Amended Final EIA Report **14/12/16/3/3/2/618**

PROPOSED RENEWABLE ENERGY GENERATION PROJECT ON PORTION 1 OF THE FARM AVONDALE 410, GORDONIA RD, //KHARA HAIS LOCAL MUNICIPALITY, ZF MGCAWU DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE

Short name: AVONDALE 1 SOLAR PARK

September 2014

Commissioned by: Tita Energy (Pty) Ltd
Document version 3.0 – Amended Final

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Proposed Renewable Energy Generation Project on Portion 1 of the Farm Avondale No. 410, Gordonia RD, //Khara Hais Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province
Short name: Avondale 1 Solar Park

September 2014

PROJECT APPLICANT

Company name:	**TITA ENERGY (Pty) Ltd - Reg. No: 2012/016697/07**
Contact Person:	Ms Izel van Rooy (PlanWize)
Physical Address:	4th Floor Aloe Grove, Houghton Estate Office Park, 2 Osborn Road, Houghton 2198, South Africa
Postal Address:	P.O. Box 225, Highlands North 2037, South Africa
Telephone Number:	+27 (0) 14 772 1758
Fax Number:	+27 (0) 14 772 1758
S.A. Mobile Number	+27 (0) 82 449 7626
E-mail:	planwize@telkomsa.net

ENVIRONMENTAL ASSESSMENT PRACTITIONER

Company Name:	AGES Limpopo (Pty) Ltd (Reg: 2006/020831/07)
Contact Persons:	Mr. Johan Botha / Ms. Engela Grobler
Physical Address:	120 Marshall Street, Polokwane, 0699, South Africa
Postal Address:	P.O. Box 2526, Polokwane, 0700, South Africa
Telephone Number:	+27 (83) 557 6494 / +27 0(15) 291 1577
Fax Number:	+27 (15) 291 1577
E-mail:	**jbotha@ages-group.com/egrobler@ages-group.com**

AGES (Pty) Ltd

J.H. Botha (Senior Environmental Scientist – M.Sc. Environmental Management (*PriSci Nat)*
E Grobler (Environmental Scientist – M.Sc. Environmental Management (Univ of Stellenbosch)

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14/12/16/3/3/2/618	4 June 2014	2.0	Final
14/12/16/3/3/2/618	15 April 2014	1.0	Draft

PROJECT MAIN FEATURES

Project main features - according to the EIA guidelines Summary of information included in the report

General site information

Site location	
Farm	**AVONDALE 410, GORDONIA RD**
Portion	**Portion 1**
Surveyor-general 21 digit site	C02800000000041000001
Local Municipality	//Khara Hais
District Municipality	Zf Mgcawu
Province	Northern Cape

Property details	
Extent	3426.1123hectares
Land Owner	JOHAN DE JAGER TESTAMENT TRUST (Yvonne Janey De Jager and Andries Johannes De Jager)
Diagram deed number	T863/1956
Title deed number	T1726/1989
Registration date	19891201
Current land use	Farming

Site data	
Latitude	28° 21’ 15” S
Longitude	21°34’ 35” E
Altitude	850 m to 870 m a.m.s.l.
Ground slope	flat

Adjacent farm portions	
Farm	**AVONDALE 410, GORDONIA RD**
Portion	**Portion 5**
Surveyor-general 21 digit site	C02800000000041000005
Land Owner	SANRAL
Diagram deed number	N/A
Title deed number	N/A
Registration date	N/A
Extent	±7.8 ha
Current land use	National Road N14
Farm	**ABEISESTAD 409, GORDONIA RD**
Portion	**Portion 4**
Surveyor-general 21 digit site	C02800000000040900004
Land Owner	BLOMERUS JACOB STEPHANUS
Diagram deed number	T152/1985
Title deed number	T761/1996
Registration date	19960418
Extent	1395.7740 hectares
Current land use	livestock farm
Farm	**FARM 596, GORDONIA RD**
Portion	**Portion 0**
Surveyor-general 21 digit site	C02800000000059600000
Land Owner	TORQHOFF BOERDERY PTY LTD

Diagram deed number	T1433/l988
Title deed number	T581/2014
Registration date	20140324
Extent	54.2431 hectares
Current land use	agriculture
Farm	**AVONDALE 410, GORDONIA RD**
Portion	**Portion 2 (Remaining Extent)**
Surveyor-general 21 digit site	C02800000000041000002
Land Owner	J C R QUALITY MEAT PTY LTD
Diagram deed number	T501/1960
Title deed number	T2645/2013
Registration date	20130726
Extent	143.0921 hectares
Current land use	agriculture (crop circles)
Farm	**KORAS 412, GORDONIA RD**
Portion	**Portion 1**
Surveyor-general 21 digit site	C02800000000041000001
Land Owner	BOOMPLAATS BOERDERY CC
Diagram deed number	T3583/2000
Title deed number	T3500/2013
Registration date	20131101
Extent	83.1287 hectares
Current land use	agriculture
Farm	**KORAS 412, GORDONIA RD**
Portion	**Portion 2**
Surveyor-general 21 digit site	C02800000000041000002
Land Owner	KORAS BOERDERY CC
Diagram deed number	T64/1961
Title deed number	T676/1963
Registration date	19630815
Extent	3987.0205 hectares
Current land use	livestock farm

PV power plant design specifications and connection to the Eskom grid

Project data	
Project name	**AVONDALE 1 SOLAR PARK**
Technology	**Photovoltaic power plant**
Number of Phases	**1**
Maximum generating capacity at the delivery point	**up to 75 MW**
Type of PV modules	Thin-film or Mono/Polycrystalline
Type of mounting system	fixed or horizontal single-axis trackers (SAT)
Average annual energy production (up to)(*)	up to 160 GWh/year with fixed mounting system up to 190 GWh/year with trackers
Load factor (*)	0.223 with fixed mounting system 0.251 with trackers
Full net equivalent hours (EOH) (*)	1950h/year (Wh/Wp/y) with fixed mounting systems 2200 h/year (Wh/Wp/y) with trackers
(*) calculated by PVSYST, simulation professional tool	

Technical specifications	
Generation Capacity	**up to 75 MW**
Installed power capacity - AC side	**up to 77 MW**
Installed power capacity - DC side	**up to 86.25 MWp**
Number of PV modules	up to 638,900 thin film modules of 135 Wp up to 287,500 mono/polycrystalline modules of 300 Wp
Number of structures (PV arrays)	up to 24,570 fixed structures up to 15,130 1-axis horizontal trackers (SAT)
Minimum structure height above ground level	0.8 m
Maximum structure height above ground level	3.1 m

Other information	
Footprint, including internal roads (fenced area)	up to 270 ha
PV power plant lifetime	25 - 30 years
Construction camp (temporary)	10 ha
Construction timeframe	approximately 15 months

Connection to the Eskom grid (**)	
Preferred connection solution: description	The connection to the Eskom grid will be done according to the Eskom connection solution which may require: (i) one small on-site high-voltage substation with high-voltage power transformers, stepping up the voltage to the voltage of the Eskom's grid (132 kV), a control building and a132 kV busbar with metering and protection devices (also called "switching station"); (ii) two new small sections of 132 kV power line allowing the **Eskom "GARONA-GORDONIA" 132 kV power line** - crossing the project site - to loop in and out of the 132 kV busbar of the new on-site loop-in loop-out substation. The connection solution may also entail intervention on the Eskom's grid.
Point of connection (preferred)	Eskom "Garona-Gordonia" 132 kV power line
Point of connection (farm, portion)	Portion 1 of the Farm Avondale 410
Delivery point: voltage level	132 kV
New sections of power line - overall length	2x100 m
New HV substation inside the property - footprint	Approximately 4,000 m^2
Servitudes for new powerlines	not required
(**) already included in the current EIA application	

Water requirements	
Water consumptions	See paragraph 4.2.5 - water requirements

Site maps and GIS information

Status quo information - site	***ESRI shapefiles***
Site	Ptn 1 of Avondale 410 Gordonia RD
Building and other structures	Historical Period farm house, Borehole, centre pivot
Agricultural field	crop circle
Natural and endangered vegetation areas	Vegetation map and sensitivity map
Cultural historical sites and elements	Heritage sites
Contours with height references	2m contours
Slope analysis	2m contours
High potential agricultural areas	crop circle
Eskom's substation(s) / power line(s)	Eskom Garona-Gordonia 132kV power line

Development proposal maps	***ESRI shapefiles***
Development Area	Development area
Access road and internal roads	Access road, internal roads
Position of solar facilities	PV arrays
Permanent laydown area footprint	Fenced area (footprint)
Construction period laydown footprint	Temporary construction camp
River, stream, drainage crossing	Not applicable
Substation and transformers	On-site HV substation
Connection routes	Loop-in loop-out lines
Buildings	MV stations, control building, warehouses
Buffer zones	Vegetation buffer zone, heritage sites, medium-high sensitive areas, endorheic pan, disturbed quarry

Annexures

Layout and technical drawings of the PV Power Plant and of the connection infrastructure	Annexure A
Photos of the project site	Annexure B
Public Participation Process	Annexure C
Ecological Impact Assessment	Annexure D
Avifauna Impact Assessment	Annexure E
Agricultural Potential Assessment	Annexure F
Wetland Delineation Study	Annexure G
Heritage Impact Assessment	Annexure H1
Palaeontological Desktop Study	Annexure H2
Geo-technical and Geo-hydrological Report	Annexure I
Visual Impact Assessment	Annexure J
Socio-economic Impact Assessment	Annexure K
Services Report	Annexure L
Draft Environmental Management Programme	Annexure M

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ANNEXURES

Annexure A Layout and technical drawings of the PV Power Plant and of the connection infrastructure:

- Vegetation Map
- Sensitivity Map
- AV1SP_00_r3 Locality Map and Development Area
- AV1SP_01_r2 Layout plan - PV power plant up to 75 MW
- AV1SP_03_r0 Mounting System – Alternative option 1: fixed mounting systems
- AV1SP_04_r0 Mounting System – Alternative option 2: horizontal single-axis trackers
- AV1SP_05_r0 Medium-voltage stations
- AV1SP_06_r1 Control building and medium-voltage receiving station
- AV1SP_07_r1 High-voltage loop-in loop-out substation
- AV1SP_08_r0 Warehouse

Annexure B Photos of the project site

Annexure C Public Participation Process

Annexure D Ecological Impact Assessment

Annexure E Avifauna Impact Assessment

Annexure F Agricultural Potential Assessment

Annexure G Wetland Delineation Study

Annexure H1 Heritage Impact Assessment

Annexure H2 Palaeontological Desktop Study

Annexure I Geo-technical and Geo-hydrological Report

Annexure J Visual Impact Assessment

Annexure K Socio-economic Impact Assessment

Annexure L Services Report

Annexure M Draft Environmental Management Programme

ABBREVIATIONS AND ACRONYMS

AGES	Africa Geo-Environmental and Engineering Consultants (Pty) Ltd
BID	Background Information Document
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CSP	Concentrating Solar Power
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DENC	Northern Cape Department of Environment and Nature Conservation
DoE	Department of Energy
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIR	Environment Impact Assessment Report
EMP	Environmental Management Programme
ESS	Environmental Scoping Study
FIT	Feed in Tariffs
GHG	Green House Gases
GIS	Geographic Information Systems
GN	Government Notice
GWh	Giga Watt hour
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
IPP	Independent Power Producer
kV	kilovolt
MW	Mega Watt
MWp	Mega Watt peak
NEMA	National Environmental Management Act - Act no. 107 of 1998
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act - Act no. 25 of 1999
NWA	National Water Act - Act no. 36 of 1998
PoS	Plan of Study
Property	Portion 1 of the Farm Avondale 410, Gordonia RD
Project	Avondale 1 Solar Park
Project company	Tita Energy (Pty) Ltd (applicant)
Project site	Portion 1 of the Farm Avondale 410, Gordonia RD
PV	Photovoltaic
REFIT	Renewable Energy Feed-in Tariffs
RFP	Request for Qualification and Proposals for New Generation Capacity under the IPP Procurement Programme
SAHRA	South African Heritage Resources Agency
SANRAL	South African National Roads Agency Limited
SANS	South African National Standard
UPS	Uninterruptible Power Supply

BACKGROUND

The purpose of this report is to amend the Final EIA Report submitted on 4 June 2014, in order to include the additional information requested by the Department of Environmental Affairs with a letter dated 4 August 2014, in which **the Final EIA Report is rejected** (please refer to the section *Authority Consultation* of the Public Participation Process - Annexure C).

The additional information requested by the DEA and included in this Amended EIA Report are listed below with the specific requirement indicated in blue:

Application Form

Following a review of the EIAr and the application form received in June 2014 and November 2013 respectively, this Department advises that the application form must be amended and resubmitted to include the correct listed activities. As such the Department advises that the applied listed activities and their relevant issues be addressed in the amended EIAr.
Please ensure that all relevant listing notice activities applied for, are specific and that it can be linked to the development activity or infrastructure as described in the project description. The application form needs to be amended to specify the relevant activities.
[…]

The application form has been reviewed and is resubmitted together with this Amended EIA Report. The listed activities applied for have been addressed in order to fully clarify which specific aspect (sub-item) of the activity is triggered.

Please note that Activity 11 of GNR 544 is not applied for anymore because it was assessed that the salt pan located close to the proposed footprint (at a minimum distance of 45 m from the security fence which will enclose the PV plant footprint) will not be affected by the proposed development, should the mitigation measures indicated in the EIA Report and EMPr be correctly implemented. This is further discussed on paragraph 3.3. LISTED ACTIVITIES IN TERMS OF NEMA of this Amended EIA Report.

The listed activities applied for are also quoted on **Table 2** of this Amended EIA Report.

The project components and related co-ordinates are indicated on **Table 3** of this Amended EIA Report. Shapefiles and a kmz file showing the project and the environmental features of the project site on Google Earth are also available in electronic format and included here on a CD.

Details of public participation process

The requirements of the public participation process (PPP) have not been adequately met. The information which has been provided in the PPP appendix is not adequate and does not meet the requirements of the EIA Regulations, 2010.

The EIAr does not contain a summary of comments received from and summary of issues raised by registered interested and affected parties, the date of receipt of these comments and response of the EAP to those comments.
Apart from the 40 day commenting period on the Draft EIAr, the EAP must, in order to give effect to regulation 56(2), give registered interested and affected parties access to, and an opportunity to comment on the final report in writing. According to the scopping acceptance letter you were required to give I&APs an opportunity to comment within 21 days before submitting the final environmental impact assessment report to the Department. The EIAr, page 58; indicated that the final EIAr will be made available for a 30 day commenting period, however; there is no indication of whether they have been given such opportunity.

Please provide proof of when and where the report was placed, and until which date was the report made available.

Proof that the final EIA report was made available for comments to I&APs is attached to Annexure C and the Amended EIA Report was made available to the I&AP's for a 21 day commenting period. Proof of this is also included in Annexure that the amended EIA report was made available for comments.

A summary of comments and issues raised by I&AP's and of the responses of the EAP to those comments has been drafted and enclosed to the Public Participation Process (Annexure C).

Activity position

Please provide coordinates of the four (4) corners of the proposed development site, if the site have curves, you are required to give coordinates for each curve.

The co-ordinates of the envisaged PV plant footprint / fenced area are indicated on **Table 3** of this Amended EIA Report. Shapefiles and a kmz file showing the proposed PV plant footprint are also available.

Distribution power line

The amended EIAr must indicate the preferred transmission alternative to distribute the generated electricity from the solar panels to the existing Eskom Substation, i.e. overhead or underground lines. Please give the advantages and disadvantages of the each alternative as well as the coordinates of the start, middle and end point of the power line.

Avondale 1 Solar Park will deliver the electrical energy to **the Eskom "Garona-Gordonia" 132 kV power line**, running through the project site. The Eskom 132 kV power line will loop in and out of the 132 kV busbar of the new on-site substation, **via two new sections of a 132 kV line (loop in line and loop out line) approximately 100 m long.**
The co-ordinates and footprint of the new on-site loop-in loop-out substation - to be located within the planned PV plant footprint - and of the two new sections of power line are indicated on **Table 3** of the Amended EIA Report.
The two new section of power line will be overhead, as per the Eskom standards. Underground cables are not considered a viable alternative: considering the short length (maximum 100 m each), the environmental benefits would be negligible.

Alternative connection solutions are not envisaged, being the the Eskom "Garona-Gordonia" 132 kV power line the only Eskom power line crossing the project site. Other Eskom substations / power lines are too far from the project site to taken into account. The closest Eskom substation is the Eskom Garona substation, 29 km west from the project site.

Site plans

According to the scoping acceptance letter dated 08 April 2014, you were required to provide the Department with the final layout plan which indicate the following:

- ***PV positions and its associated infrastructure;***
- ***Foundation footprint;***
- ***Permanent laydown area footprint;***
- ***Construction period laydown footprint;***
- ***Internal and access roads indicating width and length of the road;***
- ***Wetlands, drainage lines, rivers, stream and water crossing of roads and cables indicating the type of bridging structures that will be used;***
- ***Sub-station{s) and/or transformer(s) sites including their entire footprint;***

- ***Cable routes and trench dimensions (where they are not along internal roads);***
- ***Connection routes (including pylon positions) to the distribution/transmission network;***
- ***Cut and fill areas at panel sites, along roads and at sub-station/transformer sites indicating the expected volume of each cut and fill;***
- ***Borrow pits;***
- ***Spoil heaps (temporary for topsoil and subsoil and permanently for excess material);***
- ***All existing infrastructure on the site, especially roads;***
- ***Environmental sensitive features and buffer areas.***
- ***Buildings, including accommodation; security house; switch station and***
- ***All "no-go" areas.***
- ***An environmental sensitivity map indicating environmental sensitive areas and features identified during the EIA process.***

The site plans and/or facility illustrations provided in Appendix A does not provide the required information and must be revised for the Department to be able to interpret the infrastructure or structure on site. Please note that a map combining the final layout map superimposed (overlain) on the environmental sensitivity map must be submitted together with the amended EIAr.

A shapefile of the preferred development layout footprint must be submitted to this Department. […]

The proposed layout plan is depicted in the drawing of the Annexure A:
AV1SP_01_r2 Layout plan - PV power plant up to 75 MW

This layout, showing the project components (PV arrays, medium-voltage stations, control building, warehouses, on-site loop-in loop-out substation and new sections of power line, internal roads, access road, security fence) has been superimposed to the high-sensitive environmental features ("no-go areas" as heritage sites, medium-high to high sensitive ecological areas, undevelopable areas from the geo-technical point of view) found on the study area by the specialists during the site visits, as described in the specialist studies and summarised in the EIA Report.

Detailed drawings of project components are also depicted in the following drawings of the Annexure A:

- AV1SP_03_r0 Mounting System – Alternative option 1: fixed mounting systems
- AV1SP_04_r0 Mounting System – Alternative option 2: horizontal single-axis trackers
- AV1SP_05_r0 Medium-voltage stations
- AV1SP_06_r1 Control building and medium-voltage receiving station
- AV1SP_07_r1 High-voltage loop-in loop-out substation
- AV1SP_08_r0 Warehouse

The **PV plant footprint superimposed to the vegetation map and the sensitivity map** has been included to the Annexure A.

As described in the paragraph **4.3.5. *Earthworks*** of this Amended EIA Report:

- due to the flatness of the development area, no earthworks are envisaged for the installation of the PV module mounting systems. Foundations for the mounting systems will consist of mini piles, to be driven until a depth of maximum 1.5 m above the ground level by means of an hydraulic hammer.
- Earthworks will be required during the construction of internal roads. Small earthworks will be required for the installation of the medium-voltage stations. None of these activities should require earthworks in excess of 500 mm cut or fill.

- Only the foundation plate for the small high-voltage substation may require earthworks in excess of 500 mm cut or fill (the footprint will be up to 4000 m^2).The topsoil stripping will result in temporary spoils heaps which must be spread over the site upon completion of the project.
- Underground cables will be laid down along the internal roads.
- Concrete necessary for the basements of the medium-voltage stations, the high-voltage substation, the control building and the warehouses will be manufactured using aggregate and sand from commercial sources in the vicinity of the development (in Upington or Groblershoop).
- Aggregate necessary for the construction of internal roads will be provided from the commercial sources in the vicinity of the development (in Upington or Groblershoop).

The planned location of the temporary construction camp is depicted in **Figure 9** of this Amended EIA Report.

Shapefiles and a kmz file showing on Google Earth the proposed layout, PV plant components and the environmental features of the project site are are submitted to the DEA together to this Amended EIA Report and Annexures.

Cumulative impact assessment

Page 36-37 of the final EIAr indicated other renewable energy projects in the area, which currently are under construction and some are operational. Please describe the cumulative effect of the impacts in terms of other similar or diverse activities as a result of the proposed project activity and how will the cumulative impacts resulting from the proposed facility be managed.

The potential cumulative impacts have been included in the paragraph **9.4.1.** ***Construction & operational phases impacts and mitigation measures*** of the Amended EIA Report.

Proposed development authorisation

In terms of regulation (31) (2) (n), a reasoned opinion as to whether the activity should or should not be authorised must be provided by the EAP, however; the information provided on page 80 of the final EIAr dated June 2014 is insufficient to make an informed decision. The Department needs this information to make an informed decision, therefore the EIAr must be amended to incorporate such information. Please provide reasonable and valid conditions to be incorporated into the EA if this project is to be authorized.

In section **11** ***CONCLUSIONS AND RECOMMENDATIONS*** of this Amended EIA Report, the EAP's opinion as to whether the activity should or should not be authorised has been included.

1. INTRODUCTION

Tita Energy (Pty) Ltd (Reg. No. 2012/016697/07) is proposing the development of a **renewable solar energy facility** (with associated infrastructure and structures) in a key strategic location in terms of the connection to the Eskom grid and in terms of favourable solar irradiation.

The proposed site is **Portion 1 of Farm Avondale 410, Gordonia RD, (//Khara Hais Local Municipality, Zf Mgcawu District Municipality, Northern Cape Province)**, 34 km East of Upington. The Orange River and the national road N14 runs close and adjacent to the southern boundary of this property.

Site location: **Portion 1 of the Farm Avondale 410, Gordonia RD**
Surveyor-general 21 digit site code:

C	**0**	**2**	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**1**	**0**	**0**	**0**	**0**	**1**

The project is called **AVONDALE 1 SOLAR PARK** and it envisages the establishment of a **photovoltaic (PV) power plant having a maximum generation capacity up to 75 MW** on a **footprint (fenced area) of 270 ha**, within a development area (envisaged lease portion) of **340 ha**. The project will be located on the south-eastern side of Portion 1of Farm Avondale 410 (3426 ha in extent), north of / adjacent to the 132 kV power line crossing the project site (**Eskom "Garona-Gordonia" 132 kV power line**). Access to the Avondale 1 Solar Park will be from the N14, which runs parallel to the southern boundary of the property. A new access road within the project site and 650 m long will link the N14 to the development area.

The Avondale 1 Solar Park is participating to the Renewable Energy Independent Power Producer (REIPP) Procurement Programme, issued on 3 August 2011 by the Department of Energy (DoE).

In order to develop the facility, Tita Energy must undertake an Environmental Impact Assessment (EIA) process and acquire environmental authorization from the National Department of Environmental Affairs (DEA), in consultation with the *Northern Cape Department of Environment and Nature Conservation*, in terms of the EIA Regulations (2010) published in terms of Section 24(2) and 24D of the National Environmental Management Act (NEMA, Act No. 107 of 1998).

The project has been registered with the **DEA application reference number 14/12/16/3/3/2/618.**

Avondale 1 Solar Park will deliver the electrical energy to the **Eskom "Garona-Gordonia" 132 kV power line**, running through the project site. The Eskom 132 kV power line will loop in and out of the 132 kV busbar of the new on-site substation, via two new sections of a 132 kV line approximately 100 m long. The application for Environmental Authorization for Avondale 1 Solar Park **includes the connection to the Eskom grid.** Eskom is the entity which assesses the connection solution included and described in this EIA Report. Eskom also coordinated the necessary liaising between Tita Energy, Eskom Transmission, Eskom Distribution and Eskom Land & Rights Department.

All or part of the infrastructure required for the connection (all located inside the site) may be owned and/or operated by Eskom Distribution, this will depend on the Eskom grid code in relation to the IPPs (Independent Power Producers) and on the Connection Agreement to be finalized prior to or simultaneously with the conclusion of the PPA (Power Purchase Agreement) in respect of the options of retaining ownership of the connection works once completed.

The independent Environmental Assessment Practitioners (EAPs) which have been appointed for the undertaking of the detailed environmental studies in compliance with the 2010 EIA Regulations are **AGES Limpopo.**

With the aim of identifying and assessing all potential environmental impacts related to the development as well as suggesting possible mitigation measures and alternatives, AGES will appointed specialist sub-consultants to compile detailed reports (as identified during the scoping process) and to study the activities necessary for the assessment of the specific impacts related to their field of expertise.

AGES and the other specialist consultants are in a position of independency from Tita Energy; therefore they are not subsidiaries or affiliated to the latter. AGES and the specialist consultants have no secondary interest connected with the development of this project or of other projects which may originate from the authorization of the project.

The characteristics, the technology and the extent of the Avondale 1 Solar Park are defined and evaluated in this Amended Final EIA Report and its annexures.

2. MOTIVATION AND RATIONALE OF THE AVONDALE 1 SOLAR PARK IN LIGHT OF THE IPP PROCURMENT PROGRAMME REQUIREMENTS

2.1. THE CHOICE OF THE NORTHERN CAPE PROVINCE AND OF THE SITE LOCATION

Avondale 1 Solar Park will be located in the Northern Cape Province. The Northern Cape Province has been identified by Tita Energy as an ideal macro area for establishing a solar PV plant on the basis of several important considerations:

- solar resource is exceptionally high: the *global horizontal irradiation* of the site is 2,141 kWh/m^2/year;
- there are several green projects currently under development in the Northern Cape, because of the high solar resources and the availability of desolate lands with low ecological and agricultural value;
- The Northern Cape Province, Local Municipalities and communities are eager to continue establishing an eco-green image in consideration of the burden of CO_2 emissions they have to bear.

In the Upington area there are a number of solar (Photovoltaic CSP) projects currently under development and under construction, due to the **exceptionally high solar irradiation (the highest in the world)** and due to the presence of the Orange River, which can supply water for the CSP projects.

Eskom is planning to build **up to 1000 MW of CSP**, to be located on a farm 12 km West of Upington and 47 km West of the proposed Avondale 1 Solar Park. The first 100 MW has already been approved, as well as the **new "Eskom Solar (Upington) transmission substation"** to be built on the same site. This new transmission substation will help the Eskom grid to receive and deliver the energy generated by the new Eskom and IPP solar (CSP and PV) projects.

The following solar projects in the Upington area are currently under construction and/or already selected by the Department of Energy under the REIPP Procurement Programme:

- **8.9 MW Upington PV project**, currently under construction at the Upington airport, **29 km** West of the proposed Avondale 1 Solar Park;
- **100 MW Karoshoek Consortium CSP project**, selected by the DoE under the Window 3 of the REIPPPP and to be located **16 km** South of the proposed Avondale 1 Solar Park;
- **50 MW Bokpoort CSP project**, currently under construction on a site **58 km** East of the proposed Avondale 1 Solar Park;
- **50 MW !Khi Solar One CSP project**, currently under construction on a site **53 km** West of the proposed Avondale 1 Solar Park.

The Upington area is indeed one of the best locations for solar projects (PV and CSP), because of the exceptionally high solar resource and the low environmental impacts. Most of the areas are desolated and the agricultural potential is high only in the proximity of the Orange River. With the construction of the new Eskom Upington transmission substation, which will allow the connection of several solar projects in addition to the existing ones, the Upington area will become one of the biggest renewable energy hubs of the world. The proposed Avondale 1 Solar Park is situated 34 km East of Upington, a Primary Urban Node. In the Spatial Development Framework (SDF) of //Kara Hais Local Municipality it is stated that investment should be focused on these areas to expand Upington into a more diverse economic centre. The following vision was set for the manufacturing sector: "*Develop manufacturing and industry into a viable sector which builds on the comparative economic advantages of //Khara Hais, and operates in accordance with the highest standards for environmental management*". The objective for the vision is to explore alternative and emerging technologies to improve quality and quantity within the manufacturing and industrial sector. The strategy set out by the SDF is to research alternative / sustainable manufacturing options and emerging technologies, such as a Solar Power Plant. This puts the Avondale 1 Solar Park in line with the development objectives of the //Kara Hais Spatial Development Framework.

In addition to the very favourable characteristics in terms of desirability of renewable solar energy projects in the Upington area, the Avondale 1 Solar Park site has been chosen by Tita Energy on the grounds of several considerations, in particular:

- the availability of an easy connection solution, due to the presence of Eskom132 kV power line, called "Garona - Gordonia" which crosses the southern side of the project site;
- the flatness (topography) of the proposed project site;
- the low ecological sensitivity and agricultural value of the proposed development area.

In the light of the IPP procurement Programme requirements, **Avondale 1 Solar Park** has been developed according to the following main characteristics:

- the installed capacity is within the “eligible capacity” defined by the rules of the RFP (from 1 MW to 75 MW);
- the construction phase will last approximately 15 months and the PV plant will be able to beginning commercial operation before the end of 2020, in compliance with the timetable of the revised RFP.

With specific reference to Avondale 1 Solar Park, Eskom has indicated that the project does not interfere with Eskom’s present and future developments and does not affect negatively the voltage in the area. Eskom, as an interested and affected party, recognized the positive outcome of the project in terms of the possibility of meeting the local growth of the energy consumption that is expected.

2.2. NEED AND DESIRABILITY OF THE PROPOSED PROJECT

South Africa currently relies principally on fossil fuels (coal and oil) for the generation of electricity. At the present date, Eskom generates approximately 95% of the electricity used in South Africa. On the other hand, South Africa has a largely unexploited potential in renewable energy resources such as solar, wind, biomass and hydro-electricity to produce electricity as opposed to other energy types (fuel or coal).

South Africa’s electricity supply still heavily relies upon coal power plants, whereas the current number of renewable energy power plants is very limited. In the last few years, the demand for electricity in South Africa has been growing at a rate approximately 3% per annum. These factors, if coupled with the rapid advancement in community development, have determined the growing consciousness of the significance of environmental impacts, climate change and the need for sustainable development. The use of renewable energy technologies is a sustainable way in which to meet future energy requirements.

The development of clean, green and renewable energy has been qualified as a priority by the Government of South Africa with a target goal for 2013 of 10,000 GWh, as planned in the Integrated Resource Plan 1 (IRP1) and with the Kyoto Protocol.Subsequently the Department of Energy of South Africa (DoE) decided to undertake a detailed process to determine South Africa’s 20-year electricity plan, called Integrated Resources Plan 2010-2030 (**IRP 2010**).

The IRP1 (2009) and the IRP 2010 (2011) outline the Government’s vision, policy and strategy in matter of the use of energy resources and the current status of energy policies in South Africa. In particular, the IRP 2010 highlights the necessity of commissioning 1200 MW with solar PV technology by the end of 2015.

In order to achieve this goal, the DoE recently announced a renewable energy IPP (Independent Power Producers) Procurement Programme.

The IPP Procurement Programme, issued on 3rd August 2011, envisages the commissioning of 3725 MW of renewable projects (1450 MW with solar photovoltaic technology) capable of beginning commercial operation before the end of 2020.

Therefore, the development of photovoltaic power plants will represent a key feature in the fulfilment of the proposed target goal and the reduction of CO_2 emissions.

The purpose of the Avondale 1 Solar Park is to add new capacity for the generation of renewable electric energy to the national electricity supply in compliance with the IPP Procurement Programme and in order to meet the "sustainable growth" of the Northern Cape Province.

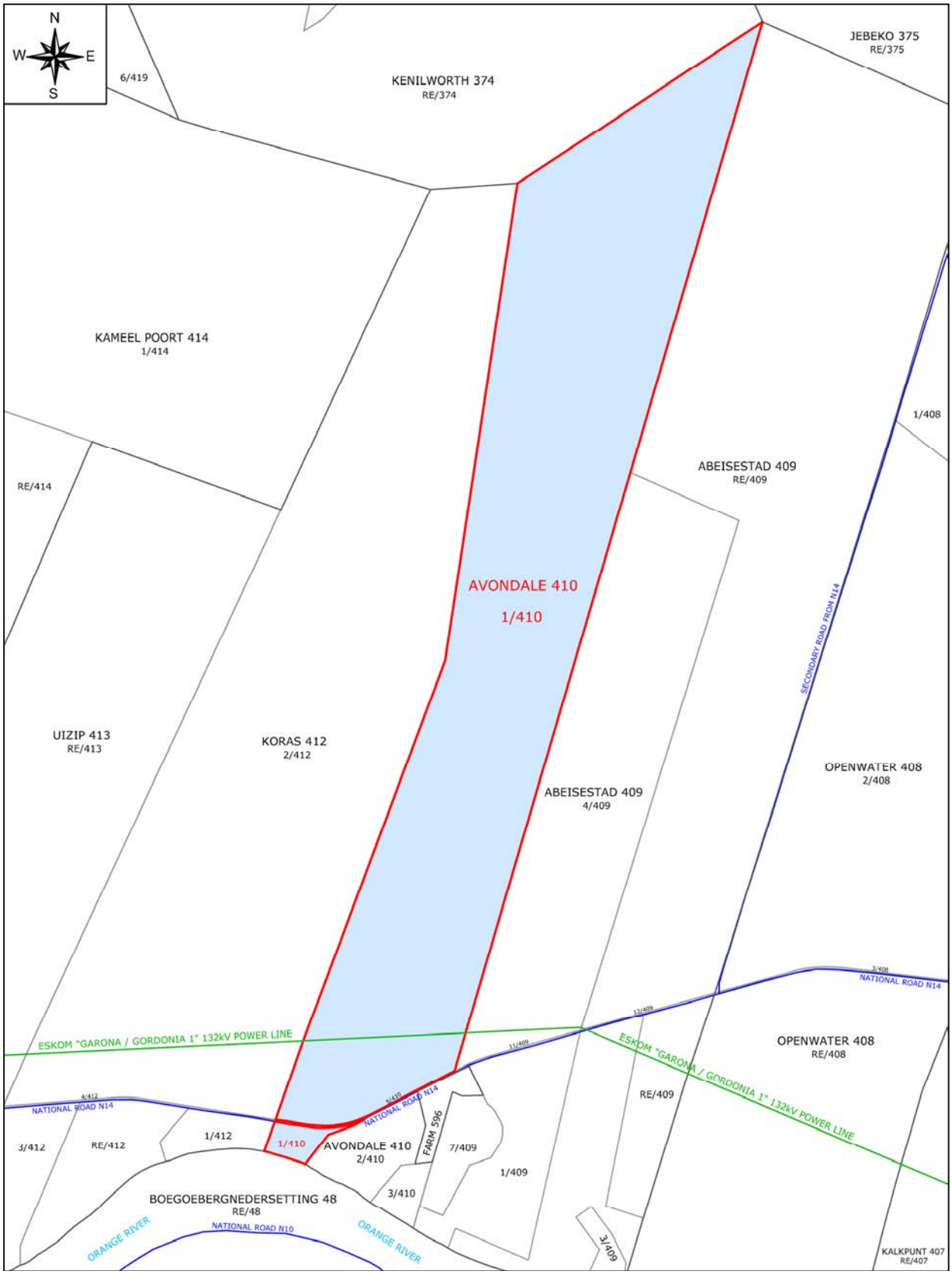
The use of solar radiation for power generation is considered a non-consumptive use and a renewable natural resource which does not produce greenhouse gas emissions. The generation of renewable energy will contribute to the growth of South Africa's electricity market, which has been primarily dominated up to this date by coal-based power generation. With specific reference to photovoltaic energy, and the proposed project, it is important to consider that South Africa has one of the highest levels of solar radiation in the world.

The reasons for the location of the project in the selected area can be synthesized as follows:

- low requirement for municipal services;
- compliance with national and provincial energy policies and strategies;
- no impact on people health and wellbeing;
- no waste and noise;
- no impact on air quality;
- compatibility with the ecosystem and the surrounding landscape;
- likelihood of social and economic development of marginalized, rural communities; and
- attraction of environmentally aware (green) tourists to the area.

Please find depicted in Figure 1 below a the locality of the proposed Avondale 1 Solar Park.

Figure 1: Locality map of the project site



3. AUTHORITIES, LEGAL CONTEXT AND ADMINISTRATIVE REQUIREMENTS

The legislative and regulatory framework of reference for the solar power plant project includes statutory and non-statutory instruments by which National, Provincial and Local authorities exercise control throughout the development of the same project.

The development and the environmental assessment process of a solar power plant project involve various authorities dealing with the different issues related to the project (economic, social, cultural, biophysical etc.).

3.1. REGULATORY AUTHORITIES

3.1.1. National Authorities

At national level, the main regulatory authorities and agencies are:

- *Department of Energy (DoE):* the Department is competent and responsible for all policies related to energy, including renewable energy. Solar energy is contemplated and disciplined under the White Paper for Renewable Energy and the Department constantly conducts research activities in this respect;
- *Department of Environmental Affairs (DEA):* the Department is competent and responsible for all environmental policies and is the controlling authority under the terms of NEMA and EIA Regulations. The DEA is also the competent authority for the proposed project, and is entrusted with granting the relevant environmental authorisation;
- *National Energy Regulator of South Africa (NERSA):* the Regulator is competent and responsible for regulating all aspects dealing with the electricity sector and, in particular, issues the licence for independent power producers;
- *South African Heritage Resources Agency (SAHRA):* the Agency is responsible for the protection and the survey, in association with provincial authorities of listed or proclaimed sites, such as urban conservation areas, nature reserves and proclaimed scenic routes under the terms of the National Heritages Resources Act (Act no. 25 of 1999);
- *South African National Roads Agency Limited (SANRAL):* the Agency is responsible for all National road routes.

3.1.2. Provincial Authorities

At provincial level, the main regulatory authority is the *Northern Cape Department of Environment and Nature Conservation;* this Department is responsible for environmental policies and is the Provincial authority in terms of NEMA and the EIA Regulations. The Department is also the commenting authority for the proposed project.
The project should comply with the *Northern Cape Nature Conservation Act* (Act No. 9 of 2009).

3.1.3. Local Authorities

At a local level, the local and municipal authorities are the principal regulatory authorities responsible for planning, land use and the environment. In the Northern Cape Province, Municipalities and District Municipalities are involved in various aspects of planning and the environment related to solar energy facilities development. The Local Municipality is *//Khara Hais,* which is part of the *ZF Mgcawu District Municipality*.

Under the terms of the Municipal System Act (Act no. 32 of 2000), all municipalities are deemed to go through an Integrated Development Planning (IDP) process in order to devise a five-year strategic development plan for the area of reference. The identification of priority areas for conservation and their positioning within a planning framework of core, buffer, and transition areas is the subject of bioregional planning. Priority areas are individuated and defined with reference to visual and scenic resources and their identification and protection is granted through visual guidelines drafted for the area included in bioregional plans.

The proposed Avondale 1 Solar Park is situated within the //Kara Hais Local Municipality.
Upington is the largest urban centre within the //Kara Hais Municipality. In addition to the large population influx, experienced due to increased renewable energy activities, the //Kara Hais Municipality administrative seat is also found in the town which is still expanding. It is expected to persist in its growth, as the renewable energy opportunities continue to expand and intensify. For this reason Upington is viewed as the Primary Urban Node within the //Kara Hais Municipality.

Upington is linked to Olifantshoek and Keimoes via the N14. The N14 not only links these smaller nodes within the Municipality, but it also serves as an important linkage between //Kara Hais and adjacent municipalities. The N14, passing through the //Kara Hais Municipality, can therefore be described as the Primary Transport Corridor within the area's spatial context.

The proposed Avondale 1 Solar Park is situated close to Upington, the Primary Urban Node. In the **Spatial Development Framework (SDF)** of //Kara Hais Local Municipality it is stated that investment should be focused on these areas to expand Upington into a more diverse economic centre. The following vision was set for the manufacturing sector: "*Develop manufacturing and industry into a viable sector which builds on the comparative economic advantages of //Khara Hais, and operates in accordance with the highest standards for environmental management*". The objective for the vision is to explore alternative and emerging technologies to improve quality and quantity within the manufacturing and industrial sector. The strategy set out by the SDF is to research alternative / sustainable manufacturing options and emerging technologies, such as a Solar Power Plant. This puts the Avondale 1 Solar Park in line with the development objectives of the //Kara Hais Spatial Development Framework.

The proposed Avondale 1 Solar Park is situated on agricultural land adjacent to the N14 that links Olifantshoek to Upington, facilitating intra-municipal movement of goods and services. Apart from the road link, Upington is also well connected with regard to railway infrastructure.

The SDF of the //Kara Hais Local Municipality does not address renewable energy projects on farmland outside the urban edge specifically. The location of the proposed Avondale 1 Solar Park will however harmonise very well with the location of other intra-municipal links addressed in the SDF of the Municipality all related to infrastructure services. These include the road link of the N14, and also the Eskom "Garona - Gordonia 1" 132 kV power line running through the Avondale 1 Solar Park site. The development of the proposed Avondale 1 Solar Park will add a further infrastructure component to the area i.e. that of energy generation by means of a photovoltaic power plant.

Provision is made in the SDF for other developments on agricultural land. The SDF states that for the //Khara Hais Municipality to consider non-agricultural development on Agricultural land, applicants have to provide assurance that such the development would not fragment high potential agricultural land and that it would significantly support the over-arching objective of environmental sustainability. The proposed development must, therefore, imply a direct, or indirect, positive impact on, for example, regional tourism, agriculture, environmental conservation and the interests of previously disadvantaged people. With the development of the proposed Avondale 1 Solar Park, being an environmentally sustainable land use to be located in a low-potential agricultural land (please refer to the Agricultural Impact Assessment - Annexure F), Tita Energy will comply with all these requirements. Provision is furthermore made in the SDF for rezoning of agricultural land to obtain the necessary land use rights to permit the development of non-agricultural uses on agricultural land. Tita Energy will take all the necessary steps to obtain approval from the Municipality for the required rezoning or change of land use rights in order to comply with the local town planning guidelines.

The proposed Avondale 1 Solar Park will comply with the general spatial development goals of the SDF and will adhere to the Land Use Management guidelines of the Municipality.

Local authorities also provide specific by-laws and policies in order to protect visual and aesthetic resources with reference to urban edge lines, scenic drives, special areas, signage, communication masts etc.

Finally, there are also various non-statutory bodies and environmental groups, who are involved in the definition of various aspects of planning and the protection of the environment, which may influence in the development of the proposed project.

3.2. LEGISLATION, REGULATIONS AND GUIDELINES

A review of the relevant legislation involved in the proposed development is detailed in table 1 below.

Table 1: Review of relevant legislation

National Legislation	Sections applicable to the proposed project
Constitution of the Republic of South Africa (Act no. 108 of 1996)	• Bill of Rights (S2) • Rights to freedom of movement and residence (S22) • Environmental Rights (S24) • Property Rights (S25) • Access to information (S32) • Right to just administrative action (S33)
Fencing Act (Act no. 31 of 1963)	• Notice in respect of erection of a boundary fence (S7) • Clearing bush for boundary fencing (S17) • Access to land for purpose of boundary fencing (S18)
Conservation of Agricultural Resources Act (Act no. 43 of 1983)	• Prohibition of the spreading of weeds (S5) • Classification of categories of weeds & invader plants and restrictions in terms of where these species may occur (Regulation 15 of GN R0148) • Requirement and methods to implement control measures for alien and invasive plant species (Regulation 15E of GN R0148)
Environment Conservation Act (Act no. 73 of 1989)	• National Noise Control Regulations (GN R154 dated 10 January 1992)
National Water Act (Act no. 36 of 1998)	• Entrustment of the National Government to the protection of water resources (S3) • Entitlement to use water (S4) - Schedule 1 provides the purposes which entitle a person to use water (reasonable domestic use, domestic gardening, animal watering, fire fighting and recreational use) • Duty of Care to prevent and remedy the effects of water pollution (S19) • Procedures to be followed in the event of an emergency incident which may impact on water resources (S20) • Definition of water use (S21) • Requirements for registration of water use (S26 and S34) • Definition of offences in terms of the Act (S151)
National Forest Act (Act no. 84 of 1998)	• Protected trees
National Environmental Management Act (Act no. 107 of 1998)	• Definition of National environmental principles (S2): strategic environmental management goals and objectives of the government applicable within the entire Republic of South Africa to the actions of all organs of state, which may significantly affect the environment

	• NEMA EIA Regulations (GN R543, 544, 545, 546, & 547 of 18 June 2010) • Requirement for potential impact on the environment of listed activities to be considered, investigated, assessed and reported on to the competent authority (S24 - Environmental Authorisations) • Duty of Care (S28): requirement that all reasonable measures are taken in order to prevent pollution or degradation from occurring, continuing and recurring, or, where this is not possible, to minimise and rectify pollution or degradation of the environment • Procedures to be followed in the event of an emergency incident which may impact on the environment (S30)
National Heritage Resources Act (Act no. 25 of 1999)	• SAHRA, in consultation with the Minister and the Member of the Executive Council of every province must establish a system of grading places and objects which form part of the national estate (S7) • Provision for the protection of all archaeological objects, paleontological sites and material and meteorites entrusted to the provincial heritage resources authority (S35) • Provision for the conservation and care of cemeteries and graves by SAHRA, where this is not responsibility of any other authority (S36) • List of activities which require notification from the developer to the responsible heritage resources authority, with details regarding location, nature, extent of the proposed development (S38) • Requirement for the compilation of a Conservation Management Plan as well as a permit from SAHRA for the presentation of archaeological sites for promotion of tourism (S44)
National Environmental Management: Biodiversity Act (Act no. 10 of 2004)	• Provision for the Member of the Executive Council for Environmental Affairs/Minister to publish a list of threatened ecosystems and in need of protection (S52) • Provision for the Member of the Executive Council for Environmental Affairs/Minister to identify any process or activity which may threaten a listed ecosystem (S53) Provision for the Member of the Executive Council for Environmental Affairs/Minister to publish a list of: critical endangered species, endangered species, vulnerable species and protected species (S56(1) - see Government Gazette 29657 • Three government notices have been published up to the present date: GN R150 (Commencement of Threatened and Protected Species Regulations, 2007), GN R151 (Lists of critically endangered, vulnerable and protected species) and GN R152 (Threatened Protected Species Regulations)
National Environmental Management: Air Quality Act (Act no. 39 of 2004)	• Provision for measures in respect of dust control (S32) • Provision for measures to control noise (S34)
National Environmental Management: Waste Management Act (Act no. 59 of 2008)	• Waste management measures • Regulations and schedules • Listed activities which require a waste licence
Northern Cape Nature Conservation Act (Act No. 9 of 2009)	• Indigenous flora protected under this act • No hunting to take place without a permit

Occupational Health and Safety Act (Act No. 85 of 1993)	• Health and safety of all involved before and after construction must be protected.

Guideline Documents	**Sections applicable to the proposed project**
South African National Standard (SANS) 10328, Methods for environmental noise impact assessments in terms of NEMA no. 107 of 1998	• Impact of noise emanating from a proposed development may have on occupants of surrounding land by determining the rating level • Noise limits are based on the acceptable rating levels of ambient noise contained in SANS 10103
Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads	• The Guidelines outline rules and conditions related to transport of abnormal loads and vehicles on public roads and detailed procedures to be followed for the grant of exemption permits

Policies and White Papers	**Sections applicable to the proposed project**
The White Paper on the Energy Policy of the Republic of South Africa (December 1998)	• The White Paper supports investment in renewable energy initiatives, such as the proposed solar power plant project
The White Paper on Renewable Energy (November 2003)	• The White Paper outlines the Government's vision, policy, principles, strategic goals and objectives for the promotion and the implementation of renewable energy in South Africa
Integrated Resource Plan (IRP1) Integrated Resources Plan 2010-2030 (IRP 2010).	• The first Integrated Resource Plan (IRP1) was released in late 2009. Subsequently the DoE decided to undertake a detailed process to determine South Africa's 20-year electricity plan, called Integrated Resources Plan 2010-2030 (IRP 2010). • The IRP1 and the IRP 2010 outline the Government's vision, policy and strategy in matter of the use of energy resources and the current status of energy policies in South Africa. • **In particular, the IRP 2010 highlights the necessity of commissioning 1200 MW with solar PV technology by the end of 2015.**
Request For Qualification and Proposals For New Generation Capacity under the IPP Procurement Programme(3 August 2011)	• The IPP Procurement Programme, issued on 3rd August 2011 by the DoE, envisages the commissioning of **3725 MW** of renewable projects (**1450 MW with Solar photovoltaic technology**) **capable of beginning commercial operation before the end of 2020**.
Equator Principles (July 2006)	• The Equator Principles provide that future developments with total project capital costs of US$10 million or more shall be financed only if socially and environmentally sustainable

3.3. LISTED ACTIVITIES IN TERMS OF NEMA

The "listed activities" in terms of sections 24 and 24D of NEMA involved (or *potentially* involved) in the proposed development are detailed in table 2 below.

Table 2: Listed Activities in terms of sections 24 and 24D of NEMA potentially involved in the proposed development

Relevant notice	Activity No.	Description
R.545, 18 June 2010	**1**	***The construction of facilities or infrastructure for the generation of electricity where the electricity output is 20 megawatts or more*** The proposed Avondale 1 Solar Park will be established on Portion 1 of the Farm Avondale 410, Gordonia RD, measuring 3426 ha and located in the //Khara Hais Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. The project will consist of construction, operation and maintenance of a Photovoltaic (PV) Power Plant with a generation capacity exceeding 20 MW (up to 75 MW).
R.545, 18 June 2010	**15**	***Physical alteration of undeveloped, vacant or derelict land for industrial use where the total area to be transformed is 20 hectares or more*** The Photovoltaic Power Plant with associated infrastructure and structures will be constructed and operated on a footprint up to 270 ha on a farm portion measuring 3426 ha. The project will be established on undeveloped land and the proposed activity is regarded as "industrial".
R.544, 18 June 2010	**10**	***The construction of facilities or infrastructure for the transmission and distribution of electricity:*** ***(i) Outside urban areas or industrial complexes with a capacity of more than 33 kilovolts but less than 275 kilovolts.*** The project will be established outside urban areas. The connection to the Eskom grid will be done according to the Eskom connection solution, which requires: (i) one small on-site high voltage loop-in loop-out substation with one or more high-voltage power transformer(s) stepping up the voltage to the voltage of the Eskom grid (132 kV), a 132 kV busbar with protection an metering devices ("switching station") and a control building; (ii) two new small sections of 132 kV power line allowing the Eskom "Garona - Gordonia" 132 kV power line - crossing the project site - to loop in and out of the 132 kV busbar of the new on-site loop-in loop-out substation. The connection may also entail interventions on the Eskom grid according to Eskom's connection requirements/solution.

R.544, 18 June 2010	**22**	***The construction of a road, outside urban areas,*** ***(i) with a reserve wider than 13,5 metres*** The new access road from N14 will be 8.0 m wide. During the construction phase, the road reserve may be wider than 13.5 meters in order to allow the transportation of abnormal loads (e.g. the high-voltage step-up transformers of the new on-site high-voltage substation). Internal roads will be maximum 8 m wide with a road reserve maximum 12.0 m wide. At the turning points / intersection points the road reserve may be wider than 13.5 m due to the shape of the intersection / turning points.
R.546, 18 June 2010	**14**	***The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation,*** ***a) In Northern Cape*** ***(i) all areas outside urban areas.*** The Photovoltaic Power Plant with associated infrastructure and structures will be constructed and operated on a footprint of 270 hectares which will be cleared from indigenous vegetation.

The footprint of the proposed development will be located on the south-eastern side of the property, OUTSIDE any drainage / pan or undevelopable areas indicated in the Ecological Impact Assessment and Geo-technical and geo-hydrological Study.

The proposed access road from N14 has been moved OUTSIDE the disturbed quarry / artificial drainage located close the south-eastern corner of the proposed footprint.

A salt pan occurs close to the western boundary of the proposed footprint, at a minimum distance of 45 m from the proposed footprint.

No material will be taken from the salt pan or from the artificial drainage and also, no material will be incorporated into the salt pan and the drainage, therefore the structure and characteristics of the salt pan and drainage will not be changed and or altered. No infilling or depositing of any material or the dredging, excavation, removal or moving of soil will take place in the salt pan and in the artificial drainage considering that the construction activities will be restricted to the proposed PV plant fenced area / footprint. Therefore, **activities 11 and 18 of GN R544 are NOT APPLICABLE**.

The current EIA procedure of the Avondale 1 Solar Park **includes the connection to the Eskom grid.** Furthermore, a part of the connection infrastructure (the 132 kV busbar of the on-site substation and the two new sections of 132 kV power line) may be executed, owned and operated by Eskom.

Final Layout and site plans drafted by Tita Energy (enclosed as Annexure A) have been finalised following the inputs received via public participation. All information acquired were analysed in order to determine the proposed final development layout and site plan. Such approach ensures a holistic view of future requirements of the site and that resources are utilised to their full availability in terms of social and environmental sustainability. It must also be pointed out that this application and all other development applications, in the area, are considered together in order to ensure general sustainability in the Local and District Municipal areas.

4. PROJECT DESCRIPTION AND FUNCTIONING

Tita Energy is proposing the establishment of a **solar power plant with a maximum generation capacity at the delivery point of up to 75 MW.**

The construction timeframe is estimated to be approximately 15 months, whereas the commissioning date will depend on the REIPP Procurement Programme timeframe.

The preferred technical solutions envisage:

- **thin-film PV modules or mono/polycrystalline PV modules,**
- **fixed mounting systems** or **horizontal 1-axis trackers.**

The estimated annual energy production is calculated in approximately:

- **1,950 kWh/kWp/year** (load factor = 0.223), in the case of PV modules mounted on fixed mounting systems; or
- **2,200 kWh/kWp/year** (load factor = 0.251) in the case of PV modules mounted on trackers.

Therefore, the Avondale 1 Solar Park will generate:

- **160.1 GWh per year** in the case of PV modules mounted on fixed mounting systems; or
- **190.1 GWh per year** in the case of PV modules mounted on trackers

The calculation is made by the professional tool "PVSYST" and the simulation is done for 1 MWp (1 "PV field").
The site data (irradiation, temperature, etc.) charged on the database consists of hourly meteo-data registered by NASA satellites (NASA-SSE satellite data 1983-1993, release 6) and the simulation is made for the timeframe of 1 year.
The output (1,950 kWh/kWp/year and 2,200 kWh/kWp/year) is also called “full net equivalent hours”, which represent the average energy injected into the grid per 1 kWp of installed capacity.
The *Global Horizontal Irradiation* of the site is 2,141 kWh/m^2/year (NASA-SSE satellite data, 1983-1993, release 6).

The energy generated by the Avondale 1 Solar Park will reduce the quantity of pollutants and greenhouse gases emitted into the atmosphere. The reduced amount of CO_2 will be the emissions that would have been generated by a thermal power plant using fossil fuels for producing the same quantity of energy that it is produced by the Avondale 1 Solar Park.

The quantity of the avoided CO_2 is calculated as follows: the energy produced by the Avondale 1 Solar Park (up to 160.1 GWh/y or 190.1GWh/y) is multiplied by the Eskom’s average emission factor which is 1.015 t CO_2/MWh (*source*: Energy Research Centre, University of Cape Town. (2009 *Carbon accounting for South Africa*).
This means that, in the case of the Avondale 1 Solar Park, the **avoided CO_2 emissions** are approximately **192,931 tons of CO_2 per year** in the case of PV modules mounted on fixed mounting systems, or **162,564 tons of CO_2 per year** in the case of PV modules mounted on trackers.

Considering that 1 kg of coal generates approximately 3.7 kWh (supposing a caloric value of 8000 kcal/kg and a coal plant efficiency of 40%), **the coal saved by the Avondale 1 Solar Park will be approximately 51,373 tons of coal / year** in the case of PV modules mounted on fixed mounting systems, or **43,287 tons of coal / year** in the case of PV modules mounted on trackers.

A detailed description of the characteristic and functioning of the PV plant and its connection is given in the following paragraphs.

4.1. PROJECT LAYOUT

The layout of the proposed development is the result of a comparative study of various layout alternatives and had been defined in consideration of the results of the specialists studies conducted during the scoping phase and annexed to this EIA Report.

The PV plant is designed and conceived in order to minimize visual and noise impacts, as well as to operate safely and assuring a high level of reliability, with low water consumption and the need only for easy and quick maintenance and repair for approximately 25-30 years.

The footprint (fenced area) of the Avondale Solar Park will be of up to 270 ha, within a development area (envisaged lease portion) of 340 ha.

The main drivers of the proposed layout are:

- to maximize the energy production and the reliability of the PV plant, by choosing proven solar technologies: thin-film or mono/polycrystalline solar modules mounted on horizontal 1-axis trackers or on fixed mounting systems;
- **to develop the PV power plant on the south-eastern side of Portion 1 of the Farm Avondale 410** (3426 ha), which is flat and has a *low to medium* ecological sensitivity, while the northern and western sides are undevelopable due to the presence of sand dunes and medium to high sensitive vegetation areas;
- to develop the PV power plant only in the vegetation units: ***dwarf karoid shrubland*** (Medium-low sensitivity) and ***Acacia mellifera – Stipagrostis obtuse interdune veld on deep Aeolian sand*** (Medium sensitivity);
- **to avoid the heritage sites found on the property, providing a minimum buffer of 30 m**;
- a 100 m vegetation buffer zone - composed by the existing vegetation - will be kept between the western boundary of the proposed footprint and the eastern boundary of the farm portion, in order to minimise the visual impact of the proposed development.

The proposed layout plan (attached as Annexure A and also shown in Figure 3) was drawn using PV modules mounted on trackers; in the case of PV modules mounted on fixed mounting systems, the layout plan does not change, except for the orientation of the PV arrays: east-west instead of north-south.

The required **footprint** - corresponding on the fenced area - **will not exceed 270 ha**, and the maximum height of the structures (PV modules and support frames) will be approximately 3.1 m above the ground level. Therefore the impacts and mitigation measures will remain exactly the same.

The project layout and the other plant components are detailed in the following drawings:

- AV1SP_00_r3 Locality Map and Development Area
- AV1SP_01_r2 Layout plan - PV power plant up to 75 MW
- AV1SP_03_r0 Mounting System – Alternative option 1: fixed mounting systems
- AV1SP_04_r0 Mounting System – Alternative option 2: horizontal single-axis trackers
- AV1SP_05_r0 Medium-voltage stations
- AV1SP_06_r1 Control building and medium-voltage receiving station
- AV1SP_07_r1 High-voltage loop-in loop-out substation
- AV1SP_08_r0 Warehouse

Figure 2: Development Area and proposed footprint

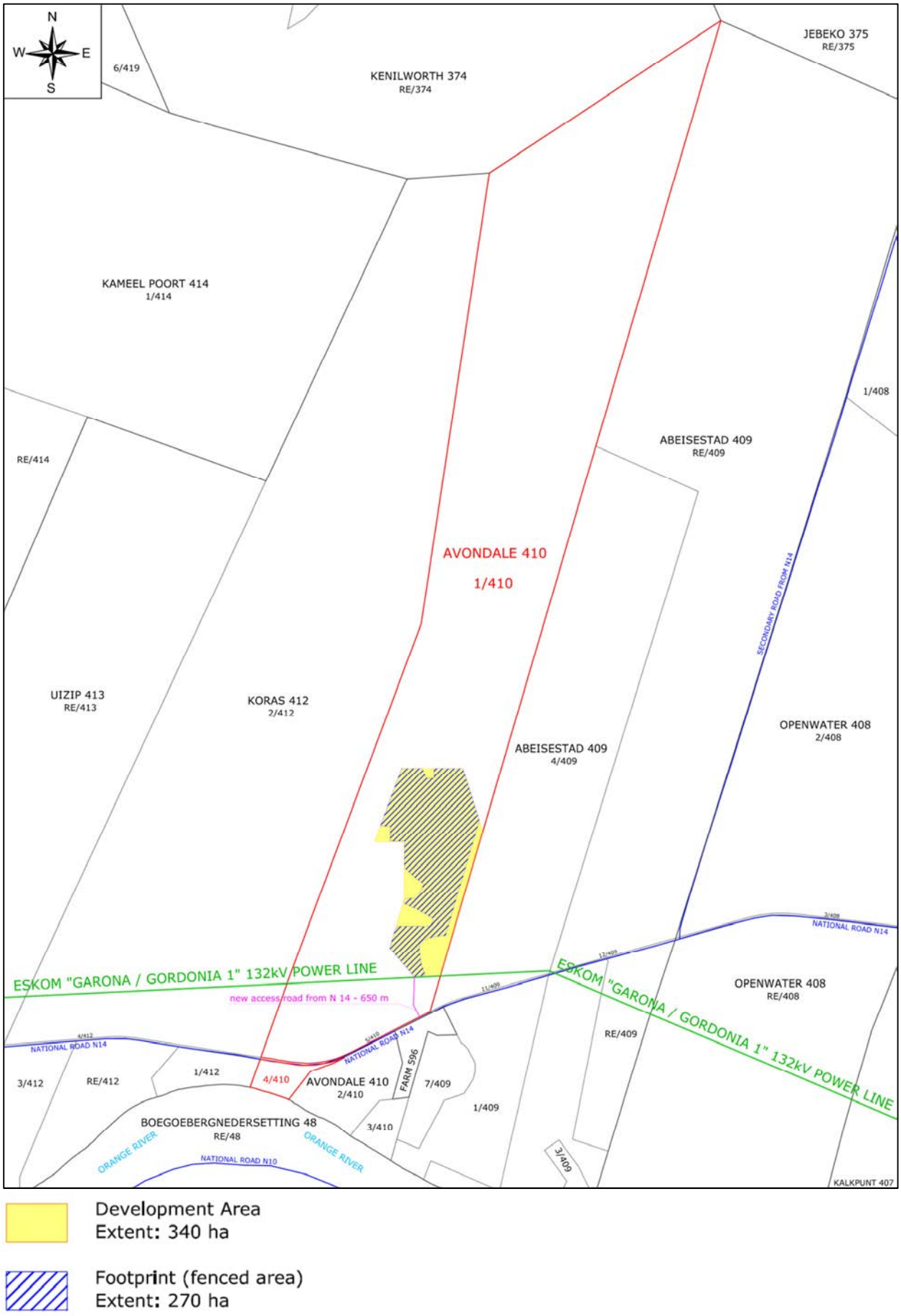


Figure 3: Proposed Layout plan of the Avondale 1 Solar Park (continued)

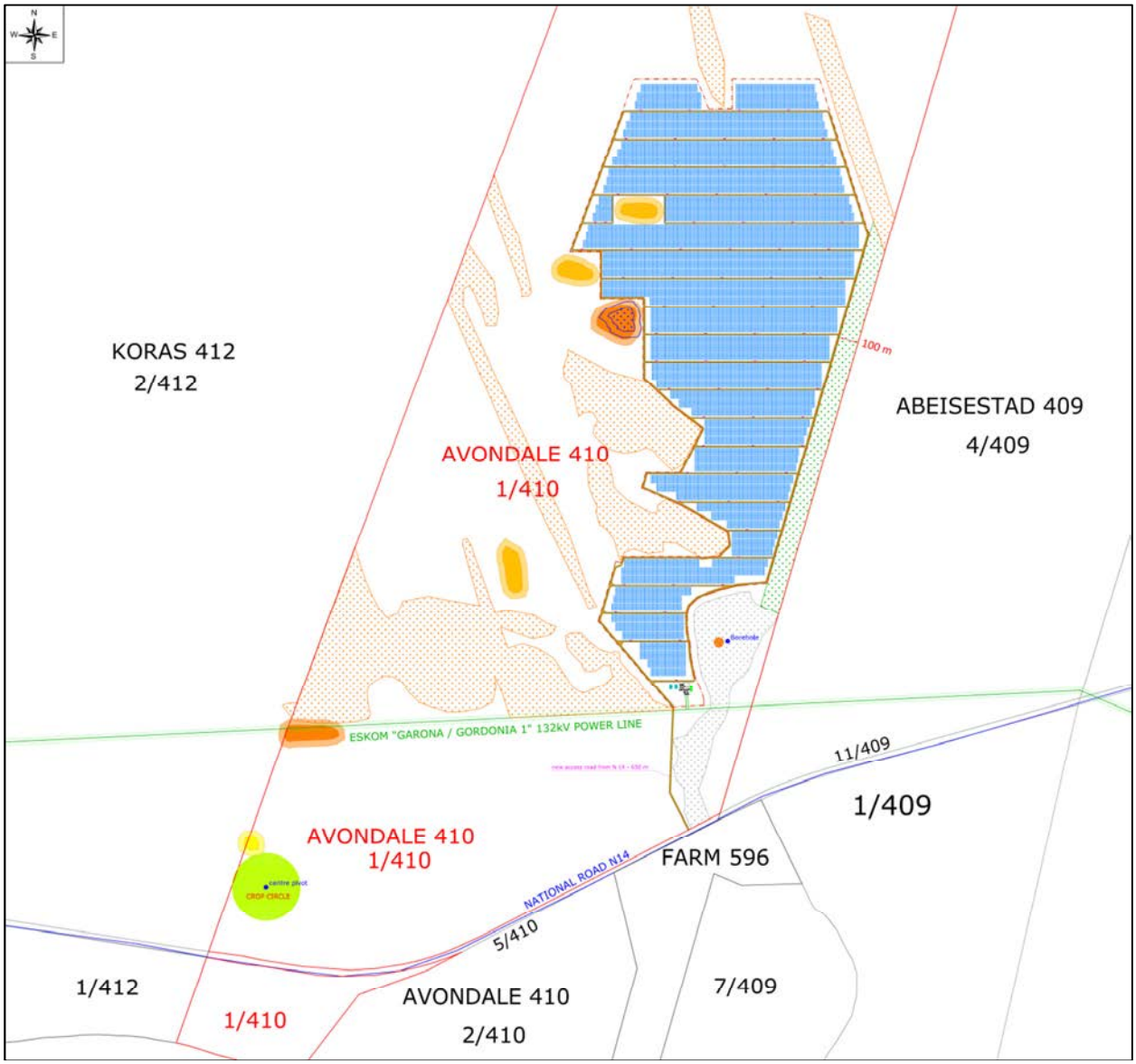
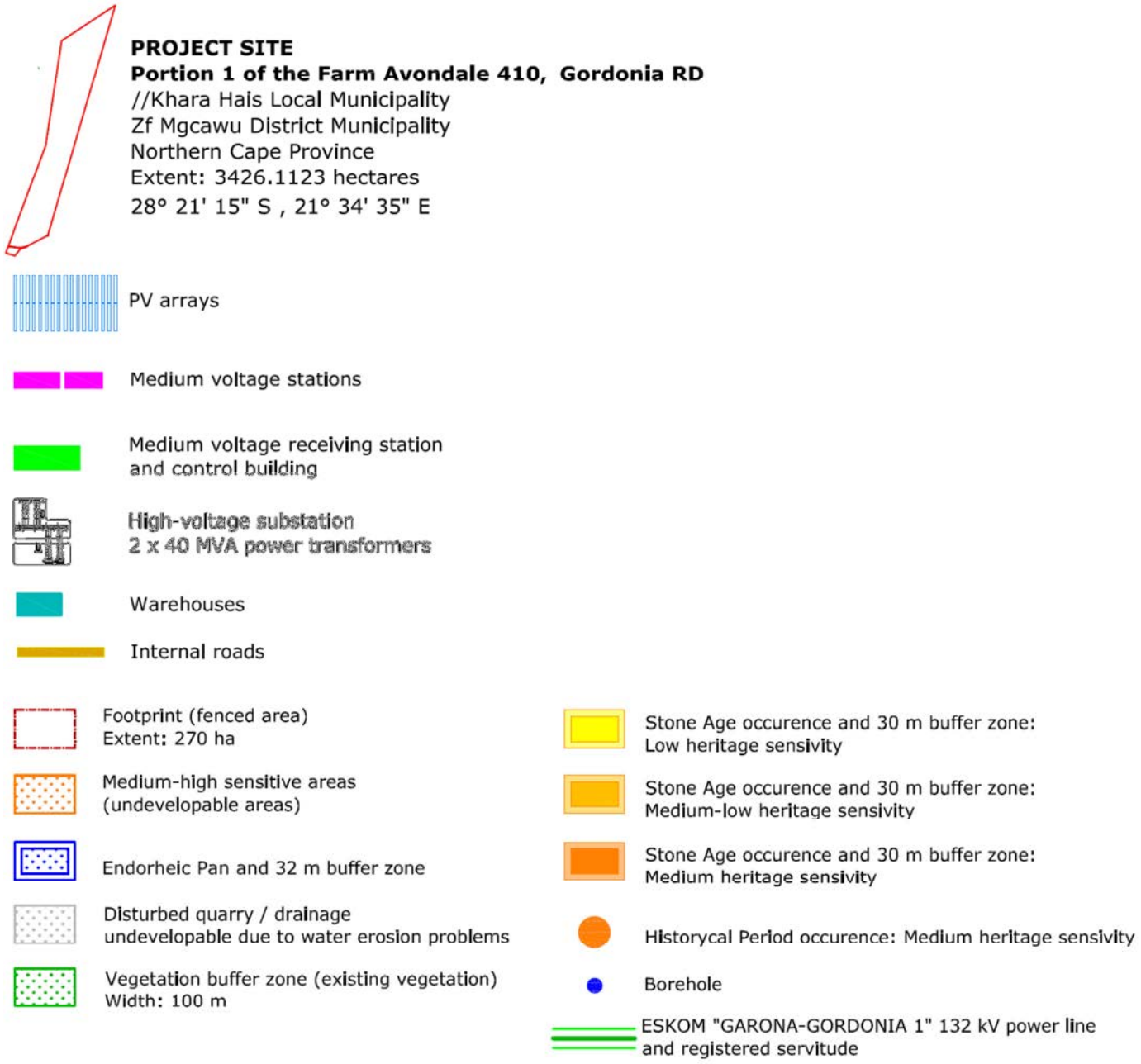


Figure 3 Proposed Layout plan of the Avondale 1 Solar Park: Legend



4.2. PRIMARY COMPONENTS

The Photovoltaic (PV) Power Plant together with its connection infrastructures and structures will require the installation of the following equipment:

- Photovoltaic modules (mono-crystalline, polycrystalline or thin-film solar modules)
- Mounting systems (fixed or single-axis horizontal trackers) for the PV arrays and related foundations
- Internal cabling and string boxes
- Medium voltage stations, hosting DC/AC inverters and LV/MV power transformers
- Medium voltage receiving station(s)
- Workshop & warehouses
- One small **on-site high-voltage loop-in loop-out substation** with high-voltage power transformers, stepping up the voltage to the voltage of the Eskom's grid, and one high-voltage busbar with metering and protection devices (also called "**switching station**")
- **Two new small sections of 132 kV line** allowing the **Eskom "Garona - Gordonia" 132 kV power line** - crossing the project site - to loop in and out of the 132 kV busbar of the new on-site switching station
- Electrical system and UPS (Uninterruptible Power Supply) devices
- Lighting system
- Grounding system
- Access road and internal roads
- Fencing of the site and alarm and video-surveillance system
- Water access point and water extraction on-site borehole(s) point, water supply pipelines, water treatment facilities
- sewage system (*Ballam Waterslot* or *Lilliput* system).

The connection may also entail interventions on the Eskom grid according to Eskom's connection requirements/solution.

During the construction phase, the site may be provided with additional:

- water access point and water extraction on-site borehole(s) point, water supply pipelines, water treatment facilities;
- pre-fabricated buildings;

to be removed at the end of construction.

Table 3: Project components

Component	Description/ Dimensions
Project site/ property	**Portion 1 of the Farm Avondale No. 410, Gordonia RD** //Khara Hais Local Municipality Zf Mgcawu District Municipality Northern Cape Province LPI code: C02800000000041000001 Latitude 28° 21.15' S Longitude 21°34.35' E
PV plant footprint	**PV plant footprint: up to 270 ha on the south eastern side of the property** Geo-graphical coordinates of the footprint / security fence: FP01 28° 20' 27.2" S, 21° 34' 35.7" E FP02 28° 20' 27.7" S, 21° 34' 52.0" E FP03 28° 20' 53.9" S, 21° 35' 00.5" E FP04 28° 21' 50.9" S, 21° 34' 39.5" E FP05 28° 21' 51.1" S, 21° 34' 39.1" E FP06 28° 21' 51.3" S, 21° 34' 33.8" E

	FP07 28° 21' 51.7" S, 21° 34' 32.1" E FP08 28° 21' 53.1" S, 21° 34' 26.5" E FP09 28° 21' 54.5" S, 21° 34' 24.8" E FP10 28° 21' 55.9" S, 21° 34' 24.4" E FP11 28° 21' 58.6" S, 21° 34' 24.4" E FP12 28° 22' 00.7" S, 21° 34' 24.8" E FP13 28° 22' 03.0" S, 21° 34' 24.9" E FP14 28° 22' 05.3" S, 21° 34' 25.4" E FP15 28° 22' 05.7" S, 21° 34' 25.4" E FP16 28° 22' 09.8" S, 21° 34' 27.0" E FP17 28° 22' 11.0" S, 21° 34' 27.0" E FP18 28° 22' 11.1" S, 21° 34' 21.0" E FP19 28° 21' 56.6" S, 21° 34' 07.6" E FP20 28° 21' 46.7" S, 21° 34' 11.3" E FP21 28° 21' 46.9" S, 21° 34' 12.3" E FP22 28° 21' 45.9" S, 21° 34' 12.7" E FP23 28° 21' 46.3" S, 21° 34' 27.0" E FP24 28° 21' 46.5" S, 21° 34' 27.4" E FP25 28° 21' 46.4" S, 21° 34' 30.4" E FP26 28° 21' 44.6" S, 21° 34' 32.6" E FP27 28° 21' 42.2" S, 21° 34' 32.3" E FP28 28° 21' 37.7" S, 21° 34' 23.9" E FP29 28° 21' 34.6" S, 21° 34' 16.5" E FP30 28° 21' 32.2" S, 21° 34' 17.4" E FP31 28° 21' 32.3" S, 21° 34' 23.7" E FP32 28° 21' 25.1" S, 21° 34' 28.2" E FP33 28° 21' 21.3" S, 21° 34' 22.8" E FP34 28° 21' 16.6" S, 21° 34' 17.4" E FP35 28° 21' 03.2" S, 21° 34' 17.8" E FP36 28° 21' 03.0" S, 21° 34' 09.8" E FP37 28° 20' 55.4" S, 21° 34' 10.0" E FP38 28° 20' 55.2" S, 21° 34' 04.3" E FP39 28° 20' 26.8" S, 21° 34' 17.4" E FP40 28° 20' 27.1" S, 21° 34' 28.9" E FP41 28° 20' 32.2" S, 21° 34' 31.1" E FP42 28° 20' 32.3" S, 21° 34' 35.5" E FP01 28° 20' 27.2" S, 21° 34' 35.7" E
Site access	Access from the **N14 National road** Access point from N14: 28°22' 31.5" S , 21° 34' 23.5" E Turning Point: 28°22' 25.2" S , 21° 34' 20.2" E Gate at the PV plant fence: 28°22' 11.1" S , 21° 34' 21.3" E Length of the new Access road: 650 m
Generation capacity	Up to 75 MW
Proposed technology	The preferred technical solutions are: **PV solar modules**: thin-film modules or monocrystalline or polycrystalline modules **Mounting systems:** fixed mounting systems or single-axis horizontal trackers (SAT)
Height of PV module supporting structures from ground level	**Maximum height** (highest point of the PV arrays): **3.1 m above the ground level** **Minimum height** (lowest point of the PV arrays): **0.7 m above the ground level**
Width and length of internal roads	The main internal road around the security fence is max. 8.0 m wide and approximately 9.2 km long.

Main Internal Road around the security fence

FIR01 28° 20' 33.2" S, 21° 34' 53.4" E
FIR02 28° 20' 53.9" S, 21° 35' 00.2" E
FIR03 28° 21' 50.8" S, 21° 34' 39.3" E
FIR04 28° 21' 51.1" S, 21° 34' 33.8" E
FIR05 28° 21' 52.3" S, 21° 34' 28.4" E
FIR06 28° 21' 53.0" S, 21° 34' 26.4" E
FIR07 28° 21' 54.4" S, 21° 34' 24.6" E
FIR08 28° 21' 55.9" S, 21° 34' 24.2" E
FIR09 28° 21' 58.7" S, 21° 34' 24.2" E
FIR10 28° 22' 00.7" S, 21° 34' 24.6" E
FIR11 28° 22' 03.0" S, 21° 34' 24.7" E
FIR12 28° 22' 05.7" S, 21° 34' 25.2" E
FIR13 28° 22' 06.8" S, 21° 34' 25.3" E
FIR14 28° 22' 06.7" S, 21° 34' 17.3" E
FIR15 28° 21' 56.6" S, 21° 34' 08.0" E
FIR16 28° 21' 47.7" S, 21° 34' 11.1" E
FIR17 28° 21' 47.3" S, 21° 34' 12.3" E
FIR18 28° 21' 46.1" S, 21° 34' 12.9" E
FIR19 28° 21' 46.5" S, 21° 34' 27.1" E
FIR20 28° 21' 46.5" S, 21° 34' 30.5" E
FIR21 28° 21' 44.6" S, 21° 34' 32.8" E
FIR22 28° 21' 42.1" S, 21° 34' 32.5" E
FIR23 28° 21' 34.5" S, 21° 34' 16.8" E
FIR24 28° 21' 32.4" S, 21° 34' 17.6" E
FIR25 28° 21' 32.5" S, 21° 34' 23.8" E
FIR26 28° 21' 25.1" S, 21° 34' 28.3" E
FIR27 28° 21' 21.2" S, 21° 34' 22.9" E
FIR28 28° 21' 16.5" S, 21° 34' 17.6" E
FIR29 28° 21' 03.2" S, 21° 34' 17.9" E
FIR30 28° 21' 02.8" S, 21° 34' 10.0" E
FIR31 28° 20' 55.3" S, 21° 34' 10.2" E
FIR32 28° 20' 55.0" S, 21° 34' 04.8" E
FIR33 28° 20' 32.2" S, 21° 34' 15.2" E
FIR01 28° 20' 33.2" S, 21° 34' 53.4" E

Secondary internal roads are 4.0 m wide (max. 5.0 m wide) and max. 17 km long

Internal Roads

East	to	West
IR1: 28°20' 37.8" S, 21°34' 54.8" E	/ IR1:	28°20' 36.7" S, 21°34' 13.3" E
IR2: 28°20' 42.4" S, 21°34' 56.3" E	/ IR2:	28°20' 41.3" S, 21°34' 11.2" E
IR3: 28°20' 47.1" S, 21°34' 57.8" E	/ IR3:	28°20' 45.9" S, 21°34' 09.1" E
IR4: 28°20' 51.8" S, 21°34' 59.3" E	/ IR4:	28°20' 50.9" S, 21°34' 22.3" E
IR5: 28°20' 50.6" S, 21°34' 12.4" E	/ IR5:	28°20' 50.5" S, 21°34' 07.0" E
IR6: 28°20' 56.4" S, 21°34' 59.1" E	/ IR6:	28°20' 55.2" S, 21°34' 10.4" E
IR7: 28°21' 01.0" S, 21°34' 57.4" E	/ IR7:	28°20' 59.8" S, 21°34' 10.2" E
IR8: 28°21' 05.6" S, 21°34' 55.7" E	/ IR8:	28°21' 04.7" S, 21°34' 18.2" E
IR9: 28°21' 10.2" S, 21°34' 54.1" E	/ IR9:	28°21' 09.3" S, 21°34' 18.0" E
IR10: 28°21' 14.7" S, 21°34' 52.4" E	/ IR10:	28°21' 13.9" S, 21°34' 17.9" E
IR11: 28°21' 19.4" S, 21°34' 50.7" E	/ IR11:	28°21' 18.6" S, 21°34' 20.3" E
IR12: 28°21' 24.0" S, 21°34' 49.0" E	/ IR12:	28°21' 23.4" S, 21°34' 26.4" E
IR13: 28°21' 28.5" S, 21°34' 47.4" E	/ IR13:	28°21' 28.0" S, 21°34' 26.9" E
IR14: 28°21' 33.1" S, 21°34' 45.7" E	/ IR14:	28°21' 32.5" S, 21°34' 24.1" E

	IR15: 28°21' 37.7" S, 21°34' 44.0" E / IR15: 28°21' 37.2" S, 21°34' 24.0" E IR16: 28°21' 42.3" S, 21°34' 42.3" E / IR16: 28°21' 42.0" S, 21°34' 32.6" E IR17: 28°21' 46.8" S, 21°34' 40.6" E / IR17: 28°21' 46.6" S, 21°34' 31.0" E IR18: 28°21' 51.2" S, 21°34' 31.1" E / IR18: 28°21' 50.7" S, 21°34' 10.4" E IR19: 28°21' 55.7" S, 21°34' 24.0" E / IR19: 28°21' 55.3" S, 21°34' 06.7" E IR20: 28°21' 00.3" S, 21°34' 24.3" E / IR20: 28°22' 00.0" S, 21°34' 11.4" E North to South IR21: 28°20' 46.4" S, 21°34' 22.4" E / IR1: 28°20' 50.8" S, 21°34' 22.3" E IR22: 28°20' 50.6" S, 21°34' 12.5" E / IR2: 28°20' 46.1" S, 21°34' 12.7" E
Height of Fencing	security fence around the footprint: maximum height: 3.0 meters above the ground level
New on-site high-voltage substation	**On-site high-voltage loop-in loop-out substation - within the fenced area** Substation Fence: 55 m x 60 m Substation Footprint: 0.33 ha Latitude 28°22' 08.1" S Longitude 21°34' 23.5" E
Loop-in loop-out lines	**Two new sections of 132 kV power line for the connection to the Eskom "Garona - Gordonia" 132 kV power line** Length: maximum **100 m each** 01 starting point: 28°22' 09.1" S, 21°34' 24.0" E 01 ending point: 28°22' 11.6" S, 21°34' 24.1" E 02 starting point: 28°22' 09.2" S, 21°34' 23.6" E 02 ending point: 28°22' 11.6" S, 21°34' 23.7" E

The connection to the Eskom grid will be done according to the Eskom connection solution which requires:

(i) one small **on-site high voltage loop-in loop-out substation** with one or more high-voltage power transformer(s) stepping up the voltage to the voltage of the Eskom grid (132 kV), a 132 kV busbar with protection an metering devices ("switching station") and a control building;

(ii) **two new small sections of 132 kV power line** allowing the Eskom "Garona- Gordonia" 132 kV power line - crossing the project site - to loop in and out of the 132 kV busbar of the new on-site loop-in loop-out substation.

The connection solution may also entail intervention on the Eskom's grid.

4.2.1. Project functioning and connection of the solar park to the Eskom grid

Solar energy facilities using PV technology convert sun energy to generate electricity through a process known as the Photovoltaic Effect, which consists of the generation of electrons by photons of sunlight in order to create electrical energy.

The preferred technical solutions are:

- thin-film modules or mono / polycrystalline modules, mounted on:
- fixed mounting systems or mounted on horizontal 1-axis trackers,

Which at present represent the best performing options in terms of reliability and costs/efficiency.

The PV technology is in constant and rapid evolution, this means that the final choice of the type of solar modules (thin-film, mono-crystalline or polycrystalline) and mounting system (fixed or tracker) can be taken at the time of the commission date, on the basis of the availability of PV modules and mounting systems, of the worldwide market and of the cost-efficiency curve.

The required footprint - corresponding on the fenced area - will not exceed270ha, and the maximum height of the structures (PV modules and support frames) will be approximately 3.1 m above the ground level. Therefore the impacts and mitigation measures will not change. For further reference please refer to section 5.2.

The following description refers to examples of “thin-film PV modules on fixed mounting systems” and “polycrystalline modules on trackers”, but the combinations “thin-film PV modules on trackers” and “polycrystalline PV modules on fixed mounting systems” are also possible and feasible.

As said before, the required **footprint** (including internal roads) will not exceed **270 ha.**

PV modules will be assembled on zinced steel or aluminium frames, to form PV arrays. The metal frames that sustain PV arrays are set to the ground by fixed support poles.

A) In the case of PV modules mounted on fixed mounting systems:

Each mounting frame will host several PV modules along two or more parallel rows consisting of PV modules placed side by side, with the position of the PV arrays northwards and at an optimized tilt. The rows are mounted one on top of the other, with an overall mounting structure height **up to 3.1 meters above ground level**.

Figure 4: Lateral views of PV arrays mounted on fixed mounting systems

Figure 5: Frontal view of PV arrays mounted on fixed mounting systems

For further details, Please refer to the Figures 4 and 5 above and to the drawing of the Annexure A:

- AV1SP_03_r0 *Mounting System – Alternative option 1: fixed mounting systems*

B) In the case of PV modules mounted on trackers:

Each PV array is composed of several PV modules disposed along one or more parallel rows consisting of PV modules placed side by side.
Each tracker is composed by several PV arrays North-South oriented and linked by an horizontal axis, driven by a motor. The horizontal axis allows the rotation of the PV arrays toward the West and East direction, in order to follow the daily sun path.
The maximum mounting structure height will be **up to 3.1 meters above ground level**.

Figure 6: Simulation views of the PV arrays mounted on horizontal 1-axis tracker

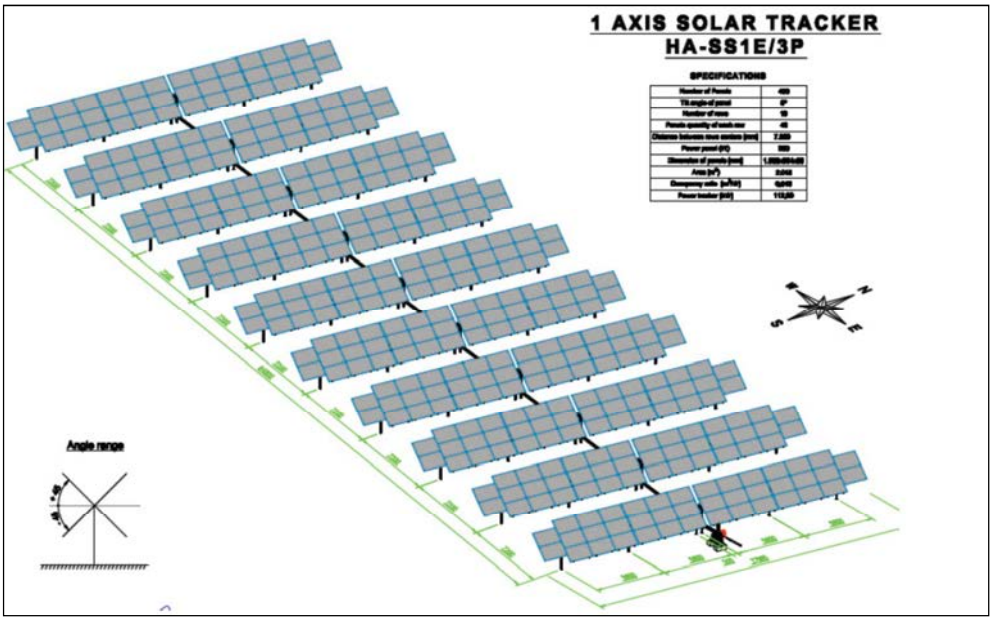


Figure 7: Frontal views of the PV arrays mounted on horizontal 1-axis tracker

For further details, see also the drawing of the Annexure A:

- AV1SP_04_r0 *Mounting System – Alternative option 2: horizontal single-axis trackers*

C) In both cases:

PV modules are series-connected outlining PV strings made of several modules, so that the PV string voltage fits into the voltage range of the inverters. PV strings are set up in order to be connected to DC-connection boxes. Each String Box allows the parallel connection of several PV strings (also called "PV sub-field").

String Boxes monitor the currents in photovoltaic modules and can promptly diagnose faults. String boxes are also designed with a circuit breaker in order to disconnect the photovoltaic sub-fields from the inverters.

The PV sub-fields are thought to be linked to central inverters, located in **75 medium voltage stations**. Each station comprises two adjacent prefabricate buildings designed to host two **DC/AC inverters**, with a total nominal output AC power of 1,000 kW (16 parallel sub-fields), and two **medium voltage power transformers** of 500 kVA each. The DC/AC inverters are deemed to convert direct current (DC) into alternate current (AC) at low voltage (270 V); subsequently the AC will pass through a medium-voltage transformer in order to increase the voltage up to 22 kV (or 11 kV).

The medium-voltage stations are detailed in the drawing of the Annexure A:

- AV1SP_05_r0 *Medium-voltage stations*

The energy delivered from the 75 medium voltage stations will be collected into one (or more) **medium voltage receiving station**(s), parallel connecting all the 75 PV fields of the PV generator.

From the medium voltage receiving station, the energy will be delivered to two high-voltage power transformers (40 MVA each, plus one as spare), which will step up the electric energy from the medium voltage level (11 kV or 22 kV) to the Eskom required connecting voltage (i.e.132 kV). The power transformers will be connected to an on-site 132 kV busbar (the so called "***switching station***"), to be equipped with protection and metering devices, according to Eskom requirements.

Avondale 1 Solar Park will deliver the electrical energy to the **Eskom "GARONA-GORDONIA" 132 kV power line**, running along and crossing the northern fence of the project site (*preferred connection solution*). The Eskom's 132 kV power line will loop in and out of the 132 kV busbar of the new on-site substation via two new sections of the 132 kV line approximately 100 m long.

The new on-site HV loop-in loop-out substation will need to be equipped with circuit breakers upstream and downstream, in order to disconnect the PV power plant and/or the power line in case of failure or grid problems**.**

Two **metering devices and related kiosks** are included in the layout: one for Eskom, close to the busbar, and one for Tita Energy (Pty) Ltd, close to the power transformers. The kiosks (2.4 x 4.8 x 3.2 m) will contain the peripheral protection and control cabinets and the metering devices. The on-site HV loop-in loop-out sub-station, composed of the power transformers, the control building, the 132 kV busbar with protection and metering devices and the kiosks, will have a **footprint covering approximately 4,000 m^2**.
The new power line and the busbar (*switching station*) of the on-site HV loop-in loop-out substation will be owned and operated by Eskom Distribution.

The layout of the on-site high-voltage substation as well as of the control building and the subdivision between Eskom's side and Tita Energy's side are detailed in the drawings included in Annexure A:

- AV1SP_06_r1 *Control building and medium-voltage receiving station*
- AV1SP_07_r1 *High-voltage loop-in loop-out substation*

The power generation capacity at the delivery point will be up to 75 MW.

4.2.2. Access road and internal roads

Access to the Avondale 1 Solar Park will be from the N14, which runs parallel to the southern boundary of the property. A new access road within the project site and **650 m long** will link the N14 to the development area. The access road is inside the project site for the whole length (650 m).

Table 4: Geographical co-ordinates of the access road

Geographical co-ordinates of the access road		
Point	**Latitude**	**Longitude**
access point from N14	28° 22' 31.5" S	21° 34' 23.5" E
turning point	28° 22' 25.2" S	21° 34' 20.2" E
final point (up to the PV plant security fence):	28° 22' 11.1" S	21° 34' 21.3" E

The proposed access road from N14 will run next to a disturbed quarry located close the south-western corner of the proposed footprint (please refer to Figure 8 below). This quarry has a low ecological sensitivity according to the Ecological Impact Assessment, because it has been already transformed in the past by human activities, for road building material purposes.
According to the Geo-technical and Geo-hydrological Report, this quarry may collect stormwater during heavy rain; therefore the access road has been moved **outside** this quarry / artificial drainage. This quarry has to be regarded as an artificial drainage line and cannot be considered as a "water resource".

Since the access road has been moved outside to this quarry / artificial drainage, Activities 11 and 18 of GNR 544 are NOT APPLICABLE in this respect.

The access road will be a gravel road to be constructed at ground level, in order not to alter the natural flow of the stormwater. Cut and fill activities are required for the pavement (thickness: 20 cm) of such road and of the internal gravel roads. Internal roads will consist of gravel roads designed in accordance with engineering standards. The roads will have a maximum width of 8.0 meters allowing for slow moving heavy vehicles. Once the solar farm is in operation, the internal roads will mainly be used for maintenance and inspections.

The vertical alignment of the roads will not present significant challenges due to the flatness of the terrain. The entire development will be contained inside a fenced area and the roads are not intended for public use.Aggregate necessary for the construction of the access road and internal roads will be provided from the commercial sources in the vicinity of the development(in Upington or Groblershoop).

4.2.3. Lighting system

The lighting system will consist of the following equipment:

- Floodlight-towers: maximum10 meters high, with 6x400W directional lamps, installed around the HV loop-in loop-out substation. Normal lighting: 15 lux; up to 40 lux in case of emergency.
- Street lighting along internal roads, for the stretch from the access point up to the HV substation inside the property: 1 streetlamp, maximum 5.5 meters high, every 20 meters, having a metal-haloids lamp of 400 W.
- 2x400 W spotlights (SAP type) mounted on the top of medium-voltage stations.

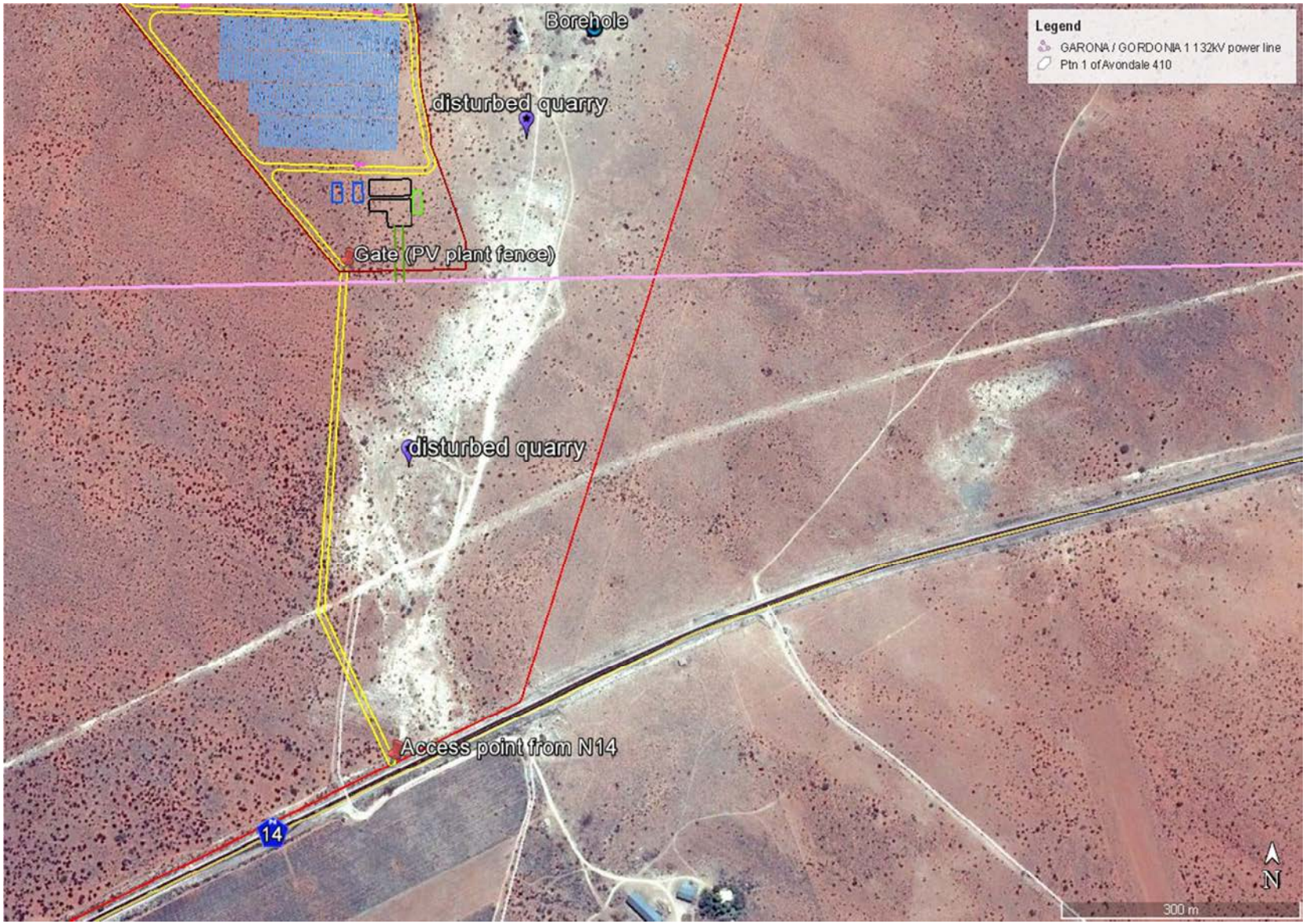
The lighting of the MV stations and of the on-site HV substation will be on only in case of intrusion/emergency or necessity to reach the MV stations / HV substation during the night.

During the night, the video-surveillance system will use infra-red (or micro-wave) video-cameras, which do not need a lighting system (which could reduce the functioning). Only streetlamps along internal roads, for the stretch from the main access up to the HV substation inside the property, may be switched on at night.

4.2.4. Stormwater collection system

Given the low rainfall, flat topography and low flow speed of run-off, **no formal storm water structures are required** as the proposed gravel roads will be developed at ground level so as not to disturb the natural flow of storm water. This means that run-off will not be concentrated and the existing drainage patterns will be left undisturbed.

Figure 8: Access road and disturbed quarry



4.2.5. Water requirements

4.2.5.1. Water requirements during the construction phase

The construction timeframe is estimated to be approximately **15 months.**

A) Construction of internal gravel roads

- Water is necessary for the construction of internal gravel roads, in order to get the gravel compacted to optimum moisture content (OMC).
- The surface of internal gravel roads will be approximately 137,000 m^2 (per PV project).
- 50 liters of water / m^2 of internal of roads will be required.

B) Workers

- Approximately 100 people are expected to be employed during the construction period of each PV plant, although this number can increase to 150 for short spaces of time during peak periods. This number can be higher in the case Tita Energy- once being selected as Preferred Bidder by the Department of Energy and having finalized the Connection Agreement with Eskom, where in particular it is agreed the envisaged connection timeline - evaluates to build the Avondale 1 Solar Park in a timeframe shorter than 15 months (i.e. 330 working days). For example, in the case the construction works are planned to last only **6 months** (*i.e* 132 working days), the average number of workers required on site during construction is **250**.
- Each worker needs 50 liters / 8 working hours for sanitary use.
- Water consumption will be:
    - 100 people per project x 50 l/person x 330 working days = 1650 m^3 over 15 months, or:
    - 250 people per project x 50 l/person x 132 working days = 1650 m^3 over 6 months.

C) Concrete production

- Concrete is necessary for the basements of the medium-voltage stations, the high-voltage loop-in loop-out substation, the control building and the warehouse and for the foundations of the mounting systems. The overall amount of concrete to be produced will be approximately 15,000 m^3 per project.
- 200 litres of water are needed for 1 cubic meter of concrete.

D) Vehicle cleaning

As mitigation measure, the cleaning of vehicles like excavators, mechanical diggers and pile rammers will be done once or twice per month and not during working days, also in order to not increase the water requirement during the construction activities.
In order not to waste a large amount of water, high pressure cleaners will be used.
Overall, the water requirement for cleaning activity is very low.

The overall and average water consumption during construction is detailed in the following table.

Table 5: Water consumption during the construction phase of the project

WATER REQUIREMENT DURING THE CONSTRUCTION PHASE OF THE PROJECT		
DESCRIPTION	**UNIT**	**TOTAL**
Timeframe of the construction activities	*months*	15
Timeframe of the construction activities - calendar days	*days*	450
Overall water consumption for internal roads	m^3	6,850
Overall water consumption for sanitary use	m^3	1,650
Overall water consumption for concrete production	m^3	3,000
OVERALL WATER CONSUMPTION	***m^3***	**11,500**
Daily water consumption (average over 450 calendar days)	***m^3/day***	**25.5**

Storage tanks will be sized in order to provide a reserve of water approximately **200 cubic meters**.

4.2.5.2. Water requirements during the operational phase

During operation, water is only required for the operational team on site (sanitary use), as well as for the cleaning of the solar panels.
Further water consumption may be only for routine washing of vehicles and other similar uses.

A) Water for sanitary use

Approximately **35-40 people** will be employed during the operation phase of the PV power plant, which will have a lifetime of 25 - 30 years.
The Avondale 1 Solar Park will be in operation 7 days per week; therefore personnel will operate according to shifts. The surveillance team will be present during day-time, night-time and weekends. The average number of people working at the site on the same time will be **14 people daytime and 6 people at night**.

The average daily water consumption for sanitary use for each project is estimated to be**150 litres** / **day** / **person** per **20 people** (14 people daytime and 6 people at night),The daily water consumption will be approximately **3,000 litres/day.**

B) Water consumption to clean the PV modules

The cleaning activities of the solar panels will take place **twice per year**.

It is assumed that up to 1.0 liters per m^2 of PV panel surface will be needed.
The amount of water for cleaning is up to **850 m^3 per cleaning cycle**and**1,700 m^3per year**.

PV modules cleaning activity can last less than 1 month. If the cleaning activity lasts approximately 2 weeks (12 working days), the daily water consumption will be approximately **71,000 liters/day**, **over 12 days**.

Conclusion

The daily water requirement will be approximately **3,000 liters/day** over 12 months for sanitary use (i.e. **90,000 l/month** and **1,095 m^3/year**). It means that, on the whole, the daily water requirement for sanitary use will be **6,000 liters/day** over 12 months.

The water consumption will increase up to **77,000 liters/day** during the cleaning of the solar modules (71,000 liters/day for cleaning activity and 3,000 for sanitary use), which will last less than a month and will occur twice per year during the dry period. Indeed PV modules are conceived as self-cleaning with the rain.

It is further proposed that **90,000 l** of water will be stored in **storage tanks** for fire, emergency and washing of panels twice a year.

The overall and average water consumption during operation is detailed in the table below.

Table 6: Water consumption during the operational phase of the project

WATER REQUIREMENT DURING THE OPERATIONAL PHASE		
DESCRIPTION	**UNIT**	**TOTAL**
Average daily water consumption for sanitary use	*l/day*	3,000
Average daily water consumption during cleaning activity (*)	*l/day*	74,000
Average monthly water consumption for sanitary use (over 30 days)	*l/month*	90,000
Annual water consumption for sanitary use	***m^3/year***	**1,095**
Annual water consumption for PV modules cleaning activities (twice/year)	***m^3/year***	**1,700**
ANNUAL WATER CONSUMPTION DURING OPERATION	***m^3/year***	**2,795**
DAILY WATER CONSUMPTION DURING OPERATION (average over 365 day)	***m^3/day***	**7.66**

(*) over 12 working days, twice per year

4.2.5.3. Water provision during construction and operation

The property is located within the **Quaternary Catchment Area (QCA) D73E**. The quaternary catchments fall within the **Lower Orange Management Area (WMA).**

In theD73E QCA no groundwater abstraction is allowed for under the DWA General Authorization.

The estimated annual groundwater recharge (0.27 mm/m2 per annum) from an average annual precipitation of 183 mm falling on the 340 ha development area will result in **918 m^3**of water available on the development area.

The maximum annual water requirement for the project is 2795 m^3/annum. The scale of abstraction relative to recharge is **304% (Category C).**As indicated in the Geo-technical and Geo-hydrological Report (Annexure I), one borehole has been identified on the south-eastern side of the property, in the “disturbed quarry area / drainage”. This borehole, currently equipped with a windpump, is 18 m deep and abstracts water from the calcrete in the drainage.

The yield of the existing borehole is unknown at this stage. Being shallow and only equipped with a wind pump, it is safe to assume that the yield is in the order of 0.2 to 0.5 l/s.

The borehole should be able to supply the project with potable water at drinking water quality.

The water sample collected from the borehole is within the specifications for drinking water on all parameters. The TDS, conductivity, chloride, nitrate, selenium and sodium levels are elevated as would be expected from water derived from a shallow aquifer in a calcrete environment. Therefore it is recommended that the water be softened before it is used to clean the solar panels as a build-up of scale can occur over time if the water is used untreated.

Water for the construction phase can be obtained from the Orange River. The land owner has a centre pivot in the south-western corner of the property and indicated that there is a pipeline to that point. Water for the PV modules cleaning activities may be sourced from the on-site borehole or from the Orange River.

A pump-test should be conducted on the existing borehole to define the sustainable yield. If the yield is not adequate, a second borehole should be located. **Alternatively, water can be sourced from the Orange River or from the Local Municipality by means of water tank trucks.**

Should the water needs of the project being provided by means of groundwater abstraction or from the Orange River, Tita Energy will submit a Water Use Licence application to the Department of Water Affairs in this regard.

4.2.6. Sewerage

Considering that the proposed developments will not include formal residential properties there is no need to connect the municipal sewer reticulation system. Sewer reticulation will be handled by the patented and commercially available *BallamWaterslot* (or similar) sewer treatment system.

The sewer system will therefore consist of an installation to serve the offices of the control building (one per PV project). It is foreseen that the system will be installed in line with the requirements of the manufacturer. Typical systems consist of a conservancy tank (built underground on site), and a patented digester. Most systems require electricity to power the pumps and fans used in aeration process, although some systems use wind power (whirlybird). The system could require chlorine tablets available commercially. The effluent from the *Ballam Waterslot* (or similar) system will be suitable for irrigation of lawns, or re-use in the dwellings as water for the flushing of toilets, or for fire-fighting purposes. This could reduce the overall water requirement of the development substantially.

A Water Use License application will be submitted to the Department of Water Affairs by Tita Energy (Pty) Ltd with regard to the water treatment system on site.

4.2.7. Refuse removal

During the construction phase, solid waste will mainly consist of vegetation material as a result of the clearing activity. Other type of solid waste will be: wood from packaging, boxboards, expanded polystyrene and household waste. Vegetation material from clearing activity can be recycled to be re-used as organic fertilizer. Other solid wastes will be recycled as much as possible. Non-recyclable waste will be delivered to the closest landfill of the Municipality.

During the operational phase (25 - 30 years), solid waste will mainly consist of household waste from the operational team. Other type of solid waste will come from the maintenance activity in case of failure of some components.

At the end of the project lifetime, the PV plant will be decommissioned. Silicon of the PV modules and cables (copper and/or aluminium conductor) will be recycled, as well as the aluminium (or zinced steel) frames and piles of the mounting systems.

Tita Energy will enter into an agreement with the //Khara Hais Local Municipality for the PV plant's refuse at the nearby municipal refuse site. No refuse will be stored for prolonged periods of time, buried or incinerated on site.

4.3. CONSTRUCTION SITE

The construction site (approximately 10ha) will be located on the southern side of the planned footprint- covering the area where the last 4MWp are planned. Consequently, the construction site area will be gradually reduced at the completion of the last four PV fields (4 MWp), and at the end of the works all the construction area will be converted into the last PV arrays.

The optimal location of the construction site is an important element of the planning phase also in order to minimize impacts on the surrounding environment.

The site's location has been dictated by the nature of the works to be undertaken, specialist studies, site restrictions, town planning intended uses and access.

The area identified for the construction site had to meet the following requirements:

- sufficient size;
- proximity to existing roads;
- availability of water and energy;
- low environmental and landscape value;
- sufficient distance from residential areas; and
- proximity to the worksite.

In addition, to ensure environmental compatibility, the following factors have been considered:

- restrictions on land use (landscape, archaeological, natural, hydrological, etc.);
- terrain morphology;
- presence of high environmental value areas (e.g. wetlands); and
- sand & gravel supply.

The establishment of the construction site will be divided into four distinct phases. The steps individuated hereinafter do not follow a time sequence, but it should be considered as overlapping and simultaneous events.

4.3.1. Phase I

The area will be fenced to prevent intrusion of animals and to protect against materials theft within the site. A video surveillance system will be provided.

4.3.2. Phase II

During the fencing operation as described in Phase I, the most valuable trees, if any, will be removed and placed temporarily in a safe location for future planting at the end of work. This procedure is required for environmental mitigation. The other low value tree species will be cut down and transferred to facilities for wood processing.

4.3.3. Phase III

At completion of the works defined in Phases I and II, the following step will be the site clearing and the construction of internal roads. The internal road network should ensure a two-way traffic of heavy goods vehicles in order to minimize trips. The road system is planned for a width of 8 meters. Roads will be of dry and compacted materials.
The facility will require constant access control, a weigh-house for heavy trucks, removable structures for the storage of yard tools and temporary storage areas.
During Phase III, the installation of MV/LV transformers connected to the Eskom grid is also planned, as well as the laying of underground electrical cables.

4.3.4. Phase IV

Temporary storage areas of materials and workshops will be constructed and used for:

- temporary storage of photovoltaic modules (covered with compacted dry material in order to avoid direct contact with the ground);
- temporary storage for frames and piles of the mounting systems of the PV arrays;
- storage and processing of building material for construction (sand, gravel, concrete batching and mixing plant, steel, etc.);
- drinking water storage for human consumption;
- worker care facilities and site management buildings,
- prefabricated housing modules for workers who may require accommodation inside the site (only key personnel should be allowed to stay overnight);
- technical cabins and management offices;

- medical care unit in a prefabricated module, in order to allow immediate first aid and minor surgical emergency;
- recreation area and canteen (prefabricated modules);
- parking lots for employees (located close to the staff housing), for visiting staff (located close to the offices area), and for trucks and work vehicles during inactivity;
- workshop and storage facilities on the site for contractors;
- electrical network for living units, offices and service structures;
- water supply for living units through polyethylene pipes connected to storage;
- *Ballam Waterslot* or similar sewer treatment system. The treated water will be used to moisten dusty areas and reduce dust gathering due to windy actions;
- chemical toilets, and
- solid waste collection point.

All facilities present in the construction site will be covered with dry material in order to avoid mud formation in case of rain.

4.3.5. Earthworks

Clearing activity is required in order to remove shrubs and trees from the planned footprint / fenced area (up to 270 ha).

Due to the flatness of the development area, no earthworks are envisaged for the installation of the PV module mounting systems. The mounting systems will consist of metallic frames to be assembled on-site, supported by the driven piles. Foundations for the mounting systems will consist of mini piles, to be driven until a depth of maximum 1.5 m above the ground level by means of an hydraulic hammer.

Earthworks will be required during the construction of internal roads. The vertical alignment of the roads will not present any significant challenges due to the flatness of the terrain so that no deep cuts or fills will be required. Considering a road pavement thickness of 300 mm and an overall road surface approximately 137,000 m^2, the amount of cut or fill is estimated to be approximately 41,100 m^3.
Given the low rainfall, flat topography and low flow speed of run-off - no formal storm water structures are required as the proposed gravel roads will be developed at ground level, so as not to disturb the natural flow of storm water. This means that run-off will not be concentrated and the existing drainage patterns will be left undisturbed.

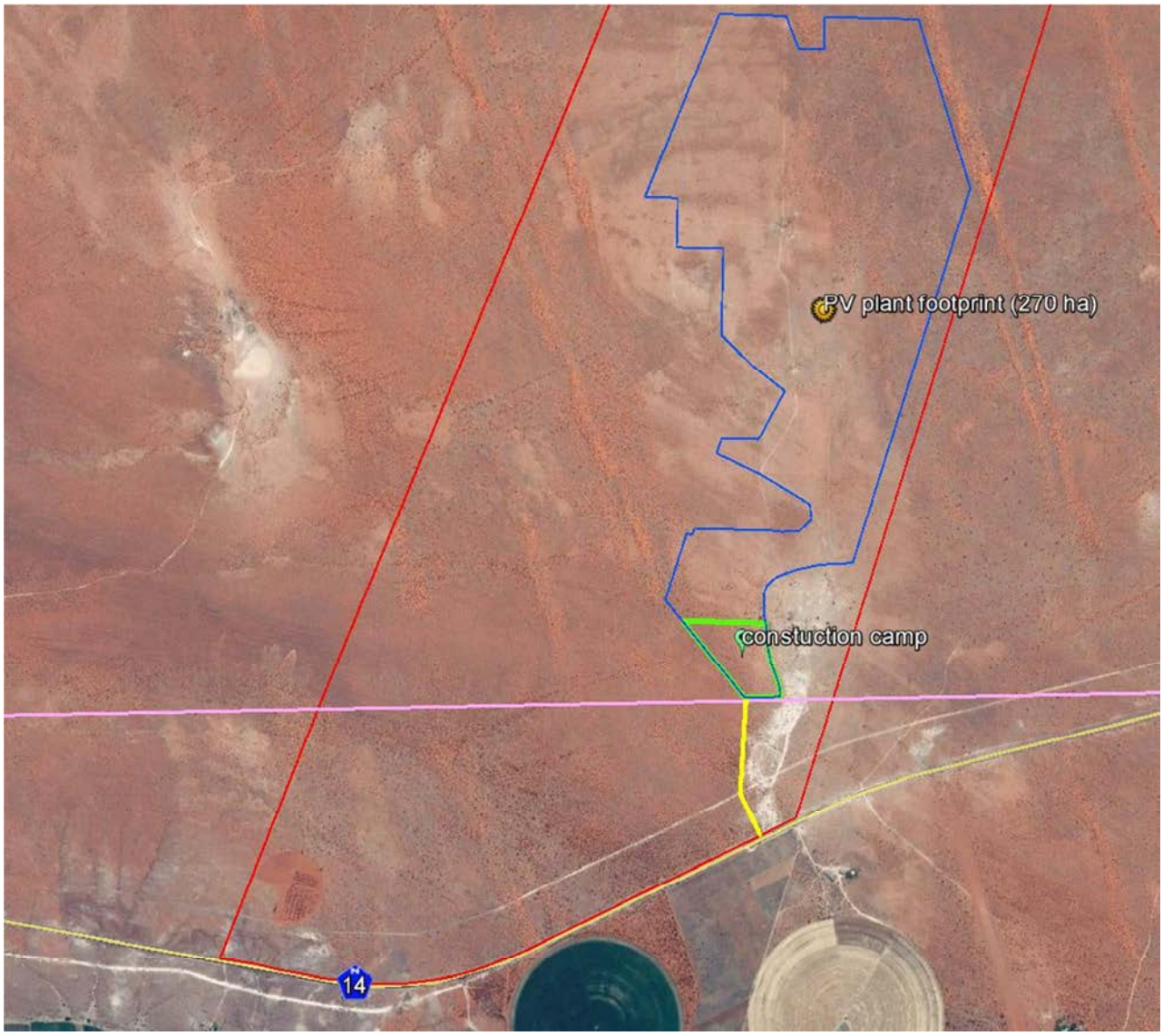
Small earthworks will be required for the installation of the medium-voltage stations. None of these activities should require earthworks in excess of 500 mm cut or fill.
Only the foundation plate for the small high-voltage substation may require earthworks in excess of 500 mm cut or fill (the footprint will be up to 4000 m^2).The topsoil stripping will result in temporary spoils heaps which must be spread over the site upon completion of the project.

Underground cables will be laid down along the internal roads.

Concrete necessary for the basements of the medium-voltage stations, the high-voltage substation, the control building and the warehouses will be manufactured using aggregate and sand from commercial sources in the vicinity of the development (in Upington or Groblershoop).

Aggregate necessary for the construction of internal roads will be provided from the commercial sources in the vicinity of the development (in Upington or Groblershoop).

Figure 9: Planned location of the temporary construction camp (10 ha)



4.4. TRAFFIC IMPACT OF THE PROPOSED DEVELOPMENT

4.4.1. Traffic impact – construction phase

The construction timeframe is estimated to be approximately **15 months.**

Approximately 100 people are expected to be employed during the construction period (15 months), although this number can increase to 150 for short spaces of time during peak periods. This number can be higher in the case Tita Energy- once being selected as Preferred Bidder by the Department of Energy and having finalized the Connection Agreement with Eskom, where in particular it is agreed the envisaged connection timeline - evaluates to build the Avondale 1 Solar Park in a timeframe shorter than 15 months (i.e. 330 working days). For example, in the case the construction works are planned to last only 6 months (i.e. 132 working days) the average number of workers required on site during construction is 250-300.
A small accommodation area with few prefabricated buildings inside the work site may be foreseen, if accommodation facilities in Upington are not sufficient to accommodate all workers.

Overall traffic to and from the work site will amount to approximately **1000 medium** / **heavy vehicle trips** over the whole construction period. As indicated in the table below, the average number of medium and heavy trucks to and from the site will be of **3 trucks per working day.**

Medium and heavy trucks will access / leave the site only during the working days (Monday to Friday), on the daytime (08h00 - 17h00).

The provision of a fuelling area on the work site could reduce the load of heavy vehicles on public roads. The installation of two steel fuel tanks (capacity of 30,000 litres each) is envisaged.

Table 7: Construction timeframe: average daily trips of medium and heavy vehicles

Transportation of:	**months**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
fencing and tools	trips/month	8	8	0	0	0	0	0	0
clearance of the site (vegetation transportation)	trips/month	56	32	0	0	0	0	0	0
piles / frames for mounting systems	trips/month	0	0	20	20	20	20	20	0
sands&gravel for on-site concrete production	trips/month	0	30	48	48	48	52	52	54
PV modules	trips/month	0	0	0	0	0	0	0	0
MV stations	trips/month	0	0	0	0	0	12	12	12
HV substationcomponents	trips/month	0	0	8	8	8	0	0	0
cables	trips/month	0	0	0	0	0	0	0	16
Averagetrips per month	trips/month	**64**	**70**	**76**	**76**	**76**	**84**	**84**	**82**
Average trips per working day (*)	trips/day	**2.9**	**3.2**	**3.5**	**3.5**	**3.5**	**3.8**	**3.8**	**3.7**

Transportation of:	**months**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**TOTAL**
fencing and tools	trips/month	0	0	0	0	0	0	0	**16**
clearance of the site (vegetation transportation)	trips/month	0	0	0	0	0	0	0	**88**
piles / frames for mounting systems	trips/month	0	0	0	0	0	0	0	**100**
sands&gravel for on-site concrete production	trips/month	52	48	32	0	0	0	0	**464**
PV modules	trips/month	0	16	32	68	66	34	0	**216**
MV stations	trips/month	12	12	0	0	0	0	0	**60**
HV substationcomponents	trips/month	0	0	0	0	0	0	0	**24**
cables	trips/month	16	0	0	0	0	0	0	**32**
Averagetrips per month	trips/month	**80**	**76**	**64**	**68**	**66**	**34**	**0**	**1000**
Average trips per working day (*)	trips/day	**3.6**	**3.5**	**2.9**	**3.1**	**3.0**	**1.5**	**0.0**	**3.03**

(*)22 working days per month

4.4.2. Traffic impact – operation phase

The traffic impact during the operation phase will be insignificant, considering that about 35/40 people will work on each PV facility, in the following manner:

- during the daytime approximately 14 people;
- during the night-time, 6 people.

4.5. MANAGEMENT OF THE SOLAR PARK DURING OPERATION

Approximately 35-40 people will be employed during the operation phase of the PV power plant, which will have a lifetime of 25 - 30 years.

The Avondale 1 Solar Park will be in operation 7 days per week; therefore personnel will operate according to shifts. The surveillance team will be present during day-time, night-time and weekends.

The operational team of each project will consist of the following people:

- 1 person as plant manager
- 1 person for administration
- 4 people as technicians / plant operators
- 9-12 people for electric and generic maintenance
- 20-22 people as guards

The "**fire team**" will consist of people for generic maintenance, who will attend a comprehensive fire-fighting training program. After this training programme, the fire team will be able to drive/use/manage properly the fire extinguishers and the fire fighting vehicle, that will be available on the site.

5. PROJECT ALTERNATIVES

The EIA Regulations, Section 28(1)(c) and NEMA, Section 24(4), require investigation and consideration of feasible and reasonable alternatives for any proposed development as part of the environmental impact assessment process. Therefore, a number of possible alternatives for accomplishing the same objectives must be identified and investigated. In particular:

- the property on which, or location where, it is proposed to undertake the activity;
- the location within the current identified site;
- the type of activity to be undertaken;
- the design or layout of the activity;
- the technology to be used in the activity;
- the operational aspects of the activity (schedule, process);
- the sustainability of other alternatives, and
- the option of not implementing the activity (No Go Alternative).

5.1. SITE ALTERNATIVES

Several sites have been inspected in order to find out the best solution for the PV power plant. The following selection criteria were applied:

- Connection availability and proximity
- Land availability
- Proper land surface area (at least 250ha)
- Current land use
- Low environmental impact (low biodiversity)
- Low agricultural potential
- High solar radiance
- Socio-economic issues (land cost and local community unemployment)

The macro area between Upington and Groblershoop–north of the N14 National Road - was investigated, due to the high value of solar irradiation and due to the presence of the Eskom "Garona - Gordonia" 132 kV power line, which is suitable for a PV plant connection.

Several sites crossed by thisEskom132 kV power line were investigated during the feasibility assessment, including:

a) Portion 2 of the Farm Koras 412, Gordonia RD
b) Portion 1 of the Farm Avondale 410, Gordonia RD
c) Remaining Portion of the Farm Abeisestad 409, Gordonia RD
d) Portion 4 of the Farm Abeisestad 409, Gordonia RD
e) Other farm portions crossed by Eskom "Garona - Gordonia" 132 kV power line

a) **Portion 2 of the Farm Koras412,Gordonia RD** is 4041 ha in extent: it resulted to be not ideal for the proposed development, due to the presence of several drainage lines which cross the site form North-West to South-East.

b) **Portion 1 of the Farm Avondale 410, Gordonia RD** is3421ha in extent: this property was found to be suitable, due to the easy access from N14 and because the Eskom "Garona-Gordonia" 132 kV line is crossing the site. The southern side is also suitable from an environmental point of view with little environmental issues, while drainages occur on the northern side of the property.

c) **Remaining Portion of the Farm Abeisestad 409, Gordonia RD** is 3426 ha in extent: it resulted to be not ideal for the proposed development, due to the presence of several drainage lines and the possibility of wetlands which crosses the site, and because it is crossed by the Eskom power line only on the south-western corner, which is too close to the national road N14 and its reserve.

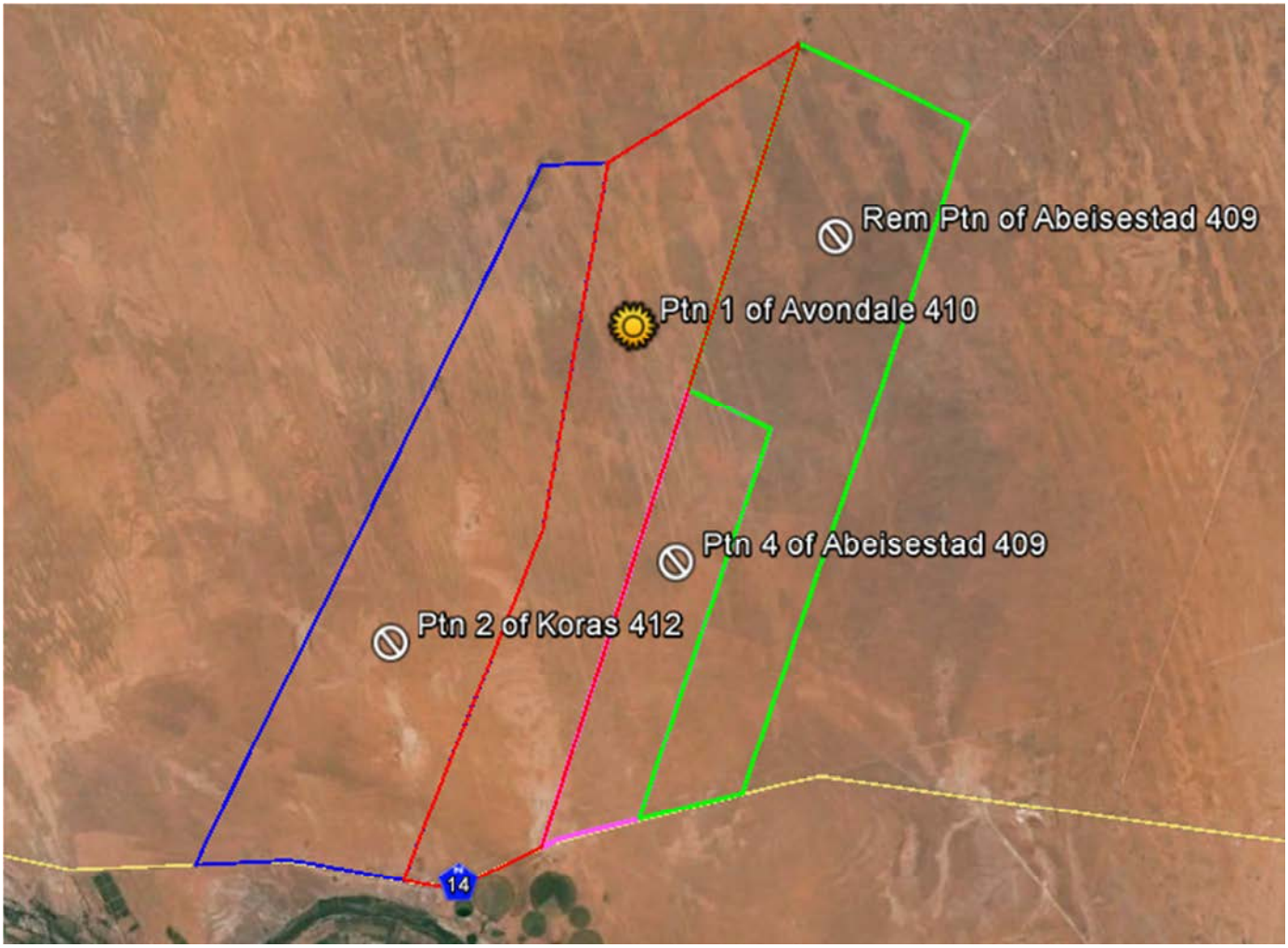
d) **Portion 4 of the Farm Abeisestad 409, Gordonia RD** is 1394 ha in extent. Even if almost suitable for a solar park, it resulted to be not ideal for the proposed development, due to the small size of the farm portion. The site also poses some presence of water run-offs.

e) Other farm portions crossed by Eskom "GARONA-GORDONIA" 132 kV power line resulted to be either: not suitable for an ecological point of view, due to the presence of several wetlands and/or drainage areas, which reduce the suitable areas to less than the required minimum footprint (at least 250 hectares); or not available for a long-term lease.

Therefore ,**Portion 1 of the Farm Avondale 410** is the *preferred site*, being the most suitable and available alternative.

The location of the alternative sites is indicated in the Figure 10 below.

Figure 10: Location of the alternative sites



5.2. TECHNOLOGY ALTERNATIVES

5.2.1. PV Plant and Solar Thermal Power Plant

The alternative to PV for producing energy from the sun is the thermal solution. There are different forms of this technology: linear Fresnel, parabolic through or tower. These technologies can also be with or without thermal storage and they can use diathermic oils or, the more sophisticated ones can use water and/or molten salts.

The final choice is the PV option because these kinds of project result in:

- lower construction costs;
- lower operating and maintenance costs (O&M);
- it is a simpler, quicker and more experienced technology; and
- lower environmental impact, considering that, among other factors, the PV solution requires a minor quantity of water.

5.2.2. Solar Photovoltaic Technology – PV

The project consists of a photovoltaic power plant with a generation capacity of up to 75 MW, on a footprint of up to 270 ha.

The preferred types of PV modules are:

- **monocrystalline or polycrystalline PV modules** and,
- **thin-film PV modules**,

which currently represent the best performing options in terms of reliability and costs/efficiency.

At present, mono/polycrystalline modules provide higher solar conversion efficiency (14% to 16%), if compared to the thin-film /PV modules (9% to 13%).On the other hand, thin-film modules (or amorphous silicon / Cd-Te as well) are cheaper and best performing at high temperatures, having an efficiency degradation of only 0.25 %/°C instead of 0.45 %/°C in the case of mono/polycrystalline modules. However, it is important to consider the fact that the PV technology is in continuous evolution and it may be possible that thin-film (or amorphous silicon / Cd-Te as well) PV modules achieve a higher solar conversion efficiency in a very short time.
The high volatility of prices of PV modules which depends on the worldwide availability of modules is also factor that needs consideration. The final choice will be taken at commissioning on the basis of the prices and availability of mono/polycrystalline and thin-film / amorphous silicon / Cd-Te PV modules.
The development will not exceed the current planned footprint (270ha).Therefore, the final choice of the type of PV modules, whatever it is, will not imply any additional visual or environmental impacts nor the necessity of specific or different mitigation measures.

5.2.3. Alternatives for the Mounting System of the PV Modules

The preferred technical solutions for the proposed solar park entails PV modules mounted on **fixed mounting systems**(*alternative option 1*) or on **horizontal single-axis trackers**(*alternative option 2*).
The tracking solution is the best performing in terms of efficiency, because its energy production is approximately 15% more if compared with fixed systems. This type of technology is characterized by higher technical complexity and deeper installing and maintenance costs, if compared with the fixed mounting solution. The selected tracking system is the horizontal single-axis tracker (SAT), which doesn't differ from the fixed system, except for the presence of the tracking devices and the orientation of the rows of the PV arrays (north - south instead of west – east direction). The technology of mounting systems is under continuous evolution. Consequently, the final decision about the mounting system technology will be taken only at the commissioning date: if addressed toward the fixed mounting system or toward horizontal single-axis trackers, the layout of the PV power plant will not imply any additional visual or environmental impacts nor the necessity of specific or different mitigation measures.

The development will not exceed the currently planned footprint (270 ha) and the height of the structures (PV modules and support frames) will be maximum 3.1 m above the ground level.
Both fixed and horizontal single-axis tracking solutions grant the reversibility of the development in respect of the terrain's morphology, geology and hydrogeology. This means that at the end of the PV plant's lifetime, the site can easily be returned to its status prior to the establishment of the PV plant.

5.3. LAYOUT DESIGN AND LOCATION ALTERNATIVES

The site chosen for the establishing of the proposed Avondale 1 Solar Park is **Portion 1 of the Farm Avondale 410, Gordonia RD**. The PV power plant will have a power generation capacity of **up to 75 MW**, on a footprint of up to 270ha within a development area (envisaged lease portion) of 340 ha, on the south-eastern side of the property, which has a *low to medium* ecological sensitivity.

5.3.1. Layout design and Location alternatives

The layout of the proposed development is the result of a comparative study of various layout alternatives and had been defined in consideration of the results of some specialists studies conducted / under drafting during this scoping phase.
The PV plant is designed and conceived in order to minimize visual and noise impacts, as well as to operate safely and assuring a high level of reliability, with low water consumption and the need only for easy and quick maintenance and repair for approximately 25-30 years.

The main drives of the proposed layout are:

- to maximize the energy production and the reliability of the PV plant, by choosing proven solar technologies: thin-film or mono/polycrystalline solar modules mounted on horizontal 1-axis trackers or on fixed mounting systems;
- **to develop the PV power plant on the south-eastern side of Portion 1 of the Farm Avondale 410** (3426.1123 ha), which is flat and has a *low to medium* ecological sensitivity, while the northern and western sides are undevelopable due to the presence of sand dunes and medium to high sensitive vegetation areas;
- to develop the PV power plant only in the vegetation units: ***dwarf karoid shrubland*** (Medium-low sensitivity) and ***Acacia mellifera – Stipagrostis obtuse interdune veld on deep Aeolian sand*** (Medium sensitivity);
- **to avoid the heritage sites found, providing a minimum buffer of 30 m**;
- A 100 m vegetation buffer zone - composed by the existing vegetation - will be kept between the western boundary of the proposed footprint and the eastern boundary of the farm portion, in order to minimise the visual impact of the proposed development.

The proposed layout plan (attached as Annexure A) was drawn using PV modules mounted on trackers; in the case of PV modules mounted on fixed mounting systems, the layout plan does not change, except for the orientation of the PV arrays: east-west instead of north-south. The required **footprint** - corresponding on the fenced area - **will not exceed 270 ha**, and the maximum height of the structures (PV modules and support frames) will be approximately 3.1 m above ground level. The impacts and mitigation measures will remain exactly the same.

The project layout and the other plant components are detailed in the following drawings:

- AV1SP_00_r3 Locality Map and Development Area
- AV1SP_01_r2 Layout plan - PV power plant up to 75 MW
- AV1SP_03_r0Mounting System – Alternative option 1: fixed mounting systems
- AV1SP_04_r0Mounting System – Alternative option 2: horizontal single-axis trackers
- AV1SP_05_r0 Medium-voltage stations
- AV1SP_06_r1 Control building and medium-voltage receiving station
- AV1SP_07_r1 High-voltage loop-in loop-out substation
- AV1SP_08_r0 Warehouse

5.3.2. Connection alternatives

The Avondale 1 Solar Park is planned to deliver the electrical energy to **the Eskom "Garona-Gordonia" 132 kV power line**, running through the project site. The Eskom 132 kV power line will loop in and out of the 132 kV busbar of the new on-site substation, **via two new sections of a 132 kV line (loop in line and loop out line) approximately 100 m long.**

The two new section of power line will be overhead, as per the Eskom standards. Underground cables are not considered a viable alternative: considering the short length (maximum 100 m each), the environmental benefits would be negligible.
Alternative connection solutions are not envisaged, being the the Eskom "Garona-Gordonia" 132 kV power line the only Eskom power line crossing the project site. Other Eskom substations / power lines are too far from the project site to taken into account. Indeed The closest Eskom substation is the Eskom Garona substation, 29 km west from the project site.

5.4. NO-GO ALTERNATIVE

The no-go alternative is the option of not establishing Photovoltaic Power Plant on the site, or any of its alternatives. The environment will remain in its current state (*status quo*). This will not create any new employment opportunities, and therefore the anticipated economic benefits of the project will accrue to the study area (see the paragraph 6.4 *Socio-Economic Environment*).
Should this alternative be selected the socio-economic and environmental benefits related to the use of renewable energy resources will not be realised with prejudice to the development of the area. The benefits related to the establishment of a renewable energy power plant are analysed in detail in the REFIT Regulatory Guideline published by NERSA (March 2009:

- ***Enhanced and increased energy security***: renewable energy plays an important role in terms of power supply, improving grid strength and supply quality and contemporarily reducing transmission and distribution costs and losses.
- ***Resource economy and saving***: the energy production by coal fired plants consumes a significant amount of water, this amount of water could instead be saved if a renewable energy facility like the proposed one is put in operation.(the Energy White Paper envisages that the implementation of its targets will determine water savings approximately 16.5 million kilolitres). This will be beneficial on the large scale for the water conservation measures that the country is currently undertaking.
- ***Support of new technologies and new industrial sectors***: the development and establishment of renewable energy power plants contribute to the growth of new technologies and new industrial sectors with benefits for its economy.
- ***Exploitation and capitalization of South Africa's renewable resources***: with the aim of increasing energy security.
- ***Employment creation and career opportunities***: the construction and operation of a renewable energy power plant contributes to job creation and new career opportunities.
- ***Pollution reduction***: the use of renewable energy resources decreases the demand and the dependence from coal and oil for electricity generation.
- ***Contrast to Global warming and climate mitigation***: the development of renewable energy contributes to reduce global warming through the reduction of greenhouse gas (GHG) emissions.
- ***Protection of natural foundations of life for future generations***: the development and establishment of renewable energy power plants offers the opportunity of consistently reducing the risks related to climate change caused by CO2 and CO emissions, therefore preserving life for future generations.
- ***Acceptability to society and community***: the use of renewable energy is largely accepted by society and community as a mean to reduce pollution concerns, improve human health and wellness, protect the environment, the ecosystem and climate;
- ***Commitment to and respect of international agreements***: in particular in light of the possible commitment to the Kyoto Protocol.

6. STATUS QUO OF THE RECEIVING ENVIRONMENT

The receiving environment has been described using a combination of specialist inputs, on-site observations, a review of existing literature and utilizing Geographic Information Systems (GIS) planning tools.

6.1. PROPERTY DESCRIPTION AND CURRENT LAND USE

The proposed development will stretch over a part ofPortion 1 of the Farm Avondale 410.

Portion 1of the Farm Avondale 410, Gordonia Registration Division

Surveyor-general 21 digit site	C02800000000041000001
Local Municipality	//Khara Hais
District Municipality	Zf Mgcawu
Province	Northern Cape
Extent	3421.1123 ha
Land Owner	JOHAN DE JAGER TESTAMENT TRUST
Diagram deed number	T863/1956
Title deed number	T1726/1989
Registration date	19891201
Current land use	farming
Geo-graphical Co-ordinates	28° 21' 15" S , 21° 34' 35" E (proposed footprint)

The site is located 34 km East of Upington and 72 km North-West of Groblershoop town. The Orange River and the national road N14 run close and adjacent to the southern boundary of this property.
Portion 1 of the Farm Avondale 410 is already affected by energetic infrastructure, such as the **Eskom "Garona - Gordonia" 132 kV power line**.
The current land-use of the proposed development site is grazing by livestock (sheep). Neighbouring farms are being used for livestock grazing. South of the project site, some areas close to the Orange River are cultivated.

6.2. OTHER RENEWABLE ENERGY PROJECTS IN THE UPINGTON AREA

In the Upington area there are a number of solar (Photovoltaic CSP) projects currently under development and under construction, due to the exceptionally high solar irradiation (the highest in the world) and due to the presence of the Orange River, which can supply water for the CSP projects.
Eskom is planning to build up to 1000 MW of CSP, to be located on a farm 12 km West of Upington and 47 km West of the proposed Avondale 1 Solar Park. The first 100 MW has already been approved, as well as the **new "Eskom Solar (Upington) transmission substation"** to be built on the same site. This new transmission substation will help the Eskom grid to receive and deliver the energy generated by the new Eskom and IPP solar (CSP and PV) projects.

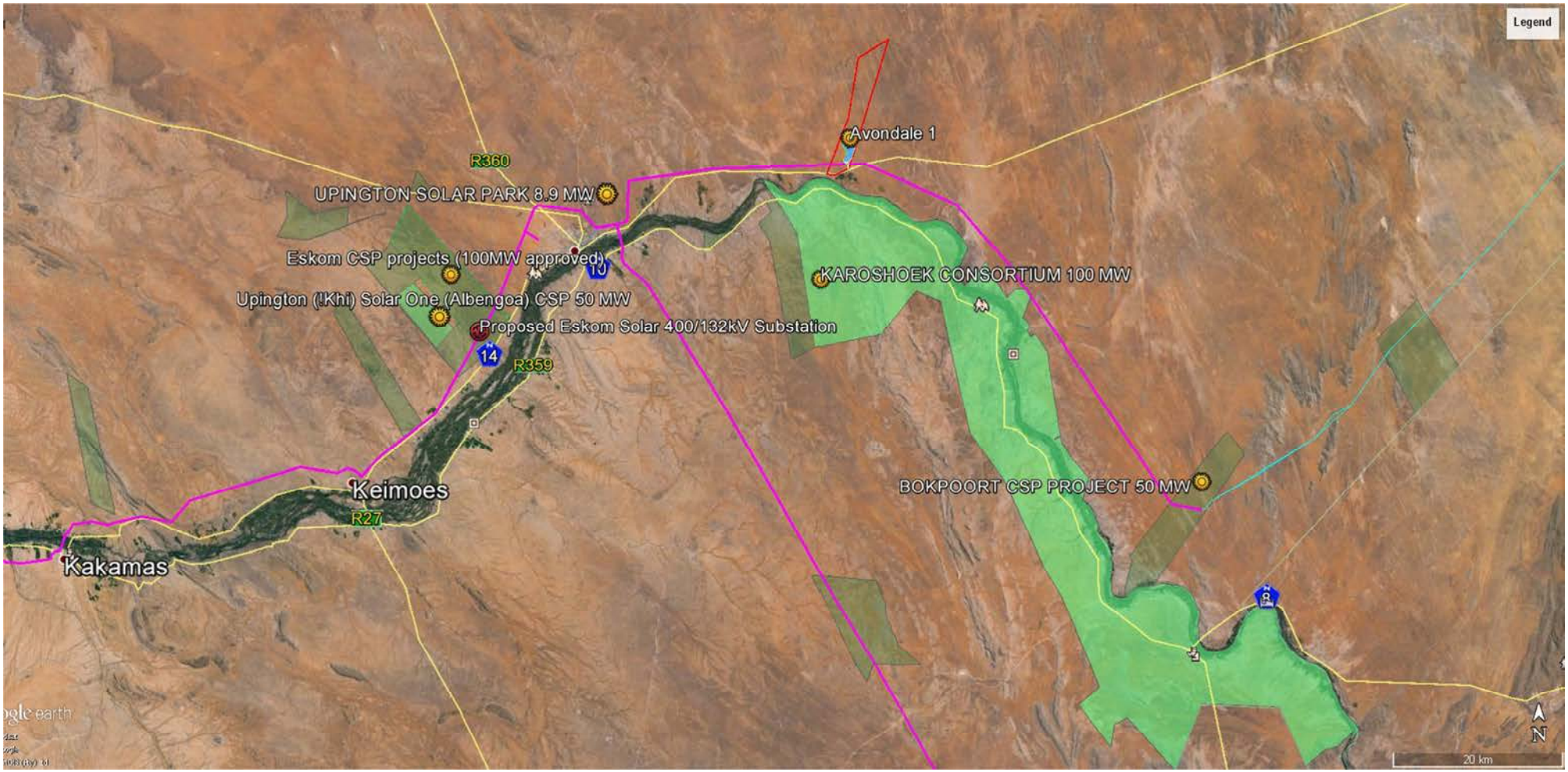
The following solar projects in the Upington area are currently under construction and/or already selected by the Department of Energy under the REIPP Procurement Programme:

- **8.9 MW Upington PV project**, currently under construction at the Upington airport, **29 km** West of the proposed Avondale 1 Solar Park;
- **100 MW Karoshoek Consortium CSP project**, selected by the DoE under the Window 3 of the REIPPPP and is located **16 km** South of the proposed Avondale 1 Solar Park;
- **50 MW Bokpoort CSP project**, currently under construction, **58 km** East of the proposed Avondale 1 Solar Park;
- **50 MW !Khi Solar One CSP project**, currently under construction on a site **53 km** West of the proposed Avondale 1 Solar Park.

Please refer to the Figure 11 below, which shows the projects under construction and / or already selected by the DoE (with a yellow placemark), as well as the proposed locations of PV and CSP projects for which an environmental authorisation process has already started or approved (in green). The existing Eskom power lines are depicted in magenta (132 KV) and ciano (275 kV).

Due to the distance (>15 km) of the projects under construction from the proposed Avondale 1 Solar Park, as well as mitigation measures implemented for the proposed Avondale 1 Solar Park, cumulative impacts are very low. The projects not yet selected by the DoE as preferred Bidders can't be taken into account for the potential cumulative impact, being the construction of them subject to the appointment of the DoE. It's very unlikely that two projects close each other are selected by the DoE, also considering that they would be in competition also in terms of "grid availability", due to the current Eskom grid constrains in the Upington area. Eskom indicated that the Eskom "Garona - Gordonia" 132 kV power line, where the Avondale 1 Solar Park would deliver the energy, **is available only for one project (75 MW).**

Figure 11: Other renewable energy projects in the Upington area



6.3. ENVIRONMENTAL FEATURES

6.3.1. Climate

Upington (the closest town with climatic record, 30 km west-south-west of the site) is a summerrainfall area and has an average rainfall of about 94 mm per year. Minimum rainfall of 0mm is in June and July; the maximum rainfall of 29 mm is in March. The average daily maximum temperature is 33.2℃ during summer and 19.8 ℃ in winter. The coldest temperature occurs during July with an average night temperature of 2.8℃.
The Weinert climatic N-number for the area is 9. This indicates that the climate is semi-arid and that physical mineral grain disintegration is the predominant mode of weathering.

6.3.2. Topography and drainage

The ridge located on the southern boundary of the study area - close to the Eskom power line crossing the property along the West - East direction- is a terrace defining the floodplain of the Orange River.
The rest of the property- North of the Eskom 132 kV power line - has a gentle northward slope (1.4%), with longitudinal dunes forming sand ridges across the valley floor. The longitudinal ridges vary in height from 2 m to 1 m.
The average elevation is 860 m amsl, with the lowest point 848 m amsl in the south eastern corner and the highest point 876 m amsl in the north-eastern corner.
Drainage occurs as sheet wash towards the low lying area, along the eastern boundary of the study area and through a drainage towards the Orange River, South of the site.
The permeability of the sand is high, the occurrence of calcrete and calcrete staining on the surface of cobbles and boulders indicates that water percolates through the soil into the fractured rock mass below.

6.3.3. Soils and geology

A Geo-technical and Geo-hydrological Report is attached as Annexure I. The site visit was conducted on 26 February 2014, when 11 trial pits were excavated across the property.

The site is underlain by:

- longitudinal unconsolidated recent aeolian sand dunes of the Kalahari Formation (Qs);
- calcrete and talus overlying arenite bedrock of the Koras Formation.

The longitudinal dunes are clearly visible on aerial photos where they occur unconformably across the older calcrete and bedrock. The dunes develop as parallel ridges along the prevailing wind direction. During periods of higher rainfall, the dunes are covered by grass vegetation, but during dry periods they are mostly void of vegetation and then the dunes migrate. The rate of migration and the direction is a factor of the micro climate and variation in the wind direction.

The Koras Formation is part of the Griekwaland West System. The Koras formation occurs as sporadic outcrops through a thin Kalahari sand cover, in places the calcrete cobbles is coated with calcrete. In the lower lying areas calcrete is well developed in the local topographical depressions.

The arenite bedrock is competent and good founding material. The Calcrete is encountered on site varies from platy calcrete to weathered friable calcrete fragments in a silty sand matrix. The aeolian sand has collapse potential but in general the sand layer is not very thick, thus limiting the total settlement. The calcrete can be used for road construction and the arenite may be usable as aggregate.

The proposed solar park development area is underlain by three soil profiles:

- Aeolian Sand
- Calcrete
- Shallow bedrock and scattered outcrop

Aeolian Sand Profile: this soil profile occurs along the longitudinal dunes underlain by dry to slightly moist, loose, uniform, reddish orange, intact, fine sand, of transported (aeolian) origin.

Calcrete Profile:this soil profile occur along local topographical low areas and varies from poorly developed hardpan calcrete (only a 0.3m thick layers (Platy Calcrete)) to well-developed hardpan calcrete of more than 1m thick, to weathered calcrete where calcrete concretions of cobble to gravel size occur in a sandy silty matrix. The excavatable depth of profiles where platy and hardpan calcrete were encountered are less than 0.5m, whereas the profiles where the weathered calcrete occurs generally exceed 0.5 m.

Shallow bedrock and scattered outcrop: this profile consists of a transported soil horizon and bedrock. The transported soil horizon is characterised by an aeolian layer of variable thickness but generally less than 0.6m thick and apebble marker or talus layer (AV-3) at the base, overlying intact, fractured arenite bedrock. In places the bedrock has a veneer of calcrete coating around angular cobbles. The deepest trial pit was AV-3 at a depth of 1.40m, the rest of the trial pits on this profile is less than 0.6m.Scattered outcrop of the arenite bedrock occur sporadically throughout the profile area.

The aeolian soil is non-plastic and consists of a 64% fine sand, 35% silt and 1 % gravel mixture. The soil has a moderate to high collapse potential. The weathered calcrete is also is non-plastic and consist of a 33% fine sand, 6% silt and 11%gravel mixture. The soil has a low collapse potential.
Using the COLTO Standard, the **excavatability** below surface is classified as *soft* to 0.3 m, below that it is *intermediate to hard*. The potential for collapse of side walls of deep excavations is low. It is recommended that the sidewalls of any excavation deeper than 0.8 m be battered back to a 1:1.5 grade slope or shored.

Four LAND USE AREAS across the property have been assessed:

LAND USE AREA A
This area, underlain by transported soil and arenite bedrock, is classified as **DEVELOPABLE WITH PRECAUTIONS WITH RESPECT TO EXCAVATABILITY**.
Slab on the ground foundations or pre-bored piled foundations are recommended for the PV modules frames.
Standard strip foot foundations are recommended for other buildings (MV stations, control building, warehouses).
The status of the area is based on the low density and collapsible nature of the silty sand. Detailed testing will be required to define the collapse potential and shear strength of the soils.

LAND USE AREA B
The development area is defined as **DEVELOPABLE WITH PRECAUTIONS WITH RESPECT TO VARIABLE EXCAVATABILITY**. The calcrete varies from hardpan to weathered conditions over short distances.
The PV modules frames can be founded on slab on the ground foundations or with a combination of rammed and pre-bored rammed piled foundations.

LAND USE AREA C
The area is not regarded as suitable for the proposed development and is classed as **UNDEVELOPABLE based on the steep slopes and loose sand encountered**. The sand is not poorly vegetated and is prone to be blown away by the prevailing winds and are therefore likely to change shape when the immediate area is disturbed, for example by the construction of a solar park that will change the micro climate in the immediate area.

LAND USE AREA D
The area is regarded as **UNDEVELOPABLE because evidence of water erosion was noted**. The area can also be flooded after periods of heavy rainfall.

It is recommended that the solar park development be restricted to **Land Use Area A and B**. A 30m exclusion zone around the longitudinal dunes is recommended at this time. With further study the mobility of the longitudinal dunes should be assessed to determine how much and in what directions they migrate. The migration seems slow but with the operational life of a solar park spanning 20 plus years the impact can be noticeable.

As said before, for the foundations of the PV modules mounting systems it is recommended that either slab on the ground concrete bases or pre-bored rammed piles be used due to the shallow and variable bedrock conditions.
For the other conventional structures on site, normal strip foot foundations with compacted trenches are recommended. The trenches should be wetted during the compaction process. Impact rolling is recommended for as foundation treatment of roads.

No shallow groundwater conditions were encountered in any of the trial pits on site.

The soil present on site is not suitable for use as aggregate. The weathered calcrete can be used for roads, but all other aggregates should be sourced from commercial suppliers in the area.

No mining activities (past or present) occurred in the property.

The Geo-technical and Geo-hydrological Study concluded that - from a geo-technical perspective - the project site - limited to the Land Use A and B - is suitable for the proposed development.

6.3.4. Geo-hydrology

As indicated in the Geo-technical and Geo-hydrological Report (Annexure I):

The site is located within the **Quaternary Catchment Area (QCA) D73E**. The quaternary catchments fall within the **Lower Orange Management Area (WMA).**
The quaternary statistics of this catchment will be used for further evaluation.

The D73E QCA has a recorded mean annual precipitation of 183 mm per annum, with an annual run-off of 3 mm. The groundwater recharge is 0.27 mm per year and the groundwater level of the area is 47 m below surface. The Eco status is category B. The total groundwater use in this quaternary is 0.13 Mm^3 per year as the majority of the water used for agriculture is sourced from the Orange River. No groundwater use is allowed under general authorization for in this QCA.

The estimated annual groundwater recharge (0.27 mm/m2 per annum) from an average annual precipitation of 183mm falling on the 340ha development area will result in **918 m^3**of water available on the development area.
The maximum annual water requirement for the project is 2795 m^3/annum. The scale of abstraction relative to recharge is **304% (Category C).**

6.3.4.1. Boreholes, groundwater availability and quality on the project site

The development area is underlain by recent unconsolidated sand and calcrete. The unit is thin and poorly developed as an aquifer. At depth the primary aquifer occurs in the fractured rock network within the quartz arenite. The tight rock mass is generally regarded as a poor aquifer, with notable groundwater occurrences occurring along major structures.

One borehole has been identified on the south-eastern side of the property, in the "disturbed quarry area / drainage". This borehole, currently equipped with a windpump, is 18m deep and abstracts water from the calcrete in the drainage.

The yield of the existing borehole is unknown at this stage. Being shallow and only equipped with a wind pump, it is safe to assume that the yield is in the order of 0.2 to 0.5 l/s.

The borehole should be able to supply the project with potable water at drinking water quality. The water sample collected from the borehole is within the specifications for drinking water on all parameters. The TDS, conductivity, chloride, nitrate, selenium and sodium levels are elevated as would be expected from water derived from a shallow aquifer in a calcrete environment. Therefore it is recommended that the water be softened before it is used to clean the solar panels as a build-up of scale can occur over time if the water is used untreated.

Water for the construction phase can be obtained from the Orange River. The land owner has a centre pivot in the south-western corner of the property and indicated that there is a pipeline to that point. Water for the PV modules cleaning activities may be sourced from the on-site borehole or from the Orange River.

A pump-test should be conducted on the borehole to define the sustainable yield. If the yield is not adequate, a second borehole should be located. If that is not successful, water can be sourced from the Orange River or from the Local Municipality by means of water trucks.

6.3.5. Ecology (fauna & flora)

An Ecological Impact Assessment (Annexure D) was conducted by AGES in order to describe the ecology (fauna and flora) present in the site, to assess its ecological sensitivity and to indicate the most suitable areas for the proposed development. For this purpose, detailed ecological (fauna habitat & flora) surveys were conducted during March 2014 to verify the ecological sensitivity and ecological components of the site at ground level.

6.3.5.1. Vegetation types

The development site lies within the Savanna biome which is the largest biome in Southern Africa. It is characterized by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs). The environmental factors delimiting the biome are complex and include altitude, rainfall, geology and soil types, with rainfall being the major delimiting factor. Fire and grazing also keep the grassy layer dominant. The most recent classification of the area by Mucina & Rutherford (2006) shows that the sites forms part of the Gordonia Dunveld vegetation type. The landscape features of the Gordonia Duneveld vegetation type are mostly parallel dunes (3-8m in height) with an open shrubland woody structure and ridges of grassland dominated by *Stipagrostis amabilis* on the dune crests and *Acacia haematoxylon* on the dunes slopes. The conservation status of the Gordonia Duneveld is Least Threatened with very little transformation and 14% statutorily conserved in the Kgalagadi Transfrontier Park (Mucina & Rutherford, 2006).

The proposed development is planned on a landscape that varies from slightly undulating plains to moderately undulating terrain associated with dunes. The property is currently managed as a livestock farm (sheep). The vegetation units on the site vary according to soil characteristics, topography and land-use. Most of the site is characterized by microphyllous woodland that varies in density and species composition.

The following vegetation units were identified during the survey:

- *Acacia mellifera* – Stipagrostis obtuse interdune veld on deep Aeolian sand;
- *Acacia mellifera* – Stipagrostis amabilis duneveld
- *Acacia mellifera* – Parkinsonia africana woodland on shallow rocky soils;
- Dwarf shrubveld (karoid shrubland) on calcareous soils;

- Drainage features:
    - Endorheic depression (pan);
    - Non-perennial drainage channels (outside the development area);
- Cultivated land (outside the development area).

The following protected tree species occur in the area:

- *Boscia albitrunca* (Shepherds tree) - which is dually protected in terms of NFA and NCNCA;
- *Acacia erioloba* (Camel thorn).

The following plant species stipulated in the NCNCA was documented:

- *Aloe claviflora (Schedule 2 species);*
- *Boscia foetida* (Schedule 2 species);
- *Harpagophytumprocumbens (Schedule 1 species).*

A licence application should therefore be submitted to DAFF and DENC before any of these trees can be removed during construction.

These species occur scattered throughout the area and no specific details of their location on site were documented due to their widespread occurrence. A permit should be obtained from the Northern Cape authorities before any of these plants could be eradicated. These plants should form part of a rescue and relocation programme should the activities impact on populations.

6.3.5.2. Fauna

A survey was conducted during March 2014 to identify specific fauna habitats, and to compare these habitats with habitat preferences of the different fauna groups (birds, mammals, reptiles, amphibians) occurring in the QDS. The area represents microphyllous woodland with some broadleaf elements in isolated areas. Detailed fauna species list for the area is included in Appendix C (birds), D (mammals) and E (herpetofauna) of the Ecological Impact Assessment (Annexure D).
During the site visits mammals, birds, reptiles, and amphibians were identified by visual sightings through random transect walks. In addition, mammals were also recognized as present by means of spoor, droppings, burrows or roosting sites. The 500 meters of adjoining properties were scanned for important fauna habitats.

The recommendations and mitigating measures highlighted in the Ecological Impact Assessment (Annexure D) should be implemented to ensure the survival of these species other fauna habitats and feeding grounds.

6.3.5.3. Summary and results of the Ecological Impact Assessment

Detailed ecological (fauna habitat & flora) surveys were conducted during March 2014 to verify the ecological sensitivity and ecological components of the site at ground level.
The development may have a medium to high impact on the vegetation and general ecology of the area, due to the sensitive habitats (dunes, pans, rocky outcrops) that occur in the area, and therefore the least sensitive areas should be considered for the proposed footprint of the Avondale 1 Solar Park.
Considering the results from the field surveys, mitigation needs to be implemented to prevent any negative impacts on the ecosystem, since most of the site is in a natural state. A sensitivity analyses was conducted to identify the most suitable site for the development. From these investigation and ecological surveys the following main observations was made:

- The **duneveld area sand woodland associated with shallow rocky soils** have *a medium to high sensitivity*. These areas play an important role as habitat for fauna and flora. Strict mitigation is needed for the preservation of some sections of this natural vegetation entity. The solar plant development should avoid these areas if possible.

- The most suitable area for the development of the project would be throughout most parts of the site on the ***dwarf karoid shrubland*** (*Medium-low sensitivity*) and ***Acacia mellifera – Stipagrostis obtuse interdune veld on deep Aeolian sand*** (*Medium sensitivity*), even though these areas are only in a slightly degraded state. Limited mitigation is needed for the preservation of some sections of this natural vegetation entity, while the eradication of invasive species such as *Prosopis* should be considered a high priority. A licence should be obtained from DAFF and DENC for the eradication of the protected tree species *Boscia albitrunca (*dually protected in terms of NFA and NCNCA) and *Acacia erioloba* on the footprint areas. The herbaceous layer should preferably be preserved below the solar panels and managed through slashing during the entire lifetime of the project.

- The **salt pans and non-perennial drainage channel** represent sensitive wetland habitat types that will be seasonally wet and have a high sensitivity. No development can occur around the pan and a buffer zone of 32 meters should be implemented, while strict mitigation should be implemented at the drainage channel crossings for the access road.

Some protected plants (NCNCA) and one red data plant classified as Data Deficient was observed during the surveys. In this respect, it should be noted that, according to the Ecological Impact Assessment, no protected plants occur in the vegetation units: *dwarf karoid shrubland* (Medium-low sensitivity) and *Acacia mellifera – Stipagrostis obtuse interdune veld on deep* Aeolian sand (Medium sensitivity), where the development is proposed to be located. Should protected plants be found on the proposed development area during construction (even though no protected species was found in these areas during the surveys), a search and rescue programme under the supervision of an ecologist should be implemented prior to any construction activities occurring on the habitat of these species.

The following protected tree species may occur in the proposed development area:

- *Boscia albitrunca* (Shepherds tree), which is dually protected in terms of NFA and NCNCA; and
- *Acacia erioloba* (Camel thorn).

A license application should therefore be submitted to DAFF and DENC before any of these trees can be removed during construction.

Some potential rare fauna may also occur in the area, and specific mitigation measures need to be implemented to ensure that the impact of the development on the species' habitat will be low.

Mitigation measures are provided that would reduce these impacts from a higher to a lower significance. A monitoring plan is recommended for the construction phase of the development should the proposed application be approved.
The Ecological Impact Assessment concluded that - provided that a licence is obtained in collaboration with the DAFF (protected trees) and Northern Cape Department of Environment and Nature Conservation (protected flora) and the areas classified as *medium-high* and *high sensitive* are kept undeveloped - the proposed development can be supported.

6.3.6. Avifauna

An Avifauna Impact Assessment (Annexure E) was conducted by AGES in order to determine whether the proposed development would have negative impact on avifauna.

About 270 hectares of natural bird habitats will be modified through the development if one considers the vegetation types (Gordonia Duneveld) associated with the larger area. The following bird habitats were identified in the study area during the field surveys that formed part of the Avifauna Impact Assessment:

- Microphyllous woodland;
- Duneveld;
- Pan (wetland habitat);
- Cultivated land habitat (outside the development area) ;
- Rocky habitats.

The project area still supports low densities of priority species such as secretary bird, kori bustard, vulture species and lanner falcons. The presence of these birds could cause collisions and increase mortality rate of these species.

The potential impact associated with the proposed solar farm development includes the following:

- Habitat destruction, fragmentation and human disturbances (indirect impacts);
- Electrocutions and collisions (direct impacts),

A series of specific mitigation measures were individuated in respect of all the aforementioned potential impacts in the Avifauna Impact Assessment.

The Avifauna Impact Assessment concluded that, provided that the suggested mitigation measures and recommendations are adhered to, it is unlikely that the proposed development will have a long-term, significant negative impact on the local avifauna, although a monitoring plan should be implemented during the construction and operational phases of the PV plant.

6.3.7. Visual

A Visual Impact Assessment (Annexure J) was conducted to determine the visual impact of the proposed solar park.

The study area is situated within a tourism 'hot spot' and linked by air and roads to most parts of the country. It is located on the Kalahari-Namaqua-Namibia (Nama-kwari) route to and from Johannesburg and Cape Town. It is also en route to well-known tourism destinations such as the Augrabies Falls National Park, Fish River Canyon, Kgalagadi Transfrontier Park, Richtersveld and the flowers of Namaqualand.

The sense of place of the study area can be described as open, barren and pastoral north of the Orange River and pastoral and fertile around the Orange River. The feel is one of open barrenness with a touch of abandoness north of the Orange River and more lush around the Orange River. Grazing and agricultural activities are the main land use within the study area. The absorption capacity of the visual resource within the horizontal field would be sparse to good due to the undulations associated with the parallel dunes.

In terms of maintaining the landscape character, according to the Bureau of Land Management of the United States of America (2005), the objective would be to "partially retain the existing character of the landscape, where the level of change to the characteristic landscape may attract attention, but should not dominate the view of the casual observer, and changes should repeat the basic elements found in the predominant natural features of the characteristic landscape".

Visually Sensitive Receivers had been identified as residential including: farmsteads, workers housing, travelling including: tourist and local travelers as well as business / open space: including some business, agricultural and grazing activities. The residential component was the most sensitive and rated as high for farmsteads and medium for workers housing. Travelers were also regarded as having a moderate sensitivity. The Relevance of the visual impact was rated as very substantial for the adjacent farmsteads of the farm Adeisestad 409, however these do have existing garden vegetation around them. This would aid in screening the project components from these farmsteads. The Relevance of the visual impact for all other residential and traveler receivers was rated as substantial.

The Significance of the visual impact would be moderate for the construction and decommissioning phases and moderate to high for the operational phase. When the effect of the existing vegetation as well as other correct and effectively applied mitigation measures are incorporated into the rating, the significance for all phases would reduce to Low - Moderate. It is thus important that integrity of the existing vegetation as well as the other proposed mitigation measures be correctly and effectively implemented. The proposed project would contribute minimally with to the existing light conditions at night time. The existing landscape already have the ability to partially screen some of the views towards the proposed development. Every care should therefore be taken to disturb as little as possible of the landscape surrounding the project footprint. This would reduce the need for additional mitigation measures other than addressing dust clouds and light impacts a night.

6.4. SOCIO-ECONOMIC ENVIRONMENT

A report on the socio-economic considerations related to the proposed project was compiled by Glen Steyn & Associates - development economists (Annexure K).

The following aspects were highlighted in the report:

- The national and local economies will benefit from civil contractor work, labour and building materials that will be required on site. On the whole, a share approximately **40% of total CAPEX (investment costs)** will be sourced locally. This share is likely to increase once there will be a specific and competitive industry in the Republic of South Africa able to supply PV modules and other technological components.
- After approval, each project will take approximately **15 months** to be built and will have a lifetime of 25-30 years. For each project, approximately **100 people** are expected to be employed during the construction period, although this number can increase to 150 for short spaces of time during peak periods. This number can be higher in the case Tita Energy - once being selected as Preferred Bidder by the Department of Energy and having finalized the Connection Agreement with Eskom, where in particular it is agreed the envisaged connection timeline - evaluates to build the Avondale 1 Solar Park in a timeframe shorter than 15 months. For example, in the case the construction works are planned to last only **6 months**, the average number of workers required on site during construction is **250**/**300**.
- During operational phase, each power plant will require a permanent staff approximately **35**/**40 people**. That impact will be positive, also in consideration of the slowing down of the recruitment rate due to mining stabilization activities.
- Approximately **50% of the operation costs** will have a local economic return (mostly for maintenance works by local sub-contractors), then the impact will also be positive during the operational phase (25÷30 years).
- The project will comply with the Economic Development Requirements, as requested by the IPP Procurement Programme, issued on 3rd August by the DoE. This economic development programme identifies needs of the surrounding communities in order to have a positive socio-economic impact. In particular, Tita Energy is required to identify a **Local Community** for the purpose of entering into a partnership for the project.

6.5. AGRICULTURAL POTENTIAL

An Environmental Report on the Soils, Land Use, Agricultural Potential and Land Capability is attached as Annexure F; the site survey was conducted during March 2014.

The current land-use of the proposed development site is grazing by livestock (sheep). Neighbouring farms are being used for livestock grazing. South of the project site, some areas close to the Orange River are cultivated.

The soils of the project site were classified into broad classes according to the dominant soil form and family as follows:

- Shallow, calcareous soils of the Glenrosa or Mispah soil form derived from limestone
- Calcareous soils of the Plooysburg soil form associated with pans / drainage channels
- Shallow rocky soils of the Glenrosa or Mispah soil forms derived from sandstone on undulating terrain
- Very deep red apedal Aeolian sandy soils of the Hutton soil form associated with dunes
- Medium depth red-yellow Aeolian sands overlying limestone (Hutton soil form).

The area is expected to receive an annual total rainfall between 120 and 260 mm, mostly between October and April. This amount is very low. The site is considered to be located in an area too dry for rained arable crop production. The high variability in rainfall distribution within the area could further render dryland farming a risky venture, even under irrigated conditions. The climatic conditions, in combination with the sandy nature of the soil are the main factors determining the soils to be unsuitable for arable agriculture.
The project site is thus dry which would contribute to moisture stress condition during crop growth and development. The potential of groundwater is relatively low to sustain a high water demanding irrigated cropping, expected at the project site.
The proposed development site is largely composed of very sandy Aeolian sands (clay content varies between 2 and 8% with depth mostly deeper than 1200mm). The soils are predominantly deep with some areas where the calcrete are exposed closer to the surface. The sandy nature of the soils and climatic conditions of the area renders the area investigated unfavourable for effective crop production. **Economically viable crop production is therefore not considered as a viable option on this site.**

The current vegetation at the proposed site of development consists mainly of microphyllous woodland with a well-developed grass layer. According to databases (ARC), the potential grazing capacity of the area for livestock is estimated to be **low (22 to 25 ha/LSU).**

The **low agricultural and grazing potential** of the soil is confirmed by the Agricultural Maps below(Figures14 to 17):

- **Agricultural Potential Map** - indicating that the project site (Portion 1 of the Farm Avondale 410) is classified as *Low Agricultural Potential.*
- **Land Capability Map** - indicating that the site is classified as *Non-arable – Low potential grazing land.*
- **Potential Grazing Capacity Map (1993)** - indicating that the project site has a potential grazing capacity of **22 -25 ha** / **large stock units**. As indicated in the previous map, this grazing potential is *low*, if compared to the maximum value indicated in the legend: less 3 ha / large stock units.
- **Potential Grazing Capacity Map (2007)** - indicating that the project site has a potential grazing capacity of **26 - 30 ha** / **large stock units**, which is *low*. This map (2007) is not official yet and should be further confirmed by the Department of Agricultural, therefore in the calculation below we refer to the Map (1993).

It can be deduced that the project site - being 3426 hectares in extent - would allow for **137 to 156*potential* large stock units (LSU)**, while the proposed development (270 ha footprint) would entail a reduction of its grazing potential for only 11 to 12 *potential* large stock units.

Therefore, the property is a viable grazing farm (126 to 143 LSU > 60 LSU) both with and without the proposed development.

These maps were generated from the Website: ***http://www.agis.agric.za/agisweb/agis.html*** [AGIS (Agricultural Geo-Referenced Information System) Comprehensive Atlas, commissioned by the Department of Agricultural to CETI Development CC (http://www.ceit.cc/)]

6.6. CULTURAL AND HERITAGE RESOURCES

An archaeological-cum-heritage assessment (Annexure H1) was conducted by AGES to ascertain whether there are any remains of significance in the area that will be affected by the proposed development.

Stone Age material occurs across the study area. A **low density Middle Stone Age** scatter occurs at **Site AGES-AD410-SA01**. These Stone Age occurrences and its cultural context is probably of low scientific value due to the low frequency of lithics and formal diagnostic tools as well as the general loss of site context. The site is situated within the demarcated development area and the impact on the site by the proposed activity will be direct and of permanent duration where in essence, the impact might result in the possible confusing of the archaeological context and potential loss of archaeological material. The significance of the impact on the heritage resources is considered to be LOW but the threshold of the impact can be limited to a NEGLIBLE impact by the implementation of mitigation measures (monitoring) for the sites, if / when required.

Two medium density MSA scatters (Site AGES-AD410-SA02, Site AGES-AD410-SA04) are of scientific interest due to the occurrence of formal diagnostic MSA lithics. The sites are situated within the demarcated development area and the impact on the site by the proposed activity will be direct and of permanent duration where in essence, the impact might result in the possible confusing of the archaeological context and potential loss of archaeological material. The significance of the impact on the heritage resources is considered to be MODERATE but the threshold of the impact can be limited to a NEGLIBLE impact by the implementation of mitigation measures (avoidance, mitigation, conservation, documentation, monitoring) for the sites, if / when required.

Three medium-low density Middle Stone Age scatters occurs at Site AGES-AD410-SA03, Site AGES-AD410-SA05, Site AGES-AD410-SA06. These Stone Age occurrences and its cultural context is probably of low scientific value due to the low frequency of lithics and formal diagnostic tools as well as the general loss of site context. The site is situated within the demarcated development area and the impact on the site by the proposed activity will be direct and of permanent duration where in essence, the impact might result in the possible confusing of the archaeological context and potential loss of archaeological material. The significance of the impact on the heritage resources is considered to be LOW but the threshold of the impact can be limited to a NEGLIBLE impact by the implementation of mitigation measures (monitoring) for the sites, if / when required. Structures dating to the Historical / Colonial Period in occur in the study area. The **Historical Period farm house and associated farmstead buildings** at **Site AGES-AD410-HP01** is older than 60 years, and these resources are therefore of heritage value. The sites are situated outside the footprint area but within the larger survey are and the impact on the sites by the proposed activity will be peripheral and of permanent duration where in essence, the impact might result in the possible destruction of sites. The significance of the impact on the heritage resources is considered MODERATE but the threshold of the impact can be limited to a NEGLIBLE impact by the implementation of mitigation measures (avoidance, monitoring) for the site, if / when required.

Heritage resources have been documented on the property and impact on these resources is anticipated. However, in the opinion of the Heritage Specialist, the proposed Avondale 1 Solar Park may proceed from a culture resources management perspective, provided that mitigation measures provided in the heritage assessment, endorsed by the relevant Heritage Resources authority, are implemented where applicable.

The layout plan has been conceived to **avoid all the heritage sites found on the property and a minimum 30 m buffer zone has been foreseen around them.**

A Palaeontological Desktop Study (Annexure H2) was conducted by Pr. B. Rubidge on July 2014.

The proposed development of the Avondale 1 Solar Park will extend over Precambrain rocks of the Koras Group as well as Tertiary calcrete deposits and Quaternary sands of the Kalahari Group. It is extremely unlikely that fossils will be exposed as a result of the solar park development. It is considered that, from a palaeontological perspective, the development of the proposed Avondale 1 Solar Park should proceed, but that if fossils are uncovered in the course of construction activities, the developer immediately calls in a qualified palaeontologist to assess the situation and, if necessary, undertake excavation of the fossils.

Figure 12: Vegetation Map of the project site

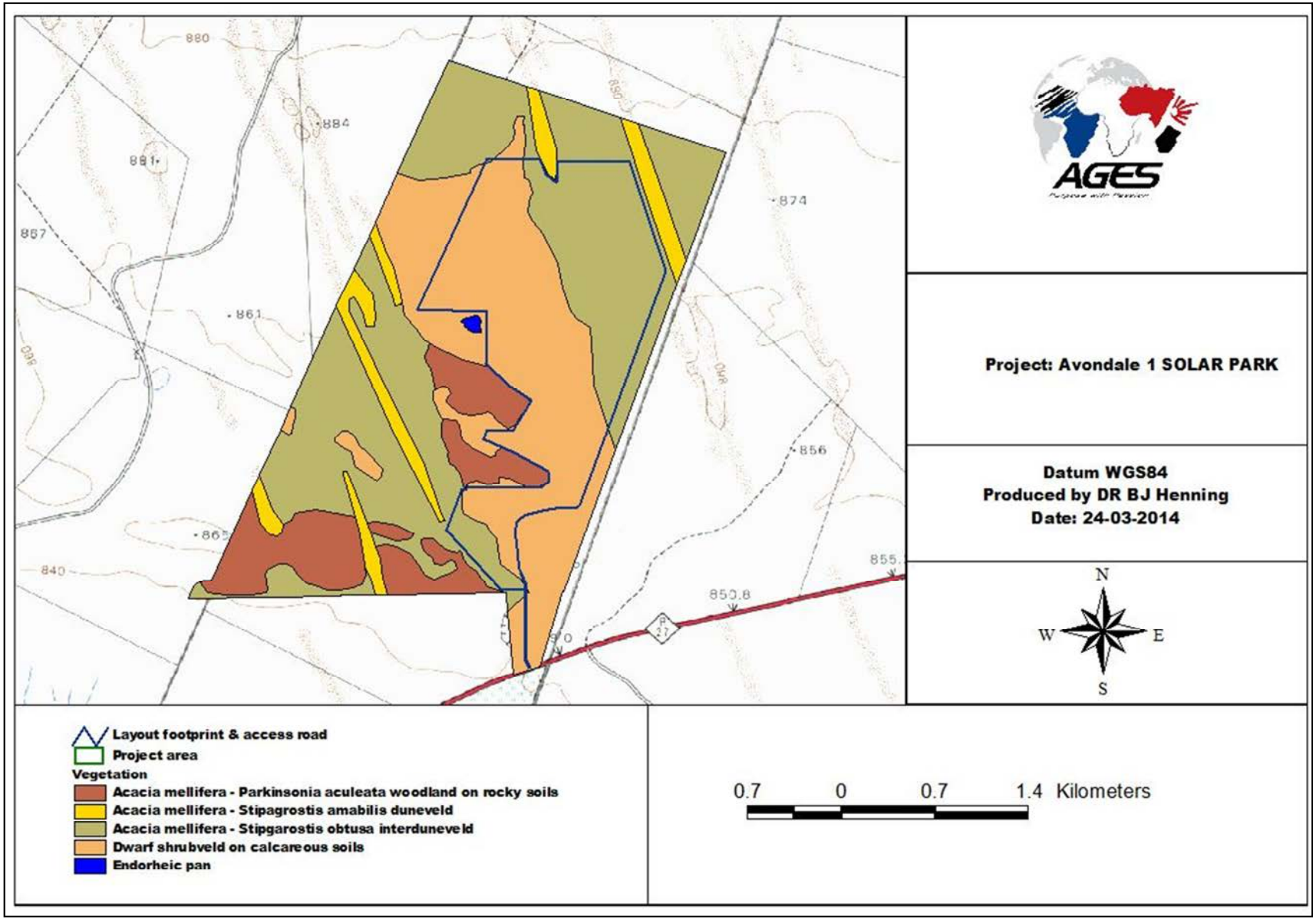


Figure 13: Sensitivity Map of the project site

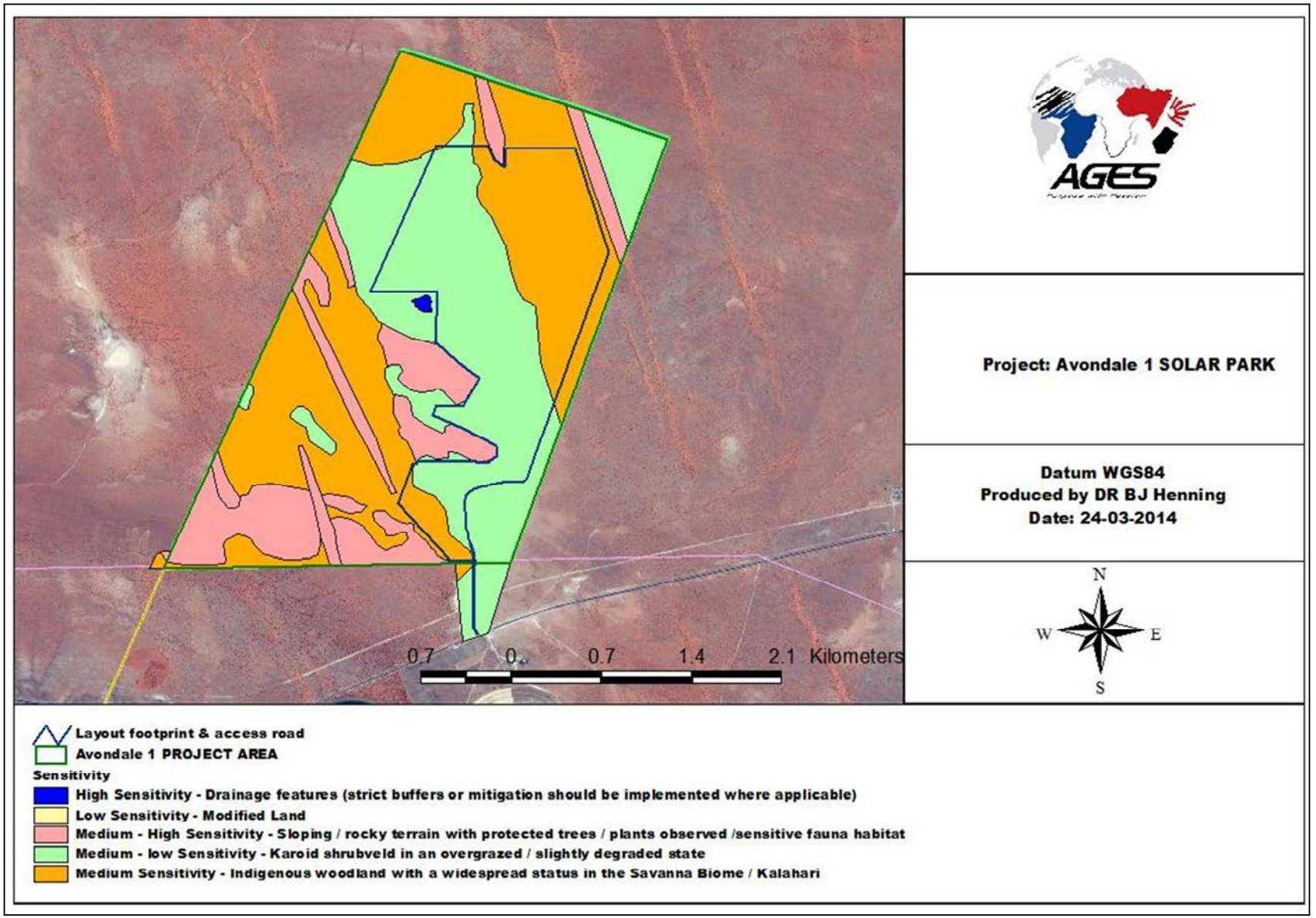


Figure 14: Agricultural Potential Map of the project site

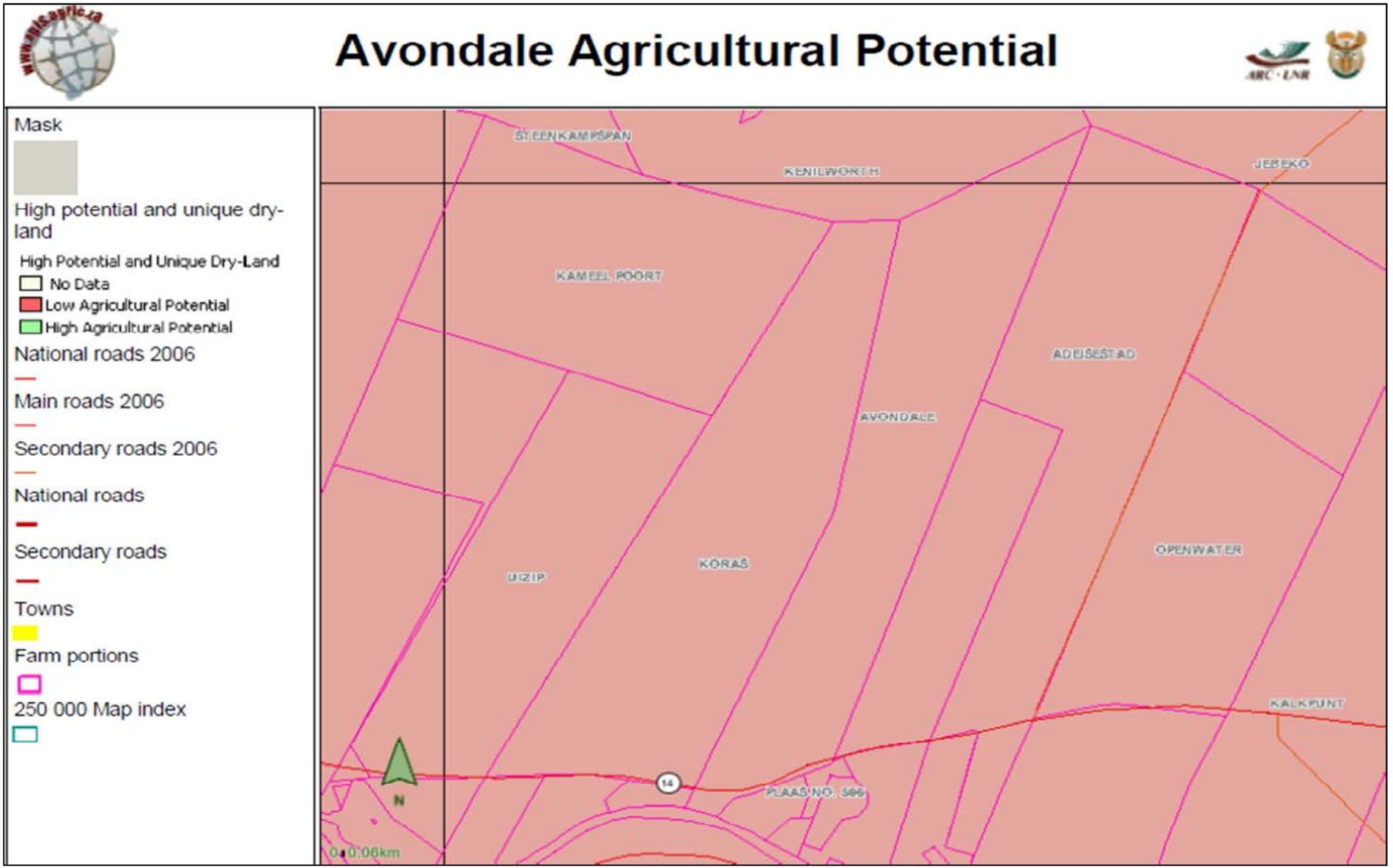


Figure 15: Land Capability Map of the project site

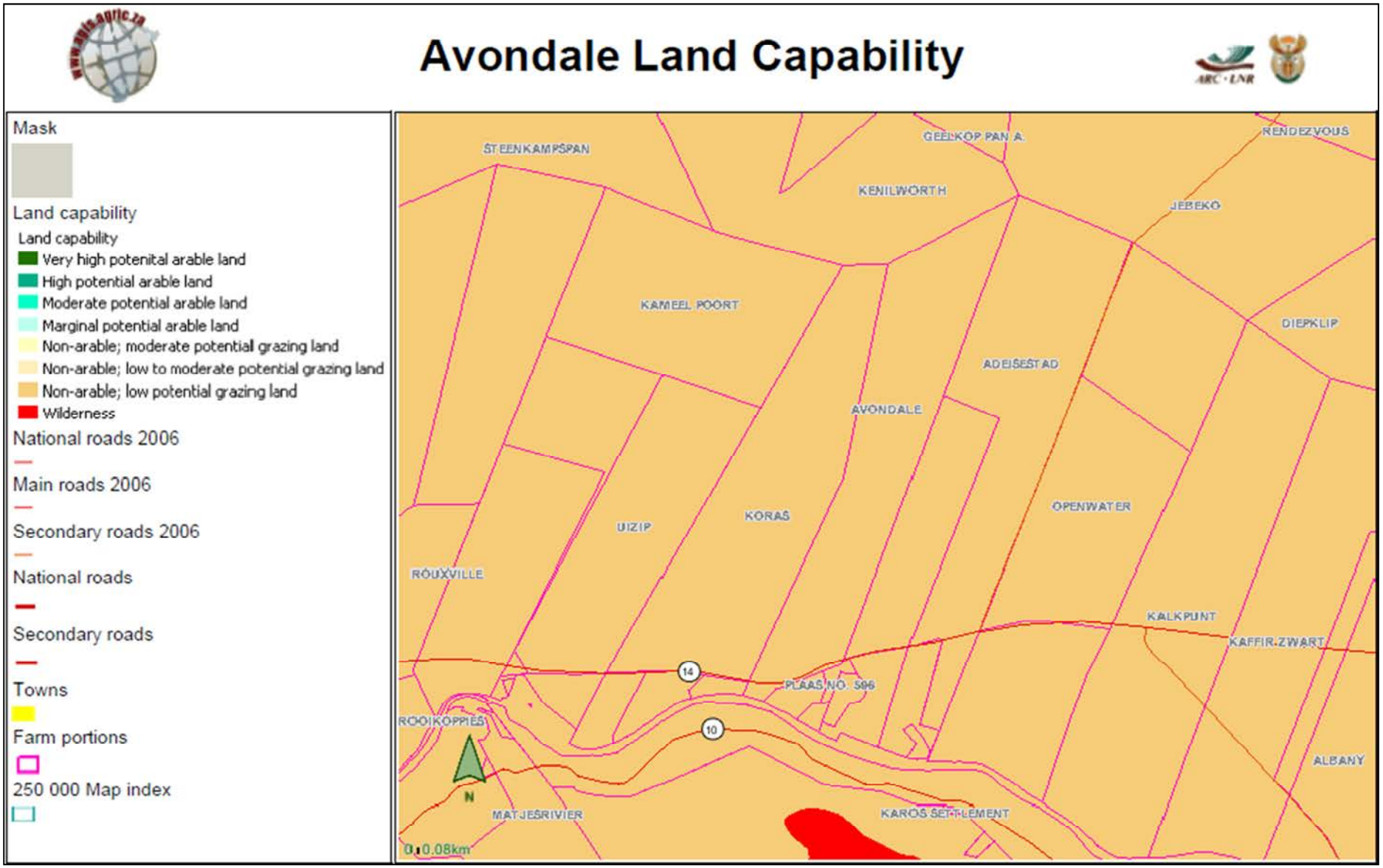


Figure 16: Potential Grazing Capacity Map (1993)

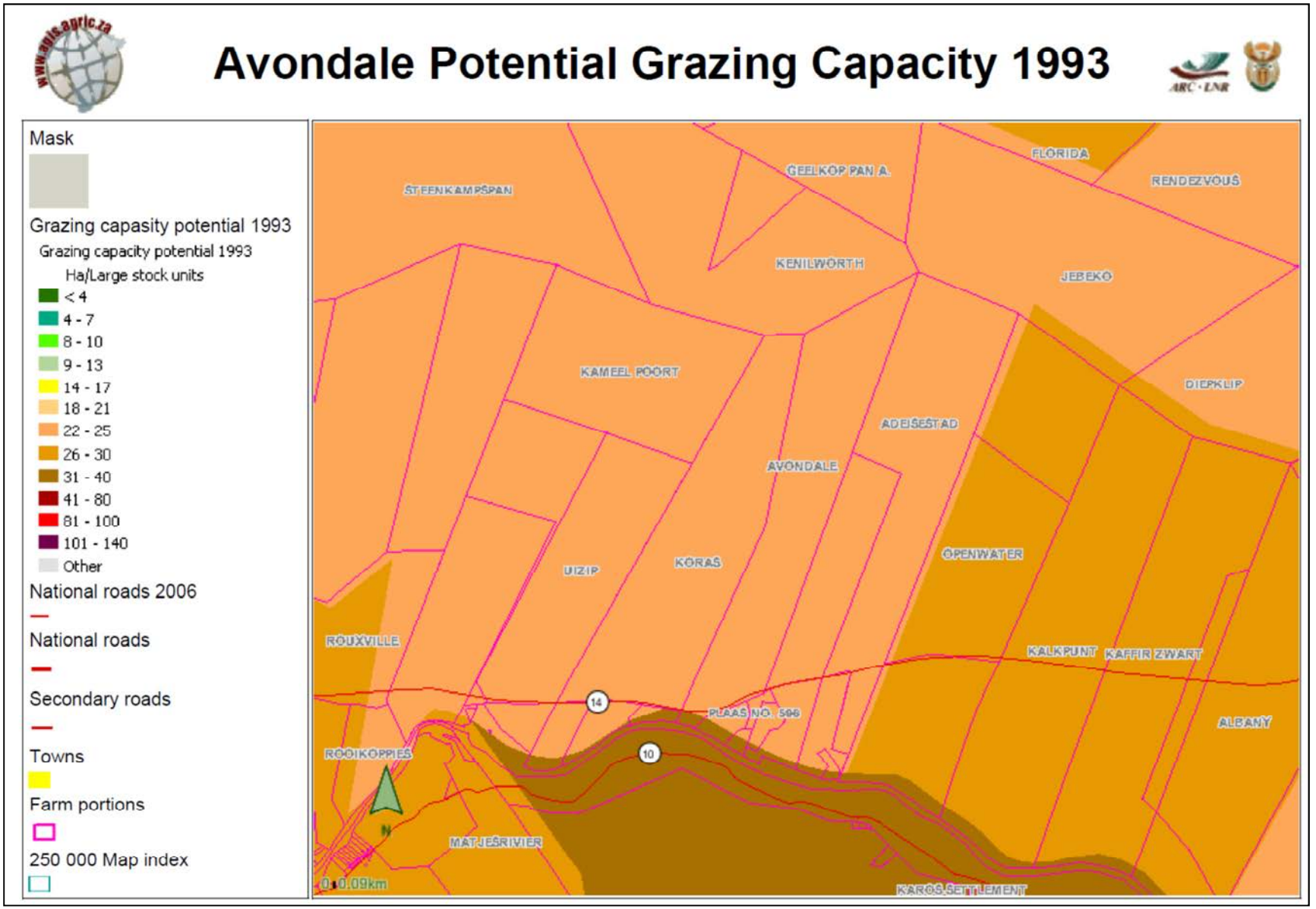
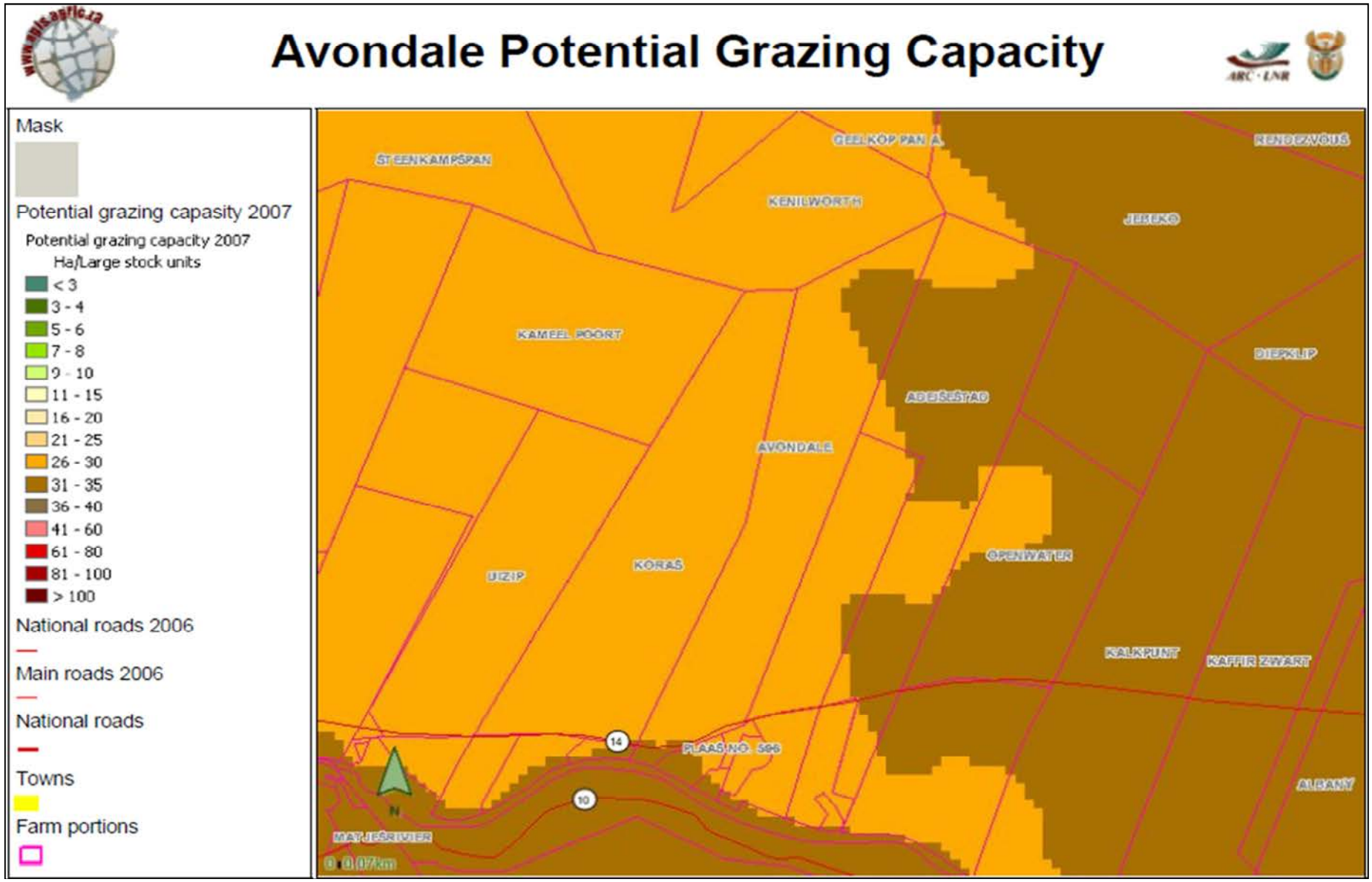


Figure 17: Potential Grazing Capacity Map (2007)



7. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS AND PUBLIC PARTICIPATION PROCESS (PPP)

The environmental impact studies can be summarized in a two-phased approach:

- Phase 1: Environmental Scoping Study (ESS)
- Phase 2: Environmental Impact Assessment (EIA) and Environmental Management Program (EMP)

The scope of the EIA procedure is to provide an assessment of all impacts related to the proposed project in compliance with the EIA Regulations 2010.

7.1. SCOPING PHASE

The Scoping Phase aims to produce the following:

- a description of the proposed activity, the property and the receiving environment;
- the identification of potential significant positive and negative impacts;
- the identification of opportunities and constraints, alternatives and mitigation measures which need to be evaluated and investigated during the successive EIA phase, especially in order to prevent environmental fatal flaws and sensitive or “no-go” areas.

The Scoping Phase includes the Public Participation Process. The PPP has the aim to identify concerns and issues by the interested and affected parties (I&AP’s).
Issues and concerns raised by the I&AP’s and key stakeholders during the Public Participation Process have been collected, processed and addressed in the Comments and Response document which forms a part of the Final Scoping Report.

All issues and concerns identified during the Scoping Phase were documented in the Final Scoping Report which was submitted to the DEA together with a Plan of Study for EIA.

7.2. EIA PHASE

The next (current) step of the EIA process is the development of guidelines for execution of the impact assessment and the compilation of an Environmental Impact Assessment Report.

The database of the stakeholders and I&AP’s developed during the scoping process is used as a reference to ensure that stakeholders are involved and participate in this second phase of the EIA process.
All relevant issues considered during the Scoping Phase were further investigated and assessed during the EIA Phase of this project. The EIA involves various specialist studies and should provide an overall assessment of the biophysical, social and economic environment affected by the proposed project.

A detailed assessment is carried out in terms of environmental criteria and rating of significant impacts of all options identified in the scoping phase. Appropriate mitigation measures are identified and recommended for all significant impacts. These measures have been included in the Environmental Management Programme (EMPr) submitted together with the Environmental Impact Assessment Report (EIAR) to the DEA.
During the EIA phase stakeholders and I&AP’s are notified in writing of the continuation of the project to the EIA Phase and are informed as to the way forward and where and when the Draft Environmental Impact Assessment Report is made available for review. Comments from the stakeholders and I&AP’s on the Draft EIR and the Draft EMPr have been incorporated into this Final EIAR.

The stakeholders and I&AP’s will furthermore be informed of the final decision regarding the Environmental Authorization and the appeal process.

7.3. PUBLIC PARTICIPATION PROCESS (PPP)

All relevant I&AP's have been identified and involved in the public participation process from the beginning of the project as per sections 54, 55, 56 and 57 of the EIA regulations 2010.

The public participation process offers the opportunity to become actively involved through constant sharing of information. The main purposes of the public participation process are to ensure that:

- all relevant information in respect of the application is made available to I&AP's for their evaluation and review;
- reasonable opportunity is given to I&AP's to comment and to submit queries related to the proposed project;
- comments and queries by the I&AP's to the Draft Scoping and to the EIA Reports are submitted and evaluated in a reasonable timeframe and in predetermined terms.

The initial informative stage of the public participation was done from 2 December 2013 until 15 January 2014.

The public was informed of the proposed development and a database of Interested and Affected parties was compiled.

In the enclosed Annexure C there is the list of all components of the public participation process.

The public was informed of the project by means of:

- Site notices;
- Background Information Documents (BID) sent to all adjacent land owners;
- Notices in a local newspaper; and
- Sending of BID to other possible interested and affected parties/stakeholders.

A data base of registered I&AP's has been established to date and will be maintained and added to as required.

Site notices were put up on site on the fence surrounding the proposed development area on 25 November 2013.

After a Deed Search was done on the surrounding properties Background Information Documents were sent to adjacent landowners. Proof of this is attached in Annexure C.A number of these documents were also distributed to the relevant governmental departments including *inter alia* Department of Water Affairs, Agriculture Land Reform & Rural Development. Other identified interested and/or affected parties/stakeholders include Eskom, the Local municipality, the District municipality *etc*. Proof of all correspondence is included in Annexure C.

A newspaper advertisement was published in the 10 January edition of the Gemsbok, which is a local daily newspaper as well as in the national daily newspaper.

One I&AP registration was received during the initial public participation process. It was from an adjacent landowner enquiring generally about the application.
Because there was so few responses, notifications were send out to all adjacent landowners and other stakeholders informing them that the Draft Scoping is available for comments and that it will be provided, on request. Also, because of the fact the newspaper neglected to publish the advertisement in December, another advertisement was place in the Gemsbok newspaper advertising the availability of the Draft Scoping Report as well as giving the public more time to register as I&APs.

All correspondence is included in Annexure C.

On 7 March 2014 notifications were sent out to all adjacent landowners and applicable governmental departments to indicate that the Final Scoping Report was available for public comment.

Hard copies of the Draft EIA Report and CD's containing the EIA report were sent to the Local Municipality office as well as all applicable governmental organizations for a commenting period of 40 days. CD's containing the report was also sent to I&AP's who requested copies after notifications were sent on 17 April 2014 to indicate the Draft EIA report is available for public comment.

The Final EIA Report was submitted to the DEA on 4 June 2014 and rejected on 4 August 2014. The Amended Final EIA Report was made available to the I&AP's and there is a 21 day commenting period during which the I&APs can send their comments to the DEA. After the I&APs have been notified and copies of the amended report sent to whomever requested it, the proof of this will be incorporated into the Public Participation Annexure

7.3.1. Further steps in Public Participation Process

To ensure a transparent and complete public participation process the following steps are still to be taken during the rest of the EIA process:

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- All I&APs and governmental organizations will be notified about the final decision of the DEA (Environmental Authorisation granted or not).
- A notice with regard to the department's decision will be published in a local newspaper

7.3.2. Results of the public participation process

Not a lot of registrations as I&APs were received throughout the public participation process. Mr. Leserwane from the Gamagara Local Municipality registered in the beginning of the process and all relevant documents were sent specifically to his office for his attention. However, no comments were received from him.

Comments were received from the Northern Cape Department of Environment and Nature Conservation (DENC) after submission of the draft EIA report, dated 23 April 2014.
In this letter the DENC only indicated who the appointed Environmental Officer is who is responsible for this project. However, no comments were received from him.
A notice was sent to the DENC indicating that the final EIA report was available for comments and still no correspondence were received from the DENC's office.

After the submission of the Draft EIA report (17 April 2014), comments were received from the Department of Agriculture, Land Reform and Rural Development, dated 13 May 2014.
The main concern was the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983).
Issues include the following:

- Utilisation and protection of vleis, marshes, water sponges and water courses.
- Rezoning as change of land use might be applicable.
- No problems are foreseen as long as there is adherence to Act 43 of 1983.

This letter was answered in a letter sent to notify all I&APs and departments that the Final EIA report is available. No further comments were received from this department.

Notifications were sent to I&APs to indicate that the final EIA report is available for comments, on 17 June 2014. It was specified that comments must be directed to the DEA (and the EAP) and the contact details were included in the letter. Proof of this is included in Annexure C.

On 4 August 2014 the DEA sent a letter indicating that the final EIA report for Avondale Solar Park is rejected and a number of reasons were given to motivate this decision.
As a result of the rejection of the EIA report an amended report had to be compiled and again made available to the I&APs and government departments.

A notification letter was sent on 17 September 2014, by e-mail and it was requested that acknowledgement of receipt of the letter is sent.

A number of I&APs requested a copy of the amended report on CD and these were sent by registered mail. Proof of all correspondence pertaining to the amended EIA report is included in Annexure C.

8. METODOLOGY USED FOR THE IDENTIFICATION AND ASSESSMENT OF THE IMPACTS

The potential environmental impacts identified in the study have been quantified and the significance of the impacts has been assessed according to the criteria set out below. Each impact has been assessed and rated. The assessment of the data, where possible, has been based on broadly accepted scientific principles and techniques. In defect, judgements and assessments are necessarily based on the consultant's professional expertise and experience.

8.1. PROJECT PHASING

For the purpose of assessing these impacts, the project has been divided into phases from which impacting activities can be identified:

- **Planning**
- **Site clearing & construction phase**
- **Operational phase**

The phases have been carefully examined in relation to the PV plant and in relation to the connection infrastructure. Indeed, as already described, in this document all impacts and mitigations are defined also for the connection infrastructure, although this part of the project may be executed, owned and operated by Eskom.

As far as the **decommissioning** phase is concerned, it is important to specify that this phase will be subject to a decommissioning plan once the project is nearing its operational life (25-30 years). Decommissioning will also be subject to an environmental authorization (Activity 27 of R544 of 18 June 2010).

This phase is important because it states the **reversibility of the development** and has to be carefully planned and executed, in order to enable the natural re-growth of indigenous vegetation and fauna re-population as well as the reuse of the area for agricultural and grazing purposes. For this reason, in the Draft Environmental Management Plan the decommissioning phase has been included and carefully analyzed, in order to anticipate activities and actions to be taken in order to minimize the relevant impacts.

The decommissioning phase, as described in Chapter 10, is similar to the commissioning phase but all possible care must be considered for the recycling of the materials and for the re-establishment of the site as it was the *status quo – ex ante* the development.

8.2. ASSESSMENT CRITERIA

The terms of reference for the study include criteria for the description and assessment of environmental impacts. These criteria are drawn from the Integrated Environmental Management Guidelines Series, Guideline 5: Assessment of Alternatives and Impacts, published by the Department of Environmental Affairs and Tourism in terms of the Environmental Impact Assessment. These criteria include:

Table 8: Impact Assessment Criteria

Nature of impact This is an appraisal of the type of effect the proposed activity would have on the affected environmental component. The description should include what is being affected, and how.		
Extent The physical and spatial size of the impact.	**Site**	The impact could affect the whole, or a measurable portion of the above-mentioned properties.
	Local	The impacted area extends only as far as the activity, e.g. a footprint.
	Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.
Duration The lifetime of the impact; this is measured in the context of the lifetime of the proposed base.	**Short term**	The impact will either disappear with mitigation or will be mitigated through natural process in a span shorter than any of the phases.
	Medium term	The impact will last up to the end of the phases, where after it will be entirely negated.
	Long term	The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter.
	Permanent	The only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.
Intensity	**Low**	The impact alters the affected environment in such a way that the natural processes or functions are not affected.
	Medium	The affected environment is altered, but function and process continue, albeit in a modified way.
	High	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
Probability This describes the likelihood of the impacts actually occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time.	**Improbable**	The possibility of the impact occurring is very low, due either to the circumstances, design or experience.
	Probable	There is a possibility that the impact will occur to the extent that provisions must be made therefore.
	Highly probable	It is most likely that the impacts will occur at some or other stage of the development. Plans must be drawn up before the undertaking of the activity.
	Definite	The impact will take place regardless of any prevention plans, and there can only be relied on mitigation actions or contingency plans to contain the effect.
Determination of significance.	**No**	The impact is not substantial and does not require

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.	**significance**	any mitigation action.
	Low	The impact is of little importance, but may require limited mitigation.
	Medium	The impact is of importance and therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels.
	High	The impact is of great importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential.

The general approach to this study has been guided by the principles of Integrated Environmental Management (IEM). In accordance with the IEM Guidelines issued by the DEA, an open, approach, which encourages accountable decision-making, has been adopted. The underpinning transparent principles of IEM require:

- informed decision-making;
- accountability for information on which decisions are made;
- a broad interpretation of the term “environment”;
- an open participatory approach in the planning of proposals;
- consultation with I&APs;
- due consideration of alternatives;
- an attempt to mitigate negative impacts and enhance positive impacts of proposals;
- an attempt to ensure that the social costs of development proposals are outweighed by the social benefits;
- democratic regard for individual rights and obligations;
- compliance with these principles during all stages of the planning, implementation and decommissioning of proposals; and
- the opportunity for public and specialist input in the decision-making process.

The study is also guided by the requirements of the EIA Regulations in terms of the NEMA. The NEMA EIA Regulations, which are more specific in their focus than the IEM principles, define the detailed approach to the EIA process.

9. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

9.1. POTENTIAL IMPACTS

Potential impacts associated with the construction and operational phases of the Avondale 1Solar Park together with its connection infrastructure are outlined and evaluated hereinafter.

As previously described, **construction activities** for the establishment of PV power plant include:

- land clearing activities necessary for preparation of the site and access routes;
- excavation and filling activities;
- transportation of various materials;
- construction of the storage structures;
- installation of the PV modules and construction of associated structures and infrastructure;
- construction of the on-site high-voltage substation;
- construction of a132 kV power line (double circuit) which will deliver the energy to the **Eskom "Garona - Gordonia" 132 kV power line** crossing the project site.

Environmental impacts associated with the **operational phase** of a solar energy facility may include visual and other impacts.

The **decommissioning activities** of the PV plant mainly include the removal of the project infrastructure and the restoring of the site *status quo ante*.

The identification of impacts will be based on:

- legal and administrative requirements;
- the nature of the proposed activity;
- the nature of the receiving environment;
- specialist studies;
- issues raised during the public participation process.

Potential impacts may include:

- Impacts on soils & agricultural potential;
- Impacts on ground water;
- Impacts on the road system and traffic;
- Impacts on air quality and potential emissions;
- Geological, soil and erosion impacts;
- Impacts on avifauna;
- Impacts on vegetation;
- Impacts on heritage resources;
- Noise impacts;
- Impacts on tourism;
- Social impacts;
- Visual impacts.

9.2. CUMULATIVE IMPACTS

Cumulative impacts were assessed and it was found that due to the distance of other renewable energy developments from the proposed Avondale 1 Solar Park, the cumulative impacts will be very low. Also, a number of mitigation measures are proposed which will lead to the impacts that may result from the establishment of the Avondale 1 Solar Park to be low. The cumulative impacts of each of the possible impacts are also assessed hereunder.

9.3. SPECIALIST STUDIES

Due to the nature of the project, a number of specialist studies are required in the EIA process in order to investigate the potential environmental impacts associated with the proposed development. Detailed studies on potentially significant impacts have been carried out to address these impacts throughout the EIA process.
The public participation process provides valuable information in the identification of issues requiring further and specific investigation throughout the EIA process.
The specialist studies which have been conducted and attached to this EIA Report are the following:

- Ecological Impact Assessment (Annexure D)
- Avifauna Impact Assessment (Annexure E)
- Agricultural Potential Assessment (Annexure F)
- Wetland Delineation Study (Annexure G)
- Heritage Impact Assessment (Annexure H1)
- Palaeontological Desktop Study (Annexure H2)
- Geo-technical and Geo-hydrological Report (Annexure I)
- Visual Impact Assessment (Annexure J)
- Socio-economic Impact Assessment (Annexure K)
- Services Report (Annexure L)

9.4. IMPACTS & MITIGATION MEASURES

9.4.1. Construction & operational phases impacts and mitigation measures

All the possible impacts that can be predicted in both the construction and operational phases of the PV plant are addressed. Specific mitigation measures are proposed and the significance of these impacts is described with and without the mitigation measures.

Considering that all or part of the construction infrastructure may be owned and/or operated by Eskom, the mitigation measures described in the following paragraphs and in particular in the attached Environmental Management Plan can be, accordingly, of the responsibility of Eskom or of the developer.

9.4.1.1. Atmospheric pollution and noise

Construction Phase
During this phase there will be a concentration of earthmoving equipment and construction vehicles that will level the area, clear vegetation for construction purposes and in the process will create dust and exhaust smoke that will impact on air quality. There will also be more noise created by the vehicles during this phase. Burning of waste and fires at construction sites may also create smoke.

Operational phase
The increased traffic volumes and people will lead to increased levels of air pollution and noise. Smoke from burning of waste can cause air pollution.

Project Phase	Impact :Atmospheric Pollution and noise								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Earthworks and Vegetation clearance	Air pollution : Dust	Low-medium	Medium-high	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Vehicle movement	Air pollution : Smoke	Low	Medium-high	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Vehicle movement	Air pollution : Dust	Low	Medium-high	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Vehicle movement	Noise pollution	Low-medium	Medium-high	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Burning of cleared vegetation, solid waste & veld fires	Air pollution by excessive smoke	Low-medium	Medium-high	Low-medium	Medium	Medium	Low-medium	Medium
	Cooking fires of workers	Air pollution : Smoke	Low	Medium-high	Low-medium	Medium	Medium	Low	Medium
Operation	Vehicle movement	Noise pollution	Low-medium	Medium-high	Low-medium	High	Medium-high	Low-medium	Medium
	Fireplaces and veldt fires	Air pollution caused by smoke	Low-medium	Medium-high	Low-medium	High	Medium-high	Low-medium	Medium
	Burning of vegetation refuse and solid waste	Air pollution by excessive smoke	Low-medium	Medium-high	Low-medium	High	Medium-high	Low-medium	Medium
Cumulative impacts	Pollution & Noise	Increase in release of smoke and increase in noise levels	Low	Medium-high	Low-medium	Medium	Medium	Low	Medium

Mitigation measures - Construction Phase

- Vehicles must be well serviced so that it does not produce excessive smoke and noise.
- Speed of construction vehicles should be kept as low as possible to reduce the generation of dust and noise.
- Construction areas must be damped to prevent excessive dust formation.
- The clearing of the site should be done in phases as the construction progresses.
- Construction should only take place during the hours between sunrise and sunset on weekdays and Saturdays.
- Contractors must comply with Provincial noise regulations. The construction machinery must be fitted with noise mufflers and be maintained properly.
- Vegetation cleared from the site and solid waste generated by the construction teams may not be burned on site or the surrounding areas, but be regularly removed to the municipal waste disposal site.
- Fire belts must be made around the development according to the regulations of the Veld and Forest Fire Act.
- The cleared vegetation should stock-piled and removed to a licensed waste disposal site on a regular basis.

Mitigation Measures - Operational Phase

- Speed of vehicles on roads should be controlled e.g. speed bumps and speed restrictions.
- All roads should preferably be sealed to eliminate dust formation caused by strong winds and vehicle movement.
- Solid waste should not be burned on the project area.
- Fire belts around the development must be made according to the regulations of the Veld and Forest Fire Act.
- Vegetation refuse should be composted if possible and re-used.

9.4.1.2. Groundwater and surface water pollution

Construction Phase

- Lack of sanitation could result in ground water pollution and associated health risks.
- Construction vehicles will be refuelled at the construction camp.
- Spillage of fuel and lubricants from construction vehicles could occur. Storm water contamination by solid waste could lead to groundwater and surface water pollution.
- In this phase the soil cover as well as the vegetation is removed and storm water over the area could cause erosion as well as siltation of watercourses. Road construction will also increase the possibility of erosion and the siltation/sedimentation of surface water streams, because of increased storm water run-off.

Operational Phase

- Pollution as a result of sanitation leakages, solid waste and erosion may lead to water pollution. Storm water run-off over open areas can cause erosion as well as the washing of soil into the surface water streams.
- Storm water flowing over sealed and/or paved areas could lead to ground and surface water pollution. Chemicals from the vehicle wash area could negatively impact on the quality of surface and groundwater resources.
- Fertilizers, pesticides and herbicides used at the project during operation can create pollution if not handled and applied correctly.

Project Phase	Impact: Groundwater and Surface water Pollution								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Spillage of fuel and lubricants from construction vehicles	Water Pollution	Medium	Medium-high	Low-medium	Medium-high	Medium-high	Low	Medium
	Clearing of vegetation	Erosion & siltation of streams	Low-medium	Medium-high	Low-medium	Medium	Medium-high	Low-medium	Medium
	Solid waste disposal freshwater resources	Pollution of freshwater resources	Low	Medium-high	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Sanitation seepage from chemical toiletsand/or from the temporary sanitation system	Water Pollution	Medium	Medium-high	Low-medium	Medium	Medium	Low	Medium

Project Phase	Impact: Groundwater and Surface water Pollution								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Operation	Spillage of fuel and lubricants from vehicles	Water Pollution	Medium	High	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Solid waste disposal- freshwater resources	Water Pollution	Low	High	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Leakage from the permanent Sanitation system	Water Pollution	Medium-high	High	Medium	Medium	Medium-high	Low-medium	Medium-high
	Use of fertilizers, insecticides and herbicides	Pollution of streams & rivers	Low-Medium	High	Low-medium	Medium	Medium	Low-medium	Medium
	Storm water runoff	Erosion & siltation of streams	Low-medium	Medium-high	Low-medium	Medium	Medium-high	Low	Medium
Cumulative impacts	Water pollution and increased water run-off	Increased potential for water pollution and increased water run-off	Low-Medium	High	Low-medium	Medium	Medium	Low-medium	Medium

Mitigation measures - construction phase

The following precautionary measures are recommended to prevent any surface or groundwater pollution:

- The solar park development should be restricted to Land Use Areas A and B indicated in the Geo-technical and Geo-hydrological Study (Annexure I).
- Clearance of vegetation should be restricted to 270 ha footprint and access road.
- Construction activities should be restricted to the proposed 270 footprint.
- The disturbed quarry / drainage located close to the south-eastern boundary of the property should be excluded by the PV plant footprint, due to erosion problems, as recommended in the Geo-technical and Geo-hydrological Study (Annexure I).
- Cleared areas should be rehabilitated by reintroducing a grass layer as soon as possible to limit the occurrence of erosion.
- Berms to limit the flow of water over cleared areas will limit erosion and the siltation of surface streams. Preference should be given to plant species indigenous to the area.
- Drip pans should be used during re-fuelling and servicing of construction vehicles. Used parts like filters should be contained and disposed of at a site licensed for dumping of these waste products.
- Oil traps must be installed in the vehicle wash bay to prevent pollution. Oil traps must be serviced on a regular basis by an approved service agent.
- Diesel storage must not exceed 80 000 litres at construction camps. Diesel tanks and other harmful chemicals and oils must be within a bunded area.
- The vehicle maintenance yard and construction storage area should be placed 100m away from watercourses. This area should have bund walls and lined with impermeable material to prevent ground and surface water pollution.

- Chemical sanitation facilities and the temporary sanitation system in the construction site should be regularly serviced by appropriate companies to ensure that no spills or leaks to surface and groundwater take place. Chemical toilets and the temporary sanitation system should not be placed within 100m from any watercourse.
- Solid waste must be kept in adequate waste bins. Building rubble and various waste should be removed on a regular basis to a licensed landfill site.

Mitigation measures - operational phase

- Solid waste must be kept in adequate waste bins and removed on a weekly basis to a waste disposal site.
- The use of eco-friendly products e.g. Organic Compost, herbicides and insecticides should be promoted.
- The permanent sanitation system should be regularly inspected to ensure that no spills or leaks from sanitation system to groundwater take place.

9.4.1.3. Water use / water quantity

Construction phase

During this phase, water consumption will be the highest because it will be utilized for gravel roads and building constructions. The water needed for the construction activities will be provided either:

- from the Orange River,
- from the Local Municipality, by means of water tank trucks.

Operational phase

Water use will be limited except for short periods(twice per year) when the PV modules are cleaned. The water needed for the operational phase will be provided either:

- from the existing on-site borehole,
- from the Orange River,
- from the Local Municipality, by means of water tank trucks.

Project Phase	Impact: Water use								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Construction process	Depletion of water resources: Water consumption	Low-medium	Medium-high	Medium-high	High	High	Medium	Medium-high
Operational	Water use & cleaning of panels	Depletion of water resources: Water consumption	Low	High	Medium	High	High	Low-Medium	Medium
Cumulative impacts	Water use	Increased pressure on local water resources	Medium	Medium - High	Very Low	Low	Low-Medium	Low-Medium	Medium

Mitigation measures – Construction Phase

- Water should be used sparingly and it should be ensured that no water is wasted.
- Roads should be treated with chemicals to lower the use of water.
- Washing of construction vehicles should be limited to once or twice a month and must be done with high-pressure sprayers to reduce water consumption.

- Drinking water supply for the staff on site should be treated through an osmotic water filtration system.

Mitigation measures - Operational Phase

- Cleaning of panels should be done only when necessary, twice per year.
- Roads should be treated with chemicals to lower the use of water.
- Washing of vehicles should be limited to once a week and must be done with high-pressure sprayers to reduce water consumption.
- Care must be taken not to waste any water. In the offices, half-flush systems in the toilets as well as water aerators in all taps must be installed to reduce water consumption.
- The workers should be educated on the value of water and how to use it sparingly.
- Drinking water supply for the staff on site should be treated through an osmotic water filtration system.

9.4.1.4. Land and soils

Planning phase

The high and medium-high sensitivity areas (***duneveld areas and woodland associated with shallow rocky soils, endorheic pan***) should remain undeveloped - in compliance with the requirements highlighted in the Ecological Impact Assessment (Annexure D) and in the Geo-technical and Geo-hydrological Study (Annexure I).

The disturbed quarry / drainage located close to the south-eastern boundary of the property should be excluded by the PV plant footprint, due to erosion problems, as recommended in the Geo-technical and Geo-hydrological Study (Annexure I).

The solar park development should be restricted to **Land Use Areas A and B** indicated in the Geo-technical and Geo-hydrological Study (Annexure I).

Construction phase

During construction, the vehicles used have the potential to spill diesel and lubricants that can pollute the soil. The storage of solid waste before it can be disposed of has the potential to pollute the soil and becomes a nuisance.

Operational phase

Solid waste can be a nuisance and has the potential to pollute the soil if not managed correctly. The use of conventional fertilizers, herbicides and insecticides should be limited as far as possible. Wastewater from activities can pollute the soil.

Project Phase	Impact: Land and soils								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Spilling of oil/diesel by construction machines	Contamination of soil	Medium	Medium-high	Low-medium	Medium-high	Medium-high	Low	Medium
	Solid waste disposal	Soil pollution + nuisance	Low	Medium-high	Low-medium	Medium-high	Medium-high	Low-medium	Medium
	Storm water over roads and cleared areas	Erosion	Low-medium	Medium-high	Low-medium	Medium	Medium-high	Low-medium	Medium
	Trenches for electric cables and water and sewerage pipes	Erosion	Low-Medium	Medium-high	Low	Medium	Medium-High	Low-medium	Medium
Operation	Solid waste	Soil pollution + nuisance	Low	High	Low-Medium	Medium-High	High	Low	Medium
	Storm water from paved areas and roofs	Erosion	Low-medium	High	Low-medium	Medium	Medium-high	Low	Medium
	Use of fertilizers, insecticides and herbicides	Pollution	Low-Medium	High	Low-medium	Medium	Medium	Low-medium	Medium
Cumulative impacts	Increased potential for negative impacts on soil resource	Increased potential for erosion and soil pollution	Low-medium	High	Low-medium	Medium	Medium-high	Low	Medium

Mitigation measures - Construction Phase

- The high and medium-high sensitivity areas (*duneveld areas and woodland associated with shallow rocky soils, endorheic pan*) should remain undeveloped - in compliance with the requirements in the Ecological Assessment (Annexure D) and Geo-technical and Geo-hydrological Study (Annexure I).
- The solar park development should be restricted to Land Use Areas A and B indicated in the Geo-technical and Geo-hydrological Study (Annexure I).
- Clearance of vegetation should be restricted to 270 ha footprint and access road.
- Construction activities should be restricted to the proposed 270 footprint.
- The disturbed quarry / drainage located close to the south-eastern boundary of the property should be excluded by the PV plant footprint, due to erosion problems, as recommended in the Geo-technical and Geo-hydrological Study (Annexure I).
- Construction vehicles must be well maintained and serviced to minimise leaks and spills.
- Spill trays must be used during refuelling of vehicles on site.
- Diesel storage must not exceed 80 000 litres at construction camp. Diesel tanks and other harmful chemicals and oils must be within a bunded area.

- Solid waste must be kept in containers and disposed of at a licensed dumping site.
- Any building rubble must be removed to a licensed disposal site on a regular basis during construction.
- Trenches that are dug for the supply of services and electrical cables must be filled up and compacted well and slightly higher than the areas around it.
- The clearing of the site should be done in phases as the construction progresses.
- Slopes produced by removing soil must be kept to a minimum to reduce the chances of erosion damage to the area.

Mitigation measures - Operational Phase

- Solid waste must be kept in adequate waste bins and removed on a weekly basis to the waste disposal site.
- The surface drainage system should be monitored after storms and storm water damage should be repaired. The maintenance of the roads must be kept up to standard to prevent and reduce the incident of erosion next to the roads.
- The use of eco-friendly products e.g. organic compost, herbicides and insecticides should be promoted.

9.4.1.5. Archaeological, Cultural and Social Features

Planning phase

The layout plan should be conceived in order to avoid all the heritage sites found on the property.

Construction phase

The clearing of the site may have a negative impact on the archaeological features of the site. Care must be taken in the excavations and moving of soil to observe any archaeological feature of importance, which must be left and reported to the archaeological consultant for comments and actions.

Operational phase

The operational phase will not have any negative impact on the archaeological features of the site, if the recommendations of the Heritage Impact Assessment and Palaeontological Desktop Study (Annexures H1 and H2) to be undertaken will be adhered to.

Project Phase	Impact: Loss of Archaeological, Cultural and social features								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Earth moving and soil clearance	Destroy archaeological evidence and heritage and graves	Low-medium	Medium-high	Low	Low	Low-medium	Low	Low-medium
Operation	Operational activities of development	Destroy archaeological evidence and heritage and graves	Low-medium	High	Low	Low	Low-medium	Low	Low-medium
Cumulative impacts	Activities on site during construction and operational	Increase in potential to unearth archaeological evidence and graves	Low-medium	High	Low	Low	Low-medium	Low	Low-medium

Mitigation measures – Construction and operational phases

All the heritage sites found on the property should be excluded from the PV plant footprint and a minimum 30 m buffer zone is recommended.

Care must be taken during the construction process that anything of archaeological value that is unearthed must be recorded. Please refer to the Heritage Impact Assessment (Annexure H1). The archaeologist or SAHRA must be notified whenever anything of importance is discovered.

According to the Palaeontological Desktop Study (Annexure H2), because of the nature of the construction of solar parks it is extremely unlikely that the proposed development will have any effect on palaeontological heritage. However if fossils are exposed in the Tertiary calcretes and Quaternary deposits of the Kalahari Group, it will create a unique opportunity to explore the area for fossils. It is thus recommended that, in the unlikely event that fossils are exposed as a result of construction activities, a qualified palaeontologist must be contacted to assess the exposure for fossils before further development takes place so that the necessary rescue operations are implemented. Depending on the nature of the fossils discovered this could entail excavation and removal to a registered palaeontological museum collection. A list of professional palaeontologists is available from SAHRA.

9.4.1.6. Impact of the development on the ecology (fauna & flora) of the area

Planning and construction phase

The removal of natural vegetation and destruction of habitat will have a negative effect on the biodiversity. The specific mitigation measures included in the Ecological and Avifauna Impact Assessment (Annexures D & E) should be adhered to.

The high and medium-high sensitivity areas (***duneveld areas and woodland associated with shallow rocky soils***, ***endorheic pan***) should remain undeveloped - in compliance with the requirements highlighted in the Ecological Impact Assessment (Annexure D) and in the Geo-technical and Geo-hydrological Study (Annexure I).

The disturbed quarry / drainage located close to the south-eastern boundary of the property should be excluded by the PV plant footprint, due to erosion problems, as recommended in the Geo-technical and Geo-hydrological Study (Annexure I).

Operational phase

The operation of the development can have a negative impact on the bio-diversity if it is not managed correctly. Exotic invasive plant species can have a negative impact on the indigenous vegetation.

Project Phase	Environmental Aspect: Ecology (Fauna and Flora)								
	Activity that causes impact	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Earthworks and vegetation clearance at construction site	Loss of indigenous plant species & disturbance to sensitive habitat	Medium	Medium	Low-Medium	Medium	Medium-High	Low-medium	Medium
	Vegetation clearance and the use of herbicides to control re-growth at the different development areas	The eradication and control of exotic invasive plant species Loss of indigenous plant species	Medium	Medium	Medium	Low-Medium	Medium-High	Low-Medium	Medium
	The occurrence of veldt fires on site	Destruction of flora/habitats Loss of indigenous fauna	Medium-High	Medium	Medium	Medium-High	High	Medium	Medium-high

Project Phase	Environmental Aspect: Ecology (Fauna and Flora)								
	Activity that causes impact	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
	Littering (e.g. cans and plastics) along access road and at construction site	Public nuisance and loss/death of indigenous fauna	Low-Medium	Medium	Medium	Medium-High	Medium	Low	Medium
	The control of animals on site Killing, poisoning or hunting of animals	Loss of indigenous fauna to the area	Medium-High	Medium	Medium	Medium	Low-Medium	Low-Medium	Medium
Operation	Rehabilitation of cleared areas	The spreading of exotic invasive plant species Loss of habitat and indigenous flora	Medium	High	Medium	Low-Medium	Medium	Low-Medium	Medium
	The occurrence of veldt fires	The loss of indigenous fauna and flora	Medium-High	Medium	Medium	Low-Medium	High	Medium	Medium-high
	The functioning of the permanent sewage treatment systems – treated sewage outflow	Deterioration in the habitat for avifauna and aquatic life	Medium-High	High	Medium	Medium-High	Medium	Low-Medium	Medium-High
	Disposal and storage of solid waste and littering	The death/loss of indigenous fauna e.g. raptors, mammals and reptiles	Medium-High	High	Medium-High	Medium-High	Medium	Low-Medium	Medium
	The control of pests and vermin	Killing and poisoning of fauna feeding on the poisoned vermin or pest	Low-Medium	High	Low-Medium	Medium-High	Medium	Low	Medium
	The feeding of fauna e.g. birds &small mammals	Disturbance to bio-diversity and the natural movement of the animals through the site The death/loss of indigenous fauna	Low-Medium	High	Low-Medium	Medium-High	Low-Medium	Low	Medium
	Catching of wild animals e.g. reptiles, bids and small mammals as pets	Disturbance to bio-diversity and decline in indigenous faunal numbers	Medium-High	High	Low-Medium	Low-Medium	Low	Low	Medium
	Birds colliding with power line and panels	Electrocution of birds	Medium-High	High	Low-Medium	Low-Medium	Low	Low	Medium
	The erection of fences and the construction of roads with a kerb	The fragmentation of available habitat and the restriction of movement of small mammals, reptiles and amphibians	Low-Medium	High	Low-Medium	High	Medium	Low	Medium
Cumulative Impacts	Increased potential of negative impacts on ecology of the area	Increase in natural vegetation to be removed.	Medium-High	High	Medium-High	Medium-High	Medium	Low-Medium	Medium

Mitigation measures – Construction phase

- Clearance of vegetation should be restricted to 270 ha footprint and access road.
- Construction activities should be restricted to the proposed 270 footprint.

- Care must be taken that unnecessary clearance of vegetation does not take place. Where possible, natural vegetation must be retained.
- The herbaceous layer should be revived after clearance of the vegetation and actively managed through slashing during the entire lifetime of the project.
- The high and medium-high sensitivity areas (*duneveld areas and woodland associated with shallow rocky soils, endorheic pan*) should remain undeveloped - in compliance with the requirements highlighted in the Ecological Impact Assessment (Annexure D) and in the Geo-technical and Geo-hydrological Study (Annexure I).
- A monitoring plan is recommended for the construction phase.
- The following protected tree species may occur in the proposed development area: *Boscia albitrunca* (Shepherds tree) which is dually protected in terms of NFA and NCNCA, and *Acacia erioloba* (Camel thorn). A license application should therefore be submitted to DAFF and DENC before any of these trees can be removed during construction. Protected trees and protected plant species can only be removed once the necessary permits have been obtained (DAFF and DENC).
- The project should comply with the *Northern Cape Nature Conservation Act* (Act No. 9 of 2009).
- The disturbed quarry / drainage located close to the south-eastern boundary of the property should be excluded by the PV plant footprint, due to erosion problems, as recommended in the Geo-technical and Geo-hydrological Study (Annexure I).
- The herbicides used to control the invasive plant species should be chosen in consultation with an ecologist, as some of the agents might be detrimental to the surrounding indigenous fauna and flora e.g. Roundup is for example extremely toxic to frogs.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.
- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
- Fires should only be allowed in designated places within the construction camp and extra care should be taken to prevent veldt fires of occurring.
- Firebreaks should comply with the National Veldt and Forest Fire Act, 1998 (Chapter 4: Duty to Prepare and maintain firebreaks).
- Cleared areas should be rehabilitated by reintroducing a grass layer as soon as possible to limit the occurrence of erosion.
- The cleared vegetation should not be burned on site. The cleared vegetation should be stockpiled and taken to the closest available landfill site.
- Solid waste must be kept in adequate animal proof waste bins at the construction camp and construction sites. Building rubble and various wastes should be removed on a regular basis to the closest available landfill site.
- Regular clean-up programs should be put into effect along the access road and throughout the premises to limit the impact of littering caused by construction activities.
- The stockpiled topsoil and construction material should be managed in such a way that the material is not transported by wind or rain. This can be done by restricting the height of the stockpiles, sandbagging and avoiding steep slopes.
- No animals may be killed, captured or hunted on site by construction workers. Do not feed any wild animals on site.
- Where trenches pose a risk to animal safety, they should be adequately cordoned off to prevent animals falling in and being trapped and/or injured. This could be prevented by the constant excavating and backfilling of trenches during construction process.

- Existing game on the developed area will be relocated when the proposed solar park is developed. The relocation of the game will be executed according to the relevant legislation.
- Cumulative impacts on the ecology of the area can be significant. However, with the mitigation measures in place, the potential is very low for significant negative impacts on the ecology of the area.
- The EMPr will have to be adhered to both during the construction as well as operational phases and regular monitoring should be done to ensure that there is sound environmental practice at the Avondale 1 Solar Park.

Mitigation measures – Operational phase

- The herbaceous layer should be revived after clearance of the vegetation and actively managed through slashing during the entire lifetime of the project.
- An ecologist should be consulted on the use of herbicides/eco-friendly products to control exotic tree and shrub species.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.
- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
- The high-risk sections of the power line should be marked with a suitable anti-collision marking device on the earth wire as per the Eskom guidelines.
- Solid waste must be kept in animal proof waste bins.
- A monitoring program should be compiled and implemented to ensure that the sewage treatment system is functioning properly and that the treated wastewater conforms to the standards set by the Department of Water Affairs.
- Staff members should be discouraged from attempting to catch or kill any wildlife for use as food, pets or to feed any wild animals.
- Firebreaks should comply with the National Veldt and Forest Fire Act, 1998 (Chapter 4: Duty to Prepare and maintain firebreaks).
- The impact on the flying invertebrates will be minimized through the use of sodium vapour (yellow) lights as outside lighting.
- The use of eco-friendly products e.g. Organic Compost and/or Effective Microorganisms (EM), which reduces the frequency of application of conventional fertilizers, herbicides and insecticides, should be promoted.
- The EMPr will have to be adhered to both during the construction as well as operational phases and regular monitoring should be done to ensure that there is sound environmental practice at the Avondale 1 Solar Park.

9.4.1.7. Visual impact

Construction phase

The natural aesthetic character of the site will be changed. The Eskom “Garona - Gordonia” 132 kV power line crossing the project site, have already changed the visual characteristics of the site.

Operational phase

Buildings and the solar modules have a *visual impact* and lights at night can be a *nuisance.*

Project Phase	Impact: Visual disturbance								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Buildings& panels	Visual	Low	High	Low-Medium	High	High	Low-Medium	Medium
	Lights	Visual	Low	Medium	Low-medium	Medium-high	High	Low-Medium	Medium
Operation	Buildings and panels	Visual	Medium	High	Medium	High	High	Medium	Medium-high
	Lights	Nuisance	Low	High	Low-medium	Medium-High	High	Low-Medium	Medium
	Electrical lines	Visual	Low	High	Low	High	High	Low-Medium	Low-Medium
Cumulative Impacts	Increased in visibility of yet another solar park in the area	Increased visual intrusion and nuisance	Medium-High	Medium	Medium	Low-Medium	High	Low-Medium	Low-Medium

Mitigation measures– Construction phase

- A 100 m vegetation buffer zone - composed by the existing vegetation - should be kept between the western boundary of the proposed footprint and the eastern boundary of the farm portion, in order to minimise the visual impact of the proposed development.
- Ensure to retain as much of the existing vegetation where possible.
- Incorporate cleared vegetation (the most value plants) into a rehabilitation plan. This should be done in conjunction with the Vegetation, Visual Impact and any other relevant specialists.
- Cleared vegetation (the most value plants) could be planted in area that has line of sight from VSRs.
- Earth works should be executed in such a way that only the footprint and a small "construction buffer zone" around the proposed components are exposed. In all other areas, the natural occurring vegetation, more importantly the indigenous vegetation should be retained.
- Ensure that dust suppressing techniques are in place at all times. These could include the regular wetting of the soil or the application of dust suppressing agents. The regular wetting of soil should however be used as a last resort due to the low availability of water within the study area.
- Refrain from causing 'light spillage' beyond the construction camp by installing light fixtures with directional illumination.
- Keep lighting to the minimum by installing bollard type lights instead of post top lights along walkways between buildings.
- Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the project site.
- Minimise the amount of light fixtures to the bare minimum and connecting these lights to motion sensors can also considered in reducing light pollution.
- A video-surveillance system using infrared or microwave video cameras, which do not need a switched on lighting system, is recommended.
- Cumulative impacts will be low as it was possible to mitigate the visual impact at Avondale 1 Solar Park successfully as a result of the natural characteristics of the area.

Mitigation measures – Operational

- Road and other exposed soil surfaces should either be paved or covered with gravel or similar materials to reduce the risk of dust particles becoming air born. Alternatively dust suppressing techniques should be used.
- It is assumed that operational and maintenance activities would be restricted to daylight hours and thus reduce the requirement for lighting at night. However where lighting at night is needed, please refer and adhere to the mitigation measures as proposed for the construction phase.

9.4.1.8. Safety, security and fire hazards

Construction phase

Construction activities such as excavating of foundations and trenches, movement of construction vehicles, the use of equipment and the congregation of workers and staff on site further increases the risk of injury. The activities of construction personnel on site may contribute to an increase in the level of crime in the area and may also contribute to an increase in the risk for fires.

Operational phase

Fires and criminal activities pose a significant risk during the operation of the development.

Project phase	Impact: Safety, security and fire hazards								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Construction	Construction activities – excavation of foundations, trenches etc.	Loss or injury to human life	Low-medium	Medium-high	Low	High	Medium	Low	Medium
	Security	Crime	Medium	Medium-high	Low-medium	Medium	Medium-high	Low - medium	Medium
	Fire hazards	Loss of human life and construction equipment etc.	High	Medium-high	Medium	Low	Low-Medium	Low-Medium	Medium
Operation	Security	Crime	Medium	High	Medium	Medium	Medium-high	Medium	Medium-high
	Fire hazards	Loss of human life, bio-diversity, buildings, infrastructure etc.	High	Medium	Medium -High	Low	Low	Low	Medium
Cumulative Impacts	Higher number of people in the area increases safety risks	Potential for an increase in criminal activity	High	Medium	Medium -High	Low	Low	Low	Medium

Mitigation measures

- The Contractor shall conform to the stipulations of the Occupational Health and Safety act (Act 85 of 1993) and regulations applicable. The Act requires the designation of a Health and Safety representative when more than 20 employees are employed.
- Open trenches or excavations must be marked with danger tape.

- The number of construction workers to stay on site should be limited to the minimum.
- Proper access control (I.D. cards) should be enforced to ensure that no authorised persons enter the site.
- No solid waste or vegetation may be burnt on the premises or surrounding areas.
- Firebreaks should comply with the National Veldt and Forest Fire Act, 1998 (Chapter 4: Duty to prepare and maintain firebreaks).
- Fire extinguishers and fire fighting equipment must be available.
- A fence should be constructed along the boundary of the development.
- The cumulative impacts of this impact can be successfully mitigated if managed properly.

9.4.1.9. Socio-economic impact

Construction phase

The construction and operation phases of the development will have a positive impact on the socio-economic environment of beneficiary communities through employment opportunities and training and skills development.

Operational phase

A number of permanent jobs will be created for local people during this phase.
Tita Energy should identify a local Community for the purpose of entering into a partnership for the Project, as required by the rules of the IPP Procurement programme.

Project phase	Impact: Job creation								
	Activity/Aspect	Specific impact	Severity	Duration	Extent	Frequency	Probability	Significance	
								With Mitigation	Without Mitigation
Operation	Job creation	Job Creation	High +	High +	Medium-high +	High +	High +	N/A	High +
Operation	Local Community development	Local Community development	High +	High +	high +	High +	High +	N/A	High +
Cumulative impacts	Increased potential for job creation.	Increased potential for local Community development	High +	High +	high +	High +	High +	N/A	High +

Mitigation measures

- During the construction and operational phases, jobs must be created for unemployed local people and skills must be transferred to them.
- Where viable, the work must be executed in a labour intensive manner to create as many jobs possible.
- The cumulative impact of this impact can just be positive. As one of the poorest provinces in South Africa, the Northern Cape is definitely in need of more job opportunities.

9.5. POTENTIALLY SIGNIFICANT IMPACTS

Impacts with a rating of Medium-high or High are impacts which are regarded as potentially significant, rated without any mitigation measures. In this impact assessment, the following impacts were regarded as potentially significant impacts:

i. Water pollution by the inadequate functioning of the sanitation system.
ii. Water consumption and depletion during construction phase.
iii. The occurrence of veldt fires.
iv. Visual impact of panels and buildings

These impacts (i-iv) will now briefly be discussed.

9.5.1. Cumulative impacts

i. The effect of water pollution (surface and groundwater) by a malfunctioning of the sanitation system will have a cumulative effect only if it is not detected by a regular monitoring and if it takes place on a regular basis.
ii. This effect is cumulative only if care is not taken to conserve water and if water usage and the water levels of boreholes are not monitored regularly.
iii. This can have a cumulative effect if preventative measures are not followed.
iv. This can have a cumulative effect if more solar farms are developed in the immediate area.

9.5.2. Nature of impact

i. This is pollution of a renewable resource.
ii. This is a negative impact that affects water quantity available for use in the area.
iii. Damage to property, ecology and safety of people.
iv. Negative impact on visual attributes of the area.

9.5.3. Extent and duration of impact

i. The extent could potentially be within the farm of the proposed development and the surrounding farms.
ii. The extent could potentially be within the area of the proposed development and the surrounding farms. The duration is only during construction.
iii. The extent is potentially on the development area as well as surrounding properties and even regional. The duration is for the life of the development.
iv. The extent is on the development area as well as surrounding properties. The duration is for the life of the development.

9.5.4. Probability of occurrence

i. The probability is unlikely.
ii. The probability is possible.
iii. The probability is infrequent or seldom.
iv. The probability is definite.

9.5.5. Degree to which impact can be reversed

i. Impact is reversible if mitigated in time.
ii. This impact is reversible because the higher abstraction will only be during the construction period.
iii. If the development is not continuing there will be no guarantee that veldt fires will not occur on the property. This impact must therefore be managed accordingly.
iv. Impact can only be reversed at the end of the project when panels are removed and natural vegetation is allowed to return.

9.5.6. Degree to which impact can cause irreplaceable loss of resource

i. If this impact takes place over a very long time and there is gross negligence, the water resource can be damaged to a point where it will take very long to recover and where it could almost be seen as being irreplaceable.
ii. The recovery of the water resource is linked to rainfall and will recover accordingly. The negative impact is during the construction period.
iii. Veldt fires can create such damage that it will take a long time for the veldt to recover but the fact is that the vegetation has been subjected to veldt fires ever since. Loss of property (buildings) can be replaced.
iv. It will not cause the irreplaceable loss of vegetation or visual attributes of the area because it can be reversed at the end of the project when panels are removed and natural vegetation is allowed to return.

9.5.7. Degree to which impact can be mitigated

i. Successful mitigation is possible
ii. Successful mitigation is possible
iii. Successful mitigation is possible
iv. Limited mitigation is possible

10. DECOMMISSIONING PHASE

Decommissioning activities of the PV plant mainly include removal of project infrastructure and restoring of the site's *status quo ante*.

The decommissioning phase will start at the end of the PV power plant lifetime (25 - 30 years) and will last approximately 6 months, involving a team of 50 workers.

Decommission will be subject to a decommissioning plan once the project is nearing its operational life (25-30 years). Decommissioning will also be subject to an environmental authorization (Activity 27 of R544 of 18 June 2010).

10.1. SITE PREPARATION

In order to ensure a correct decommissioning of the site, the first step of the process will include adequate site preparation. Integrity of access points and of lay down areas will be confirmed and eventually re-established in order to accommodate equipment and to load vehicles.

10.2. DISASSEMBLE AND REPLACEMENT OF EXISTING COMPONENTS

All components will be disassembled. Silicon of the PV modules will be recycled, as well as mounting structures (aluminium or zinced steel frames and piles) and cables (copper and/or aluminium conductor).

Non-recyclable components of inverter, transformers and electrical devices will be disposed in appropriate way, in compliance with applicable laws and international standards.

10.3. RESTORATION OF THE SITE

Adequate measures will be undertaken in order to restore the site by re-planting of indigenous plant species.

10.4. ALTERNATIVE OPTION: UPGRADING THE SOLAR PARK

At the end of the PV power plant lifetime (25 ÷ 30 years), as alternative option to the decommissioning, it will be evaluated the feasibility of upgrading the solar park with the most appropriate technology/infrastructure available at that time.

11. CONCLUSIONS AND RECOMMENDATIONS TO BE INCORPORATED INTO ENVIRONMETNAL AUTHORIZATION

The EIA Report describes the activities undertaken for the development of the Avondale 1 Solar Park.

The purpose of this report is to provide the relevant authorities and interested and affected parties with sufficient information regarding the potential impacts of the development to render meaningful comments. Potential impacts were identified in consultation with I&AP's and technical specialists (where applicable) and were assessed using a matrix and by applying professional knowledge.

The potentially significant negative impacts that have been identified should be mitigated through the implementation of the mitigation measures highlighted in this report. It is submitted that the proposed mitigation measures, will effectively diminish the impacts to acceptable levels. Given the socio-economic imperatives of the development, the residual impacts are not of sufficient importance to thwart the development.

It is the professional opinion of AGES that the proposed development is **highly desirable** and **does not present any fatal flaws in terms of negative impacts to the environment** and therefore will not have any significant detrimental impacts to render the project unfeasible.

It is proposed that the following conditions must be included in the Record of Decision if the project is authorised:

- The development should be restricted to the development footprint including construction activities and operational activities and includes vegetation clearance.
- The mitigation measures contained in this report must be implemented.
- The management and or mitigation measures contained in the Environmental Management Plan must be implemented.
- All permits and licenses in terms of any relevant legislation must be in place at commencement of construction.
- Areas for different activities must be clearly demarcated and include sensitive areas that are to be avoided, areas for stockpiling cleared vegetation material and building rubble as well as the construction camp.
- Signage must be in place to indicate speed limits, no-go areas etc.
- Pollution of any nature should be restricted and avoided and include, soil, water, air and sound pollution. If an incident took place remedial action should take place immediately to limit further pollution. Prevention of any pollution should be a priority.
- I anything is encountered that has not been found in previous studies, it should be reported immediately and include *inter alia* finding any human remains or archaeological artefacts, finding any animals that might be relocated, protected trees or exotic and/or invader plant species. The appropriate specialist should be informed immediately.
- All activities should be conducted in the most environmentally responsible manner practically possible.
- An environmental officer should be appointed to monitor construction activities on a monthly basis and on a bi-annual basis during the operational phase.
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