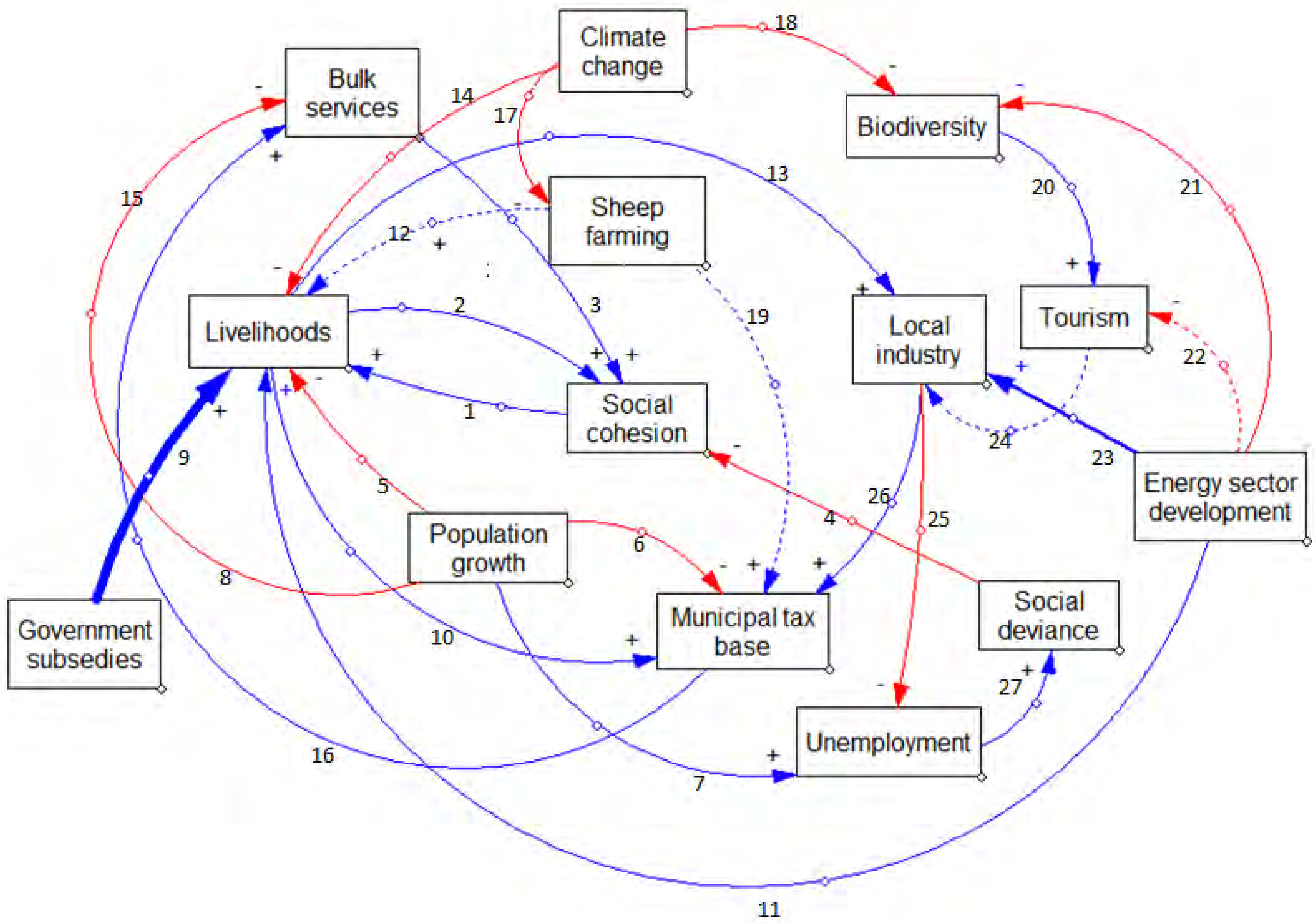

Figure 14.9: Causal Loop Diagram (CLD) of the Kenhardt Socio-ecological System (SES)

14.4 IDENTIFICATION OF KEY ISSUES AND ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

This section of the report discusses the expected social impacts resulting from the proposed Solar PV and transmission line projects near Kenhardt. These impacts are discussed in terms of its construction-, operational- and/or decommissioning phase impacts. Impacts are determined based on the assessment methodology discussed in Chapter 4 of the EIA Report.

All seven of the proposed solar PV projects will result in the same anticipated impacts. This is due to the remote location of the actual project footprint and the subsequent absence of substantial concentrations of people (i.e. communities) wherein socio-economic impacts could manifest. As previously noted, Kenhardt is the closest settlement; accordingly, most of the significant socio-economic impacts are expected to be experienced here.

14.4.1 Key issues identified during the Project Initiation and Scoping Phase

By far the most significant driver of change likely to result from the proposed project is the influx of people into the study area, and the corresponding increase in spending and employment. Such an influx of “strangers” into the receiving environment is likely to cause a disturbance in the order of the existing social structure and might also lead to increases in social deviance. Increased spending and employment (even though such employment might be short-term) generates positive impacts through the multiplier effect and by providing much needed financial relief in the area. However, it also creates significant, and often unrealistic, expectations regarding potential employment. The specific influence of anticipated impacts on woman and children will be an important consideration in the SIA.

14.4.2 Identification of Potential Impacts

Based on the status quo conditions of the study area and the nature of the proposed development, the following social impacts are identified:

- Influx of jobseekers;
- Increases in social deviance;
- Increases in incidence of HIV/AIDS infections;
- Expectations regarding jobs;
- Local spending;
- Local employment;
- Human development resulting from the proposed Economic Development Plan; and
- Job losses at the end of the project life-cycle.

The above mentioned impacts are discussed and assessed according to its relevant construction phase and operational phase (Section 4.3) and decommissioning phase (Section 4.4) impacts, as well as expected residual (Section 4.5) and cumulative impacts (Section 4.6) below.

14.4.3 Construction and Operational Phase Impacts

Social impact discussed in this section is expected to occur in the construction phase and persist into the operational phase of the project.

14.4.3.1 Potential Impact 1: Influx of job seekers

Construction of the proposed projects is likely to attract job seekers to the town of Kenhardt. Such an influx generally causes a disturbance in the existing social order as prevailing leadership, kinship and social control mechanisms are challenged by new and alternative values, beliefs and practices. Disturbance of the existing social order commonly results in the deterioration of social capital and general disorientation of affected communities. Furthermore, in-migration is likely to place additional strain on formal housing and bulk services. This can lead to a growth in informal housing and a deterioration of hygiene conditions in informal areas. It should however be noted that influx of job seekers is considered as a social disruptor and not an impact in itself. Accordingly, disturbance in the existing social order might result from such an influx, or it might not. The influx of job seekers, in the interest of the precautionary principle, is treated as an impact for the purposes of this impact assessment process.

The potential impact is expected to be ***medium to long term*** in duration and ***local in extent***. Influx of job seekers into the study area is therefore rated as having a ***moderate significance (negative)*** rating before mitigation. Should the mitigation measures discussed below be implemented, this significance rating will drop to ***low***.

Mitigation

The proponent (Mulilo) must develop a Workforce Recruitment Policy. This policy must clearly state the criteria used to allocate jobs. It is strongly recommended that the Workforce Recruitment Policy should reserve employment, where practically possible, for local residents (particularly for vulnerable groups such as women and previously disadvantaged individuals). This requirement should be contractually binding. Local in this regard is defined as firstly, the residents of Kenhardt (given its close proximity); followed by the residents of the other urban nodes in the immediate area (I.e. Grobelaarshoop, Marydale and Keimoes). Position should only be filled with outsiders should the requisite skills not be available in the study area.

The proponent must also clearly define who is considered to be local (Kenhardt) residents; known as the Project Affected People (PAP). This should ideally be conducted in collaboration with the local community and local government structures. The purpose of demarcating the PAP is to develop a criterion of characteristics considered to identify a given job seeker as a PAP. Once this criterion is known; all subsequent job seekers can be screened against it in order to determine whether they qualify for employment. The criterion for a PAP should be incorporated into the Workforce Recruitment Policy.

It is also suggested that the proponent assembles a database of local residents and their relevant skills and experience (in collaboration with local structures such as the NGO Marcyrox: www.marcyrox.org) well in advance of the construction phase of the project. This will assist in the early identification of a suitable workforce. Should a similar database already be available in the study area; it can be used by the proponent to achieve the same purpose. However, such an existing database must be regarded as legitimate by the local community in order for it to be used as a substitute by the proponent.

Finally, the proponent must develop a Stakeholder Engagement Plan which sets-out the communication strategy to be followed with regards to the proposed projects. This should be done well in advance of the construction phase of the project. The intention of the plan should be to ensure that all project related information (including those related employment) is communicated: (*i*) accurately; (*ii*) timeously; (*iii*) to the appropriate constituency; (*iv*) in an appropriate format; and is aimed towards fostering realistic expectations.

14.4.3.2 Potential Impact 2: Increases in social deviance

In-migration into the study area, particularly Kenhardt, could lead to an increase the incidence of teenage pregnancies, drug abuse, prostitution and other social disorders. As discussed above, such increases are associated with the social disturbance caused by in-migration; however, it is also related to a growth in alternative livelihood strategies (e.g. prostitution) and conflict regarding limited employment opportunities. Increase in social disorders could deteriorate both Social and Human capital through the violation of cultural norms and values (Social capital), as well as through the spread of Sexually Transmitted Diseases (STDs) (Human capital).

This impact is expected to be ***long term to medium term*** in duration and ***local*** in extent. Increases in social deviance within the study area are therefore rated as having a ***moderate significance (negative)*** rating before mitigation which drops ***to low significance*** after mitigation. Increases in social deviance are extremely difficult to control and often lies outside the exclusive control of the proponent as it is driven by complex socio-ecological conditions related to poverty and feelings of hopelessness.

Mitigation
Mitigation against increases in social deviance is largely indirect in nature. In other words, the overall success of the project and the ability and commitment of the proponent to involve the local community in the benefits of the project is of much greater importance than direct interventions. This is due to the need to change the prevailing conditions of unemployment, poverty and disempowerment, as opposed to command and control mechanisms aimed at simple regulation of activities.

The mitigation measures proposed for Potential Impact 1 must also be used to mitigate impacts resulting from increases in social deviance, as Potential Impact 1 is a precursor to Potential Impact 2. Furthermore, the proponent should be contractually bound to deliver on its Economic Development Plan for the area once the proposed projects are successfully awarded preferred bidder status.
Though not an official mitigation measure; it is proposed that the proponent seeks to actively engage with Marcyrox NPC to investigate possible synergies in community development within Kenhardt.

14.4.3.3 Potential Impact 3: Expectations regarding jobs

Informants in the Kenhardt area indicated a significant level of frustration with other potential developments in the area due to expectations related to possible employment. Unrealised expectations in a poor community could lead to feelings of desperation, disempowerment, anger and a general distrust in developers. In isolated cases, such frustration of expectations might lead to malicious damage of project property and intimidation of employees.

The impact is expected to be ***short term*** in duration and ***local in extent***. Influx of job seekers into the study are is therefore rated as having a ***low (negative)*** rating before mitigation. Should the mitigation measures discussed below be implemented, this significance rating will drop to ***very low***.

Mitigation
It should be recognised that expectations of employment are probably unavoidable in totality. However, proper implementation of the Stakeholder Engagement Plan proposed for Potential Impact 1 should lead to realistic expectation of employment for most of the local community. It is important to note that communication should not only elaborate on what kind of employment is on offer and to whom it is offered; but also the worst-case timeframe for such employment to commence. Forewarned community members are better equipped to adjust livelihood strategies to the variability of the project timeframe.

14.4.3.4 Potential Impact 4: Local Spending

Procurement of goods and services in the Kenhardt area during the construction and operational phases of the proposed projects is likely to hold socio-economic benefits as a result of the multiplier effect (i.e. the increase in final income resulting from a new injection of spending). Such benefits are already evident in Kenhardt as a result of other energy-related developments in the area. As indicated earlier, B&B establishments appear to dominate local industry in Kenhardt as a result of increased numbers of consultants and project staff frequenting the area. It is therefore reasonable to assume that the proposed project will result in similar positive impacts.

A secondary positive impact might result from entrepreneurial development in the project area, whereby niche and/or supporting goods and service industries are developed in response to the demand created for such services in the area. It is important to note the unintended consequence related to this positive impact. Clearly, the economic pull factors created by demand could lead to the in-migration of outsiders.

The impact is expected to be ***medium to long term*** in duration and ***local in extent***. Local spending in the study area is therefore rated as having a ***low significance (positive)*** rating.

<u>Enhancement</u>

The proponent must procure goods and services, as far as practically possible, from within the project area (with a focus on Kenhardt). Only if required goods and services are not available in the study area should the proponent seek to obtain it elsewhere. It is also suggested that regularly required goods and services (e.g. food and accommodation) be obtained from as large a selection of service providers as possible to ensure distribution of project benefits.

14.4.3.5 Potential Impact 5: Local Employment

The creation of short term employment for low skilled community members in the study area, though not ideal, does provide much needed temporary financial relief, while also contributing to a sense of empowerment and dignity. The limited number of long term employment offered by the proponent provides long term (small scale) socio-economic benefit to the affected community and may also contribute to the multiplier effect, as more income generally results in greater spending.

Local employment not only improves access to Financial capital, but also boosts Human and Social capital as skills sets and experience increases and reciprocal and kinship relationships are invigorated through the ability to give and support. Importantly, on an individual level, employment has the ability to empower people. Such empowerment could lead individuals (and communities) to perceive themselves not as suffering entities, but as active, doing entities that has the ability and potential to change their environment in a positive way (Davids, Theron & Maphunye, 2005).

The impact is expected to be ***long term*** in duration and ***local in extent***. Local employment is therefore rated as having a ***moderate significance (positive)*** rating.

<u>Enhancement</u>

As recommended for Potential Impact 1, the proponent must develop a Workforce Recruitment Policy. This policy should reserve employment, where practically possible, for local residents (particularly for vulnerable groups such as women and previously disadvantaged individuals). This requirement should be contractually binding on the proponent.

Though not an official mitigation measure; it is proposed that the proponent actively engages with the local government and other NGOs and CBOs to investigate how skills can be developed to enable short term workers to gain the necessary skills in pursuit of longer-term employment. Such employment does not necessarily have to be with Mulilo

14.4.3.6 Impact 6: Human development via the proposed Economic Development Plan

Mulilo indicated that an Economic Development Plan will be developed, should the proposed project be successful (i.e. selected as a preferred bidder, not merely obtaining a positive Environmental Authorisation). The proposed Economic Development Plan aims to achieve the following broad objectives:

- Create a local Community Trust to empower the communities-by buying them a stake in the renewable energy projects to promote economic transformation;
- Initiate a training strategy to facilitate employment from the local community; and
- Give preference to local suppliers of components for the construction of the facility.

It is recognised that this plan is still in its infancy and will be refined once the proposed project has reached maturity. However, it is clear that even the obtainment of the broad objectives alone will result in significant positive and negative impacts.

The positive impacts are self-evident and will relate to the creation of employment, local spending and human capacity development. However, the attainment of these positive impacts will create substantial social and economic pull factors which are likely to attract job seekers. Such job seekers will not only be attracted by the employment offered by Mulilo, but also by the secondary growth and development which might result from the Economic Development Plan. Accordingly, negative socio-economic impacts resulting from in-migration are inherent to the positive impacts of the Economic Development Plan. Such negative impacts are however considered to be acceptable in light of the much needed development in the area. Furthermore, these negative impacts are largely unavoidable, especially through EIA-level (i.e. project-level) interventions; as it is caused by complex structural inequalities which needs to be addressed at a strategic policy level. Subsequently, no mitigation is proposed.

The impact is expected to be ***long term*** in duration and ***local in extent***. Human development is therefore rated as having a ***moderate significance (positive)*** rating.

<u>Enhancement</u>

A systems thinking approach (discussed in Section 2.2.3) reveals that the SES of which the Kenhardt area is a part of, can be considered to be vulnerable. This vulnerability is attributed to, amongst others, the system's disproportional dependence on exogenous flows of capital for its continued existence. It is therefore imperative to build resilience within the SES to enable greater adaptive capacity. Such adaptive capacity could be created by growing the skills base of the local community. However, such skills development should not be limited to vocational training relevant to the solar energy industry, but should also be extended to address life skills and other relevant skills/competencies as might be required.

The Economic Development Plan, once fully developed, must be implemented. It is also proposed that the proponent should engage with local NGOs, CBOs and local government structures to identify and agree upon relevant skills and competencies required in the Kenhardt community. Such skills and competencies should then be included in the proponent's Economic Development Plan. The proponent must also align economic development and skills development initiatives with the Kai !Garib Local Municipality's IDP objectives.

14.4.4 Decommissioning Phase Impacts

Impacts identified in this section are expected to occur during the decommissioning phase of the proposed projects. Decommissioning of the proposed solar energy developments and transmission lines entails termination of most (if not all) local created employment opportunities.

14.4.4.1 Impact 7: Job Losses

It is expected that the proposed projects could be decommissioned after an operational lifespan of approximately 20 years. Decommissioning of the proposed development will result in job losses. Though unavoidable in projects of this nature, appropriate measures should be taken to plan for such retrenchments and to provide the affected community with alternatives where practical and appropriate. Secondary impacts might result from incorrect decommissioning of project infrastructure which might be used for inappropriate purposes. This in turn could result in health and safety impacts on the local community.

This impact is expected to be ***long term*** in duration and ***local*** in extent. Job losses resulting from decommissioning within the study area are therefore rated as having a ***moderate significance (negative)*** rating before mitigation and ***low (negative)*** with mitigation. This impact is however considered to be acceptable in light of the local need for employment and development.

Mitigation

The proponent must comply with relevant South African labour legislation when retrenching employees. Mulilo should also consider appropriate succession training of locally employed staff earmarked for retrenchment during decommissioning. Such training could gradually equip workers to enter gainful employment in other locally viable sectors. Finally, all project infrastructures should be decommissioned appropriately and thoroughly to avoid misuse.

14.4.5 Residual Impacts

A number of potential negative socio-economic impacts resulting from the proposed projects are likely to persist regardless of proposed mitigation measures. Increases in social deviance are unlikely to be mitigated completely and a certain measure of social disruption and loss of social capital must be accepted as part of the proposed developments. Secondly, an influx of job seekers will occur in spite of the mitigation proposed. In-migration is a double edged sword; as not all in-migration necessary leads to social disruption. Lastly, job losses once the project reached the end of its operational lifespan are unavoidable.

14.4.6 Cumulative Impacts

Socio-ecological cumulative impacts associated with the proposed projects, as with most cumulative impacts, are notoriously difficult to predict. Part of this challenge is due to the fact that a certain level of educated guesswork is required in order to construct a probable picture of the future as it relates to socio-economics in particular and the development in the area in general. Significant subjectivity in this regard should not be denied, nor should it be rejected. When faced with complex problems, like cumulative impacts, conventional reductionist and empirical processes tend to become less useful. It is therefore appropriate to employ subjective (but informed) reasoning as a pragmatic solution.

Development of more solar energy facilities and associated electrical infrastructure (such as transmission lines) in the study area is likely to negatively impact on biodiversity, farming and tourism. These impacts might further negatively affect local industries, and consequently diminish certain livelihood strategies. However, the relationship of biodiversity, tourism and farming to the majority of local livelihood strategies is weak (Section 3.3.3)[7]. As a result, cumulative impacts on biodiversity, tourism and farming in the study area appear to be acceptable.

[7] It is noted that the agricultural sector is the most significant contributor to the local economy (generating 51.8% of jobs). However, the nature of agriculture within the study area (i.e. the Kenhardt area) is characterised by livestock farming which is relatively resilient to surface area losses as would be caused by solar energy developments. This is due to the fact that sheep farming typically consists of a vast surface area to livestock ratio; thereby making allowance for limited surface

Similarly, the incidence and severity of the in-migration of job seekers as well as increases in social deviance might increase as more solar energy facilities and associated electrical infrastructure (such as transmission lines) are developed in the study area. This is of importance as several other solar energy developments are being proposed in the immediate Kenhardt area (e.g. the Mulilo Renewable Project Developments (Pty) Ltd Nieuwehoop Phase 1 and Phase 2 solar energy developments and Scatec Solar 163 (Pty) Ltd Onder Rugzeer Kenhardt PV1, PV 2 and PV 3 solar energy developments), as listed in Chapter 4 of the EIA Report. However, such increases are also associated with most other forms of economic and social development and should therefore be expected from any industrial scale developments in the study area. Given the close correlation between the achievement of local economic growth and industrial scale developments, the in-migration associated with efforts to grow the local economy appears to be unavoidable and a necessary risk in pursuit of improved human welfare.

Finally, the cumulative success of the proposed project and other projects offering significant socio-economic benefits are likely to present a major economic pull factor which might exacerbate in-migration into the study area as well as increases in social deviance. However, the cumulative socio-economic benefit offered by industrial scale development in the study area outweighs the negative impacts associated with economic growth. It should also be borne in mind that influx of job seekers does not necessarily equate in social deviance; i.e. influx of job seekers is a social disruptor which *could* result in social impacts. Given the relative balance between cumulative benefits and impacts, the significance rating ascribed to the cumulative impact of the proposed development is expected to be of **medium to *long term*** in duration, ***local*** in extent and of ***moderate significance*** (negative) rating in terms of exacerbated social disruption, and of ***moderate significance*** rating (positive) in terms of local economic development.

area loss. Also, the relative employment figures per sheep farm are typical very low. This should be contrasted with intensive irrigation agriculture practiced primarily along the Orange River, which is surface area intensive and is a major employer per farm unit. The overall contribution of agriculture to the local jobs market must be interpreted within light of this important difference in agricultural practices and subsequent employment and surface area sensitivities.

Table 14.4: Impact rating table (applicable to all seven sites)

Site	Nature of Potential Impact/ Risk	Status	Spatial Extent	Dura tion	Conse quence	Prob ability	Reversibility of Impact	Irreplace ability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
CONSTRUCTION AND OPERATIONAL PHASE													
Impact 1: Influx of job seekers into the Kenhardt area	Disruption of existing social structures	Negati ve	Local	Medium to Long-term	Substantial	Likely	Low	Moderate	• Develop and implement a Workforce Recruitment Plan • Reserve employment, where practical, for local residents • Clearly define and agree upon the PAP • Develop a database of PAP and their relevant skills and experience • Develop and implement a Stakeholder Engagement Plan	Moderate	Low	4	Medium
Impact 2: Outsiders moves into the Kenhardt area	Increases in social deviance	Negati ve	Local	Medium -term	Substantial	Likely	Low	Moderate	• Develop and implement a Workforce Recruitment Plan • Reserve employment, where practical, for local residents	Moderate	Low	4	Medium

Site	Nature of Potential Impact/ Risk	Status	Spatial Extent	Dura tion	Conse quence	Prob ability	Reversibility of Impact	Irreplace ability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
									• Clearly define and agree upon the PAP • Develop a database of PAP and their relevant skills and experience • Develop and implement a Stakeholder Engagement Plan • Delivery on the Economic development Plan must be contractually binding on the proponent				
Impact 3: Expectations created regarding possible employment	Increased frustration in the local commu nity	Negati ve	Local	Short-term	Moderate	Likely	High	Moderate to low	• Develop and implement the Stakeholder Engagement Plan	Low	Very low	5	Medium

Site	Nature of Potential Impact/ Risk	Status	Spatial Extent	Dura tion	Conse quence	Prob ability	Reversibility of Impact	Irreplace ability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Impact 4: Local spending	Socio-economic benefits as a result of the multiplier effect	Positive	Local	Medium to long-term	Moderate	Likely	n/a	n/a	• Procure goods and services, where practical, within the study area • Obtain regularly required goods and services from as large a selection of local service providers as possible	Low	Low	4	Medium
Impact 5: Local employment	Socio-economic benefits	Positive	Local	Long-term	Substantial	Very likely	n/a	n/a	• Develop and implement a Workforce Recruitment Policy	Moderate	Moderate	3	High

Site	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Impact 6: Economic Development Plan	Contribute to local employment, local spending and human capacity development	Positive	Local	Long-term	Substantial	Very likely	n/a	n/a	• The proponent should engage with local NGOs, CBOs and local government structures to identify and agree upon relevant skills and competencies required in the Kenhardt community • Such skills and competencies should then be included in the Economic Development Plan • Where possible, align Economic development Plan with Local Municipality's IDP	Moderate	Moderate	3	High
DECOMMISSIONING PHASE													

Site	Nature of Potential Impact/ Risk	Status	Spatial Extent	Dura tion	Conse quence	Prob ability	Reversibility of Impact	Irreplace ability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Impact 7: Decommissioning of the proposed development	Job losses	Negative	Local	Long-term	Substantial	Very likely	Moderate	Moderate	• The proponent should comply with relevant South African labour legislation when retrenching employees • Mulilo should also implement appropriate succession training of locally employed staff earmarked for retrenchment during decommissioning • All project infrastructures should be decommissioned appropriately and thoroughly to avoid misuse	Moderate	Low	4	High

Site	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
CUMULATIVE IMPACTS													
Exacerbated social disruption	Disruption of social structures	Negative	Local	Medium to long-term	Substantial	Likely	Low	Moderate	n/a	Moderate	Moderate	3	Medium
Local economic development	Increased wellbeing of local community as a result of economic development	Positive	Local	Medium to long-term	Substantial	Likely	Low	n/a	n/a	Moderate	Moderate	3	Medium

14.5 INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

The key mitigation measures proposed by the specialist, and which needs to be included in the EMPr for each of the proposed seven sites are listed below:

Construction and Operational Phase Mitigations:

- Develop and implement a Workforce Recruitment Plan;
- Reserve employment, where practical, for local residents;
- Clearly define and agree upon the PAP;
- Develop a database of PAP and their relevant skills and experience, or use an existing legitimate database of skills and expertise;
- Develop and implement a Stakeholder Engagement Plan;
- Delivery on the Economic Development Plan must be contractually binding on the proponent;
- Procure goods and services, where practical, within the study area;
- Obtain regularly required goods and services from as large a selection of local service providers as possible;
- The proponent should engage with local NGOs, CBOs and local government structures in the Kenhardt community to identify and agree upon relevant skills and competencies required;
- Such skills and competencies should then be included in the Economic Development Plan; and
- Where possible, align the Economic Development Plan with Local Municipality's IDP.

Decommissioning Phase Mitigations

- The proponent should comply with relevant South African labour legislation when retrenching employees;
- Mulilo should also consider appropriate succession training of locally employed staff earmarked for retrenchment during decommissioning; and
- All project infrastructures should be decommissioned appropriately and thoroughly to avoid misuse.

Monitoring recommendations for the above mitigation measures are included in the complete EMPr (included as Part B of the EIA Report).

14.6 CONCLUSION AND RECOMMENDATIONS

Very little socio-economic data is available for the study area. Census data and information from the Kai !Garib Local Municipality IDP (2015) was obtained; however, these only deal with the larger municipal area and offer no site specific data on socio-economic conditions within and around the town of Kenhardt. Secondary data was subsequently augmented by a site visit. The site visit suggests that Kenhardt is an area of low employment, substantial poverty and limited livelihood strategies. Access to Human and Social capital appears to be acceptable, while access to Physical capital seems average. However, access to Natural and Financial capital is limited. This constrained access to capital limits the ability of vulnerable members of the community to adapt livelihood strategies should it be required; which results in vulnerability.

The main income source among vulnerable communities appears to be government subsidies, with limited income generated from employment within industries operating in Kenhardt. Social deviance (i.e. teenage pregnancy and drug abuse) is a major challenge in the area. Such deviance could threaten Social capital on which much of the existing livelihood strategies depend. Unemployment seems to be the single greatest challenge and problem driver in Kenhardt. Not only does unemployment deprive community members from income, it also constrains empowerment and the subsequent ability to perceive one's subjective social reality as meaningful. This more often than not exacerbates social deviance.

Vulnerable community members might be negatively impacted by the proposed projects through the influx of opportunistic job seekers. Such an influx might threaten existing social structures and could lead to increased pressure on bulk services and housing. Social disorders might also be increased as a result of the proposed projects; as unusual behaviour (e.g. prostitution and teenage pregnancy) are likely to increase as more outsiders migrate into Kenhardt in search of employment. Frustrated expectations of employment, created by the proposed developments, could also contribute feelings of distrust in the developer and, in isolated instances, damage to project property and potential intimidation of staff. Furthermore, the likelihood of job losses once the proposed projects reach their decommissioning phase is high.

Positive socio-economic impacts likely to result from the projects are increased local spending, the creation of local employment opportunities and the proposed development of an Economic Development Plan. These impacts will benefit the community through the creation of income generation opportunities and human development through skills development and training.

No conditions are proposed for inclusion in the Environmental Authorisation.

14.6.1 Overall Significance Rating and Specialist Opinion

The overall significance rating of the *negative* socio-economic impacts associated with the proposed project is ***low to moderate***; whereas the overall significance rating of the *positive* socio-economic impacts associated with the proposed development is ***moderate***.
Given the relative balance between cumulative benefits and impacts, the significance rating ascribed to the cumulative impact of the proposed development is expected to be of ***long term to medium term*** in duration, ***local*** in extent and of ***moderate significance*** (negative) rating in terms of exacerbated social disruption, and of ***moderate significance*** rating (positive) in terms of local economic development.

It should be accepted that the development of the proposed projects is likely result in some form of negative social impact to the local community. However, such a negative impact needs to be weighed against the potential benefit likely to result from the same development. Given the overall moderate significance negative impact of the project, as compared to the overall moderate-high significance positive impact of the project; it can be concluded that the prospective socio-economic benefits of the proposed project outweighs the socio-economic losses/impacts. In addition, the local vulnerability context strongly suggests that acceptable, though declining, levels of Social and Human capital is present within the Kenhardt community, which should assist with the mitigation of potential negative socio-economic impacts resulting from the proposed project. Conversely, very limited Financial capital is available in the local community, which in turn adds to the erosion of existing Social and Human capital. Accordingly, there appears to be a clear need to invest in the development of Financial capital within the Kenhardt community in order to restore some level of balance between asset classes which in turn should facilitate more options to local community members in terms of viable livelihood strategies.

From a social impact perspective, in light of the above argument, the specialist conducting this SIA is of the opinion that the proposed seven projects should be authorised by the competent authority.

14.7 REFERENCES

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14.8 APPENDIX 14.A: EXTERNAL REVIEW REPORT

EXTERNAL PEER REVIEW

OF THE REPORT:

Social Impact Assessment for Mulilo Renewable Project Developments for the Proposed seven 75 MW Solar Photovoltaic Facilities (Boven Solar PV2; Boven Solar PV3; Boven Solar PV4; Gemsbok Solar PV3; Gemsbok Solar PV4; Gemsbok Solar PV5 and Gemsbok Solar PV6) and associated 132 kV Transmission Lines on Portions 3 and 8 of Farm Gemsbok Bult 120 and the Remaining Extent of Farm Boven Rugzeer 169, north-east of Kenhardt, Northern Cape Province.

PEER REVIEWER	LIZA VAN DER MERWE
EXPERTISE	• Resettlement Planning and Implementation • Social Impact Assessment • Land Acquisition • Social Monitoring
YEARS OF EXPERIENCE	• 28 Years
ORGANISATION	• Independent Consultant

PROJECT	Proposed seven 75 MW Solar Photovoltaic Facilities and associated 132 kV Transmission Lines
LOCATION	Portions 3 and 8 of Farm Gemsbok Bult 120 and the Remaining Extent of Farm Boven Rugzeer 169, north-east of Kenhardt, Northern Cape Province
PROPONENT	Mulilo Renewable Project Developments (Pty) Ltd.
EAP	CSIR
REPORT AUTHOR AND AFFILIATION	Rudolph du Toit (CSIR)
REPORT DATE	14 February 2016

14 February 2016

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CONTENTS

1. BACKGROUND

I was appointed by the CSIR on 11 February 2016 to provide expert peer review of the above mentioned Social Impact Assessment (SIA) report. The peer review encompasses issues which include:

- Adequacy of the Social Impact Assessment (SIA);
- Validity of the report content; and
- Benchmarking against best practice.

2. DECLARATION

I, **Liza van der Merwe**, declare that I am independent expert and that no conflict of interest exists in the performance of my review for the CSIR. In familiarising myself about the project, I have read the SIA report.

Liza van der Merwe
15 February 2016

3. SCOPE OF REVIEW

The scope of the review of the SIA report includes a focus on:

- Objective and non-judgemental presentation of information;
- Scientific validity and robustness of SIA methods;
- Technical credibility of report content;
- Impacts to be disaggregated from the impacts of other projects and the background social environment;
- Clear and systematic logic in identification of cause and effect relationships in terms of impact identification, quantification and assigning significance;
- Appropriateness and soundness of proposed mitigation and/or enhancement actions;
- Logical and systematic presentation of information;
- Identification of information gaps;
- Probability of alternative interpretations of impacts; and
- SIA Report is consistent with best practice.

4. REVIEW CRITERIA

The review is structured to assess the report in a systematic manner in terms of content, methodology, information gathering, data analysis, assessment and conclusions. The review is divided into the following sections:

1	**Project and SIA Context:** • Project description (project inputs and project activities) • Terms of reference • Issues of concern from Scoping Report	5	**Mitigation and Enhancement:** • Identification of mitigation options • Identification of enhancement opportunities • Identification of appropriate management actions
2	**Methodology:**	6	**Information Gaps, Uncertainty and**

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	• Data gathering • Method description		**Assumptions:** • Qualifying data sufficiency and reliability
3	**Social Baseline:** • community profile • Project affected people • Economic activities and livelihoods • Social systems • Use of natural resources	7	**References and Data Sources:** • Credible sources are listed
4	**Impact Assessment and Significance:** • Identification and understanding of social issues and linkages • social impact pathways • zones of influence • sensitive receptors • Linking social processes to social impacts • Differentiation of social impacts at the individual, household level and community level • Job Creation • Population change • Social networks • Displacement and relocation • Economic opportunities (Lease Payments) • Tourism • Quality of Life • Social Cohesion • Health, noise and visual • Safety and security • Use and access to natural resources • Sense of place • Land acquisition	8	**Report Structure:** • Organisation of information • Presentation of information

5. PEER REVIEW SCORING SYSTEM

For each question posed under the Review Criteria, professional judgement is expressed in relation to the requirement for decision-making. Commentary is also provided to compare report content against best practice. The specific terminology used to express professional judgement is explained below:

- **Exceeds (E) requirements**: information exceeds requirements for decision-making. No changes to report section is required.
- **Meet (M) requirements**: the information meets requirements for decision-making. Minor edits/changes to report section is required.
- **Fail (F) to meet requirements**: the information does not meet the requirements for decision-making. Major edits/changes to report section is required.
- **Reject (R)**: Information cannot be used to decision-making. Major gaps in logic and content. Poor report writing and analysis. Section needs to be re-written.

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6. PEER REVIEW SUMMARY FINDINGS

	Professional Judgement (E/M/F/R)	Comments
1. **Project and SIA Context**	F	The project description needs to be improved as suggested in this review. Examples of how the project description can be improved are given in Section 10 of this Review Report. It is not sufficient to state that the full project description is provided in a separate chapter of the main EIA Report. The point about having a full list of the sequence of construction and operational activities; is to clearly link the project activities with the resultant social processes and the consequential impacts. This is a weakness of this SIA report and needs to be addressed.
2. **Methodology**	E	The choice of systems theory and the application of social methods; is commended. However, it is not carried through to its logical conclusion in the assessment, interpretation and design of mitigation measures.
3. **Social Baseline**	M	Social baseline is adequate, but can be improved as suggested in this review.
4. **Impact Assessment and Significance**	M	A weakness of this report is the lack of distinction between social processes and actual social impacts. In general, impact assessment and significance ratings are adequate. Sensitive receptors are not clearly identified. An analysis of Receptor Sensitivity is required. Areas for improvement and suggestions in this regard are provided in Section 12 of this report.
5. **Mitigation and Enhancement**	M	Mitigation and enhancement measures proposed are adequate.
6. **Information Gaps, Uncertainty And Assumptions**	E	The SIA report clearly indicates the assumptions and inherent uncertainties.
7. **References and Data Sources**	E	The data sources and references are more than adequate.
8. **Report Structure**	E	The report structure is good.

7. PEER REVIEW CONCLUSIONS

The conclusion of the peer review is that the report is:

☐ **Good**: The report exceeds the level and quality of information that is required for decision-making. No edits required to the report.

☑ **Adequate**: The report meets the level and quality of information that is required for decision-making. Relatively minor information gaps with the report requiring minimal changes.

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☐ **Poor:** The report is of poor quality with flawed scientific logic. Major information gaps, requiring a complete report re-write. The report should be rejected.

8. PEER REVIEW RECOMMENDATIONS

In general the SIA report is adequate, but there are specific areas identified in this peer review where the report can be improved.

9. DETAILED REVIEW QUESTIONS AND EVALUATION

		Professional Judgement (E/M/F/R)	Comments
1.	**PROJECT AND SIA CONTEXT**		
i.	Does the report provide information on the project inputs, activities, sequencing of activities, nature of infrastructure and footprint of land required? Does the project description contain sufficient detail to understand the resultant social processes and likely impacts. Is there information on labour requirements (actual numbers, by sex and skills-base) and source(s) of such labour for both construction and operational phases?	F	The information provided in Section 2.1 does not give any detailed information on the sequence of project activities. For social processes to be identified it needs to be linked to the detailed project activities during all phases of the project. It is suggested that a detailed "Project Activities Register/Table" be developed as a first step (a generic list of project activities is provided in Section 10 of this Review Report as an example). This should form the "y-axis" input to develop a detailed "social processes" list that forms the "x-axis" information in the matrix. The value of such a matrix gives the reader an immediate understanding of the social processes that can potentially be triggered by the individual project activities. Table 10.2 which outlines the employment opportunities and duration is useful, but does not differentiate between the specific skilled, semi-skilled and unskilled job categories. There is no indication of what types of jobs constitute "skilled employment" and what jobs constitute "skilled employment". For example, it would be useful for local I&APs to understand the difference between skilled, semi-skilled and unskilled work. An example of the list of generic jobs and an indication of the difference between the job categories are provided in Section 11 at the end of this Review Report. It is likely that a significant number of local people

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		Professional Judgement (E/M/F/R)	Comments
			would not be able to take advantage of the semi-skilled jobs on offer.
ii.	Does the report contain a terms of reference outlining the scope of the SIA?	M	Adequate terms of reference described.
iii.	Has the study area been delineated? Has the SIA defined the area of direct and indirect influence of the project? Has the social area of influence, likely impacted and beneficiary communities and stakeholders been identified?	M	SIA study area is defined as the urban node or human settlement at the town of Kenhardt. The project sites are on farm portions which have extremely low population densities.
iv.	Have location maps and existing land-use patterns been provided?	M	Location maps are adequate.
2.	**METHODOLOGY**		
i.	Is the theory and methods for the SIA explained? Is the selected SIA methodology appropriate for the project and location?	E	The author has a good grasp of social theory and methods and uses them appropriately. However, the author does not robustly use the theory and methods to inform data gathering, interpretation and analysis. The use of systems theory is commended, however, it is not carried through in the assessment, interpretation and design of mitigation measures.
ii.	Are the data gathering techniques described?	M	Data gathering techniques are adequately described.
3.	**SOCIAL BASELINE**		
i.	Has the location of the local population in relation to the proposed project area been indicated?	M	SIA study area is defined as the urban node or human settlement at the town of Kenhardt.
ii.	Has demographic information been provided (population size, age composition, growth, literacy levels, education, etc)?	F	Information presented in Section 3.3.1 needs to answer the "so what" question to make it relevant for the project. Currently the demographic information and primary qualitative data (gathered from field work) is presented without sufficient interpretation and does not assess the implications of the data for the project. For example, what are the implications to the project of having a high percentage of female headed households? Or, what are the implications to the project of having a high unemployment rate. There are clear constraints for project developers when they implement projects in rural areas with high

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		Professional Judgement (E/M/F/R)	Comments
			unemployment and low levels of education and where the skills are orientated towards agriculture.
iii.	Has local community health status information been provided (HIV and AIDS prevalence, causes of mortality, incidences of diseases such as TB, STIs; Life expectancy in project area)?	F	Why hasn't an attempt been made to access information on the health status of the local community? It needs to be stated whether this information is lacking.
iv.	Have the Project affected people been identified?	M	The project affected people form the human settlement of the town of Kenhardt.
v.	Have the existing land uses and economic activities in the project area been described?	M	Adequate information is provided in Section 3.3.1
vi.	Has information on public safety and security been provided?	F	No information is provided on the existing levels of safety and security. In farming communities there is typically a feeling of over exposure to crime and stock theft. It would have been useful to even have a qualitative narrative on the perceived sense of safety and security.
vii.	Have the implications of the Local Integrated Development Plans and Spatial Development Plans for the project been analysed? What are the spatial policy and planning frameworks for the site and surround areas?	F	A cryptic overview is provided on relevant legislation and local plans and the implications for the project are not assessed. No indication is given whether a Spatial Development Framework exists for the Municipality and whether it covers the project site. A brief evaluation of the implications of the municipal planning frameworks would be useful. Even an indication that there are no implications would be useful to know, as well as a general recommendation that if the proposed project were to proceed, a significant development of this nature would need to be included in future municipal plans.
viii.	Does the report analyse the potential resilience and status of affected communities?	E	The report analyses vulnerability of the local community using an "Asset Pentagon", as well as provide an insight into social dynamic by applying systems theory in the form of a "Socio-ecological System Causal Loop Diagram". However, the analysis (Figure 10.8 - Kenhardt Asset Pentagon) is not supported by any empirical evidence, whether

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		Professional Judgement (E/M/F/R)	Comments
			quantitative or qualitative. Section 3.3.3 states that there is a "strong causal link between Energy sector developments in the study area with "Livelihoods" and that "Sheep farming" has a weak causal link with "Livelihoods". I strongly disagree with this statement. There is no empirical evidence to support these statements about the positive link between energy projects contributing significantly to livelihoods. During construction there would possibly be 100 unskilled jobs available. This is significant employment for a small town. However the long term operational employment of 7 unskilled workers cannot be claimed to be contributing significantly to overall livelihoods. It is significant for the 7 individuals and families benefiting from that employment but it is not significant at a town or municipal level. Section 3.3.3 also states that "energy related developments in the study area will ultimately reduce biodiversity and could also negatively impact on tourism". I disagree with this analysis. There is no evidence to support these statements and conclusions. Sheep farming in the area has degraded the landscape and significantly effected biodiversity for more than 100 years. Biodiversity linked tourism in the Karoo is focused on national parks, game farming and conservation areas. Energy projects in the Karoo will in my opinion have no significant impact on biodiversity, if they are appropriately sited. There is no evidence to support the conclusion that energy projects would be linked to a decline in tourism. It is quite possible that the opposite could happen.
ix.	What are the existing land uses and land tenure patterns in the area?	M	Adequate information is provided on land use and land tenure patterns for the project farm portions and

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	Professional Judgement (E/M/F/R)	Comments
		surrounding area. Detailed information is provided for Kenhardt.
x. What are the existing levels of municipal services (housing, water, electricity, schools, clinics, policing etc) and current state of infrastructure in the area?	F	Information on the level of municipal services and the state of local infrastructure is not provided. An indication needs to be given whether there are any projects implications of the quality of municipal services and the state of infrastructure. Is the project (if it goes ahead) totally independent of municipal services and the state of local infrastructure?
4 IMPACT ASSESSMENT AND SIGNIFICANCE		
4.1 General		
i. Does the SIA focus on the issues that most concern the community? Are the social issues that have been identified in the Scoping Report referred to in the SIA?	M	Issues raised in the Scoping Report are carried through to the SIA Report. However, I am not convinced that issues of concern from the landowner and farming community are reflected in the SIA report. An influx of job seekers, as well as a migrant construction workforce associated with the development, tends to increase the anxiety/concerns of farmers (real and perceived) with regards to issues of security, crime (stock theft) and negligence (e.g. the contractor leaving farm gates open).
ii. Are the discrete social impacts clearly identified?	F	The impacts identified in Section 4.2 are not impacts in my opinion. What are mostly listed are social processes. The impacts are the actual experiences by sensitive receptors to social processes triggered by the development. Section 4.2 needs to be edited to clearly differentiate what social processes are triggered by the different project activities and then identify what the actual social impacts are that are felt by the individual sensitive receptor groups. For example, the influx of job seekers is not a social impact, it is a social process. How receptors (be it the municipality or certain sections of the local community) experience this social process is what matters and is where the impacts are

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	Professional Judgement (E/M/F/R)	Comments
		experience and manifested. To explain what I mean, I've included a generic list of social processes and social impacts (at the individual and community level) as an example in Section 12 of this Review Report.
iii. Are the social impact pathways identified?	F	Social pathways are identified in Figure 10.9 which outlines the Causal Loop Diagram of the Kenhardt Socio-ecological System. This diagram is useful but there is no clear link on how the discrete project activities link to social processes and what the resultant social impacts are.
iv. Are the spatial zones of influence identified?	M	Kenhardt is considered to be the area of influence.
v. Are the sensitive receptors (individuals, households and communities) clearly identified?	F	Particular sensitive receptors are not clearly identified. An analysis of the sensitive receptors and their levels of vulnerability need to be undertaken. This is a particularly weak aspect of the SIA report. Table 10.4 needs to identify who are the sensitive receptors. It would be useful to clearly indicate who are the sensitive receptors for each social process and social impact. An analysis of Receptor Sensitivity is required. For each impact identified in Table 10.4, there needs to be an identification of the particular "sensitive receptors". There is no way that a defined impact has an homogenous and equal impact across all community groups. The SIA makes the common mistake of not disaggregating impacts and differentiating how different groups experience impacts (e.g. women, unemployed men, farmers, etc.).
vi. Is there an indication whether residual impacts would be acceptable?	F	Section 4.5 which describes the Residual Impacts is particularly weak. It would be useful to tabulate the residual impacts and provide a list and summary description of the individual Residual Impacts with a statement on their level of acceptability. An analysis of the Residual Impacts along the lines of the Impact Assessment methodology used in this report should be

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	Professional Judgement (E/M/F/R)	Comments
		considered.
4.2 Community impacts		
i. Population change: Will the development lead to an increase in a certain section of the population? What would the impact of such a change be on the existing social environment?	F	The SIA report acknowledges the background local population increase. However, the report does not clearly distinguish what population segment the job seekers from outside will negatively impact on.
ii. In-migration of unemployed work seekers: Will the development intentionally or unintentionally contribute to the in-migration of work seekers into the area? What would the impact of this change be on the existing social environment? Is rapid population growth predicted?	M	The report acknowledges the potential impact of the influx of job seekers on the population. The SIA report does acknowledge the inevitability of the influx of job seekers. No qualitative estimation is made of whether there is likely to be rapid in-migration. The SIA report author makes contradictory statements in Section 4.3.1 when he states that "…influx of job seekers is considered as a social disruptor and not an impact in itself… The influx of job seekers, in the interest of the precautionary principle, is treated as an impact for the purposes of this impact assessment process". I disagree with this statement as it uncritically supports the dominant narrative that the influx of job seekers is an impact. The movement of vulnerable people to seek work is a natural social process and should be recognised as such. It is how the host communities react to the social process of influx and how the outside job seekers adapt to their new social environment that is important. The SIA author misses the point that the "influx of job seekers" is not an impact. The precautionary principle has no bearing on whether "influx" should be treated as an impact. The SIA report author appears to accept the dominant narrative that an influx of job seekers is a "bad thing" and would result in negative impacts. The author needs to acknowledge that the dominant way in which governments and project proponents understand in-

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	Professional Judgement (E/M/F/R)	Comments
		migration, is as a problem. In-migration of job seekers cannot be prevented. There is a powerful negative discourse around in-migration. In-migration is not a problem but rather a response to extreme poverty. In-migration needs to be acknowledged as an irreversible and integral part of rural livelihoods. A pragmatic approach to in-migration needs to be taken with the aim of facilitating the benefits and mitigating against the negative impacts faced by both the host community as well as the migrants. When in-migration is viewed through this lens, it then becomes clear that job seekers from elsewhere are also sensitive receptors that need to be acknowledged in the SIA report.
iii. Disruption of social networks: Will the development impact on existing social networks? (e.g. due to the presence of outsiders in communities with a high degree of homogeneity and social cohesion)	M	Adequately dealt with in report. However, the SIA report does not provide a good understanding of social dynamics and social networks.
iv. Relocation or displacement of individuals or families: Will the development lead to relocation of residents? What will the implications be for their livelihood sustainability?	M	Not relevant.
v. Disruption in daily living and movement patterns: Will the development change the lifestyle of residents? Will it impact on movement patterns? Will it divide communities physically	M	Adequately dealt with in report.
vi. Job creation opportunities: Will the development lead to an increase or decrease in employment opportunities? Does the report clearly describe the gender, number and type of permanent and temporary employees required for each phase of the project, where the labour will be sourced from and the company's employment policies? Will skilled workers be imported? Will the local labour pool be qualified for professional, technical, and supervisory jobs? Has the report identified the secondary employment created indirectly by the facility (e.g. local stores, Bed & Breakfast, services)? Is loss of local labour from current jobs predicted (current workers may be tempted to leave their jobs in pursuit of improved wages)?	M	The report provides general information on job opportunities but does not disaggregate the jobs into the specific and typical type of jobs for unskilled, semi-skilled and skilled classes (see Section 11 in this Review Report). No indication is given on whether the local labour would only be able to access the unskilled jobs. The SIA states that: "decommissioning of the proposed developments will result in job losses". The report needs to state what categories of permanent jobs would be lost. Section 10 in this Review Report outlines the

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	Professional Judgement (E/M/F/R)	Comments
		activities/services that need to be performed during the Operation and Maintenance Phase. It is the jobs performing these services that will be lost. The mitigation measure proposed in Section 4.3.1 is that a Workforce Recruitment Policy be developed and that employment should be reserved for local residents. Jobs cannot be "reserved". You need to use different terminology. The Proponent can seek to optimise local employment by placing employment targets for Contractors to achieve. It is not only impractical to "reserve" employment for locals, but it is also illegal. For example, you can state in the SIA that the Proponent needs to achieve the target of 100% local employment for unskilled jobs. This is very different to saying that employment should be reserved for local residents. It is highly unlikely that the local population could provide any of the skilled jobs on offer.
vii. Infrastructure and services: Will the development create increased demand for basic services, e.g. water, electricity, sewerage, roads?	M	The SIA predicts that "in-migration is likely to place additional strain on formal housing and bulk services". I think it would be plausible to suggest that in-migration is likely to be undertaken by unemployed people but who are seeking work. They likely stay in the informal settlement (which would not place a strain on formal housing and bulk services). In-migration in the short-term will cause a population increase and result in more job seekers for the limited available jobs.
viii. Change in housing demands: Will the development create a housing need, e.g. due to the in-migration of construction workers?	M	The SIA report suggests that there will be additional strain on formal housing. No indication is given how the Proponent will deal with this matter. The Proponent may choose to specify to the Main Contractor, to price for the construction of temporary accommodation close to the construction site. In this instance, there will be no need for housing for the project. I recommend that the SIA Report includes a provision for the Proponent

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	Professional Judgement (E/M/F/R)	Comments
		to commit to providing temporary accommodation. To look at maximising benefits for the local population and Municipality, I suggest that a recommendation be included in the report that the Proponent "hands over" any temporary construction facilities (whether for housing or office space) to the Municipality after the construction period for the benefit of the local community.
ix. Impact on other businesses: Will the development impact on tourism?	M	The SIA report provides a weak analysis of the impacts on tourism. I disagree with the view in the SIA report that the project will have a negative impact on tourism. It is likely that there will be no impact, except as a "curiosity feature" by South African tourists. A positive mitigation measure that can be considered, is for the Proponent to commit to installing interpretative signage on site and working with the local Municipality (to train tour guides) to include the PV facility as a tourism destination option.
x. Local Content (economic): Will the development provide opportunities for local procurement and training? (e.g. rental housing, restaurants and stores, etc.)	F	The SIA report recommends that the proponent "must procure goods and services, as far as practically possible, from within the project area (with a focus on Kenhardt)". The report is lacking in detailing what the specific goods and services are that would be required. Section 10 below in this Review Report provides a list of the project activities and it can be inferred from this list what goods and services can realistically be provided from the local area.
xi. Staff accommodation: Has accommodation (male and female) for construction and permanent staff been identified?	F	The SIA report recommends that: "accommodation be obtained from as large a selection of local service providers as possible to ensure distribution of project benefits". There is no indication in the report whether this is even possible. The SIA should at least have gathered data on whether there is sufficient rooms/housing available for construction staff.
4.3 Health impacts		

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	Professional Judgement (E/M/F/R)	Comments
i. Spread of disease, addiction and antisocial behaviours: Has the the spread of HIV and its impacts on vulnerable groups such as women and children been identified? What are the health vulnerabilities of the host community? What are the predicted spread of the disease by construction workers, truck drivers and sex workers?	F	The SIA report does not provide any information on the existing health status of the local community and neither is there any indication and assessment of the likely spread of disease from the migrant construction workforce. This is a deficiency in the report.
ii. Gender (women and girls): Will the project have a negative effect on women and girls?	F	The SIA report gives little indication on the discrete and separate impacts of the project on women and girls. The gendered nature of impacts are totally ignored. The report needs to acknowledge that typically, construction work is mostly provided to males in the demographic group between 18-50 years old. The report does however, highlight the need for the "Workforce Recruitment Policy" to provide opportunities for women.
iii. Psychosocial disorder: What impact will the project have on psychosocial disorders of local residents?	F	No specific indication and analysis is given of potential psychosocial disorders such as: stress, substance abuse, social disruption, unrest, violence and decreased tolerance.
4.4 Quality of life and social well-being impacts		
i. Quality of Life: Have impacts on the landscape character, natural setting and visual amenity been identified?	F	No indication is given on the impacts to "quality of life".
ii. Crime and safety: Will the development impact on existing crime (petty crime and stock theft) and safety patterns?	F	No indication is given on the impacts to "crime and safety".
iii. Social well-being: Will the development impact on the peaceful coexistence of communities? Will the development lead to conflict between sectors of the social environment? Will tensions form in communities where the economic benefits are not necessarily equally shared among the residents? Will the community identity be preserved?	F	Social well-being issues are not addressed in the report. There is no indication of issues related to: social cohesion and support structures, self-determination, human rights and equity.
4.5 Cultural and heritage impacts		
i. Heritage: Will the development impact on archaeological, historical or cultural resources?	M	Heritage issues appear to not be applicable for this site. However, there is no mention in the report that heritage issues are not relevant.
ii. Culture: Will the development impact on the customs, values,	F	No mention is made of the existing cultural patterns

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	Professional Judgement (E/M/F/R)	Comments
religious and spiritual beliefs?		and whether it is an issue.
4.6 Land and natural resource impacts		
i. Livelihoods: Will the development impact on the landowners and local people's (legal or illegal, formal or informal) access to natural resources that help to sustain their livelihoods?	M	The SIA report clearly indicates that the livelihoods of landowners will not be affected.
ii. Land acquisition: Will the development negatively impact the landowner/land users by having a large spatial footprint that limits existing land use (such as loss of grazing land)?	F	The SIA report does not mention land acquisition at all. It can be inferred that land acquisition (even through lease contracts) will not impact the landowner. However, an indication should be given that land acquisition is not an issue.
iii. Land rezoning: Will the existing land be required to be rezoned before the Project can commence?	M	It can be inferred from the report that rezoning will not be an issue.
4.7 Economic Impacts		
Have the social implications of economic impacts been assessed?: • Change in modes of production • Changes in property values	M	It can be inferred from the report that there are no negative economic impacts.
4.8 Impact Identification		
i. Have direct and indirect/ secondary effects of construction activities and, where relevant, operation and decommissioning of the project been clearly explained (including both positive and negative effects)?	F	The SIA report can be improved by clearly indicating what the individual project activities are (see Section 10 in this Review Report) and the consequential primary and secondary impacts (see Section 12 in this Review Report). A major weakness of the SIA report is its patently incorrect identification of social impacts. The report identifies the following as social impacts: ▪ Influx of jobseekers; ▪ Increases in social deviance; ▪ Increases in incidence of HIV/AIDS infections; ▪ Expectations regarding jobs; ▪ Local spending; ▪ Local employment; ▪ Human development resulting from the proposed Economic Development Plan; and ▪ Job losses at the end of the project life-cycle.

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		Professional Judgement (E/M/F/R)	Comments
			These are not social impacts but social processes. The SIA report author is encouraged to study Section 12 in this Review Report to see the difference between social processes and social impacts. This SIA report makes the common mistake, which is prevalent in SIA practice of confusing social processes with social impacts. It is critically important to correctly identify social impacts and to delink it from background social processes.
ii.	Is there a clear understanding of impact causation processes, by first listing in detail the project activities per phase and the corresponding social effect? Have social processes clearly been differentiated from social impacts?	F	This is an area of deficiency in the SIA report and needs to be addressed. See Section 10 and 12 in this Review Report for suggestions on improvements to the report.
iii	Have impacts been identified in a non-judgemental manner?	M	The SIA report by and large uses non-judgemental language in the identification of impacts. My preference is not to use the term "socially deviant behaviour", but rather "social disorders" or "psychosocial disorder".
iv.	Are there clear linkages (in impact identification) to health and ecosystem services issues?	F	There is no clear link with other specialist study areas and no link with health and ecosystem services issues.
v.	Have cumulative impacts been assessed?	F	Section 4.6 which describes the cumulative impacts is weak. This Section highlights the other proposed energy projects, but does not analyse cumulative effects in any meaningful way.
4.9 Assessment of Impacts			
i.	Are impacts described in terms of the nature, magnitude and probability of the change occurring and the effect (location, number, value, sensitivity) on sensitive receptors?	M	Impacts are adequately described in a consistent manner. However, no mention is made of "sensitive receptors".
ii.	Has the timescale over which the effects will occur been predicted such that it is clear whether impacts are short, medium or long term, temporary or permanent, reversible or irreversible?	M	Timescale are adequately described in a consistent manner.
iii.	Have qualitative predictions of impacts been adequately	M	Qualitative predictions of impacts have been adequately

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		Professional Judgement (E/M/F/R)	Comments
	expressed?		expressed. In Section 4.3.6 the author makes the following statement: "Accordingly, negative socio-economic impacts resulting from in-migration are inherent to the positive impacts of the Economic Development Plan". This sentence doesn't make any sense and needs to be re-phrased.
iv.	Where quantitative predictions have been provided is the level of uncertainty attached to the results described?	M	No quantitative impact predictions have been made in the SIA report.
v.	Have the impacts of the social environment on the construction and operation of the project been considered?	F	The impacts/implications of the dynamics of the existing social environment on the project are not adequately described.
4.10 Impact Significance			
i.	Does the information include a clear indication of which impacts may be significant and which may not and to whom?	M	Significance is adequately dealt with in the report. However, the report can be improved by answering the question: "to whom is this impact significant"?
ii.	Has the significance of effects been discussed taking account of appropriate national and international standards or norms, where these are available?	M	Significance is adequately dealt with in the report.
iii.	Where there are no generally accepted standards or criteria for the evaluation of significance, is a clear distinction made between fact, assumption and professional judgement?	M	There is a clear distinction in the report between assumption and professional judgement.
iv.	Have the magnitude, location and duration of the impacts been discussed in the context of value and sensitivity?	F	Issues of value and sensitivity are not addressed.
5 MITIGATION AND ENHANCEMENT			
i.	Is there evidence of the application of the Mitigation Hierarchy? (in terms of the sequential application of the mitigation options from avoid ⇨ minimise ⇨ restore ⇨ compensate)	F	There is no evidence of the application of the Mitigation Hierarchy.
ii.	Does the report clearly state the objectives and specific goals for the management of social impacts, socio-economic conditions and historical/cultural aspects?	M	The report can be improved by providing a much clearer statement of objectives and goals. For example, on the issue of local employment, the report can give a much clearer objective statement for achieving targets for local employment of unskilled and semi-skilled workers.

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		Professional Judgement (E/M/F/R)	Comments
iii.	Does the report describe the appropriate technical and management options to address each social impact, socio-economic condition and historical/cultural aspects for each phase of the project?	M	Appropriate management actions and mitigation measures have been proposed.
iv.	Where appropriate, do mitigation methods considered include modification of project design, construction and operation, the replacement of facilities/ resources, and the creation of new resources?	M	Suitable mitigation measures have been proposed.
v.	Is it clear to what extent the mitigation methods are likely to be effective?	F	There is no indication of the likely effectiveness of the proposed mitigation measures. A "Workforce Recruitment Policy" is recommended. Employment cannot be reserved for local residents, as the report recommends. Neither can this requirement be contractually binding. Local residents may not have the requisite skills to take advantage of the semi-skilled and skilled job opportunities. In addition, they may be untrainable for a variety of reasons and therefore not suited for the available jobs. In any event, it is the responsibility of the Contractor to recruit people for jobs and not the Proponent. All the Proponent can do is to define the overall project objectives (for unskilled, semi-skilled and skilled jobs and training). The objectives can then form part of the contractual obligations for the Main Contractor.
vi.	Have negative social effects of mitigation measures been investigated and described?	F	The negative social effects of mitigation measures proposed have not been described.
6. INFORMATION GAPS, UNCERTAINTY AND ASSUMPTIONS:			
i.	Has field work been undertaken and if not, has the implications been acknowledged?	M	Field work has been undertaken and the qualitative information from the interviews has added richness to the social baseline.
ii.	Has issues of data sufficiency and reliability been addressed?	M	The SIA report does indicate the lack of data in certain areas.
iii.	Have information gaps been identified and its implications assessed?	F	The SIA report needs to clearly identify the information gaps.

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		Professional Judgement (E/M/F/R)	Comments
iv.	Have the SIA assumptions been disclosed?	M	Assumptions have been fully disclosed.
v.	Has any scientific uncertainty inherent been acknowledged and communicated?	M	The SIA report does allude to areas of uncertainty.
7. REFERENCES			
i.	Does the report contain a reference list?	M	All sources have been fully referenced.
ii.	Are the reference sources credible and reliable?	M	Reference sources are scientifically credible.
8 REPORT STRUCTURE			
8.1 Organisation			
i.	Does the report contain an Executive Summary which provides a concise presentation of the most significant issues contained in the body of the SIA?	M	Clear Executive Summary provided.
ii.	Is the information logically arranged in sections?	M	Report is logically structured.
iii.	Is the location of the information identified in an index or table of contents?	M	Table of Contents provided.
iv.	Are the credentials of the report authors and specialists presented, with a clear indication of their respective contributions?	M	CV of report author included in report.
8.2 Presentation			
i.	Has information and analysis been offered to support all conclusions drawn?	M	Information and analysis is adequate, but interpretation can be improved as suggested in sections in this Review Report.
ii.	Has information and analysis been presented so as to be comprehensible to the non-specialist, using maps, tables and graphical material as appropriate?	M	Information is adequately presented in graphics, maps and tables where appropriate.
iii.	Is the information balanced and unbiased?	M	Information is presented in a balanced manner.
iv.	Is the layout, language and overall presentation of the information accessible to both the lay public and decision-makers?	E	The author writes well and the language is clear and unambiguous.

10. GENERIC EXAMPLE OF CONSTRUCTION ACTIVITIES FOR THE DEVELOPMENT OF A PV FACILITY

	PROJECT PHASE	SEQUENCE OF DETAILED ACTIVITIES
1	Mobilisation / Site Preparation	• Installing perimeter fencing around the site

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		• Locating temporary construction offices and construction equipment to site • Earthworks for construction of road access and construction parking areas, including vegetation clearing • Minor grading and trimming of areas for permanent site office and switchyard • Minor grading and trimming in array areas • Drum rolling and compaction of array areas • Installation of onsite erosion and sediment controls
2	Construction	• Install steel support posts for array tables • Trenching and wiring of underground cabling (DC and AC) • Attachment of tilt brackets and rails using prefabricated steel members • Connection of PV modules to the brackets • Installation of inverter and transformer skid • Commencement of site rehabilitation works within the development area
3	Commissioning	• Commissioning and testing of solar plant, noting that each array block would be commissioned as it is completed.
4	Demobilisation	• Removal of temporary construction facilities and completion of works within the development area and of temporary access tracks within the site.
5	Operation and Maintenance	Compared to other power generating technologies, solar PV power plants have low maintenance and servicing requirements. Activities include: • Inverter servicing • ground-keeping • security • Low technology module cleaning using brush trolley or dust broom

11. GENERIC EXAMPLE OF DIFFERENCE BETWEEN 'SKILLED, "SEMI-SKILLED AND "UNSKILLED" WORKERS

Category	Jobs
Skilled	• Project Manager • Construction managers • Professionals (engineering) • Technicians (engineering)
Semi-skilled	• Clerks (office clerks) • Trade workers (building trades workers; metal, machinery and related trades workers) • Plant and machine operators and assemblers (stationary-plant and related operators; machine operators and assemblers; and drivers and mobile-plant operators)
Unskilled	• General workers (labourers)

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12. GENERIC EXAMPLE OF THE DIFFERENTIATION BETWEEN SOCIAL PROCESSES AND SOCIAL IMPACTS

Selected list of social processes	***Selected list of social impacts at the individual and household level***	***Selected list of social impacts at the community level***
Demographic processes ▪ Increase in population size (in-migration) ▪ Presence of newcomers (perceived or real cultural differences) ▪ Presence of temporary construction workers ▪ Presence of tourists *Economic processes* ▪ Conversion of economic activities ▪ Conversion of land use ▪ Increase in economic activity ▪ Decrease in economic activity ▪ Job creation or job loss *Social processes* ▪ Prostitution ▪ Excessive alcohol, drug use and gambling ▪ Opposition ▪ Pollution (air, water and dust) ▪ Litter ▪ Traffic ▪ Vandalism	▪ Debt bondage ▪ Reduced level of health ▪ Reduced mental health, increased stress, anxiety, alienation, apathy, depression ▪ Uncertainty about impacts, development opportunities, about own life as a result of social change ▪ Reduced actual personal safety ▪ Reduction in perceived quality of life, subjective well being ▪ Worsening of economic situation, level of income, property values ▪ Change in status or type of employment or becoming unemployed ▪ Decrease in occupational opportunities ▪ Objection/opposition to project, NIMBY (not-in-my-back-yard) attitude ▪ Dissatisfaction due to failure of a project to achieve heightened expectations ▪ Annoyance because of dust, noise, strangers or more people ▪ Increased density and crowding ▪ Reduced aesthetic quality, outlook, visual impacts	▪ Reduced adequacy of infrastructure (water supply, sewerage, services and utilities) ▪ Reduced adequacy of community social infrastructure, health, welfare, education facilities ▪ Reduced adequacy of housing ▪ Increased workload on institutions ▪ Increase inequity (economic, social, cultural) ▪ Increased unemployment level ▪ Loss of other options (opportunity cost) ▪ Increased actual crime or violence ▪ Increased social tensions, conflict or divisions within community

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Scoping and Environmental Impact Assessment for the proposed Development of a 75 MW Solar Photovoltaic Facility (GEMSBOK SOLAR PV6) on Portion 8 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape Province

EIA REPORT

CHAPTER 15:

Summary of Electromagnetic Interference Technical Report (Cumulative Topographical Analysis of Proposed PV Projects in AGA Area)

CONTENTS

TABLES

LIST OF ABBREVIATIONS

AGA	Astronomy Geographic Advantage
DEM	Digital Elevation Model
EMI	Electromagnetic Interference
PV	Photovoltaic
RFI	Radio Frequency Interference
RFI-WG	Radio Frequency Interference Working Group
SARAS	South African Radio Astronomy Services
SKA	Square Kilometre Array
SKA-SA	Square Kilometre Array South Africa
TL	Terrain Loss
TPL	Total Path Loss

15 CUMULATIVE TOPOGRAPHICAL ANALYSIS OF PROPOSED PV PROJECTS IN AGA AREA

This chapter provides a summary of the topographical analysis, Cumulative Topographical Analysis of proposed PV Projects in Astronomy Geographic Advantage (AGA) Area, that was undertaken by MESA Solutions (Pty) Ltd for the proposed Phase 2 Nieuwehoop Solar Park development.

15.1 INTRODUCTION

MESA Solutions (Pty) Ltd (MESA Solutions) was appointed by the Developer to undertake a topographical analysis of the terrain profiles between various photovoltaic (PV) project locations in the Astronomy Geographic Advantage (AGA) area and the closest and core-site Square Kilometre Array (SKA) telescopes. A total of thirteen project sites were considered in this cumulative assessment. These include ten Mulilo project sites (Boven Solar PV1 to PV4; Gemsbok Solar PV1 to PV6) and three Scatec Solar sites (Kenhardt PV1 to PV3). The project sites for Gemsbok Solar PV1 and 2 and the Boven Solar PV1 were part of the Nieuwehoop Phase 1 Solar Park proposed by Mulilo, which received Environmental Authorisation from DEA on 11 November 2015. For each of the proposed PV sites, a preferred and an alternative site location was considered in terms of the total path loss to the closest and core SKA telescopes, in order to identify the recommended site location based on minimum potential impact. The full report, dated 9 February 2016, is included in Appendix J of this EIA Report. This technical report aims to determine the potential impact that the proposed project will have on the SKA project and to determine suitable mitigation measures to manage the risk (if any) posed to the SKA project by the development of this project.

15.1.1 Background to the Astronomy Geographic Advantage Area

The Astronomy Geographic Advantage (AGA) Act (AGA) (Act 21 of 2007) aims to provide for the preservation and protection of areas within the Republic that are uniquely suited for optical and radio astronomy; to provide for intergovernmental co-operation and public consultation on matters concerning nationally significant astronomy advantage areas; and to provide for matters connected therewith. The purpose of the AGA Act is to preserve the geographic advantage areas that attract investment in astronomy. The AGA Act also notes that declared astronomy advantage areas are to be protected and properly maintained in terms of Radio Frequency Interference (RFI).

The proposed projects for the Nieuwehoop Phase 2 Solar Park (Gemsbok Solar PV3-6 as well as Boven Solar PV2-4) fall within the Karoo Central Astronomy Advantage areas, which are protected against unnecessary Electromagnetic Interference (EMI) under the AGA Act. The closest SKA station (SKA 2360) is located within 14 km of the Gemsbok Solar project sites, and 15 km of the Boven Solar PV Projects. According to the SKA Project Office, based on distance to the nearest SKA station, the location of the station, and the information currently available on the design of the proposed PV installation, the proposed facilities pose a medium to high risk of detrimental impact on the SKA.

The SKA recommended (as shown in Appendix G of this EIA Report) that any transmitters that are to be established at the site for the purposes of voice and data communication will be required to comply with the relevant AGA Act Regulations (currently out for public comment) concerning the restriction of use of the radio frequency spectrum that applies in the study area. Furthermore, the SKA Project Office recommended that further EMI and RFI studies be undertaken.

In general, the dominating EMI produced by PV facilities are mainly in the form of switching noise from power electronics in the inverters or conditioning units, as well as clock signals from microprocessor control boards.

15.2 APPROACH AND METHODOLOGY

15.2.1 Approach

Propagation Analysis

A preferred and alternative site location was included for the Mulilo solar developments in terms of the total path loss to the SKA receivers. The recommended site locations based on the total path loss calculated are summarised below. In the event where the alternative site is recommended, the maximum difference in total path loss for the preferred site is indicated.

Table 15.1: Summary of preferred and alternate site locations based on predicted total path loss.

Site Location	Closest Telescope 1	Closest Telescope 2	SKA Core Site	Recommendation	Max. TPL Difference
Boven PV 2 Preferred	X	X	X	X	28.39 dB
Boven PV 2 Alternative	✓	✓	✓	✓	
Boven PV 3 Preferred	X	✓	~	✓	N/A
Boven PV 3 Alternative	✓	X	~	X	
Boven PV 4 Preferred	~	~	~	~	N/A
Boven PV 4 Alternative	~	~	~	~	
Gemsbok PV 3 Preferred	✓	✓	X	✓	N/A
Gemsbok PV 3 Alternative	X	X	✓	X	
Gemsbok PV 4 Preferred	~	~	~	~	N/A
Gemsbok PV 4 Alternative	~	~	~	~	
Gemsbok PV 5 Preferred	X	X	X	X	30.21 dB
Gemsbok PV 5 Alternative	✓	✓	✓	✓	
Gemsbok PV 6 Preferred	~	~	~	~	N/A
Gemsbok PV 6 Alternative	~	~	~	~	

Legend:

- ✓ : Recommended; ~ :Neutral; X : Not Recommended; N/A: Not Applicable (i.e. Preferred site is the recommended site).

Using the above recommended site locations, this study attempts to define an E-field upper limit as a function of frequency at which the plants are allowed to radiate without exceeding emission limits (South African Radio Astronomy Services (SARAS) limits) at the various SKA telescope locations. The conformance of the plant can be determined by comparing representative measured results to the calculated levels provided.

15.3 FINDINGS

From the results it is found that:

- Radiated emissions at levels below that of CISPR 11/22 Class B are required (especially in the case of the closest telescope).
- Negligible terrain loss exists between majority of sites and closest SKA telescope.
- Predictions for the maximum allowed E-field level, as measured according to CISPR 11/22 Class B, are given in Figs. (a) to (c) below. A comparison with measured emission levels for each plant is shown.
- Based on expected plant emission levels, mitigation measures will be required to comply with the SKA requirements. This is particularly relevant for the closest telescope where negligible terrain loss applies.

An initial risk assessment for each telescope location was determined by comparing the maximum allowable radiation limit of each plant to the CISPR standard at discrete frequencies. The three resulting risk tables were then used to calculate each plant's average risk factor for all three locations combined. The ranking of the plants, as well as the cumulative impact of constructing all the plants up to a specific ranking, are given in Table 15.2 and Table 15.3 respectively below. The cumulative impact is in addition to any existing RFI from the plant.

Table 15.2: Site locations sorted according to risk to the closest, second closest and core-site SKA telescopes

Risk	Ranking	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Lowest Risk	1	Boven PV1	Boven PV1	Boven PV1
	2	Boven PV4	Scatec PV2	Boven PV4
	3	Boven PV3	Gemsbok PV6	Gemsbok PV4
	4	Gemsbok PV4	Gemsbok PV4	Gemsbok PV6
	5	Gemsbok PV6	Boven PV4	Scatec PV2
	6	Scatec PV2	Gemsbok PV2	Boven PV3
	7	Boven PV2 Alt	Gemsbok PV3	Boven PV2 Alt
	8	Gemsbok PV2	Gemsbok PV1	Scatec PV1
	9	Gemsbok PV5 Alt	Gemsbok PV5 Alt	Gemsbok PV5 Alt
	10	Gemsbok PV1	Boven PV3	Gemsbok PV3
	11	Gemsbok PV3	Scatec PV3	Scatec PV3
	12	Scatec PV1	Scatec PV1	Gemsbok PV2
Highest Risk	13	Scatec PV3	Boven PV2 Alt	Gemsbok PV1

Table 15.3. Site locations sorted according to the average risk to SKA telescopes. Included is the cumulative effect if any given plant, together with the higher ranked plants, are constructed together. (For example: if sites ranked 1 to 7 are constructed, a cumulative effect of 8.45 dB is assumed; if sites ranked 1 to 10 are constructed, a cumulative effect of 10.0 dB is assumed.)

Risk	Ranking	Average Risk	Cumulative Impact
Lowest Risk	1	Boven PV1	0.00 dB
	2	Boven PV4	3.01 dB
	3	Gemsbok PV6	4.77 dB
	4	Gemsbok PV4	6.02 dB
	5	Scatec PV2	6.99 dB
	6	Boven PV3	7.78 dB
	7	Gemsbok PV5 Alt	8.45 dB
	8	Gemsbok PV2	9.03 dB
	9	Gemsbok PV3	9.54 dB
	10	Gemsbok PV1	10.0 dB
	11	Boven PV2 Alt	10.4 dB
	12	Scatec PV1	10.8 dB
Highest Risk	13	Scatec PV3	11.1 dB

15.4 MITIGATION MEASURES

It is strongly recommended that the following mitigation practises be incorporated into the plants design:

- The inverter units, transformers, communication and control units for an array of panels should all be housed in a single shielded environment;
- For shielding of such an environment ensure:
  - RFI gasketting be placed on all seams and doors.
  - RFI Honeycomb filtering be placed on all ventilation openings.
- Cables to be laid directly in soil or properly grounded cable trays (not plastic sleeves);
- The use of bare copper directly in soil for earthing is recommended;
- Assuming a tracking PV plant design, care will have to be taken to shield the noise associated with the relays, contactors and hydraulic pumps of the tracking units;
- AC brushless motors to be used for tracking motors; and
- All data communications to and from the plant to be via fibre optic.

15.5 CONCLUSION

It is MESA's expectations that, if the mitigation measures that are specified are implemented correctly, attenuation of between 20 dB and 40 dB are likely. The required maximum mitigation 50 dB for some plants, especially towards the closest telescope, would require significant attention to detail. Additional shielding is required between the sites for Boven-PV2 and Gemsbok-PV5. The additional shielding required is included in the study. It is important to note that the success of the mitigation measures cannot be guaranteed or confirmed until measurements on the post-mitigated operating plants (or representative installations) are performed. Furthermore, the findings from this assessment are for the client's own edification, and will be taken into account by SKA-SA during their own propagation analysis. This study is therefore not meant to supersede any investigation done by SKA-SA or relevant RFI Working Groups. It remains the responsibility of the developer to meet compliance to the SKA requirements, and MESA Solutions cannot accept responsibility for any assessments made in this report which could cause non-compliance.

The EAP recommends close liaison with the appropriate SKA-personnel with respect to the operation of tracking panels, e.g. when maintenance of the tracking motors needs to be done they are likely to be unshielded thus it is important to arrange mutually suitable times for this to be undertaken to avoid unnecessary electromagnetic interference with the SKA.

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CHAPTER 16:

Traffic Impact Assessment

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16 TRAFFIC IMPACT ASSESSMENT

16.1 INTRODUCTION

In the DEA's acceptance letter of the PoS and Scoping Report, dated 28 January 2016, it was indicated in point (xii) that an assessment of the potential traffic impacts and a statement regarding the findings and recommended mitigation measures must form part of the EIAr.

16.1.1 Terms of Reference

The key issues associated with the construction and operational phases of the project that will be assessed as part of the traffic assessment are:

- Increase in traffic generation throughout the lifetime of the project;
- Decrease in air quality; and
- Increase in road maintenance required.

16.1.2 Assumptions

The assessment has been based on the traffic information available at this stage of the project. Information was sourced from the Transport Study and Traffic Management Plan, prepared Aurecon, (March 2014) for the 75MW Mulilo Sonnedix Prieska PV. Since this project will have the same generation capacity and therefore the same construction, operational and decommissioning requirements, it has been assumed that the traffic estimated to be generated by the proposed Mulilo Sonnedix Prieska PV project and potential impacts associated with this, will also apply to all the solar PV projects currently proposed by Mulilo in the Kenhardt area.

16.2 APPROACH AND METHODOLOGY

16.2.1 Objectives

- Determine the current traffic conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured;
- Identify potential impacts and cumulative impacts that may occur during the construction, operational and decommissioning phases of development;
- Provide recommendations with regards to potential monitoring programmes;
- Determine mitigation and/or management measures which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts; and
- Incorporate and address all issues and concerns raised by I&APs and the public (if applicable).

16.2.2 Methodology

The key steps followed in this assessment are:

- Review of available desktop information, including the South African National Roads Agency (SANRAL) National traffic count information, google earth images and similar projects; and
- Liaison with Transnet SOC Ltd regarding access roads to be used and requirements associated with it.

16.3 AFFECTED ENVIRONMENT

During all phases (construction, operation and decommissioning) of the project, traffic will be generated. The highest traffic volumes will be created during the construction phase. This includes activities associated with:

- Site preparation and transporting the construction materials, and associated infrastructure to the site; and
- Transportation of employees to and from the site on a daily basis.

The proposed project site can be accessed via the existing Transnet Service Road (private). The R27 extends from Keimoes (in the north) to Vredendal in the south. The R27 is 6 m wide and falls within a 45 m road reserve. This National Road is designed for minimum daily traffic exceeding 1000 vehicle units. The Transnet Service Road can be accessed from the R27. The Transnet Service Road is 7-8 m wide.

It is proposed that internal gravel roads be constructed from the Transnet Service Road to the proposed project sites.

A photo plate is included (Photo 16.1-16.4) to show the intersection of the Transnet Service Road with the R27 and the current condition of the roads.

Photo 16.1: R27 towards the south (taken towards Kenhardt). The board shows "Loop 14", located to the left, which is accessed via the Transnet Service Road. (Image source: Google, 2010)

Photo 16.2: The intersection of the R27 and Transnet Service Road, going towards Kenhardt. As can be seen on this image, the R27 was being upgraded in 2010 (Image source: Google, 2010)

Photo 16.3: The intersection of the R27 and Transnet Service Road, going towards Keimoes (Image source: Google, 2010)

Photo 16.4: The access point to the Transnet Service Road (Image taken: July 2014)

The closest roads to the site for which traffic counts are available show that the R383 (road between Kenhardt and Marydale) and the R361 (between Van Wyksvlei and Kenhardt) have Average Daily Traffic (ADT) counts of 35 and 41, respectively (SANRAL, 2007). The ADTs how that the current traffic volumes are well below the maximum traffic limits for the roads discussed above. Even though traffic will be generated during the construction and operation of the solar energy facility, given the low ADTs of the surrounding roads, it is not expected that the traffic generated by the solar energy facility will exceed the maximum daily traffic limits for the abovementioned roads.

16.4 TRANSPORT INFORMATION

The general current limitations on road freight transport are:

- Axle load limitation of 7,7 ton front axle, 9 t on single rear axles;
- Axle unit limitations are 18 t for dual axle unit and 24 t for 3 axle unit;
- Gross vehicle mass of 56 t. This means a typical payload of about 30 t;
- Maximum vehicle length of 22 m for interlink, 18,5 m for horse and trailer and 13,5 m for a single unit;
- Width limit of 2,6 m; and
- Height limit 4,3m.

Abnormal permits are required for vehicles exceeding these limits.

16.4.1 Solar Farm Freight

Materials and equipment transported to the site comprise of:

- Building materials (concrete aggregates, cement and gravel);
- Construction equipment such as piling rigs and cranes;
- Solar panels (panels and frames); and
- Transformer and cables.

The following is anticipated:

A. Building materials comprising of concrete materials for strip footings or piles will be transported using conventional trucks which would adhere to legal limits listed above.

B. Solar Panels and frames will probably be transported in containers using conventional heavy vehicles within the legal limits. The number of loads will be a function of the capacity of the solar farm and the extent of the frames (the anticipated number of loads are discussed below).

C. Transformers will be transported by abnormal vehicles.

16.4.2 Traffic generation

The traffic generation estimates detailed below have been determined based on a single solar energy facility and the associated electrical infrastructure (collector substation and transmission line).

16.4.2.1 Construction Phase:

It is estimated that the number of heavy vehicles trips, per 75 MW facility, during the construction phase would be between 3 000 and 4 000. These trips would be made over an estimated period of 9 to 16 months.

In the worst case, the number of heavy vehicle trips per day for each facility would be in the order of 15 - 20 trips i.e. should the three projects proposed by the proponent proceed at the same time, a maximum of 60 daily trips would be made. The impact of this on the general traffic would therefore be negligible as the additional peak hour traffic would be at most 6 trips.

16.4.2.2 Operational Phase:

Limited private vehicles will need to access the site on a daily basis and it is not expected to exceed 10 vehicles coming to site per day. The lifetime of the project is 20 years.

16.4.2.3 Decommissioning Phase:

It is estimated that the number of heavy vehicles trips, per 75 MW facility, during the decommissioning phase would be between 3 000 and 4 000 (the same as for the construction phase), worst case scenario. The decommissioning phase will take approximately ~12 months.

16.5 IDENTIFICATION OF IMPACTS

The traffic impacts that will be generated by the proposed facility are detailed below. The impacts will largely occur during the construction phase of the project, since this is when the highest amount of traffic will be generated by the proposed facility (refer to Section 16.4).

The impacts identified and further assessed are:

1. Increase in traffic generation;
2. Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads;
3. Impact on air quality due to dust generation, noise and release of air pollutants from vehicles and construction equipment;
4. Decrease in quality of surface condition of the roads; and
5. Cumulative impact of traffic generation of three projects and related projects.

16.6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

This section assesses the significance of the impacts identified in Section 16.5. Appropriate mitigation and management measures to reduce the significance of the negative impacts and promote the positive impacts have been included in the draft EMPr.

16.6.1 Increase traffic generation

As discussed in Section 4 of this report, conventional trucks, conventional heavy vehicles and abnormal vehicles, transporting loads will need to come to site to deliver the infrastructure required for the solar facility. At worst, during the construction phase, 15 -20 trucks would need to come to site daily. The impact of this on the general traffic would be negligible as the additional peak hour traffic would be at most 2 trips.

16.6.1.1 Significance of impacts without mitigation

Although the construction phase would have the greatest impact on traffic generated by the proposed project, the increase in traffic will only result in an addition of 2 trips during peak hour traffic (worst case scenario). Based on the traffic counts discussed in Section 3 of this Chapter, the ADT for this area is between 35 - 41 vehicles. The R27 is designed for 1000 units per day and therefore, the additional traffic generated during the construction phase will have a **low** negative impact.

The operational phase will have a lower traffic generation since only the personnel permanently employed on site would need to go to site every day. It is not expected that this would exceed 10 trips per day. This negative impact would therefore be **very low.**

Since is it unclear at this stage what the traffic numbers will be in the Kenhardt area in 20 years' time and the amount of trucks required for decommissioning, the impacts associated with this phase of the project were based on the construction phase details given that this is the worst case scenario in terms of traffic generation. Therefore, the significance of the impact would be **low** negative.

16.6.1.2 Proposed mitigation

Even though the traffic generated would not be significant, the following requirements should still be met by the developer during the construction and decommissioning phases:

- Should abnormal loads have to be transported by road to the site, a permit needs to be obtained from the Provincial Government Northern Cape (PGNC) Department of Public Works, Roads and Transport;
- Provide a Transport Traffic Plan to SANRAL;
- Ensure that roadworthy and safety standards are implemented at all time for all construction vehicles; and
- Plan trips so that it occurs during the day but avoid construction vehicles movement on the regional road during peak time (06:00-10:00 and 16:00-20:00).

Requirements to be met during the operational phase:
- Adhere to requirements made within Transport Traffic Plan;
- Limit access to site to personnel; and
- Ensure that where possible, staff members carpool to site.

16.6.2 Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads.

During all phases, vehicles will need to access the site via the R27 and the Transnet Service Road. As shown in the photo plate in Section 3, the Transnet Service Road intersects with the R27 just outside of Kenhardt. There is the potential that should vehicles not indicate soon enough that they are turning off from the R27, an accident can occur. In addition, not adhering to the relevant speed limits may cause accidents with other drivers and collisions with animals.

16.6.2.1 Significance of impacts without mitigation

The significance of causing an accident with pedestrians, animals and other drivers would have a **high** negative impact significance since the probability of the impact occurring would be highly probable and could be fatal and therefore would cause irreplaceable loss to the environment.

16.6.2.2 Proposed mitigation

- Road kill monitoring programme (inclusive of wildlife collisions record keeping) should be established and fences (such as Animex fences) installed, if needed to direct animals to safe road crossings (for the project site and the Transnet road));
- Adhere to speed limits applicable to all roads used; and
- Implement clear and visible signalisation indicating movement of vehicles and when turning off or onto the Transnet Service Road to ensure safe entry and exit.

16.6.2.3 Significance of impact with mitigation

By implementing the abovementioned mitigation measures the probability of the impact occurring would be lowered significantly which would reduce the significance of the impact to **medium** negative impact.

16.6.3 Impact on air quality due to dust generation, noise and release of air pollutants from vehicles and construction equipment.

16.6.3.1 Nature of the impact

During all the phases of the project, there will be a decrease in air quality due to the noise created by and pollutants released from vehicles coming to site during all phases of the projects, construction activities occurring on site and dust created from driving on the Transnet Service Road. Since the site is located in a very rural setting, no sensitive receptors are present within close proximity of the proposed project. Therefore, the extent of the impact would remain local.

16.6.3.2 Significance of impacts without mitigation

As discussed above, the decrease in air quality would be local in extent. The worst case scenario for impacts on air quality is that no dust suppression is implemented on the Transnet Service Road, on site and that construction activities occur throughout very windy conditions. This negative impact would be **medium**, without mitigation.

16.6.3.3 Proposed mitigation

- Implement management strategies for dust generation e.g. apply dust suppressant on the Transnet Service Road, exposed areas and stockpiles;
- Postpone or reduce dust-generating activities during periods with strong wind;
- Limit noisy maintenance/operational activities to daytime only;
- Earthworks may need to be rescheduled or the frequency of application of dust control/suppressant increased;
- Ensure that all construction vehicles are roadworthy and respect the vehicle safety standards implemented by the Project Developer; and
- Avoid using old and noisy construction equipment and ensure equipment is well maintained.

16.6.3.4 Significance of impact with mitigation

With the implementation of the mitigation measures detailed above, the probability of noise emissions and dust realised would be lowered and the impact would be of a **low** significance.

16.6.4 Change in quality of surface condition of the roads

16.6.4.1 Nature of the impact

The R 27 and the Transnet Service Road are going to be used as the two main access roads to the site. As discussed in Section 3, the R 27 has been designed for minimum daily traffic exceeding 1000 (equivalent vehicle units), therefore is not expected that an increase in traffic on the R 27 would significantly affect the R 27. On the other hand, the Transnet Service Road is a gravel road and would require additional maintenance to ensure that the traffic generated would not decrease the surface condition of the road.

16.6.4.2 Significance of impacts without mitigation

The Transnet Service Road is currently being maintained by Transnet. Since the project applicant is going to use this road during all phases of the project, it is expected that, should no mitigation measures be implemented, the road's surface condition would decrease significantly. This would therefore have a **low** negative impact on the road.

16.6.4.3 Proposed mitigation

- Construction activities will have a higher impact than the normal road activity and therefore the road should be inspected on a weekly basis for structural damage;
- Ensure that road network is maintained in a good state for the entire operational phase;
- Implement management strategies for dust generation e.g. apply dust suppressant on the Transnet Service Road, exposed areas and stockpiles; and
- A Road Maintenance Plan should be developed for the section of the Transnet Service Road that will be used by the project applicant and should address the following:
  - Grading requirements;
  - Dust suppressant requirements;
  - Drainage requirements;
  - Signage; and
  - Speed limits.

16.6.4.4 Significance of impact with mitigation

Provided that the above mitigation measures are implemented and agreed to by Transnet, the impact would be a **low** positive impact since this section of the road would be well maintained.

16.6.5 Cumulative impact of traffic generation

The cumulative impact assessment assumes that all the projects outlined within the cumulative impact section occur at the same time. Even though there will most likely be overlap in the operational phases of these projects, it is unlikely that the construction phases for all these projects would occur at the same time. Since the construction phase will give rise to the most amount of trucks coming to site, this would be considered the worst case scenario in terms of traffic generation. The projects that are proposed within close proximity of each other are detailed within Table 16.1 below. The estimates detailed within the table below have been obtained from the Developers. Based on these current estimates, the total amount of additional trips that would occur on the R27 during the construction phase is 261.81, which is still well below the daily average limit of 1000 units. The impact on this road is therefore not anticipated to be significant but should the Transnet Service Road be used for all the projects, a maintenance plan, agreed upon all parties involved must be implemented to ensure that the road's quality and integrity is maintained.

16.6.5.1 Significance of cumulative impacts

It is assumed that the mitigation measures discussed in the Section 16.6 of this TIS and included in Table 16.2 below are implemented, that the traffic generation impacts would be suitable managed to ensure that the traffic impacts are suitably managed. Based on this, the cumulative negative impact is **low**.

Table 16.1: Cumulative daily traffic generation estimates for all PV projects proposed north-east of Kenhardt

Project name		Daily traffic generation estimates		
		Construction Phase	Operational Phase	Decommission Phase
1	Proposed construction of Gemsbok PV1 75 MW Solar PV facility	20	10	20
2	Proposed construction of Gemsbok PV2 75 MW Solar PV facility	20	10	20
3	Proposed construction of Boven PV1 75 MW Solar PV facility	20	10	20
4	Proposed development of a 75 MW Solar PV Facility (Kenhardt PV 1) and proposed development of a 132 kV Transmission Line to connect to the proposed 75 MW Solar PV Facility (Kenhardt PV 1)	20.62	4.14	20.62
5	Proposed development of a 75 MW Solar PV Facility (Kenhardt PV 2) and proposed development of a 132 kV Transmission Line to connect to the proposed 75 MW Solar PV Facility (Kenhardt PV 2)	20.62	4.14	20.62
6	Proposed development of a 75 MW Solar PV Facility (Kenhardt PV 3) and proposed development of a 132 kV Transmission Line to connect to the proposed 75 MW Solar PV Facility (Kenhardt PV 3)	20.62	4.14	20.62
7	Proposed construction of the Phase 2 Nieuwehoop Solar PV Park Development consisting of seven 75 MW PV or Concentrated PV Solar Energy Facilities and associated infrastructure (this project)	140	70	140
	Total	**261.86**	**112.42**	**261.86**

Table 16.2: Traffic Impact Assessment Table

Aspect/ Impact Pathway	Nature of impact	Status	Spatial Extent	Duration	Conse quence	Proba bility	Reversi bility	Irreplace ability	Mitigation Measures	Significance of Impact/Risk = Consequence x Probability		Ranking of Impact/ Risk	Confidence Level
										Without Mitigation	*With Mitigation*		
CONSTRUCTION AND DECOMMISSIONING PHASES													
Traffic generation	Increase in traffic	Nega tive	Region al	Short term	Mode rate	Very likely	Yes	Replacea ble	• Should abnormal loads have to be transported by road to the site, a permit needs to be obtained from the Provincial Government Northern Cape (PGNC) Department of Public Works, Roads and Transport • Provide a Transport Traffic Plan to SANRAL • Ensure that roadworthy and safety standards are implemented at all time for all construction vehicles • Plan trips so that it occurs during the day but avoid construction vehicles movement on the regional road during peak time (06:00-10:00 and 16:00-20:00).	Low	Low	4	Medium
	Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads	Nega tive	Local	Long term	Extreme	Likely	No	High irreplace ability	• Road kill monitoring programme (inclusive of wildlife collisions record keeping) should be established and fences (such as Animex fences) installed, if needed to direct animals to safe road crossings.(for the project site and the Transnet road) • Adhere to all speed limits applicable to all roads used. • Implement clear and visible signalisation indicating movement of vehicles and when turning off or onto the Transnet Service Road to ensure safe entry and exit.	High	Moderate	3	Medium

Aspect/ Impact Pathway	Nature of impact	Status	Spatial Extent	Duration	Conse quence	Proba bility	Reversi bility	Irreplace ability	Mitigation Measures	Significance of Impact/Risk = Consequence x Probability		Ranking of Impact/ Risk	Confidence Level
										Without Mitigation	*With Mitigation*		
	Impact on air quality due to dust generation, noise and release of air pollutants from vehicles and construction equipment	Nega tive	Local	Medium term	Mode rate	Unlikely	Yes	Replacea ble	• Implement management strategies for dust generation e.g. apply dust suppressant on the Transnet Service Road, exposed areas and stockpiles. • Postpone or reduce dust-generating activities during periods with strong wind. • Earthworks may need to be rescheduled or the frequency of application of dust control/suppressant increased. • Ensure that all construction vehicles are roadworthy and respect the vehicle safety standards implemented by the Project Developer. • Avoid using old and noisy construction equipment and ensure equipment is well maintained.	Moderate	Low	4	Medium
	Change in quality of surface condition of the roads	Posi tive	Local	Long term	Slight	Likely	Yes	Replacea ble	• Construction activities will have a higher impact than the normal road activity and therefore the road should be inspected on a weekly basis for structural damage; • Implement management strategies for dust generation e.g. apply dust suppressant on the Transnet Service Road, exposed areas and stockpiles; and • A Road Maintenance Plan should be developed for the section of the Transnet Service Road that will be used to addresses the following: o Grading requirements; o Dust suppressant requirements; o Drainage requirements; o Signage; and o Speed limits.	Low	Low	4	Medium

Aspect/ Impact Pathway	Nature of impact	Status	Spatial Extent	Duration	Conse quence	Proba bility	Reversi bility	Irreplace ability	Mitigation Measures	Significance of Impact/Risk = Consequence x Probability		Ranking of Impact/ Risk	Confidence Level
										Without Mitigation	*With Mitigation*		
Traffic generation	Increase in traffic	Nega tive	Region al	Short term	Slight	Very likely	High	Replacea ble	• Adhere to requirements made within Transport Traffic Plan; • Limit access to the site to personnel; and • Ensure that where possible, staff members carpool to site.	Very low	Very low	5	Medium
	Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads	Nega tive	Local	Long term	Extreme	Likely	No	High irreplace ability	• Road kill monitoring programme (inclusive of wildlife collisions record keeping) should be established and fences installed, if needed to direct animals to safe road crossings.(for the project site and the Transnet road) • Adhere to all speed limits applicable to all roads used. • Implement clear and visible signalisation indicating movement of vehicles and when turning off or onto the Transnet Service Road to ensure safe entry and exit.	High	Moderate	3	Medium
	Impact on air quality due to dust generation, noise and release of air pollutants from vehicles and construction equipment	Nega tive	Local	Medium term	Mode rate	Unlikely	Yes	Replacea ble	• Implement management strategies for dust generation e.g. apply dust suppressant on the Transnet Service Road, exposed areas and stockpiles; • Limit noisy maintenance/operational activities to daytime only.	Moderate	Low	4	Medium
	Change in quality of surface condition of the roads	Posi tive	Local	Long term	Slight	Likely	Yes	Replacea ble	• Implement requirements of the Road Maintenance Plan.	Low	Low	4	Medium
CUMULATIVE IMPACTS													
Traffic generation	Increase in traffic	Nega tive	Region al	Long term	Mode rate	Very likely	High	Replacea ble	n/a	Low	Low	4	Medium

16.7 TRAFFIC IMPACT STATEMENT

Based on the assessment of the potential impacts that can be associated with the traffic to be generated during the construction, operation and decommissioning phases of these projects, the overall impact from traffic generation is deemed to be **low** when implementing suitable mitigation measures, discussed in Section 16.5 and 16.6 of this Statement. The highest traffic will be generated during the construction phase.

The measures included within the EMPr must be adhered to, with the main requirements outlined below:

- Should abnormal loads have to be transported by road to the site, a permit needs to be obtained from the Provincial Government Northern Cape (PGNC) Department of Public Works, Roads and Transport.
- Provide a Transport Traffic Plan to SANRAL.
- Ensure that roadworthy and safety standards are implemented at all time for all construction.
- Adhere to all speed limits applicable to all roads used.
- Implement clear and visible signalisation indicating movement of vehicles and when turning off or onto the Transnet Service Road to ensure safe entry and exit.
- Implement management strategies for dust generation e.g. apply dust suppressant on the Transnet Service Road, exposed areas and stockpiles.
- Construction activities will have a higher impact than the normal road activity and therefore the road should be inspected on a weekly basis for structural damage.
- A Road Maintenance Plan should be developed for the section of the Transnet Service Road.
- Ensure that road network is maintained in a good state for the entire operational phase.

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17 CONCLUSIONS AND RECOMMENDATIONS

This chapter contains the main conclusions and recommendations from the EIA Process, provides the key findings of the specialist studies (i.e. outlines the most significant impacts identified, together with the key management actions required to avoid or mitigate the negative impacts or enhance positive benefits). In addition it presents an integrated summary of impacts that will influence decision-making by the Competent Authority (i.e. the DEA) and the associated management actions. In addition, the chapter also includes the EAP's opinion on the environmental suitability of the project and whether the project should receive EA.

17.1 Summary of Impact Significance: Main Impacts and Key Recommendations

The 2014 NEMA EIA Regulations define a significant impact as "an impact that may have a notable effect on one or more aspects of the environment or may result in non-compliance with accepted environmental quality standards, thresholds or targets and is determined through rating the positive and negative effects of an impact on the environment based on criteria such as duration, magnitude, intensity and probability of occurrence".

Based on the definition above, this section provides a summary of significant impacts identified and assessed by the specialists in Chapters 7 to 14 of this EIA Report (as noted in Table 17.1 below). The significant impacts and corresponding impact significance ratings before and after mitigation and associated mitigation and management measures are summarised in this section.

Table 17.1: Specialist Studies

Name	Organisation	Specialist Study Undertaken	Chapter in this EIA Report
Henry Holland	Private	Visual Impact Assessment	Chapter 7
Ina Venter	Kyllinga Consulting (sub-contracted by Pachnoda Consulting CC)	Vegetation and Wetlands	Chapter 8
Lukas Niemand	Pachnoda Consulting cc	Avifauna	Chapter 9
Lukas Niemand	Pachnoda Consulting cc	Fauna	Chapter 10
Johann Lanz	Private	Soils and Agricultural Potential Assessment	Chapter 11
Dr. Jayson Orton	ASHA Consulting (Pty) Ltd	Heritage Impact Assessment (Archaeology and Cultural Landscape)	Chapter 12
Dr. John Almond	Natura Viva cc	Desktop Palaeontological Impact Assessment	Chapter 13
Rudolph du Toit	CSIR	Social Impact Assessment	Chapter 14
P. S. van der Merwe and A. J. Otto	MESA Solutions (PTY) Ltd	Electro Magnetic Interference and Radio Frequency Interference Surveys (Refer to the explanation provided below)	Chapter 15
Surina Laurie	CSIR	Traffic Impact Statement (Refer to the explanation provided below)	Chapter 16

It must be reiterated that the Socio-Economic Impact Assessment specialist study (included in Chapter 14 of this EIA Report) was subject to a peer review process by an external reviewer (Ms. Liza van der Merwe, a private consultant), as requested by the DEA in their letter of acceptance of the Scoping Report. This external review report is included as Appendix A to the Socio-Economic Impact Assessment.

In addition, an Electro Magnetic Interference (EMI) and Radio Frequency Interference (RFI) Survey Technical Study was commissioned by the Project Applicant to determine the impact of the proposed project on the Square Kilometre Array (SKA) project, as requested by the SKA Project Office (a summary of this study is contained in Chapter 15 and the full study is included in Appendix J of this EIA Report). This report is not a standard specialist study in terms of Appendix 6 of the 2014 NEMA EIA Regulations, as it is a detailed, technical report which provides a cumulative topographical analysis of the proposed PV projects in the Astronomy Geographic Advantage (AGA) Area and was undertaken to determine appropriate mitigation and management measures to reduce the risk of a detrimental impact on the SKA project.

A Traffic Impact Statement was also compiled by the EAP and is included in Chapter 16 of this EIA Report, however it serves as a general description of the existing and predicted traffic associated with the proposed project and does not classify as a specialist study in terms of Appendix 6 of the 2014 NEMA EIA Regulations. Furthermore, this statement considered the full development (i.e. the development of the seven Solar PV Facilities and the associated electrical infrastructure.

It should be noted that all the mitigation and management measures proposed by the specialists, including those additional impacts and management measures identified by the EAP (such as impacts on traffic, air quality, stockpiling recommendations, waste management and the management of dangerous goods on site) have been included in the EMPr (Part B of this EIA Report).

17.1.1 Visual Impact Assessment

A Visual Impact Assessment was undertaken by Henry Holland (Chapter 7 of the EIA Report).

The landscape surrounding the proposed site has a rural agricultural character which has been affected by extensive stock farming and large scale infrastructure in the form of the Sishen-Saldanha ore railway line and the Eskom Nieuwehoop Substation.

The following sensitive visual receptors potentially will be affected by the introduction of a large PV plant into the landscape:

- Residents and viewpoints on farms surrounding the proposed development site. These are highly sensitive visual receptors since they have an active interest in their surrounding landscape; and
- Motorists using the R383 and the Transnet Service Road (Loop 14) adjacent to the ore railway line.

Motorists are classified as low sensitivity visual receptors since they pass through the landscape and their attention is mostly focused on the road.

The area proposed for this project falls within a renewable development zone (REDZ 7 – Upington Solar) as identified in the national SEA for renewable energy developments and is therefore seen on a regional scale as an appropriate area for solar energy developments. On a local scale the visually disturbed landscape surrounding the Nieuwehoop Substation and the low number of highly sensitive visual receptors that potentially will be affected, makes this an ideal area to locate the proposed Gemsbok Solar PV6 solar energy facility.

Impacts

The key impacts and their significance ratings are listed below:

IMPACT (NEGATIVE)	SIGNIFICANCE (BEFORE MITIGATION)	SIGNIFICANCE (AFTER MITIAGION)
CONSTRUCTION PHASE		
Potential visual intrusion of construction activities associated with a PV plant on existing views of sensitive visual receptors.	Moderate	Low
Potential visual intrusion of construction activities associated with a 132 kV powerline on existing views of sensitive visual receptors.	Low	Low
OPERATIONAL PHASE		
Potential landscape impact of a large solar energy facility on a rural agricultural landscape.	Very Low	Very Low
Potential landscape impact of a 132 kV powerline on a rural agricultural landscape	Very Low	Very Low
Potential visual intrusion of the proposed solar energy facility on the views of sensitive visual receptors.	Moderate	Low
Potential visual intrusion of a 132 kV powerline on the views of sensitive visual receptors.	Very Low	Very Low
Potential impact of night lighting of a large solar energy facility on the nightscape of the region.	Very Low	Very Low
DECOMMISSIONING PHASE		
Potential visual intrusion of decommissioning activities associated with a PV plant on views of sensitive visual receptors.	Moderate	Low
Potential visual intrusion of decommissioning activities related to a 132 kV powerline on the existing views of sensitive visual receptors.	Low	Low

Overall the impacts are Negative, Low to Moderate before mitigation, and Low to Very Low after mitigation. No impacts of high significance (after mitigation) were identified.

Cumulative impacts

- *Cumulative Impact of Solar Energy Generation Projects and Large Scale Electrical Infrastructure on the Existing Rural-Agricultural Landscape*

The introduction of a large railway line, siding and tower has changed the landscape character of the region by reducing its sense of remoteness. This is further changing with the addition of a large substation and a network of high-voltage power lines which are highly visible structures due to their height and linear extent. The substation and power lines are being constructed and therefore represent a definite change in landscape character. Several large solar energy facilities are being proposed for the region immediately surrounding the proposed Gemsbok Solar PV 5 project area (within 20 km of the site as indicated in Chapter 4). In the event that some of them are built, large areas of natural vegetation and stock farming land will be transformed into fields covered in thousands of solar panels. Solar fields will become a common feature of the landscape and the rural-agricultural landscape character will have a significant power generation component (as well as large scale electrical infrastructure). The cumulative change in landscape character from rural agricultural/electrical infrastructure to include a large power generation component will have only a slight consequence since the original character is not one of high quality and there are other landscapes in the surrounding region with higher quality. These do not include electrical infrastructure of this magnitude and are more representative of rural agriculture in an arid landscape.

The significance of cumulative impacts of this and the other solar projects proposed for the area on the surrounding landscape character is **very low** since the landscape is rapidly changing due to the introduction of large scale and highly visible rail and electrical infrastructure.

- *Cumulative Visual Impact of Solar Energy Generation Projects and Large Scale Electrical Infrastructure on Existing Views of Sensitive Visual Receptors in the Surrounding Landscape*

The original visual resources of the region under assessment were represented by open, long distance views of arid landscape with low hills and sparse vegetation cover. There were limited opportunities for scenic vistas but the sense of place was remote wilderness. Subsequent stock farming practices have reduced the visual resources by impacting on the vegetation and wilderness. The railway line and associated infrastructure (including the new substation and electrical infrastructure), have further altered the sense of place of the region and reduced the opportunities for scenic views. The addition of several large fields of solar arrays (and associated electrical infrastructure will affect the existing visual resources but since these are not of high quality, very few sensitive visual receptors will be affected, and opportunities for scenic views are very limited, the consequence of the cumulative visual impact is rated as moderate.

It should be noted that the projects currently proposed for the region are all in close proximity to the railway line and new substation (structures with high visibility and visual intrusion). Furthermore, very few highly sensitive visual receptors are likely to be affected even if all of them are eventually built, and at this point Kenhardt lies outside any of the viewsheds. Game farms are mostly outside of the viewsheds (or are further than 10 km from any of the projects indicating at most low visual exposure for areas in any viewsheds). The R27 is more than 10 km from any of the projects and only short sections of this road provide any potential views of solar plants for tourists using this road.

The significance of the cumulative visual impact on sensitive visual receptors is **low** due to the existing and new structures which have severely limited potential scenic views in the region.

Overall the cumulative impacts are Negative, and Very Low to Low (before and after mitigation). No impacts of high significance (after mitigation) were identified.

Mitigation measures

The main mitigation measures are the following:

Construction and operation phase

- Preparation of the solar field area (i.e. clearance of vegetation, grading, contouring and compacting) and solar field construction should be phased in a way that makes practical sense in order to minimise the area of soil exposed and duration of exposure;
- Night lighting of the construction sites should be minimised within requirements of safety and efficiency; and
- A lighting plan that documents the design, layout and technology used for lighting purposes should be prepared, indicating how nightscape impacts will be minimised. The requirements or

the specifications to be included in the lightning plan as set out in the visual study should be adhered to.

Solar Arrays

- Painted features should be maintained and repainted when colour fades or paint flakes; and
- The type of power line towers used for the proposed power line should be similar to existing power line towers in the landscape.

Buildings

- Appropriate coloured materials should be used for structures to blend in with the backdrop of the project where this is technically feasible and the colour or paint will not have a deleterious effect on the functionality of the structures;
- Appropriate colours for smooth surfaces often need to be two to three shades darker than the background colour to compensate for shadows that darken most textured natural surfaces where this is technically feasible and the colour or paint will not have a deleterious effect on the functionality of the structures;
- Materials, coatings and paints should be chosen based on minimal reflectivity where possible; and
- Grouped structures should be painted the same colour to reduce visual complexity and contrast.

Decommissioning phase

- Disturbed and transformed areas should be contoured to approximate naturally occurring slopes to avoid lines and forms that will contrast with the existing landscapes;
- Edges of re-vegetated areas should be feathered to reduce form and line contrasts with surrounding undisturbed landscape;
- Working at night should be avoided where possible; and
- Night lighting of reclamation sites should be minimised within requirements of safety and efficiency.

It is the opinion of the visual specialist that this project should be authorised with adherence to mitigation measures as set out in the Visual Impact Assessment report (Chapter 7 of this EIA Report).

17.1.2 Vegetation and Wetlands

A Vegetation and Wetland Impact Assessment was undertaken by Ina Venter of Kyllinga Consulting (sub-contracted by Pachnoda Consulting (Chapter 8 of the EIA Report).

Vegetation

The vegetation on the Gemsbok Solar PV6 site comprises the Bushmanland Arid Grassland (Mucina & Rutherford 2006). This vegetation type is present in the Northern Cape Province, between Aggeneys and Prieska, to the north of the Bushmanland Basin and to the south of the desert vegetation. The vegetation type is located on plains, sparsely vegetated by grassland (dominated by *Stipagrostis* species) and with semi-desert characteristics. During years of abundant rainfall annual species flower abundantly. The soils are mostly a red-yellow apedal soil of less than 300 mm deep, but exceeding this depth in approximately a fifth of the area. The area has a low rainfall, with a mean annual precipitation (MAP) of between 70 and 200 mm. The vegetation type is classified as Least Threatened. Although a very small area is statutorily conserved, very few areas have been transformed.

A few vegetation units falling under the Bushmanland Vloere vegetation type (AZi5: Mucina and Rutherford 2006) are present a short distance outside the site investigated (Figure 3.8). Salt pans and broad riverbeds are included in this vegetation type, as well as several dysfunctional river tributaries. The vegetation type is present on flat and very even surfaces. The soil is mostly silt and clayey alluvial soils and often has a high salt content. In some areas, erosion can be considerable. The vegetation type is classified as Least Threatened in Mucina and Rutherford (2006).

The quiver tree, *Aloe dichotoma,* was observed on site during a site visit in December 2015. *Aloe dichotoma* is a Vulnerable species, which is specially protected under the Northern Cape Nature Conservation Act, (Act 9 of 2009) (NCNCA). The removal or movement of this species will require a permit from Northern Cape Nature. The species will have to be moved to appropriate habitat outside the proposed development area. This will require planning that takes the seasons and rainfall into account. In addition, *Boscia albitrunca* and B. *foetida* were observed on site. *Boscia albitrunca* is a protected species under the National Forest Act (Act 84 of 1998 (NFA), as well as the NCNCA, and *Boscia foetida* is protected under the NCNCA. *Boscia albitrunca* is fairly rare, with less than one individual present per 50 ha. *Boscia foetida,* a similar species, are much more abundant.

The majority of this site falls within a moderate sensitivity area. The high sensitivity areas must however be avoided.

Watercourses

The NFEPA atlas indicates three rivers in the immediate surroundings of the investigated area, i.e. the Rugseersrivier, and two are unnamed. These rivers fall in class B, which is largely natural. There are, therefore, few impacts on the river systems in the area. These systems are ephemeral river systems and only have flow during the rainy season.

Several watercourses are delineated on the 1:50 000 topographical maps of the area. These are ephemeral. The watercourse units, and associated vegetation unit, identified on site include:

- Ephemeral streams – Mostly vegetation Sub-unit 3.1 (*Prosopis glandulosa* watercourse);
- Floodplains – Mostly vegetation Sub-unit 3.3 (*Roepera morgsana* floodplain), although portions are dominated by *Prosopis glandulosa; and*
- First order drainage lines – These units mostly correspond to vegetation Sub-unit 3.2 (*Rhigozum trichotomum* watercourse).

The ephemeral streams and the first order drainage lines have alluvial soils, although the soil is often very shallow in the ephemeral stream beds. The soil in the floodplain area is a deep sandy soil and better structured than the soil in the ephemeral streams.

The ephemeral stream can be classified as a riparian zone, but no aquatic assessments can take place due to the lack of water for most of the year. The floodplain zone is a marginal riparian zone. This section may occasionally be flooded during large rainfall events. These watercourses are of high conservation importance, but have a moderate to high sensitivity due to the presence of *Prosopis glandulosa* and require a 32 m buffer zone. The estimate PES class of these units are B/C, also due to the high cover abundance of *Prosopis glandulosa.*

The first order drainage lines on site are mostly very narrow, in many cases only approximately 1 m wide and due to the scale of the assessment could not be delineated as a polygon feature. A line feature was however created for each of these systems. The drainage lines mostly have a clear change in vegetation dominance. These areas cannot be clearly defined as riparian or wetland areas, although some riparian characteristics are present. They are however definitely watercourses and are therefore of high conservation importance. These systems are mostly intact, with very few impacts and fall within PES class A. These drainage lines also require a buffer zone, but the buffer zone can possibly be decreased to a 20 m in width.

Impacts

They key impacts on vegetation and watercourses and their significance ratings are listed below:

IMPACT (NEGATIVE)	SIGNIFICANCE (BEFORE MITIGATION)	SIGNIFICANCE (AFTER MITIAGION)
CONSTRUCTION PHASE		
Loss of Species of Special Concern	Moderate	Low
Loss of Primary Vegetation	Moderate	Low
Soil compaction and vehicle wheel track entrenchment	Low	Very Low
Erosion and sedimentation	Low	Very Low
Change in flow patterns due to erosion and sedimentation	Low	Very Low
Establishment of Invasive Alien species	Low	Low
Pollution and littering	Low	Very Low
OPERATIONAL PHASE		
Loss of Species of Special Concern	Low	Low
Loss of Primary Vegetation	Low	Low
Soil compaction and vehicle wheel track entrenchment	Low	Very Low
Erosion and sedimentation	Low	Very Low
Change in flow patterns due to erosion and sedimentation	Low	Very Low
Establishment of Invasive Alien species	Low	Low
Pollution and littering	Very Low	Very Low
DECOMMISSIONING PHASE		
Loss of Species of Special Concern	Low	Low
Loss of Primary Vegetation	Low	Low
Soil compaction and vehicle wheel track entrenchment	Low	Very Low
Erosion and sedimentation	Low	Very Low
Change in flow patterns due to erosion and sedimentation (positive)	Low	Very Low
Establishment of Invasive Alien species	Low	Low
Pollution and littering	Very Low	Very Low

Overall the impacts are Negative, Very Low to Moderate before mitigation, and Low to Very Low after mitigation. No impacts of high significance (after mitigation) were identified.

Cumulative impacts

The cumulative impacts on vegetation and watercourses and their significance ratings are listed in the table below:

IMPACT (NEGATIVE)	SIGNIFICANCE (BEFORE MITIGATION)	SIGNIFICANCE (AFTER MITIAGION)
Construction phase		
Loss of Species of Special Concern	High	Moderate
Loss of Primary Vegetation	High	High
Erosion and sedimentation	Moderate	Low
Change in flow patterns due to erosion and sedimentation (positive)	Moderate	Low
Establishment of Invasive Alien species	Low	Low

Overall the impacts are Negative, Low to High before mitigation, and High to Low after mitigation. The loss of primary vegetation is identified as an impact of high significance (after mitigation)

Mitigation measures

The main mitigation measures are the following:

- No development can be allowed to take place within the High sensitivity areas or buffer zones. Development should avoid the Moderate to High sensitivity areas. Species of Special Conservation Concern must be avoided as much as possible. If not, all individuals of *Aloe dichotoma and Hoodia gordonii* impacted on site must be relocated to suitable habitat in the area. All relevant permits pertaining to the Species of Conservation importance on site must be obtained before construction commences.
- Appropriate buffers must be implemented. All major watercourses must be avoided with a buffer of 32 m (*Prosopis glandulosa*) and all minor drainage lines must be avoided with a buffer of 20 m.
- A suitably qualified ECO must be appointed to implement the EMPr and the relevant conditions in the Environmental Authorisation for the project and must contractually be held responsible for the implementation.
- The construction areas must be fenced off prior to construction.
- No movement of vehicles or people are allowed outside the fenced area or approved roads during construction (unless absolutely necessary).
- No construction related activities, such as the site camp, storage of materials, temporary roads or ablution facilities may be located in the moderate to high or the high sensitivity areas (should be located outside buffer areas and buffers).
- A comprehensive vegetation rehabilitation plan for the site must be compiled for implementation during post-construction and decommissioning. The vegetation rehabilitation plan must be compiled before decommissioning commences and must take the most recent features or conditions of the site into account.
- The crossing of watercourses must be avoided, where possible.
- Have an erosion prevention plan and storm water management plans for the site and implement when necessary.
- Dangerous goods may not be stored within 100 m of a watercourse and should be stored in a bunded area to contain spillages.
- Hydrocarbon fuels must be stored in a secure, bunded area.

It is the opinion of the vegetation and wetland specialist that this project should be authorised with adherence to mitigation measures as set out in the Vegetation and Wetland Impact Assessment report (Chapter 8 of this EIA Report). The high sensitivity areas must be avoided.

17.1.3 Avifauna

An integrated Avifaunal Impact Assessment was undertaken by Lukas Niemand of *Pachnoda Consulting cc* as part of the EIA Process (included in Chapter 9 of this EIA Report). The impact assessment is specific to each project.

Bird diversity is positively correlated with vegetation structure. Therefore, floristic richness is not regarded to be the most important contributor to the observed patterns in bird abundance and spatial distribution. The Northern Cape, in particular the Namib-Karoo Biome, is generally poor in bird species richness although considered to be an important habitat for many terrestrial and often cryptic bird species such as larks, korhaans, bustards and chats. However, the Northern Cape is an important speciation centre for larks and stenotopic warblers. It therefore hosts a small assemblage of endemic (or near-endemic) species such as the Sclater's Lark *Spizocorys sclateri* and the Cinnamon-breasted Warbler *Euryptila subcinnamomea*. The lark species are typical Bushmanland Basin endemics, and many species of this region are also threatened by habitat destruction (Barnes, 2000) or alteration (e.g. grazing).

The study area does not contain any Important Bird Areas (IBAs). The nearest IBAs to the study area are the Augrabies Falls National Park (SA029; located 110 km north-west of the study site) and the Mattheus-Gat Conservation Area (SA034; located 144 km west of the study area) (Marnewick *et al*., 2015). The latter area is one of a few areas which provide protection to the globally threatened Red Lark *Certhilauda burra* and the Near-Threatened Sclater's Lark *Spizocorys sclateri*.

The following key considerations were identified and noted during the site visit and in the overall bird study:

- The study area was investigated during 04 - 11 December 2015 and corresponded to the November/December rainfall period. However, the area was experiencing exceptionally hot and dry conditions due to late rains. This affected invertebrate prey and graminoid seed abundance, resulting in biased bird observations (e.g. underestimated bird richness and abundance). The site visits were not conducted during the other seasons nor did it take place during optimal of precipitation events during late February to April. It should, therefore, be interpreted as an early summer season survey and it is highly recommended that a second survey (as part of the pre-construction monitoring phase) be conducted during late March/early April, i.e. the wet season (provided the area received sufficient rainfall).
- Eleven bird species habitat types were identified, ranging from *Salsola* – *Stipagrostis* short shrubveld, *Salsola* outcrops and gravel plains to *Prosopis glandulosa* watercourses and artificial livestock watering points. The artificial watering points and shrubveld correlated with high bird species richness, while the quartz gravel plains provided habitat for specialised bird species (mainly larks);
- A total of 88 bird species was confirmed during the investigation in the study area;
- The study area supported habitats for many Threatened and Near-threatened bird species, with five species recorded during the investigation: Martial Eagle *Polemaetus bellicosus* (Endangered), Ludwig's Bustard *Neotis ludwigii* (Endangered), Red Lark *Certhilauda burra* (Vulnerable), Karoo Korhaan *Eupodotis vigorsii* (Near Threatened) and Sclater's Lark *Spizocorys sclateri* (Near Threatened);
- The study area supported a high richness of near-endemic species and bird species restricted to the Namib-Karoo Biome;
- The study area was represented by three distinct avifaunal assemblages consisting of an assemblage confined to the *Prosopis glandulosa* watercourses, an assemblage confined to the artificial watering points and a large and varied assemblage confined to the shrubveld – outcrop mosaics;

- A large part of the study area contains sensitive habitat based on the occurrence of Threatened and Near-threatened bird species. The artificial livestock watering holes, dams and all quartz and dolerite outcrops were identified as being of high bird sensitivity. Most of these areas support local populations of the Threatened Ludwig's Bustard and Red Lark and the near Threatened Karoo Korhaan and Sclater's Lark. In addition, it also provides habitat for the Burchell's Courser, *Cursorius rufus* and Lanner Falcon *Falco biarmicus*. These high sensitivity areas must be avoided with a buffer of 100 m. The major water courses must be avoided with a buffer of 32 m.

Impacts

The key impacts and their significance ratings are listed below:

IMPACT (NEGATIVE)	SIGNIFICANCE (BEFORE MITIGATION)	SIGNIFICANCE (AFTER MITIAGION)
CONSTRUCTION PHASE		
Habitat loss, fragmentation and displacement of threatened and near threatened species and species loss.	High	Moderate
Displacement and disturbances caused to birds due to noise generation and construction, operational and maintenance activities. Displacement of foraging taxa and loss of genetic cohesion between populations.	High	Moderate
OPERATIONAL PHASE		
Increased bird mortalities due to collision with panels.	Moderate	Moderate
Disorientation of bird species due to exterior lighting and increased bird mortalities (due to collision with infrastructure).	Moderate	Low
Cleaning of panels could result in chemical pollution of water resources.	Low	Low
Secondary impacts related to the infrastructure attracting birds: nest –building activities and roosting birds.	Moderate	Low
Collision with power lines resulting in bird mortalities, especially threatened species.	Very High	High
Electrocution by power lines resulting in bird mortalities, especially threatened species.	High	Moderate
DECOMMISSIONING PHASE		
Increased competition and decline in species richness during rehabilitation.	Moderate	Low

Overall the impacts are negative, Low to Very High before mitigation, and High to Low after mitigation. The collision with power lines resulting in bird mortalities, especially threatened species, was identified as an impact of High significance (after mitigation).

Cumulative impacts

- ***Cumulative Impacts - Indirect impacts related to anthropogenic encroachment***

The proposed solar facilities, especially during construction will provide employment for the local community as well as people from afield. Unfortunately, such an activity will impact negatively on the surrounding habitat types by facilitating increased human presence and consequential plundering of natural resources (e.g. fire-wood collection, snaring and poaching).

Human environments are often magnets for alien and invader species which include feral dogs and cats. The domestic cats specifically are problematic since they could prey on local native birds. The significance of the impact is rated as **High (without mitigation) and Moderate (with mitigation).**

Mitigation

It is difficult to manage or control informal settlements in an economic environment where jobs are scarce and nearly unobtainable in rural areas. It is recommended that the local community be used during the construction phase or that the labour force be housed at Kenhardt. Illegal squatting should be prohibited in the study area. During construction, employment will be temporary and construction camps should not be allowed to become permanent squatter camps.

Cumulative Impacts – "Congestion" of other planned and approved solar projects on the study region

Considering the interest in and rapid expansion of solar farm energy plants in South Africa, especially in the Northern Cape, it is anticipated that these structures could cumulatively have an impact on the surrounding ecological integrity, including bird populations.

The Nieuwehoop Solar Park Project is not the only project of this kind planned for the Kenhardt area. Scatec Solar SA (Pty) Ltd is also proposing to construct and operate three additional 75 megawatt (MW) Solar Photovoltaic (PV) power generation plants in the area. These plants will be constructed on the Farm Onder Rugzeer 168, which is situated adjacent to the Farm Boven Rugzeer (Remaining Extent of Farm 169) and the Eskom Nieuwehoop Substation. Each 75 MW plant (and associated infrastructure) will cover an approximate area/footprint of 250 ha (i.e. total area of approximately 750 ha).

Therefore, it is anticipated that an increase in surface activity and infrastructure, herewith composed of solar energy infrastructure could result in additional ecological impacts. These will be the same as those described earlier, although the magnitude and severity of the impacts are increased due to the addition of these other structures to the landscape. Therefore, more surface area will become lost and further loss of habitat affecting bird species with large home range size are likely to be affected should their ranges overlap with these activities (e.g. large terrestrial bird species). In addition, a cumulative increase in the surface area of PV panels could also increase the risk of bird collisions with the panels and overhead power lines. The significance of the impact is rated as **Very High (without mitigation) and High (with mitigation).**

Overall the cumulative impacts are negative, and High to Very High (before mitigation) and High to Moderate (after mitigation). The collision with power lines resulting in bird mortalities, especially threatened species, was identified as an impact of High significance (after mitigation).

Mitigation measures

Key mitigation measures include:

- Avoid development on habitat with High sensitivity and buffer zones or align along existing infrastructure;
- Apply appropriate buffer zones to sensitive habitat types and sensitive features:
    - 100 m from NFEPA rivers and wetlands (National priority);
    - 32 m from all other major watercourses (*Prosopis glandulosa*) where waterbirds could congregate when surface water is present;
    - 100 m from watering points and dams; and

  - 100 m from prominent quartz outcrops, koppies, and *Aloe dichotoma* outcrops.

- It is critical that the workers and members of the project applicant keep within the boundaries of the actual PV facility and treat the rest of the site as a nature reserve.
- Avoid where possible construction at or in close proximity to sensitive areas during the months of August – November when most korhaan, bustard and lark species are breeding. These areas include prominent outcrops, quartz outcrops and dolerite gravel plains, optimal forging habitat used by threatened and near threatened species) and optimal breeding habitat and at areas where these birds were observed;
- Where possible (depending on the sensitivity of the habitat and the surface area of the habitat), increase the distance between neighbouring arrays (currently 3 m) and allow for single-axis tracking of the sun which will increase the amount and frequency of sunlight made available to the vegetation underneath the arrays (thereby decreasing the "shade-out" effect). This will facilitate rehabilitation which will minimize possible changes/ shifts to the avifaunal composition (with relevance to specialists vs. generalists);
- Install appropriate bird deterrent devices at strategic positions to reduce the probability of collisions – proposed devices could include small rotating devices with highly reflective or contrasting surfaces and bird flappers;
- Minimise areas cleared for construction activities. This includes the area used by personnel and labour during construction;
- Where possible, construction activities should be located in areas with low-medium ecological sensitivity;
- Additional pre-construction bird monitoring must be undertaken during the wet season.
- Additional long-term data collection and analysis of bird distribution and abundance to refine the sensitivity analysis;
- Limit construction activities to daytime where possible.
- Minimise the use of earthmoving equipment that results in noise generation.
- Construction personnel must be restricted to the construction area. No access to undeveloped areas should be allowed (unless this is absolutely necessary);
- Minimise exterior lighting. Some migratory birds flying at night are attracted to lights, and these should be kept to a minimum.
- Intentional killing of birds should be avoided by means of awareness programmes presented to the labour force. The labour force should be made aware of the conservation issues pertaining to the animals occurring in the study area. Any person found deliberately harassing any animal in any way should face disciplinary measures, followed by the possible dismissal from the site.

It is the opinion of the bird specialist that this project should be authorised with adherence to mitigation measures as set out in the Avifaunal Impact Assessment report (Chapter 9 of this EIA Report).

17.1.4 Fauna

An integrated Faunal Impact Assessment was undertaken by Lukas Niemand of *Pachnoda Consulting cc* as part of the EIA Process (included in Chapter 10 of this EIA Report). The impact assessment is specific to each project.

The main impacts on fauna associated with solar farm facilities are two-fold and include the loss of habitat and displacement of fauna due to the large ecological footprint required during construction, and direct interaction of animals with the surface infrastructure required during the operational phase.

The study area is likely to support habitat for three regionally Near Threatened species (Honey Badger *Mellivora capensis*, Littledale's Whistling Rat *Parotomys littledalei* and Lesueur's Wing-gland Bat *Cistugo* *lesueuri*) and two Data Deficient species (Reddish-Grey Musk Shrew *Crocidura cyanea* and Lesser Red Musk Shrew *C. hirta* (according to Friedmann and Daly, 2004). However, three of these are peripheral and probably absent (Littledale's Whistling Rat, *Parotomys littledalei*, Lesueur's Wing-gland Bat, *Cistugo lesueuri* and Lesser Red Musk Shrew, *Crocidura hirta*, while two have a high probability of occurrence.

The majority of the proposed solar farms coincide with areas of high and medium-high sensitivity. In general, the impact (loss of habitat and displacement of fauna) during the construction of the proposed solar facilities will be more severe on natural outcrops, calcrete and gravel plains (including azonal habitat such artificial watering points) and proximal to large watercourses where high faunal richness is expected and where mechanical drilling equipment is necessary. The watercourses, for example, also support vegetation that is taller than the infrastructure which would require pruning or clearing. The subsequent alteration of outcrop and watercourse habitat will displace fauna, mainly substrate specialists and rupicolous (rock-loving) species from the footprint site, as well as large bodied species that requires large home ranges.

There are no conservation or protected areas in the immediate vicinity of the study area. The nearest protected areas are Augrabies Falls National Park and Witsand Nature Reserve, which are located respectively 110 km north-west and 120 km north-east of the study area.

Ecological Sensitivity analysis

A composite ecological sensitivity map based on the presence of habitat with a high probability to sustain Threatened and Near-threatened fauna species and areas of high faunal richness is presented in Figure 10.10 in Chapter 10 of this EIA Report. The following sensitivity classes are identified in the faunal study:

- Areas of high ecological sensitivity

It is evident that the artificial livestock watering holes, artificial dams, all quartz and calcrete plains, *Aloe dichotoma – Tetradenia retrofracta* outcrops and prominent outcrops are identified with high faunal sensitivities. The outcrops provide habitat for more than 50 % of the expected reptile species, of which the granite sheet-rock of the *Aloe dichotoma – Tetradenia retrofracta* outcrops provide habitat for nearly all obligate rupicolous taxa.

In addition, the dams and watering points hold high faunal diversities since they provide (drinking water in a water-scarce environment). Also, the major watercourses (*Roepera morgsana* floodplains and *Prosopis glandulosa* watercourse) are equally important movement corridors for a variety of mammals. Lastly, the calcrete plains provide a specialised niche for burrowing animals with localised distribution patterns in the study area which invariably prefer compacted soil substrates.

- Areas of medium to high ecological sensitivity

These areas are represented by the low *Salsola* outcrops and the smaller *Rhigozum trichotomum* watercourses. The animal assemblages in these habitat types consist of widespread species, although observations suggest that the *Salsola* outcrops support more reptile species (when compared to neighboring shrubveld areas). In addition, the *Salsola* outcrops were found to be poorly represented by Threatened and Near-threatened species, even though it provides ephemeral foraging habitat for many smaller taxa.

Although *R. trichotomum* watercourses are generally regarded as important, especially since they act as movement corridors for a variety of smaller mammals, they only marginally contribute towards the daily dispersal of large-bodied species. However, they are still regarded as important based on their ecological connectivity with the larger watercourses.

- Areas of medium ecological sensitivity

These habitat types are dominant in the study area and represent an extensive area of open shrubland and plains network which provide ephemeral foraging habitat for many mammals. However, the faunal compositions of this unit comprise widespread species typical of arid environments, and are fairly widespread and abundant in the region.

- Areas of low ecological sensitivity

Currently none of the habitat types is regarded as being of low ecological sensitivity.

<u>The following key considerations were identified and noted during the site visit and in the avifaunal study in general:</u>

- Ten habitat types were identified based on the presence of the dominant vegetation communities. These ranged from *Salsola – Stipagrostis* short shrubveld, quartz and *Aloe dichotoma*-dominated outcrops, calcrete plains to *Prosopis glandulosa* watercourses and artificial livestock watering points. The shrubveld and artificial watering points contain high faunal diversities, although most of these have widespread distribution ranges within the Nama-Karoo Biome. However, the *Aloe dichotoma* outcrops, quartz outcrops and all prominent koppies provided habitat for habitat specialists, mainly rock-loving taxa;
- A total of 24 mammal species was confirmed during the investigation. Important ecological considerations pertaining to the mammal composition include:
  - The open *Salsola – Stipagrostis* shrubveld was capable of sustaining a high mammal richness consisting of a diversity of different guilds – it also sustained high densities of myrmecophagous (ant- eating) species such as aardwolf *Proteles cristatus* and aardvark *Orycteropus afer*. In addition, this is one of a few habitat types with a graminoid grass cover (dominated by *Stipagrostis*) which provides an ephemeral foraging habitat (due to the seed bank) for rodent taxa;
  - The calcrete soils provide an additional habitat for mammal taxa with a preference for hard substrates (e.g. Large-eared Mouse *Malacothrix typica*, Cape Short-tailed Gerbil *Desmodillus auricularis* and Bat-eared Fox *Otocyon megalotis*);
  - The watercourses are important dispersal corridors for foraging mammal species, while the artificial watering points provide essential surface drinking water, thereby augmenting the mammal richness and abundance; and
  - The koppies and prominent outcrops sustain a unique, albeit species-poor composition of rupicolous (rock-loving) taxa – thereby augmenting local richness (e.g. Namaqua Rock Mouse *Micaelamys namaquensis*, Western Rock Sengi *Elephantulus rupestris* and Rock Hyrax *Procavia capensis)*.

- The study area is poorly represented by amphibians, with four species expected to be present;
- Thirty five reptile species are expected to be present, of which 12 were confirmed during the survey. High species richness was observed on the *Aloe dichotoma* outcrops;
- No Threatened or Near-threatened taxa was observed in the study site; and
- The majority of the site is dominated by habitat (mainly shrubveld and *Salsola* outcrops) with medium ecological sensitivities.

<u>Impacts:</u>

The key impacts and their significance ratings are listed below:

IMPACT (NEGATIVE)	SIGNIFICANCE (BEFORE MITIGATION)	SIGNIFICANCE (AFTER MITIAGION)
CONSTRUCTION PHASE		
Habitat loss, fragmentation and displacement of Near- threatened species and species loss due to the clearing of habitat/vegetation	Moderate	Low
Displacement and disturbances caused to animals due to noise generation. Displacement of foraging taxa and loss of genetic cohesion between populations.	Moderate	Low
OPERATIONAL PHASE		
Disorientation of nocturnal animals and increased predation by insectivores caused by exterior lighting	Moderate	Low
Cleaning of panels could result in chemical pollution of water resources	Low	Low
Nest –building and roosting activities and interference with infrastructure - secondary impacts related to the infrastructure attracting animals	Moderate	Low
Increased composition, loss of local diversity and potential increase in pest species due to habitat chance and associated change to local community composition and abundance (under infrastructure)	Moderate	Low
DECOMMISSIONING PHASE		
Increased competition and decline in species richness - indirect impacts associated with changes in the local community structure	Moderate	Low

Overall the impacts are negative, Low to Moderate (before mitigation) and Low (after mitigation). No impacts of high significance (after mitigation) were identified.

Cumulative Impacts

- ***Indirect impacts related to anthropogenic encroachment***

The proposed solar facilities, especially during construction will provide employment for the local community as well as people from further afield. Unfortunately, such an activity could impact negatively on the surrounding habitat types by facilitating informal settlements and the consequent plundering of natural resources (e.g. fire-wood collection, snaring and poaching). Human environments are magnets for alien and invader species which include feral dogs and cats (see discussion above). Domestic cats specifically are a problem since they will prey on local native bird population. In addition, domestic cats are specifically a problem since they will hybridise with the African Wild Cat *Felis sylvestris*, resulting in genetic contamination of the natural population. The significance of the impact is **High (before mitigation) and Moderate (after mitigation).**

Mitigation

It is difficult to manage or control the growth of informal settlements in economic environment where jobs are scarce and nearly unobtainable in rural areas. It is recommended that the local community be used during construction or that the labour force be housed at Kenhardt. Illegal squatting should be prohibited on the study area. Where possible, construction camps on site should be properly organized and should be of short duration. The client confirmed that illegal squatting will not be allowed in site. The people who will be accommodated on site are minimal (less than 10). It will only be the security staff and a few management staff members.

- ***'Congestion" of other planned and approved solar projects on the study region***

Considering the interest in, and rapid expansion of, solar farm energy plants in South Africa, especially in the Northern Cape, it is anticipated that these structures could cumulatively have an impact on the surrounding ecological integrity.

The Nieuwehoop Solar Park Project (Phase 1 consisting of three approved projects and Phase 2-subject of this assessment, consisting of seven solar PV projects) is not the only project of this kind planned for the Kenhardt area. Scatec Solar SA (Pty) Ltd is also proposing to operate three 75 megawatt (MW) Solar Photovoltaic (PV) power generation plants in the area. These proposed plants will be constructed on the Farm Onder Rugzeer 168, which is situated alongside the Farm Boven Rugzeer (Remaining Extent of Farm 169) and the proposed Eskom Nieuwehoop Substation. Each 75 MW plant (and associated infrastructure) of Scatec will cover an approximate area/footprint of 250 Ha (i.e. total area of approximately 750 Ha).

Therefore, it is anticipated that an increase in surface infrastructure could result in additional ecological impacts. These will be the same as those described earlier, although the magnitude and severity of the impacts are increased due to the addition of these structures to the landscape. Therefore, surface area will be lost, entailing the loss of vegetation communities and the additional loss of habitat. The significance of the impact is **High (before mitigation) and moderate (after mitigation).**

Overall the cumulative impacts are negative, and High (before mitigation) and Moderate (after mitigation). No impacts of high significance (after mitigation) were identified.

Mitigation measures

The key mitigation measures are:

- According to the results, areas identified with high faunal sensitivity should be seen as sensitive habitat and development activities preferably should not be undertaken in these areas.
- All key habitat features should have a buffer of at least 100 m and all major watercourses by at least 32 m to minimize any induced ecological edge-effects and associated fragmentation during the construction and operation of the project;

Loss of habitat, habitat transformation and displacement of fauna (Construction Phase)

- A conceptual layout of each proposed solar site should allow for the preservation of sensitive habitat features, thereby implying that the entire site will not be utilised.
- Development in habitats with high ecological sensitivity should be avoided;
- If possible, make use of manual techniques and labour during the placement of the foundation/ piles to minimize the possible trampling and destruction of surrounding vegetation and the use of drilling equipment should be avoided;
- Limit construction activities to the project footprint. Workers must not be allowed outside these areas except if absolutely necessary.
- Buffer all natural linear dispersal corridors (e.g. *P. glandulosa* and *M. roepera* watercourses) by at least 32 m and all *Aloe dichotoma* outcrops, quartz outcrops and prominent outcrops by at least 100 m; and
- Where possible (depending on the sensitivity of the habitat and the surface area of the habitat), increase the distance between neighbouring arrays (currently 3 m) which will increase the

amount and frequency of sunlight made available to the vegetation underneath the panels (thereby decreasing the “shade-out” effect).

Disturbance and displacement of animal taxa due to construction noise (Construction Phase)

- Minimize area cleared for construction activities. This includes the area used by personnel and labour during construction;
- If possible, make use of manual techniques and labour during the placement of the foundation/ piles to minimize the possible trampling and destruction of surrounding vegetation and the use of drilling equipment should be avoided;
- Construction activities should be confined to areas with low-medium ecological sensitivity.
- Linear features (watercourses) must be retained irrespective of their floristic condition or composition to facilitate the movement of fauna;
- Appropriate buffer zones must be implemented around key habitat types (watering points, dams, prominent outcrops, quartz outcrops and *Aloe dichotoma* outcrops) to alleviate the effect of habitat fragmentation and edge effects. These features should be buffered by at least 100 m;
- Limit construction activities to daytime where possible;
- Minimize the use of earthmoving and drilling equipment that results in noise generation.
- Construction personnel must be restricted to the construction area;
- Minimize external lighting. Some animals dispersing at night could be attracted to lights, and these should be kept to a minimum. If possible, external lighting should make use of longer wave lengths (550 nm) and should contain preferably green or yellow hues. External lighting should not make use of fluorescent lights since these emit significant amounts of UV, which will attract invertebrates (insects) and possibly also insectivorous mammals, invertebrates and reptiles;
- Intentional killing or trapping of animals (especially snakes) should be avoided by means of awareness programmes presented to the labour force. The labour force should be made aware of the conservation issues pertaining to the animals occurring in the study area. Any person found deliberately harassing any animal in any way should face disciplinary measures, followed by possible dismissal from the site; and
- Hunting and snaring are prohibited and labour personnel are not allowed to venture away from any designated construction site. Construction camps should preferably be situated near the town of Kenhardt.

Loss of dispersal corridors used by fauna species (Construction Phase)

- Where possible, roads should avoid crossing major watercourses and dams.
- Minimise the number of vehicles using access roads;
- Existing roads should be used;
- The width of roads should be kept to a minimum;
- Implement traffic calming structures to limit the speed of vehicles (e.g. speed humps); and
- Run-off control measures on either side of roads must be constructed so that small terrestrial animals can cross them. Ditches/trenches should have slopes of less than 45° rather than vertical sides.

Exterior lighting and potential collision with infrastructure (Operational Phase)

- Minimize exterior lighting and implement operational strategies to reduce "light spill".

Potential localised chemical pollution of surface and groundwater resources (Operational Phase)

- Avoid the placement of panels near dams, watercourses or watering points;

- Only water should be used to clean the panels; and
- Washing of the facility should be minimized to a level consistent with efficient operation of the panels.

The faunal specialist concludes that there are no fatal flaws in the proposed development, nor are there objections to its authorisation provided the mitigation measures included in Chapter 10 of the Faunal study are implemented and adhered to.

17.1.5 Soils and Agricultural Potential Assessment

A Soils and Agricultural Potential Assessment (Chapter 11 of this EIA Report) was conducted as part of the EIA Process in order to identify and assess all potential impacts of the proposed development on agricultural resources including soils and agricultural production potential, and to provide recommended mitigation measures, monitoring requirements, and rehabilitation guidelines for all identified impacts.

The proposed development is on land zoned and used for agriculture. South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable for cultivation. This assessment has found that the investigated site is on land which is of very low agricultural potential and is not suitable for cultivation.

Because of the low agricultural potential of the site, the development should, from an agricultural impact perspective, be authorised. Environmental Authorisation is promoted by the fact that the site falls within a proposed renewable energy development zone (i.e. REDZ 7, Upington), where such land use has been assessed as very suitable in terms of a number of factors, including agricultural impact. It is preferable to incur a loss of agricultural land to renewable energy development in such a region, without cultivation potential, than to lose agricultural land that has a higher potential, to renewable energy development elsewhere in the country.

No agriculturally sensitive areas occur within the proposed site and no part of it is therefore required to be set aside from the development. Because the site is uniformly low potential, from an agricultural point of view, there is no preferred location or layout within the preferred site. There are no conditions resulting from this assessment that need to be included in the environmental authorisation.

Impacts

The key impacts and their significance ratings are listed below:

IMPACT (NEGATIVE)	SIGNIFICANCE (BEFORE MITIGATION)	SIGNIFICANCE (AFTER MITIAGION)
Degradation of veld vegetation beyond the direct footprint of the proposed PV facility due to constructional disturbance and potential trampling by vehicles.	Very Low	Very Low
Loss of topsoil due to poor topsoil management.	Very Low	Very Low
Loss of agricultural land use.	Very Low	Very Low
Soil erosion due to alteration of the land surface characteristics.	Very Low	Very Low
Additional land use income generation (positive impact).	Very Low	Not applicable

Overall the impacts are negative, Very Low (before mitigation) and Very Low (after mitigation). Additional land use income was identified as a positive impact of Very Low significance (before mitigation). No impacts of high significance (after mitigation) were identified.

Cumulative Impact

- ***Regional Loss of Agricultural Land Resources***

The implementation of various other developments (See Chapter 4 of the EIA Report) in conjunction with this proposed project are expected to result in a cumulative impact in terms of the loss of agricultural land resources on a regional scale. The impact is rated with a regional spatial extent and long-term duration (i.e. the impact and risk will be experienced for the duration of the proposed project). The consequence and probability of the impact is respectively rated as moderate and very likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as moderate. No mitigation measures are recommended.

Overall the cumulative impact is negative and Moderate (before mitigation). No impacts of high significance (after mitigation) were identified.

Mitigation measures

The following main mitigation measures and monitoring requirements are proposed for inclusion in the EMPr:

- Minimize the footprint of disturbance during construction and decommissioning activities;
- Confine vehicle access to roads only;
- Control dust generation during construction and decommissioning activities by implementing suitable, standard construction site dust control measures;
- Strip and stockpile topsoil from all areas where soil will be disturbed;
- After cessation of disturbance, re-spread topsoil over the surface;
- Dispose of any sub-surface spoil material, generated from excavations, where they will not impact on land that supports vegetation, or where they can be effectively covered with topsoil; and
- Implement an effective system of run-off control, where it is required, that collects and safely disseminates run-off water from all hardened surfaces and prevents potential down slope erosion.

The agricultural and soil specialist concludes that because of the low agricultural potential of the site, the development should, from an agricultural impact perspective, be authorised, provided the mitigation measures in this study are adhered to.

17.1.6 Heritage Impact Assessment (Archaeology and Cultural Landscape)

A Heritage Impact Assessment (Archeology and Cultural Landscape) was conducted as part of the EIA Process (Chapter 12 of this EIA Report).

A field survey of the preferred site and the transmission corridor revealed archaeological material to be very thinly scattered throughout. However, more significant artefacts scatters were located around pans and rocky outcrops. The scatters are of low-medium significance and all are likely to be easily avoided.
There will also be impacts to the cultural landscape, but these would be of low significance. Mitigation would serve to slightly reduce the contrast of the built elements in the landscape.
There are no fatal flaws and overall the heritage impacts are considered to be of low significance for all phases. Mitigation would reduce the significance of impacts to archaeology and graves to very

low, while impacts to the landscape will remain of low significance. Cumulative impacts to archaeology are insignificant because no important heritage sites would be lost during implementation of the proposed development. The clustering of this development with the many others proposed in the area means that the cumulative impacts to the landscape are considered to be acceptable and of low significance.

The potential impacts are quite limited and easily avoidable.

Impacts

The key impacts and their significance ratings are listed below:

IMPACT (NEGATIVE)	SIGNIFICANCE (BEFORE MITIGATION)	SIGNIFICANCE (AFTER MITIAGION)
CONSTRUCTION		
Damage to and destruction of archaeological resources.	Low	Very Low
Destruction of graves	Low	Very Low
Impacts to the natural and cultural landscape.	Low	Low
OPERATION AND DECOMMISSIONING		
Impacts to the natural and cultural landscape.	Low	Low

Overall the impacts are negative, Low (before mitigation) and Low to Very Low (after mitigation). No impacts of high significance (after mitigation) were identified.

Cumulative Impacts to Archaeological Resources

The development of multiple solar energy facilities will result in many archaeological artefacts and sites being disturbed and/or destroyed over a wide area. Few of the sites recorded in the region have high cultural significance and it is likely that the vast majority of those that do would be protected from harm because of their proximity to water courses and pans. Cumulative impacts would be negative and direct in nature. They would occur at the local level and would be permanent. Because no sites of high archaeological significance were found within the present study area, the cumulative impact consequence is rated as moderate with the probability of impacts being likely. These combine to provide a significance rating of low for this project. The impacts are irreversible and the irreplaceability of archaeological resources is high. With mitigation the impact significance is reduced to **very low**.

Cumulative Impacts to Graves

The development of multiple solar energy facilities may result in a number of graves being disturbed and/or destroyed over a wide area. However, because graves can be very difficult to identify and many may well continue to exist beneath any developments, it is difficult to evaluate any cumulative impacts. The nature of graves as individual and generally isolated heritage resources is such that, although each is significant, the disturbance of multiple examples will not result in a significant cumulative impact. Cumulative impacts would be negative and direct and occur at the local level. They would be permanent in duration. The moderate consequence and very unlikely probability combine to give an impact significance rating of low before mitigation. After mitigation it is expected to be very low. The only mitigation that can be suggested at present is to ensure that all works remain within the authorised footprint. If graves were found during construction then they should either be protected and avoided or exhumed with the permission of SAHRA. The post-mitigation impact significance would be **very low**.

Cumulative Impacts to the Natural and Cultural Landscape

The development of multiple solar energy facilities will result in significant visual degradation of the local environment. However, it is also worth noting that it is far better, from the cumulative impact point of view, to cluster the facilities rather than to have them spread out over the landscape. The present application is one of a number of applications for solar energy facilities in close proximity to the Nieuwehoop Substation and, because of this clustering, the cumulative impacts are more acceptable. The impacts would be direct and negative, occurring at the local level and with long term duration. The consequence is rated as moderate and, although the impact is very likely to occur, the significance of the impact is low. Although mitigation is suggested (i.e. use earthy-coloured paint on built elements where technically feasible), this will not have much effect overall, therefore the significance of the impact after mitigation is still rated as being **low**.

Overall the cumulative impacts are negative, Very Low to Low (before mitigation) and Low to Very Low (after mitigation). No impacts of high significance (after mitigation) were identified.

Mitigation Measures

The main mitigation measures are:

- Should it not be possible to avoid the significant archaeological sites with a minimum buffer of 20 m from the waypoints, then they should be excavated;
- The possible graves should be avoided with a buffer of at least 5 m or else tested and, if necessary, exhumed prior to construction with approval from SAHRA;
- The construction team should be made aware of the potential to locate graves and be instructed to report any suspicious stone features to SAHRA prior to disturbance;
- Where technically feasible, the built elements of the facility should be painted in an earthy colour to minimise visual contrast in the landscape; and
- If any archaeological material or human burials are uncovered during the course of construction then work in the immediate area should be halted. The find would need to be reported to SAHRA and may require inspection by an archaeologist. Such a heritage resource is the property of the state and may require excavation and curation in an approved institution.

The Archaeological Impact Assessment concludes that there are no fatal flaws in the proposed development, nor are there objections to its Authorisation as far as Archaeology and Cultural Landscape is concerned, since significant impacts on heritage resources are not anticipated. The mitigation measures contained in the specialist study must be adhered to.

17.1.7 Desktop Palaeontological Impact Assessment

A desktop Palaeontological Impact Assessment (Chapter 13 of this EIA Report) was conducted as part of the EIA Process.

The study area for the proposed solar PV facility (including the associated 132 kV transmission line) is underlain at depth by Precambrian basement rocks (c. 1-2 billion years old) assigned to the Namaqua-Natal Province. These ancient igneous and high-grade metamorphic rocks - mainly gneisses of the Jacomynspan Group - crop out at surface in small areas and are entirely unfossiliferous. A large proportion of the basement rocks are mantled by a range of superficial sediments of Late Caenozoic age that may contain sparse fossil remains. These predominantly thin, unconsolidated deposits include small patches of calcretes, gravelly to sandy river alluvium, pan sediments, surface gravels, colluvium (scree) as well as Pleistocene to Recent wind-blown sands of the Gordonia Formation (Kalahari Group). Most of these younger rock units are of widespread occurrence and low palaeontological sensitivity. Scientifically important vertebrate fossil remains (e.g. Pleistocene mammalian bones and teeth) have been recorded within older stratified pan and river sediments elsewhere in the Bushmanland region where they are often associated with stone artefacts, while a limited range of trace fossils (e.g. plant root casts, termitaria and other invertebrate burrows) may be found within calcrete horizons.

No previously recorded areas or sites of exceptional fossil heritage sensitivity or significance have been identified within the Nieuwehoop Solar Park Development project area as a whole. Due to the inferred scarcity of scientifically important fossil remains within the study area, the overall impact significance of the construction phase of the proposed solar energy project is assessed as VERY LOW (before and after mitigation). No significant impacts on fossil heritage are anticipated during the operational and decommissioning phases of the proposed solar energy facility. The potentially fossiliferous sedimentary rock units represented within the study area (e.g. Gordonia sands, calcrete) are of widespread occurrence and this is also likely to apply to most of the fossils they contain. It is concluded that the cumulative impacts on fossil heritage resources posed by the known alternative energy and other infrastructural developments in the region (as explained in Chapter 4 of the EIA Report) is of very low significance. There are no fatal flaws in the proposed solar facility development, nor are there objections to its authorisation as far as fossil heritage conservation is concerned, since significant impacts on scientifically valuable fossils or fossil sites are not anticipated here. The only proposed condition to accompany environmental authorisation is that the recommendations for monitoring and mitigation included in the EMPr are fully complied with. The no-go option (no solar developments) will have a neutral impact on local palaeontological heritage resources.

Given the low palaeontological sensitivity of the eastern Bushmanland region, as determined from the desktop study, as well as the inferred very low impact significance of the Gemsbok Solar PV6 75 MW Solar PV Facility for fossil heritage conservation, no specialist palaeontological monitoring or mitigation is recommended here, pending the discovery of substantial new fossil remains during construction.

IMPACT

The key impact and its significance ratings are listed below:

IMPACT (NEGATIVE)	SIGNIFICANCE (BEFORE MITIGATION)	SIGNIFICANCE (AFTER MITIGATION)
Potential loss of palaeontological heritage resources through disturbance, damage or destruction of fossils and fossil sites (including associated geological contextual data) through surface clearance and excavation activities during the construction phase.	Very Low	Very Low

Overall the impact is negative, Very Low (before and after mitigation). No impacts of high significance (after mitigation) were identified.

Cumulative Impact

The palaeontological heritage impact significance of all seven solar energy developments and associated electrical infrastructure proposed for Phase 2 of the Nieuwehoop Solar Development, as well as other proposed solar facilities and electrical infrastructure (discussed in Chapter 4 of the EIA Report) near Kenhardt (within a 20 km radius of the proposed project) are rated equally as **very low**. The potentially fossiliferous sedimentary rock units represented within the broader project area are of widespread occurrence and this is also likely to apply to most of the fossils they contain. It is concluded that the cumulative impact on fossil heritage resources posed by the proposed seven projects of the Nieuwehoop Solar Park Development and associated electrical infrastructure to the northeast of Kenhardt is of a low significance.

Overall the cumulative impact is negative and Very Low (before and after mitigation). No impacts of high significance (after mitigation) were identified.

Mitigation measures

The following main mitigation measures and monitoring requirements are proposed:

- During the construction phase all substantial bedrock excavations should be monitored for fossil material by the responsible Environmental Control Officer (ECO); and
- Should significant fossil remains - such as vertebrate bones and teeth, plant-rich fossil lenses, petrified wood or dense fossil burrow assemblages - be exposed during construction, the responsible ECO should safeguard these, preferably *in situ*. The SAHRA should be alerted as soon as possible Appoint a professional palaeontologist to record and sample any chance fossil finds.

The Palaeontological Impact Assessment concludes that there are no fatal flaws in the proposed development, nor are there objections to its authorization as far as fossil heritage conservation is concerned, since significant impacts on scientifically valuable fossils or fossil sites are not anticipated. The mitigation measures contained in the specialist study must be adhered to.

17.1.8 Socio-Economic Impact Assessment

A Socio-Economic Impact Assessment (included in Chapter 14 of this EIA Report) was undertaken as part of the EIA Process to investigate the potential social disruptors and associated social impacts likely to result from the proposed project.

Very little socio-economic data are available for the study area. Census data and information from the Kai !Garib Local Municipality IDP (2015) were obtained; however, these only deal with the larger municipal area and offer no site specific data on socio-economic conditions within and around the town of Kenhardt. Secondary data were subsequently augmented by a site visit. The site visit suggests that Kenhardt is an area of low employment, substantial poverty and limited livelihood strategies. Access to Natural and Financial capital is limited. This constrained access to capital limits the ability of vulnerable members of the community to adapt livelihood strategies should it be required; which results in vulnerability.

The main income source among vulnerable communities appears to be government subsidies, with limited income generated from employment within industries operating in Kenhardt. Social deviance (i.e. teenage pregnancy and drug abuse) is a major concern in the area. Such deviance could threaten Social capital on which much of the existing livelihood strategies depend. Unemployment seems to be the single greatest challenge and problem driver in Kenhardt. Not only does unemployment deprive community members from income, it also constrains empowerment and the subsequent ability to perceive one's subjective social reality as meaningful. This more often than not exacerbates social deviance.

Vulnerable community members might be negatively impacted by the proposed project through the influx of opportunistic job seekers. Such an influx might threaten existing social structures and could lead to increased pressure on bulk services and housing. Social disorders might also be increased as a result of the proposed projects; as unusual behaviour (e.g. prostitution and teenage pregnancy) are likely to increase as more outsiders migrate into Kenhardt in search of employment. Frustrated expectations of employment, created by the proposed developments, could also contribute feelings of distrust in the developer and, in isolated instances, damage to project property and potential intimidation of staff. Furthermore, the likelihood of job losses once the proposed projects reach their decommissioning phase is high.

Positive socio-economic impacts likely to result from the projects are increased local spending, the creation of local employment opportunities and the proposed development of an Economic Development Plan. These impacts will benefit the community through the creation of income generation opportunities and human development through skills development and training.

It should be accepted that the development of the proposed projects is likely to result in some form of negative social impact to the local community. However, such a negative impact needs to be weighed against the potential benefit likely to result from the same development. Given the overall moderate significance negative impact of the project, as compared to the overall moderate-high significance positive impact of the project; it can be concluded that the prospective socio-economic benefits of the proposed project outweighs the socio-economic losses/impacts.

Impacts

The key impacts and their significance ratings are listed below:

IMPACT	SIGNIFICANCE (BEFORE MITIGATION)	SIGNIFICANCE (AFTER MITIAGION)
CONSTRUCTION AND OPERATIONAL PHASES (NEGATIVE IMPACTS)		
Influx of jobseekers	Moderate	Low
Increases in social deviance	Moderate	Low
Expectations regarding jobs	Low	Very Low
CONSTRUCTION AND OPERATIONAL PHASES (POSITIVE IMPACTS)		
Local spending	Low	N/A
Local employment	Moderate	N/A
Human development resulting from the proposed Economic Development Plan	Moderate	N/A
DECOMMISSIONING PHASE (NEGATIVE IMPACT)		
Job losses at the end of the project life-cycle	Moderate	Low

Overall the negative impacts are Low to Moderate (before mitigation) and Low to Very Low (after mitigation). The positive impacts are Low to Moderate (before mitigation). No impacts (positive or negative) of high significance (after mitigation) were identified.

Cumulative Impacts

Overall the cumulative impacts are of **moderate significance (negative)** rating in terms of exacerbated social disruption before and after mitigation, and of **moderate significance rating (positive)** in terms of local economic development (before and after mitigation).

Mitigation Measures

The following main mitigation measures were identified:

Construction and Operational Phases:

- Develop and implement a Workforce Recruitment Plan;
- Clearly define and agree upon the Project Affected People (PAP);
- Develop a database of PAP and their relevant skills and experience, or use an existing legitimate database of skills and expertise;
- Develop and implement a Stakeholder Engagement Plan;
- Delivery on the Economic Development Plan must be contractually binding on the proponent;
- Procure goods and services, where practical, within the study area;
- The proponent should engage with local NGOs, CBOs and local government structures in the Kenhardt community to identify and agree upon relevant skills and competencies required;
- Such skills and competencies should then be included in the Economic Development Plan; and
- Where possible, align the Economic Development Plan with Local Municipality's IDP.

Decommissioning Phase:

- The project applicant should also consider appropriate succession training of locally employed staff earmarked for retrenchment during decommissioning; and
- All project infrastructure should be decommissioned appropriately and thoroughly to avoid misuse.

From a socio-economic impact perspective, the specialist conducting this study is of the opinion that the proposed seven projects should be authorised by the competent authority.

17.1.9 Traffic Impact Statement

As noted above and included in Chapter 16 of the EIA Report, the Traffic Impact Statement (TIS) was produced by the CSIR to show the amount of traffic that can be expected during the construction and operational phase of the proposed development of the proposed Phase 2 Nieuwehoop Solar Park Development, including the electrical infrastructure. The TIS focuses on the regional setting in which these projects are proposed and the roads that will be utilised for these projects.

Overall, the above impacts identified as part of the TIS are predicted to be of a **moderate to low significance** without and with the implementation of mitigation measures. No impacts were assessed as being of high significance after the implementation of mitigation.

The following main mitigation measures were identified in the TIS:

Construction, Operational and Decommissioning Phases:

- Should abnormal loads have to be transported by road to the site, a permit needs to be obtained from the Provincial Government Northern Cape (PGNC) Department of Public Works, Roads and Transport.
- A Road Maintenance Plan should be developed for the section of the Transnet Service Road.

17.1.10 Cumulative Topographical Analysis of the proposed PV projects in the Astronomy Geographic Advantage Area

As noted above, MESA Solutions (Pty) Ltd (MESA Solutions) was appointed by Mulilo to undertake a topographical analysis of the terrain profiles between various PV project locations (assessed separately as part of EIA Processes) in the Astronomy Geographic Advantage (AGA) area and the closest and core-site SKA telescopes.

It is strongly recommended that the following mitigation practices be incorporated into the plants design:

- The inverter units, transformers, communication and control units for an array of panels all be housed in a single shielded environment.
- For shielding within such an environment ensure RFI gasketting be placed on all seams and doors and RFI Honeycomb filtering be placed on all ventilation openings.
- Cables to be laid directly in soil or properly grounded cable trays (not plastic sleeves).
- The use of bare copper directly in soil for earthing is recommended.
- Assuming a tracking PV plant design, care will have to be taken to shield the noise associated with the relays, contactors and hydraulic pumps of the tracking units.
- All data communications to and from the plant to be via fibre optic cable.

17.2 Summary: Comparative Assessment of Positive and Negative Direct and Indirect Impacts

Section 17.1 provides a summary of the findings of the specialist studies (or inputs) that were undertaken as part of this EIA Process. Table 17.2 summarises the overall significance of these impacts following the implementation of the recommended mitigation and management measures. The bird study identified an impact of high significance following mitigation measures. This impact is the collision with power lines resulting in bird mortalities, especially Threatened species.

The positive impacts generated by the project are associated with the economic benefits from employment opportunities, and the additional source of income from the rental of the land for the construction and operation of the PV facility. Considering that all the negative impacts would be appropriately managed and the positive impacts enhanced through mitigation measures and management actions via the EMPr (Part B of the EIA Report), the potential negative impacts associated with the proposed project are not anticipated to be significant.

Table17.2: Comparative Assessment of Positive and Negative Direct and Indirect Impacts

Specialist Study	Overall Impact Significance Before Mitigation or Enhancement	Overall Impact Significance After Mitigation or Enhancement
Visual	Negative: Low-Moderate	Negative: Low to Very Low
Vegetation and wetlands	Negative: Very Low-Moderate	Negative: Low to Very Low
Avifauna	Negative: Low-Very High	Negative: High–Low
Fauna	Negative: Low-Medium	Negative: Low
Soils and Agricultural Potential Assessment	Negative: Very Low	Negative: Very Low
	Positive: Very Low	N/A
Heritage Impact Assessment (Archaeology and Cultural Landscape)	Negative: Low	Negative: Low–Very Low
Desktop Palaeontological Impact Assessment	Negative: Very Low	Negative: Very Low
Socio-Economic Impact Assessment	Negative: Low-Moderate	Negative: Low-Very Low
	Positive: Low-Moderate	N/A
Traffic Impact Statement	Negative: Moderate	Negative: Low

17.3 Consideration of Alternatives

The alternatives that were considered as part of the EIA Phase for the proposed solar PV facility are included in Chapter 5 of this EIA Report.

17.3.1 No-go Alternative

The no-go alternative assumes that the proposed Solar PV project will not go ahead i.e. it is the option of not constructing the proposed Gemsbok Solar PV6 Facility. This alternative would result in no environmental impacts on the sites or surrounding local area. It provides the baseline against which other alternatives are compared and will be considered throughout the report. At present the proposed site is zoned for agricultural land-use and is mostly used for livestock grazing. Preliminary investigations indicate that the area is classified as non-arable and low potential grazing land – hence, utilising the area for continued agricultural land-use is not a preferred or sustainable alternative. A detailed Soil and Agricultural Potential specialist study has been conducted during the EIA in order to identify and assess the potential impacts of the proposed development on soils and agricultural potential for both environmental and economic aspects (Chapter 11 of the EIA Report).

Table 17.3: The costs and benefits of implementing the 'no-go' alternative (i.e. no Gemsbok Solar PV6 development)

COSTS	BENEFITS
• No benefits will be derived from the implementation of an additional land-use. • No additional power will be generated or supplied through means of renewable energy resources by this project at this location. The proposed 75 MW facility is predicted to generate approximately 200 GW/h per year which could power 50 000 households. • The "no go" alternative will not contribute to and assist the government in achieving its proposed renewable energy target of 17 800 MW by 2030. • Additional power to the local grid will need to be provided via the Eskom grid, with approximately 90% coal-based power generation with associated high levels of CO_2 emissions and water consumption. • Electricity generation will remain constant (i.e. no additional renewable energy generation will occur on the proposed sites) and the local economy will not be diversified. • Electricity produced from solar power is cheaper than coal-produced electricity. The 'no-go' alternative thus entails higher electricity costs. Local communities will continue their dependence on agricultural production and government subsidies. The local municipality's vulnerability to economic downturns will increase because of limited access to capital. • There will be no opportunity for additional employment in an area where job creation is	• The agricultural land use will remain. • The current landscape character will not be altered by a solar energy facility and electrical infrastructure such as transmission lines. • No fragmentation of habitat or disturbance to faunal species. • No threatened vegetation will be disturbed or removed. • No additional water use associated with the construction phase and for the cleaning of panels and maintenance during the operational phase. • No increase in traffic associated with the construction phase. • No impacts associated with the construction phase will occur, i.e. dust generation, noise and littering. • No influx of people (mainly job-seekers) driven by the development of a solar energy facility will occur, which entails that there would not be additional pressures on the infrastructure and service delivery of local municipalities and towns in the area.

identified as a key priority. It is estimated that between 60 and 90 skilled and 100 and 120 unskilled employment opportunities will be created during the construction phase. During the operational phase, approximately 5 skilled and 7 unskilled employment opportunities will be created over the 20 year lifespan of the proposed facilities. • No additional opportunities for skills transfer and education/training of local communities created. • Potential positive socio-economic impacts likely to result from the project such as increased local spending and the creation of local employment opportunities will not be realised. • The local economic benefits associated with the REIPPPP will not be realised, and socio-economic contribution payments into the local community trust will not be realised.	

The country is facing serious power and water shortages due to its heavy dependency on fossil fuels such as coal. There is therefore a need for additional electricity generation options to be developed throughout the country. As discussed in Chapter 1 of the EIA Report the main purpose of the proposed Solar PV Facility is to feed electricity generated by a renewable energy resource into the national electricity grid. Many other socio-economic and environmental benefits will result from the development of this project such as development of renewable energy resources in the country and contribution to the increase of energy security, employment creation and local economic development (as noted above).

In summary, whilst the “no-go” alternative will not directly drive any negative environmental and social impacts; it will also not result in any positive community development or socio-economic benefits. Furthermore, it will also not assist the government in addressing climate change, reaching its set targets for renewable energy, nor will it assist in supplying the increasing electricity demand within the country. **Based on the above, the “no-go” alternative is not a preferred alternative.**

17.3.2 Land-Use Alternative

As discussed above, the sole use of the land for agriculture is not a preferred alternative.

The proposed site is zoned for agricultural land-use at present, and is mainly used for livestock grazing. As noted in the Agricultural study of this EIA Report (Chapter 11), agricultural potential is uniformly low across the preferred and alternative sites and the choice of placement of the proposed facility on the farm therefore has minimal influence on the significance of agricultural impacts. No agriculturally sensitive areas occur within the sites. As indicated in the Soils and Agricultural Potential Assessment, none of the potential impacts identified have been rated with a high significance with the implementation of mitigation measures. The loss of agricultural land is rated as low with mitigation It is important to re-iterate that the economic benefits to the farmer associated with the proposed Solar PV Facility are likely to be more significant than that of the current agricultural activities on site and these two land uses (agriculture and renewable energy generation) can potentially both be undertaken on site. This aspect is also addressed in the Soils and Agricultural Potential Assessment. **Hence, the sole use of the land for agriculture is not a preferred alternative**.

17.3.3 Site and Location Alternatives

As discussed in Chapter 5 of this EIA Report, an alternative site was considered during the Scoping Phase, however only the preferred site for the Gemsbok Solar PV6 facility has been assessed in this EIA. Furthermore, from an impact and risk assessment perspective, the implementation of Solar PV Facility on Portion 8 of Gemsbok Bult Farm 120 will result in fewer risks in comparison to its implementation at alternate sites that were considered during the Scoping Phase within the Northern Cape (i.e. regions with similar solar irradiation levels). The following risks and impacts will be likely in this case:

- There is no guarantee that suitable land will be available for development of a Solar PV Facility/ies. Site geotechnical conditions, topography, fire potential and ready access to a site/s might not be suitable, thus resulting in negative environmental implications and reduced financial viability.
- There is no guarantee that the current land use of alternative sites (that were considered during the Scoping Phase) will be flexible in terms of development potential, for example the agricultural potential for alternative sites might be higher and of greater significance.
- There is no guarantee of the willingness of other landowners to allow the implementation of a Solar Facility on their land and if the landowners strongly object, then the project/s will not be feasible.
- There is no guarantee that other sites within the Northern Cape will be located close to existing or proposed electrical infrastructure to enable connection to the national grid. The further a project is located from the grid, the higher the potential for significant environmental and economic impacts.

As previously noted, the proposed Gemsbok PV6 facility forms part of a bigger project by Mulilo Renewable Project Developments (PTY) LTD to develop seven Solar PV Facilities in total as part of their Phase 2 development near Kenhardt. The main driver for Mulilo was to find suitable, developable land in one contiguous block to optimise design, minimise costs, minimise sprawling development and impact footprints and that it is located close to the Nieuwehoop substation.

Given the site selection requirements associated with Solar Energy Facilities and the suitability of the land available on Portion 8 of Gemsbok Bult Farm 120, no other site alternatives have been considered in the EIA Phase.

17.3.4 Technology Alternatives

In the Scoping phase the applicant considered PV and CPV solar panel technology. As discussed in Chapter 2 and Chapter 5 of the EIA Report, only the PV solar panel technology has been considered in the EIA Phase.

In addition, four main mounting systems have been included in the proposed project description namely: single axis tracking systems; fixed axis tracking systems; dual axis tracking systems; and fixed tilt mounting structures. Only Horizontal Single Axis Tracking and Fixed Axis Structures were assessed in the EIA Phase.

17.4 Permits and Licences required

17.4.1 NEMA and 2014 NEMA EIA Regulations

Before clearing of the proposed site is initiated, an EA must be granted by the DEA in terms of the NEMA and associated 2014 NEMA EIA Regulations. This report has been has been compiled to provide the DEA with the information required in order to make an informed decision on whether to grant or reject EA.

17.4.2 Permit in terms of the National Water Act (Act 36 of 1998)

The National Water Act (Act 36 of 1998) controls activities in and around water resources, as well as the general management of water resources, including abstraction of groundwater and disposal of water. As noted in Chapter 4 of this EIA Report, Section 21 of the Act lists the following water uses that need to be licensed:

a) taking water from a water resource;
b) storing water;
c) impeding or diverting the flow of water in a watercourse;
d) engaging in a stream flow reduction activity contemplated in section 36;
e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) disposing of waste in a manner which may detrimentally impact on a water resource;
h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
i) altering the bed, banks, course or characteristics of a watercourse;
j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
k) using water for recreational purposes.

The Ecological Impact Assessment states that authorisation for changes in land use up to 500 m from a defined water resource/wetland system will require an application for a Water Use Licence from the DWS. A Water Use Licence will be required in respect of the proposed development under Section 21 (c) and (i) of the Act, however such licence should not preclude this development. The DWS will be consulted with during the EIA Process to confirm the need for a WUL, as well as to seek comment on the proposed project.

17.4.3 A Permit in terms of the National Forest Act (Act 84 of 1998) and the Northern Cape Nature Conservation Act (Act 9 of 2009)

The National Forest Act (Act 84 of 1998) governs the removal, disturbance, cutting or damage and destruction of identified “protected trees”.

The Northern Cape Conservation Act (Act 9 of 2009) under its pertinent regulations governs the disturbance of species, or possibly other species not yet identified on site. A permit from the Provincial Department of Environment and Nature Conservation (DENC) will be required in order to disturb or translocate such species.

The quiver tree, *Aloe dichotoma,* is present on the site. *Aloe dichotoma* is a Vulnerable species, which is specially protected under the Northern Cape Nature Conservation Act, (Act 9 of 2009) (NCNCA). The removal or movement of this species will require a permit from Northern Cape Nature. Obtaining a permit for the removal of *Aloe dichotoma* is likely to be problematic. The species will have to be moved to appropriate habitat outside the proposed development area. This will require planning that takes the seasons and rainfall into account.

In addition, *Boscia albitrunca* and *B. foetida* were observed on site. *Boscia albitrunca* is a protected species under the National Forest Act (Act 84 of 1998 (NFA), as well as the NCNCA, and *Boscia foetida* is protected under the NCNCA. *Boscia albitruca* is fairly rare, with less than one individual present per 50 ha. *Boscia foetida,* a similar species, is much more abundant. The individuals of *Boscia albitruca* are on average approximately 2 m high, with a stem circumference of approximately 300 to 400 mm.

17.4.4 Permit in terms of the National Heritage Resources Act (Act 25 of 1999) (NHRA)

Neither the Heritage Impact Assessment nor the Palaeontological Impact Assessment indicated that permits would be required at this stage.

As noted in the Heritage Impact Assessment (Chapter 11 of the EIA Report), the NHRA does not require the developer to obtain permits prior to construction. However, any archaeological mitigation work (i.e. test excavations, sampling etc.) that may be required (in the event of archaeological resources or graves of significance being found within the development footprint during construction) would need to be conducted under a permit issued to, and in the name of, the appointed archaeologist. The permit application process allows the heritage authorities to ensure that a suitably qualified and experienced archaeologist undertakes the work and that the proposed excavation/sampling methodology is acceptable.

In terms of palaeontology (as noted in the Palaeontological Impact Assessment (Chapter 12 of the EIA Report)), where palaeontological mitigation is required in the event of any fossil material found on site during construction, the palaeontologist concerned with mitigation work would need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (e.g. museum or university collection). All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (e.g. data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies recently developed by SAHRA (2013).

17.4.5 Astronomy Geographic Advantage (Act 21 of 2007)

As mentioned previously EMI and RFI studies have been undertaken and commissioned by the Project Applicant to determine appropriate mitigation and management measures to reduce the risk of a detrimental impact on the SKA project. This technical report, compiled by MESA Solutions (PTY) Ltd, is included in Appendix K of this EIA Report, with a summary provided in Chapter 15. The SKA Project Office will review this report during the 30 day review period and will provide any recommendations. The mitigation of all risk associated with RFI on the SKA must be confirmed by measurement following construction to the satisfaction of the SKA Office. Should the risk of radio interference still exist, based on measurements, further mitigation methods must be implemented to remove outstanding risk of radio frequency interference. Scatec has confirmed that this will be undertaken, should this project receive preferred bidder status.

17.4.6 Subdivision of Agricultural Land Act (Act 70 of 1970)

The Subdivision of Agricultural Land approval (SALA) is required for long term lease of land zoned for agriculture. The process of acquiring SALA consent will be executed by the Project Developer independently of this EIA process.

17.4.7 Civil Aviation Act (Act 13 of 2009)

The Civil Aviation Act and the Civil Aviation Regulations (CAR) of 1997 apply to the proposed solar PV development. Approval from the Civil Aviation Authority (CAA) is required. The process of acquiring CAA consent will be executed by the Project Developer independently of this EIA process.

17.5 Overall Evaluation of Impacts by the EAP

Need and desirability

South Africa is facing serious electricity shortages. Linked to this, the proposed project aims to supply additional electricity to the national grid. Furthermore, the urgent need to reduce greenhouse gas emissions and the importance of a secure and diversified energy supply has resulted in a global shift towards, and an increased focus on, the use of renewable energy technologies. In South Africa, the government has encouraged the utilisation of renewable energy through national policy and strategic planning. The objective is to expand electricity generation capacity in South Africa and promote the practice of sustainable development. The key elements describing the need and desirability of the proposed solar PV project are summarised in Figure 17.1.

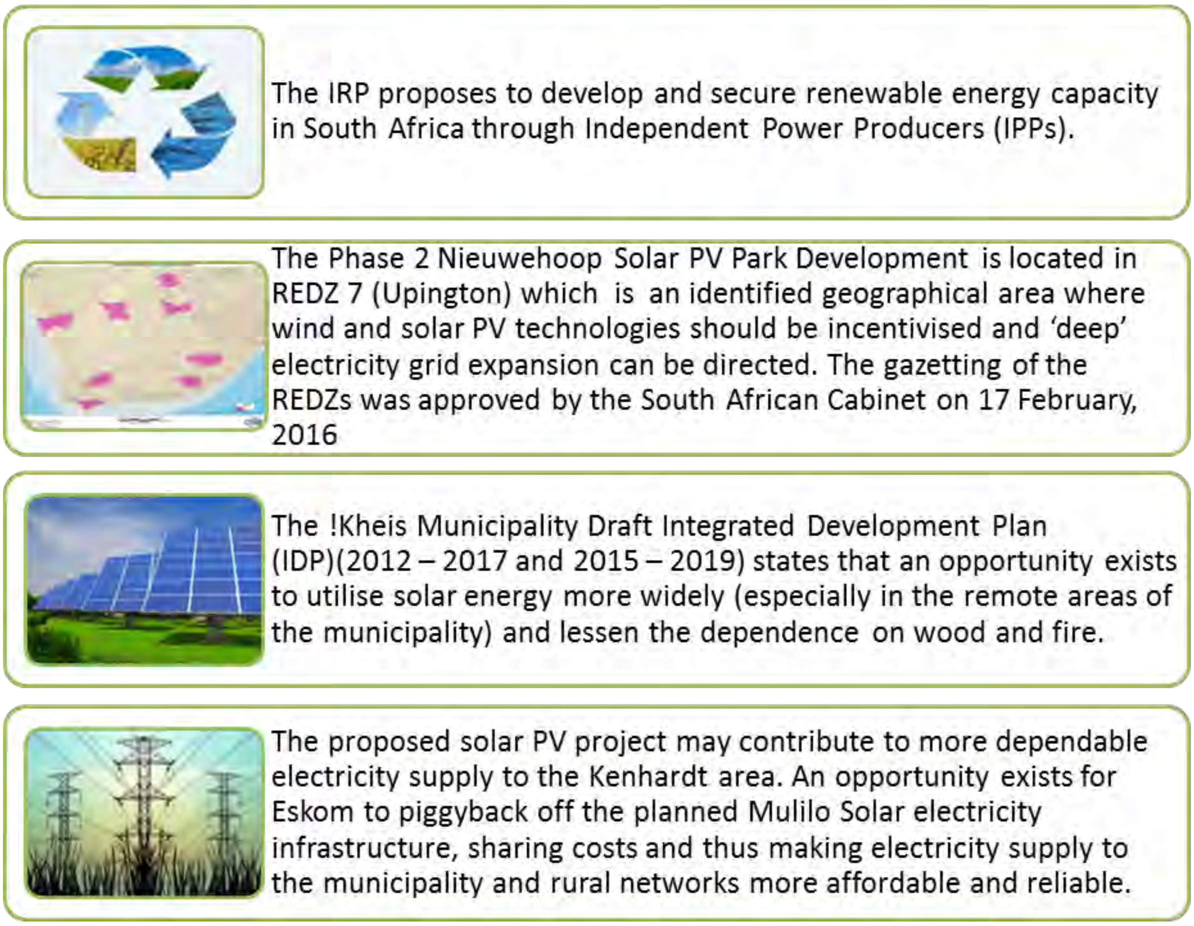

Figure 17.1: Need and desirability for the proposed Gemsbok Solar PV6 project.

17.6 Project specifications

The components and relevant specifications of the proposed project are presented in Table 17.4.

Table 17.4: Summary of project components and their specifications.

Component	Description
Solar Field: 220 ha	
Type of Technology	Solar PV Technology
Generation Capacity	75 MW and up to 100 MW DC
PV Panels Structure (with following possible tracking and mounting systems): Horizontal Single axis tracking systems; Fixed axis mounting structures;	Height: 3 m (maximum)
Area of PV Array	Footprint: 220 ha
Total Surface Area to be covered (including all associated infrastructure and roads etc.)	Footprint: 25 ha
Building Infrastructure	
Offices	Height: 7 m Footprint: 30 x 30 m
Operational and Maintenance Control Centre	Height: 7 m Footprint: 50 x 50 m
Warehouse/Workshop	Height: 7 m Footprint: 50 x 50 m
Ablution Facilities	Height: 5 m Footprint: 10 x 10 m
Inverter Stations x 100	Height: 3 m Footprint: 4 x 10 m
Number of Inverter Stations Required	100
On-site Substation and Substation Building	Height : 30 m Footprint : 100 x 100 m
Guard Cabin	Height: 3 m Footprint: 10 m x 10 m
Solar Panels	Height: 3 m Footprint: 220 ha
Solar measuring station	Height: 5 m Footprint : 9 x 9 m
Associated Infrastructure	
On-site substation	Capacity: 132 KV
22/33 kV internal transmission lines/underground cables	Length: 10 km
Underground low voltage cables or cable trays	Capacity: 380VAC and 1500V DC Depth belowground: 1 m
Access Roads: Unnamed Farm Road (Widening)	Length: 8 km Width: 6 m
Access Roads: Transnet Service Road	Length: 35 km Width: 8 m
Internal gravel access roads	Length: 10 km Width: < 8 m
Fencing	Type: Electrified Height: 3 m
Panel maintenance and cleaning area	Footprint: 5 ha
Stormwater channels	Length: > 1000 m Width: <1 m

Component	Description
Temporary work area during the construction phase (i.e. laydown area)	Footprint: Maximum 20 ha
Permanent laydown area during the operational phase	Footprint: 5ha
High Voltage Overhead Transmission Lines	Height = 30 m Length = 4 km Footprint = 32 m servitude
Proximity to Grid Connection	Approximately 4 km

17.7 Environmental considerations

Potential risks and impacts associated with the proposed Gemsbok Solar PV6 project have an overall moderate to low negative significance, whilst positive impacts stem from the potential diversification of land use income, and economic development associated with the proposed project (employment opportunities and local economic growth in terms of local spending. The mitigation measures, as prescribed in Part B: EMPr, are key to reducing anticipated impacts associated with the development.

The findings of the specialist studies have been used to inform the layout of the proposed facility within the preferred site, Gemsbok Solar PV6.

The following environmental buffers/setbacks have been proposed by specialists, and were included in the development footprint planning (see Figures 17.2 and 17.4).

- 100 m from NFEPA rivers and wetlands (National priority);
- 32 m from all other major watercourses (e.g. *Prosopis glandulosa*) where waterbirds could congregate when surface water is present;
- 20 m from minor drainage lines;
- 100 m from watering points and dams; and
- 100 m from prominent quartz outcrops, koppies, and *Aloe dichotoma* outcrops;

The avoidance of the above sensitive features is critical and will minimise the potential impacts of the proposed Gemsbok Solar PV6 Project.

17.8 Final development layout

The following maps are included for the proposed Gemsbok Solar PV6 Facility:

- Figure 17.2: Sensitivity map (including associated powerline and electrical infrastructure);
- Figure 17.3: Proposed Layout map; and
- Figure 17.4: Sensitivity map overlain with the proposed project layout.

17.9 Reasoned opinion of the EAP

The proposed project is considered to have an overall low negative environmental impact and an overall low positive socio-economic impact (with the implementation of respective mitigation and enhancement measures).The project proponent (Gemsbok Solar PV3 (Pty) Ltd) has indicated its commitment to environmental responsibility by adhering to the recommendations by the specialists for environmental buffers in planning the development footprints.

In order to ensure the effective implementation of the mitigation and management actions, an EMPr has been compiled and is included in Part B of this EIA Report. The mitigation measures necessary to ensure that the project is planned, constructed, operated and decommissioned in an environmentally responsible manner are listed in this EMPr. The EMPr is a dynamic document that should be updated regularly and provide clear and implementable measures for the establishment and operation of the proposed Solar PV facility.

The proposed Gemsbok Solar PV3 project falls within the Renewable Energy Development Zone 7 (REDZ 7) (Upington). The REDZs were identified during the wind and solar PV Strategic Environmental Assessment, conducted in support of the Presidential Infrastructure Coordinating Committee's Strategic Integrated Project (SIP) 8: "Green energy in support of the South African economy", to address the need of spatial strategic planning for the development of wind and solar PV projects in South Africa.

All the specialist studies recommend that the proposed project can proceed and be authorised by DEA. Based on the above considerations and given the strategic importance of renewable energy development in South Africa, it is the opinion of the EAP that the project benefits outweigh the costs and that the project will make a positive contribution to steering South Africa on a pathway towards sustainable infrastructure development.

Provided that the specified mitigation measures are applied effectively, it is recommended that the proposed Gemsbok Solar PV3 project receives Environmental Authorisation in terms of the 2014 EIA Regulations promulgated under the NEMA.

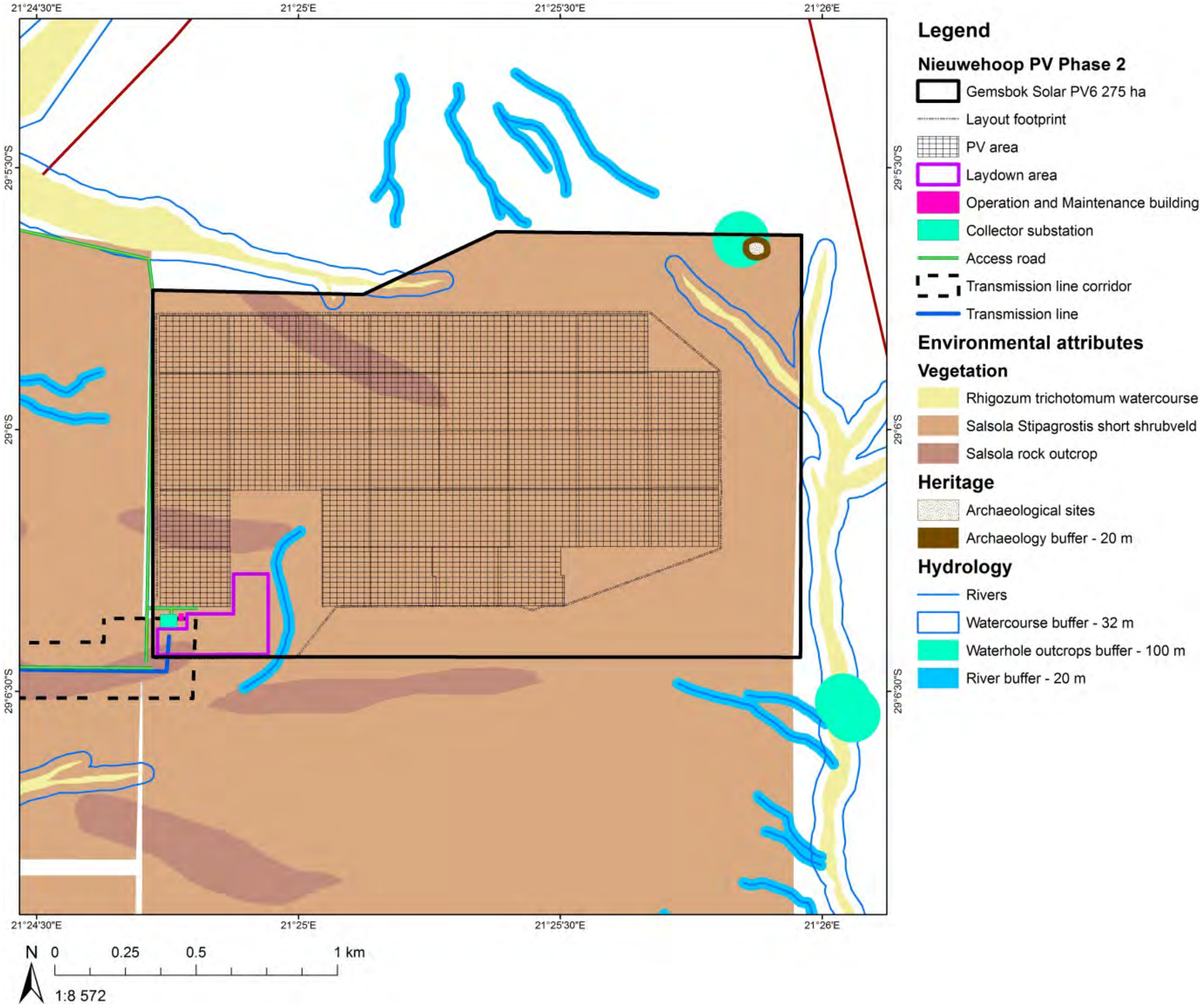

Figure 17.2: Environmental sensitivity map for the proposed Gemsbok Solar PV6 Facility.

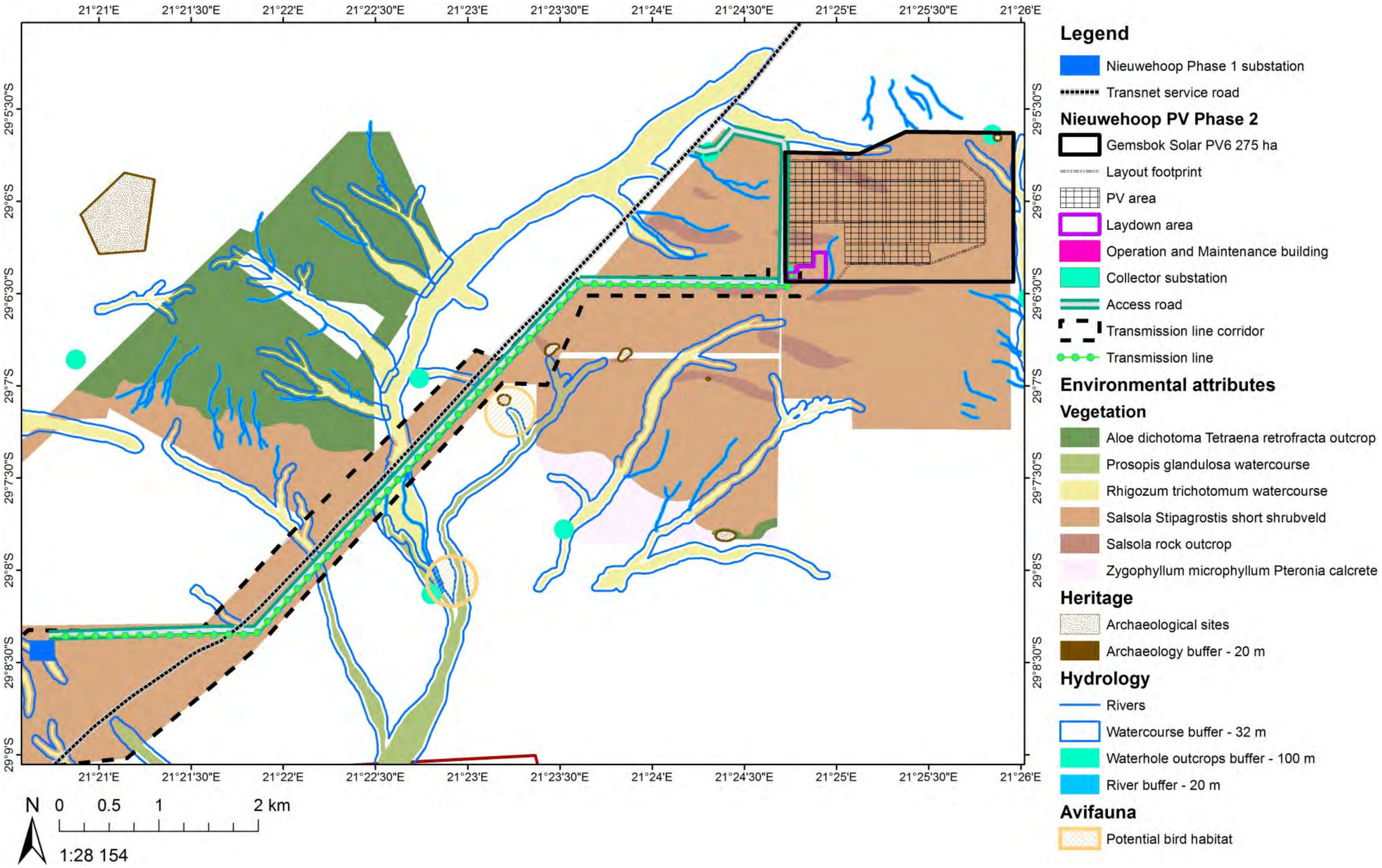

Figure 17.2: Environmental sensitivity map for the proposed Gemsbok Solar PV6 Facility (including powerline).

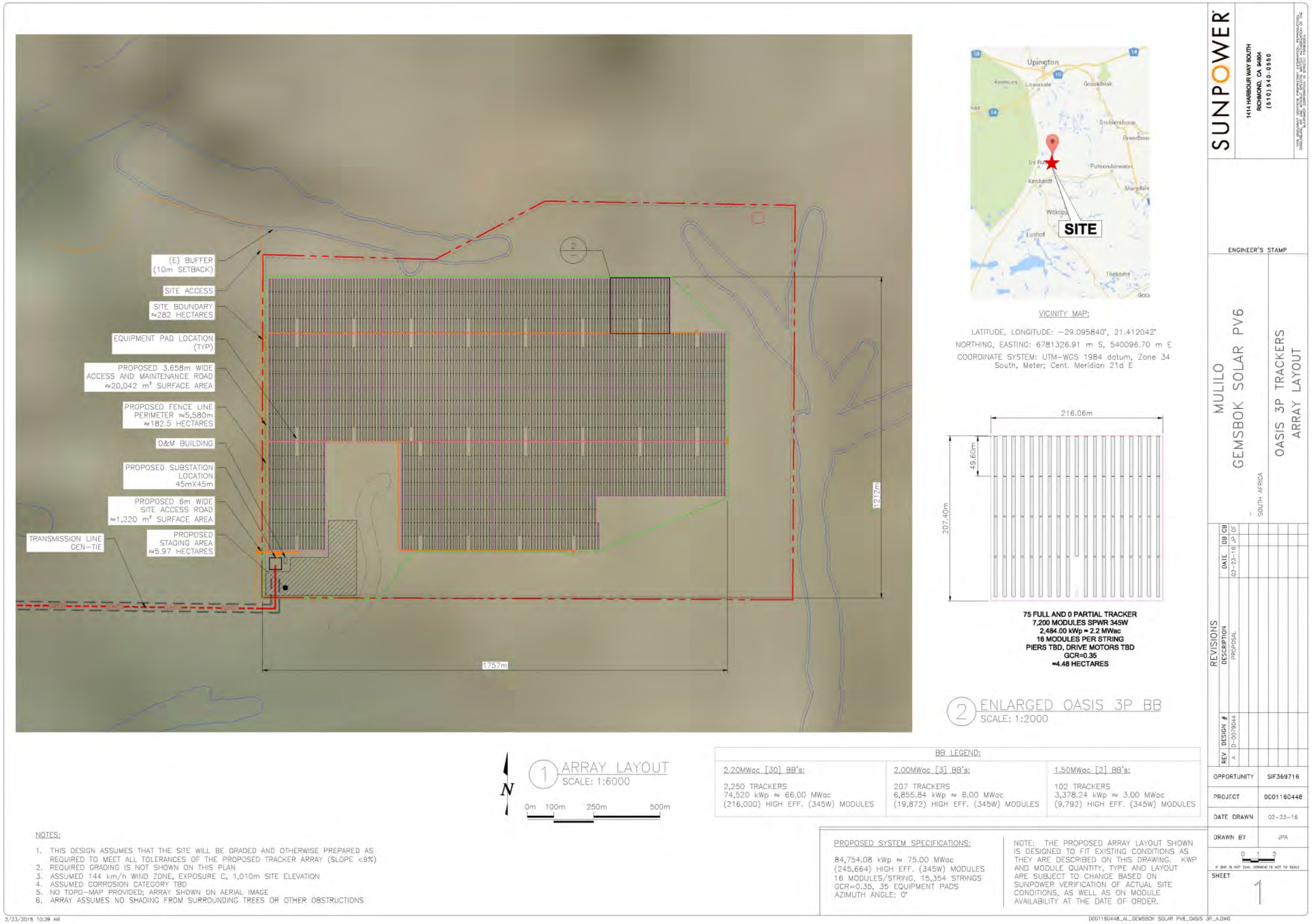

Figure 17.3: Layout for the proposed Gemsbok Solar PV6 Facility.

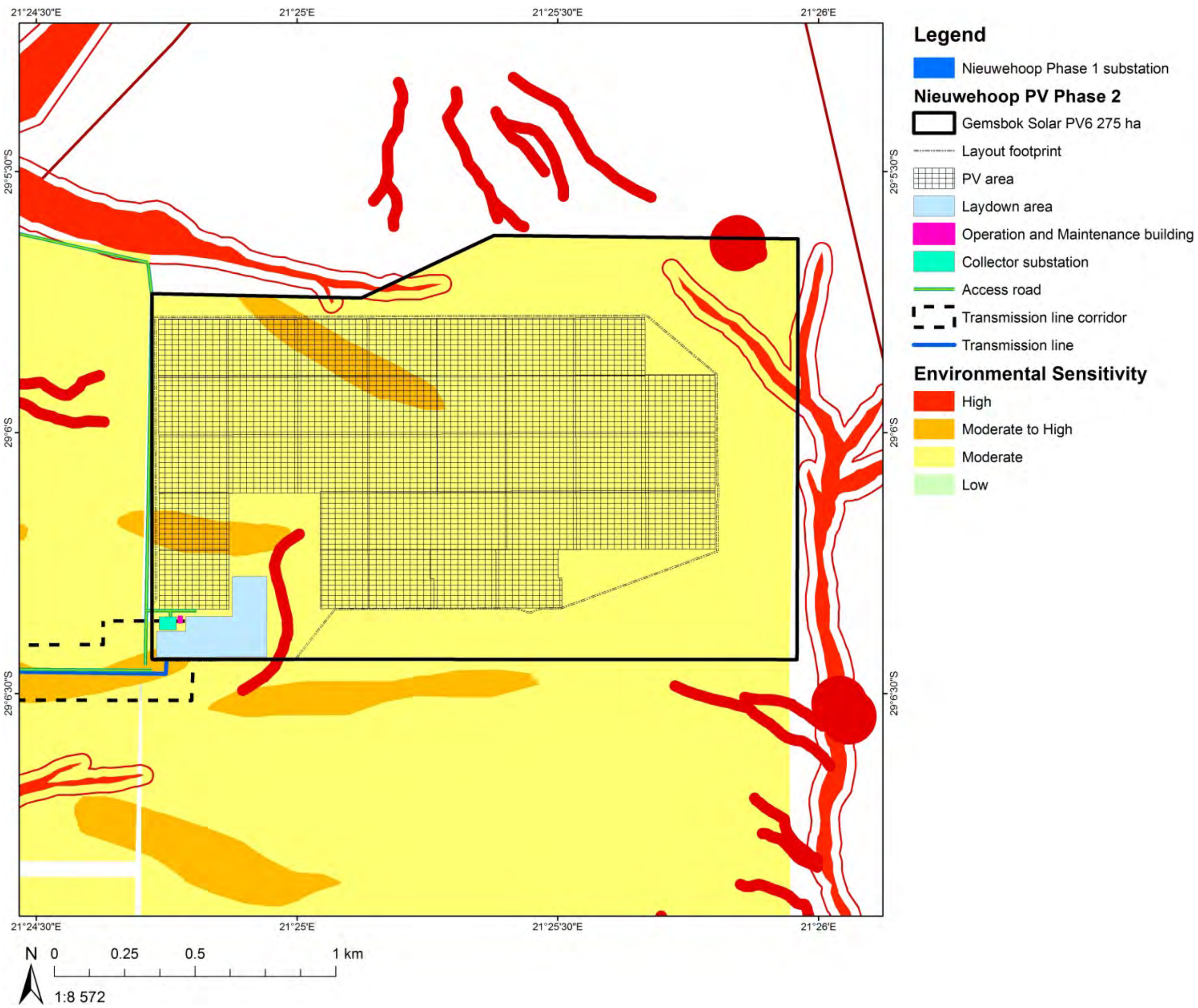

Figure 17.4: Combined layout and sensitivity map for the proposed Gemsbok Solar PV6 Facility.

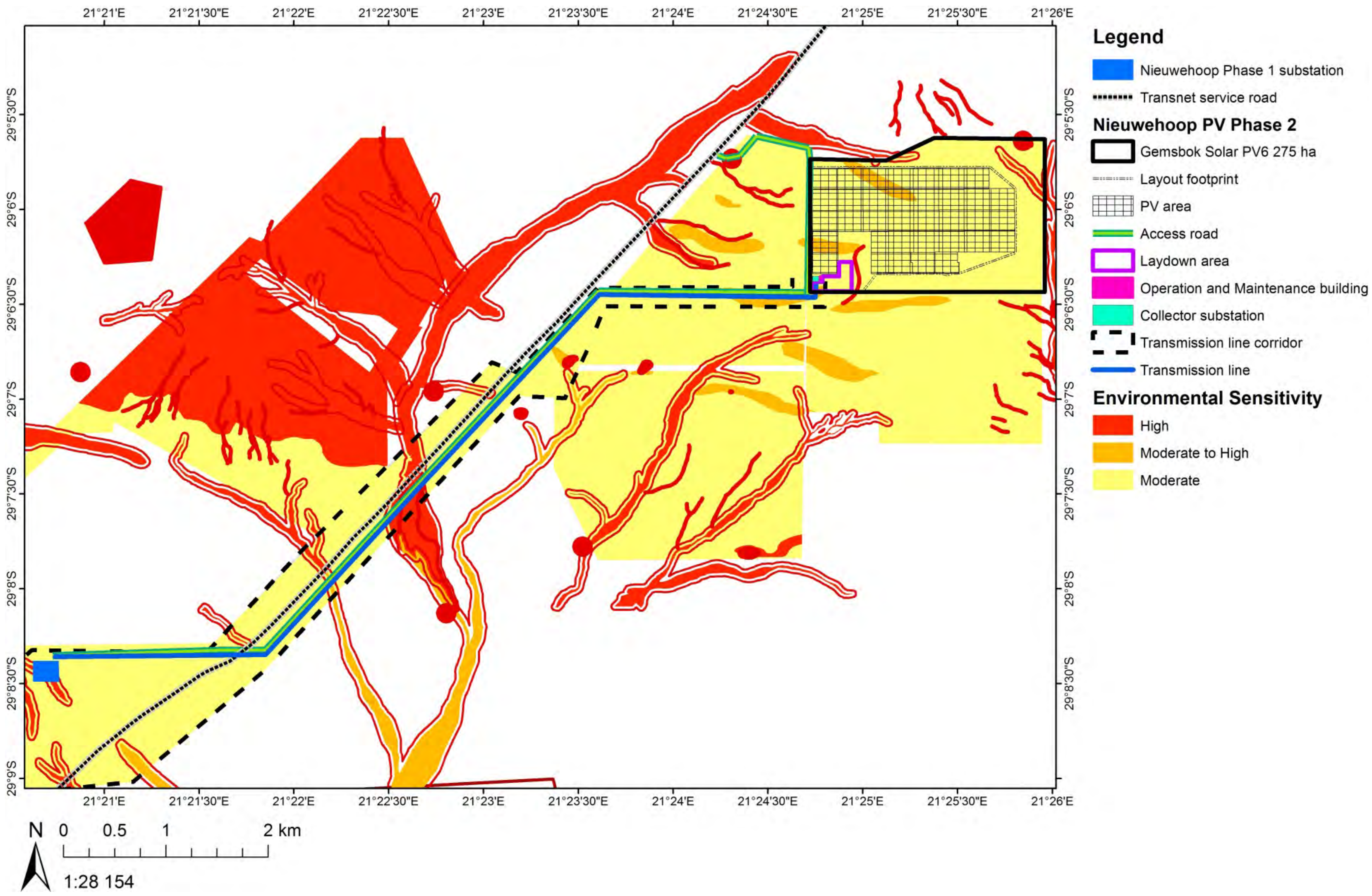

Figure 17.4: Combined layout and sensitivity map for the proposed Gemsbok Solar PV6 Facility (including powerline).

MULILO
RENEWABLE PROJECT DEVELOPMENTS

Scoping and Environmental Impact Assessment for the proposed Development of a 75 MW Solar Photovoltaic Facility (GEMSBOK SOLAR PV6) on Portion 8 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape Province

EIA REPORT

CHAPTER 18:

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