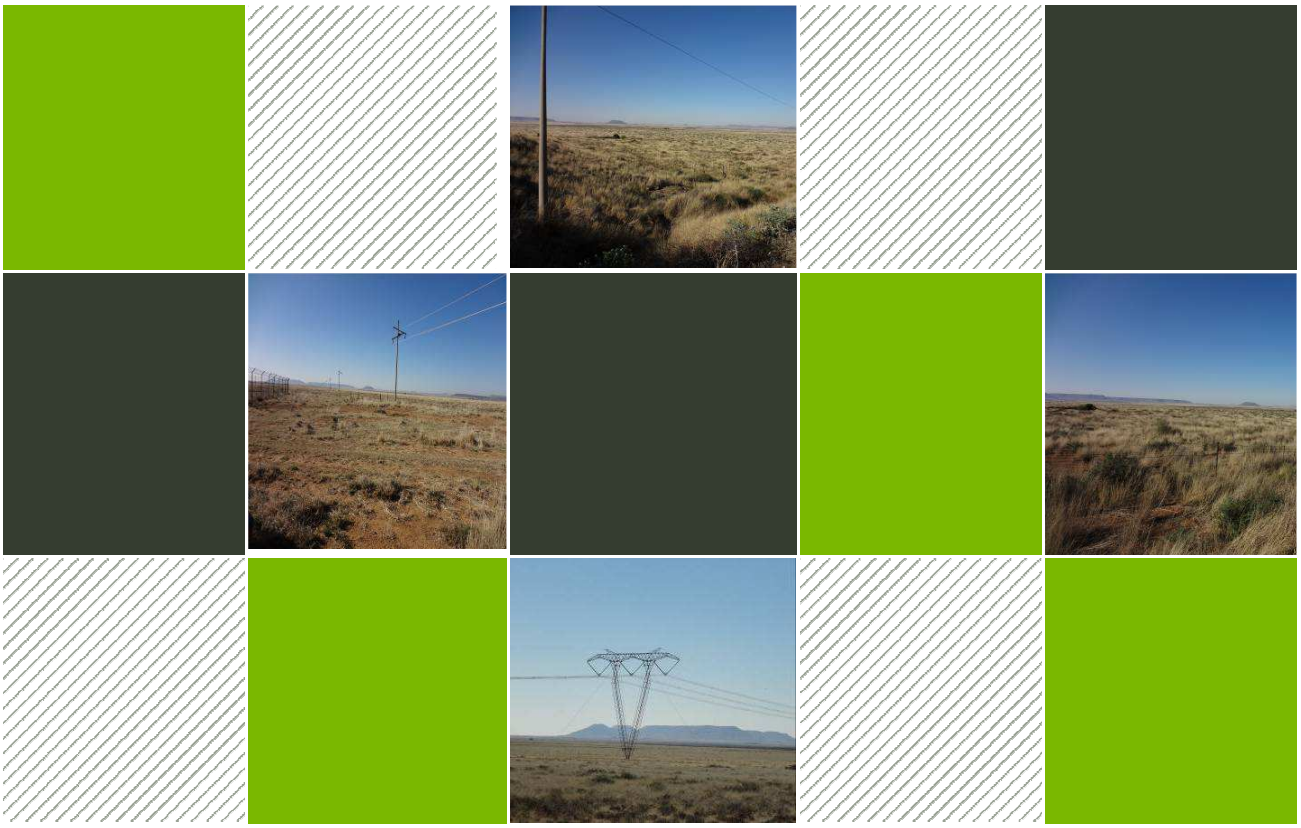

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ENVIRONMENTAL IMPACT ASSESSMENT PROCESS PROPOSED PHOTOVOLTAIC (SOLAR) ENERGY FACILITIES ON DU PLESSIS DAM FARM NEAR DE AAR, NORTHERN CAPE

DEA REF NO. & NEAS REF NO.:

PV2: 14/12/16/3/3/2/454; DEA/EIA/0001774/2013
PV3: 14/12/16/3/3/2/455; DEA/EIA/0001772/2013
PV4: 14/12/16/3/3/2/456; DEA/EIA/0001773/2013

DRAFT EIA REPORT-
Submission date: 19 September 2013

CONSULTANT
Aurecon South Africa (Pty) Ltd
PO Box 494
Cape Town
8000
Tel: (021) 526 9400
Fax: (021) 526 9500
Email: karen.versfeld@aurecongroup.com

PROPONENT
Mulilo Renewable Energy (Pty) Ltd
PO Box 50
Cape Town International Airport
Cape Town
7525
Tel: (021) 934 5278
Fax: (021) 935 0505
Email: warren@mulilo.com

NEMA REQUIREMENTS FOR EIA REPORTS WITH REFERENCE TO RELEVANT SECTIONS OF THIS EIA REPORT

The Environmental Impact Assessment (EIA) process undertaken to date has culminated in the production of a comprehensive Scoping Report, which provided detailed information relevant to the project. However, for the sake of being succinct, information contained within the Scoping Report is not repeated within this EIA Report unless it has direct bearing on the issues under discussion. Accordingly, to ensure a holistic understanding of the project, the nature of the activities and the substance of the EIA process, it is critical that this EIA Report is read in conjunction with the Final Scoping Report (FSR) (Aurecon, 2013). The FSR will remain available at the De Aar Public Library and at the Emthanjeni Municipal, and will be available for download from the Aurecon website until the EIA process has been completed.

Table 1 presents the structure of the EIA report as well as the applicable sections that address the required information in terms of NEMA.

Table 1 | NEMA requirements for EIA Reports and location in this EIA Report

Regulation 543		Chapter or section
Section 31(2) of Regulation 543		
(a)	Details of: (i) the EAP who prepared the report; and (ii) the expertise of the EAP to carry out an EIA;	Section 2.7
(b)	a detailed description of the proposed activity;	Section 3
(c)	a description of the property on which the activity is to be undertaken and the location of the activity on the property, or if it is: (i) a linear activity, a description of the route of the activity; or (ii) an ocean-based activity, the coordinates where the activity is to be undertaken;	Section 3.2.1
(d)	a description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity;	Section 4
(e)	details of the public participation process conducted in terms of subregulation (1), including- (i) steps undertaken in accordance with the plan of study; (ii) a list of persons, organisations and organs of state that were registered as interested and affected parties; (iii) a summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments; and (iv) copies of any representations and comments received from registered interested and affected parties;	Section 2.5 and Annexure B
(f)	a description of the need and desirability of the proposed activity;	Section 3.3
(g)	a description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity;	Section 3.2
(h)	an indication of the methodology used in determining the significance of	Annexure F

Regulation 543		Chapter or section
Section 31(2) of Regulation 543		
	potential environmental impacts;	
(i)	a description and comparative assessment of all alternatives identified during the environmental impact assessment process;	Section 4
(j)	a summary of the findings and recommendations of any specialist report or report on a specialised process;	Section 4 and Annexure E
(k)	a description of all environmental issues that were identified during the environmental impact assessment process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures;	Section 4
(l)	an assessment of each identified potentially significant impact, including- (i) cumulative impacts; (ii) the nature of the impact; (iii) the extent and duration of the impact; (iv) the probability of the impact occurring; (v) the degree to which the impact can be reversed; (vi) the degree to which the impact may cause irreplaceable loss of resources; and (vii) the degree to which the impact can be mitigated;	Section 4
(m)	a description of any assumptions, uncertainties and gaps in knowledge;	Section 2.6
(n)	a reasoned opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	Section 5.1.6
(o)	an environmental impact statement which contains- (i) a summary of the key findings of the environmental impact assessment; and (ii) a comparative assessment of the positive and negative implications of the proposed activity and identified alternatives;	Section 5.1
(p)	a draft environmental management programme containing the aspects contemplated in regulation 33;	Annexure D
(q)	copies of any specialist reports and reports on specialized processes complying with regulation 32;	Annexure E
(r)	any specific information that may be required by the competent authority; and	Annexure B - see letter from DEA accepting the FSR as well as information requirements and where in the report it is located.
(s)	any other matters required in terms of sections 24(4)(a) and (b) of the Act.	

Report No: [109378/8389]

ENVIRONMENTAL IMPACT ASSESSMENT PROCESS: PROPOSED PHOTOVOLTAIC (SOLAR) ENERGY FACILITIES ON DU PLESSIS DAM FARM NEAR DE AAR, NORTHERN CAPE

DEA AND NEAS REF. NO'S
PV2: 14/12/16/3/3/2/454; DEA/EIA/0001774/2013
PV3: 14/12/16/3/3/2/455; DEA/EIA/0001772/2013
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DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

19 September 2013

CONSULTANT
Aurecon South Africa (Pty) Ltd
PO Box 494
Cape Town
8000

Tel: (021) 526 9400
Fax: (021) 526 9500
Email: karen.versfeld@aurecongroup.com

PROPONENT
Mulilo Renewable Energy (Pty) Ltd
PO Box 50
Cape Town International Airport
Cape Town
7525

Tel: (021)934 5278
Fax: (021) 935 0505
Email: warren@mulilo.com

Document Control Record

Document prepared by:
Aurecon South Africa (Pty) Ltd
1977/003711/07
Aurecon Centre
1 Century City Drive
Waterford Precinct
Century City
Cape Town
7441
PO Box 494
Cape Town
8000
South Africa

T +27 21 526 9400
F +27 21 526 9500
E capetown@aurecongroup.com
W aurecongroup.com

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Name	Karen de Bruyn	Name	Karen Versfeld
Title	Project staff	Title	Project leader

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

AC	Alternating Current
CRR	Comments and Responses Report
CSP	Concentrating Solar-thermal Power
dB	Decibels
DEA	Department of Environmental Affairs (previously Department of Environmental Affairs and Tourism)
DEA&DP	Department of Environmental Affairs and Development Planning
DEANC	Department of Environmental Affairs and Nature Conservations
DEAT	Department of Environmental Affairs and Tourism
DM	District Municipality
DME	Department of Minerals and Energy
DoE	Department of Energy
DSR	Draft Scoping Report
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EAPSA	Environmental Assessment Practitioner of South Africa
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Programme
ESA	Early Stone Age
FEPA	Freshwater Ecosystem Protected Areas
FSR	Final Scoping Report
GN	Government Notice
GWh	Gigawatt hours
ha	Hectares
HIA	Heritage Impact Assessment
I&APs	Interested and Affected Parties
HIV/ AIDS	Human Immunodeficiency Virus Infection and Acquired Immunodeficiency Syndrome
IDP	Integrated Development Plan
IEP	Integrated Energy Plan
IHI	Index for Habitat Integrity
IPP	Independent Power Producer
IRP	Integrated Resource Plan
kV	Kilovolt
LEMP	Life-cycle Environmental Management Plan
LM	Local Municipality
LOWMA	Lower Orange Water Management Area
LSA	Later Stone Age
MAP	Mean Annual Precipitation
MSA	Middle Stone Age
MW	Megawatts

NEMA	National Environmental Management Act (No. 107 of 1998) (as amended)
NHRA	National Heritage Resources Act (No. 25 of 1999)
NWA	National Water Act (No 36 of 1998)
PV	Photovoltaic
SAHRA	South African Heritage Resources Agency
SACNSP	South African Council for Natural Scientific Professions
SDF	Spatial Development Framework
ToR	Terms of Reference
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment

1 INTRODUCTION AND BACKGROUND

The purpose of this section is to briefly introduce the proposed photovoltaic (PV) solar facilities on Du Plessis Dam farm and to provide a legislative overview.

1.1 INTRODUCTION

Mulilo Renewable Energy (Pty) Ltd (Mulilo) proposes to construct three separate solar energy facilities, on Du Plessis Dam Farm (Remainder of Farm 179), near De Aar in the Northern Cape. Aurecon South Africa (Pty) Ltd (Aurecon) previously investigated a proposed photovoltaic (PV) facility at Du Plessis Dam Farm. After completion of the Basic Assessment Process (DEA Reference Number: 12/12/20/2498, NEAS Reference Number: DEAT/EIA/0000609/2011), the Department of Environmental Affairs (DEA) authorised a PV facility with 19.9MW capacity (Environmental Authorisation (EA) dated 28 September 2012). The previously approved PV facility will herein after be referred to as Du Plessis PV1. A 132kV overhead transmission line (6.1km) connecting the approved site to the existing Eskom infrastructure was also approved in the EA dated 28 September 2012 as indicated in Figure 1.

Mulilo is now proposing three PV facilities, which would each have a maximum generation capacity of 75MW Alternating Current (AC) through PV technology. Ancillary infrastructure associated with the three proposed PV facilities would include onsite 132kV transmission lines and substations, a boundary fence around each 75MW facility, onsite water supply infrastructure and stormwater management infrastructure. In addition, a connection building, control building, guard cabin and a solar resource measuring substation would be established.

In terms of the NEMA, the proposed project triggers a suite of activities which require authorisation from the competent authority via an Environmental Impact Assessment (EIA) process before they can be undertaken. Since the project is for the generation of energy, and energy projects are dealt with by the national authority, the competent authority is the national DEA. DEA's decision will be based on the outcome of this EIA process. Aurecon has been appointed to undertake the requisite EIA as required in terms of the National Environmental Management Act (No. 107 of 1998) (NEMA), as amended, on behalf of Mulilo. This report serves to document the EIA Phase and structured as follows:

Section One:	Provides the introduction, describes the legal framework and listed activities in terms of NEMA.
Section Two:	Introduces the EIA process, describes the public participation undertaken to date, notes the assumptions, uncertainties and limitations and describes the independence of the Environmental Assessment Practitioners.
Section Three:	Describes the proposed project, identified alternatives and potential social and environment aspects and impacts. It also describes the motivation for the proposed PV facilities.
Section Four:	Provides a description of the environment and an assessment of the impacts thereto, it also provides mitigation measures to reduce negative impacts and enhance positive impacts.

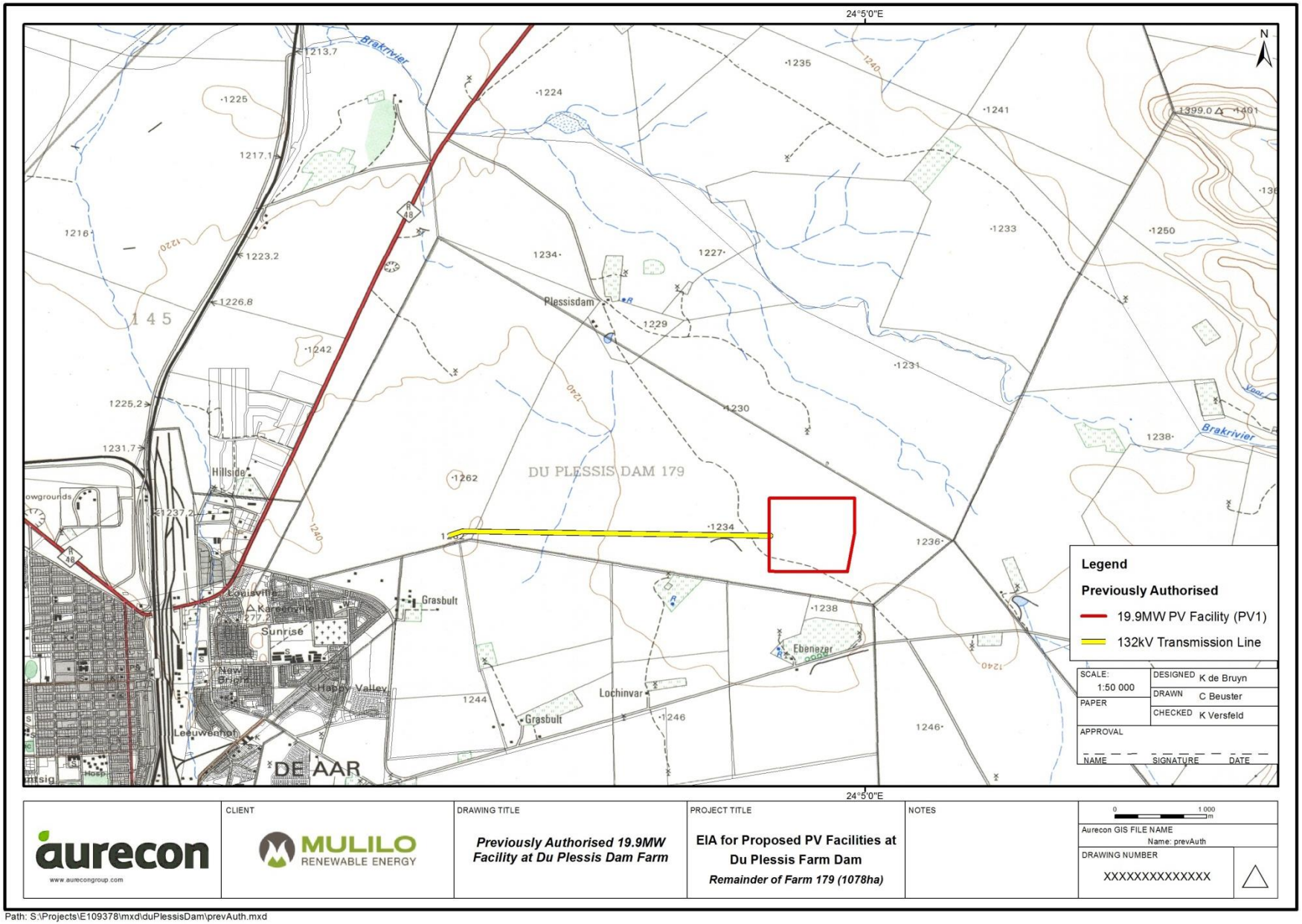


Figure 1 | Previously approved PV facility (PV1) and approved transmission line on Du Plessis Dam farm

Section Five: Provides recommendations and concludes the report by describing the way forward

1.2 LEGISLATIVE REQUIREMENTS

There are a host of legal and policy documents and guidelines to consider when undertaking an EIA. An overview of the legislation relevant to this proposed project is provided in Table 2.

Table 2 | Relevant legislation and the applicability thereof

Legal Requirements		
Legislation considered	**Relevant Organ of State / authority**	**Aspect of Project**
National Environmental Management Act (Act No. 107 of 1998) (NEMA) (as amended)	DEA	NEMA, as amended, establishes the principles for decision-making on matters affecting the environment. Section 2 sets out the National Environmental Management Principles which apply to the actions of organs of state that may significantly affect the environment. Furthermore, Section 28(1) states that: "*every person who causes or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring*". If such pollution or degradation cannot be prevented then appropriate measures must be taken to minimise or rectify such pollution. Mulilo has the responsibility to ensure that the proposed activity as well as the EIA process conforms to the principles of NEMA. In developing the EIA process, Aurecon has been cognisant of this need, and accordingly the EIA process has been undertaken in terms of NEMA and the EIA Regulations promulgated on 18 June 2010[1]. Several listed activities in terms of NEMA GN No. 544, 545 and 546 (18 June 2010), are triggered as indicated in Table 3. NEMA guides the EIA process which will be undertaken in terms of Section 31 of the EIA Regulations.
National Water Act (Act No. 36 of 1998) (NWA)	Department of Water Affairs (DWA)	Several drainage lines were identified on the site that might be impacted upon by the proposed PVs. Should the proposed development trigger any of the water uses as defined in Section 21 of the NWA, the proponent will be advised to apply for the appropriate authorisation from the DWA. Comment will however be sought from the DWA as part of the EIA process. The application for authorisation from the DWA will not form part of this EIA process.
National Heritage Resources Act (Act No. 25 of 1999) (NHRA)	South African Heritage Resources Agency (SAHRA)	In terms of the National Heritage Resources Act (No. 25 of 1999) (NHRA), any person who intends to undertake "any development which will change the character of a site exceeding 5,000m^2 in extent", "the construction of a road powerline, pipeline exceeding 300m in length" or "the rezoning of site larger than 10,000m^2 in extent…" must at the very

[1]GN No. R 543, 544, 545, 546 and 547 in Government Gazette No.33306 of 18 June 2010.

Legal Requirements		
Legislation considered	**Relevant Organ of State / authority**	**Aspect of Project**
		earliest stages of initiating the development notify the responsible heritage resources authority, namely SAHRA or the relevant provincial heritage agency. These agencies would in turn indicate whether or not a full Heritage Impact Assessment (HIA) would need to be undertaken. Section 38(8) of the NHRA specifically excludes the need for a separate HIA where the evaluation of the impact of a development on heritage resources is required in terms of an EIA process. Accordingly, since the impact on heritage resources would be considered as part of the EIA process outlined here, no separate HIA would be required. SAHRA or the relevant provincial heritage agency would review the EIA reports and provide comments to DEA, who would include these in their final environmental decision. However, should a permit be required for the damaging or removal of specific heritage resources, a separate application would have to be submitted to SAHRA or the relevant provincial heritage agency for the approval of such an activity, if Mulilo obtains authorisation and makes the decision to pursue the proposed projects further.
Aviation Act (Act No 74 of 1962)	Civil Aviation Authority (CAA)	The proposed PV facilities are adjacent to the De Aar Aerodrome and therefore CAA will be provided with the opportunity to comment on the proposed project.
Conservation of Agricultural Resources Act (Act No. 43 of 1983) (CARA)	Department of Agriculture	The purpose of this Act is to ensure that the agricultural production of land is maintained, soil erosion is prevented, and any water bodies and natural vegetation on site is protected. The CARA makes provision for the conservation of the natural agricultural resources of South Africa through maintaining the production potential of land, combating and preventing erosion, preventing the weakening or destruction of the water sources, protecting vegetation, and combating weeds and invader plants. As such, as part of the EIA process, recommendations should be made to ensure that measures are implemented to maintain the agricultural production of land, prevent soil erosion, and protect any water bodies and natural vegetation on site. Mulilo together with the relevant farmers should also ensure the control of any undesired aliens, declared weeds, and plant invaders listed in the regulation that may pose as a problem as a result of the proposed PV facilities.
National Road Traffic Act (Act No. 93 of 1996) (as amended) (NRTA)	Department of Roads and Public Works, Northern Cape	Certain vehicles and loads cannot be moved on public roads without exceeding the limitations in terms of the dimensions and/or mass as prescribed in the Regulations of the NRTA. Although abnormal loads are not anticipated, the Department of Roads and Public Works, Northern Cape will be provided with an opportunity to comment on the proposed PV facilities.
National Environmental Management: Biodiversity Act	DEA	The NEM: BA aims to conserve and manage the country's biodiversity via protecting species and ecosystems, specifically those which are considered to be critically endangered. As determined by the botanical specialist assessment (summary of the specialist findings provided in Section 4.1 and the full report is included in Annexure E) the property

Legal Requirements		
Legislation considered	**Relevant Organ of State / authority**	**Aspect of Project**
(Act No. 10 of 2004) (NEM: BA)		does not contain Critical Biodiversity Areas (CBAs) or Ecological Support Areas.
Northern Cape Nature Conservation Act (Act No. 9 of 2009) (NCNCA)	Department of Environment and Nature Conservation (DEANC)	Numerous sections (specifically Sections 50 to 51) under NCNCA deal with indigenous and protected plants. A permit under NCNCA is required should any species on site, with a protected status, be removed or destroyed i.e. a permit is required before development may commence.
The National Energy Act (Act No. 34 of 2008)	Department of Energy (DoE)	One of the purposes of this Act is to promote sustainable development of renewable energy infrastructure. The proposed PV facilities will generate energy through renewable energy and will be guided through this Act.

Relevant policies		
Policies considered	**Relevant Organ of State / authority**	**Aspect of Project**
Policies regarding greenhouse gas and carbon emissions		Electricity generation using carbon based fuels is responsible for a large proportion of carbon dioxide (CO_2) emissions worldwide. In Africa, the CO_2 emissions are primarily the result of fossil fuel burning and industrial processes, such coal fired power stations. South Africa accounted for some 40% of Africa's CO_2 emissions during 2011 (US Energy Information Administration, 2013). The global per capita CO_2 average emission level was 1.23 metric tonnes per person per annum in 2010. In South Africa however, the average CO_2 emission level was 10 tonnes per person per annum in 2010 (SA Climate Action Partnership, 2010). The International Energy Agency (2008) "Renewables in global energy supply: An IEA facts sheet" estimates that nearly 50% of global electricity supplies will need to come from renewable energy sources in order to halve carbon dioxide emissions by 2050 and minimise significant, irreversible climate change impacts. The United Nations Framework Convention on Climate Change (UNFCCC) has initiated a process to develop a more specific and binding agreement on the reduction of greenhouse gas (GHG) emissions. This led to negotiations with a particular focus on the commitments of developed countries, and culminated in the adoption of the Kyoto Protocol in 1997, which came into effect in February 2005. Using the above framework to inform their approach, the Kyoto Protocol has placed specific legal obligations in the form of GHG reduction targets on developed countries and countries with 'Economies in Transition'.

Relevant policies		
Policies considered	**Relevant Organ of State / authority**	**Aspect of Project**
		Under the Copenhagen Accord 2010, countries representing over 80% of global emissions have submitted pledges on emission reductions. South Africa's commitment is to reduce GHG emissions totalling by 34% by 2020 and 42% by 2025. The Kyoto Protocol, to which South Africa is a signatory, was informed by the principles of sustainable development which resulted in related policies and measures being identified to promote energy efficiency while protecting and enhancing the 'sinks and reservoirs' of greenhouse gases (forests, ocean, etc.). In addition to increasing the use of new and renewable energy and the adoption or implementation of advanced and innovative environmentally sound technologies. South African policies are being informed by the Kyoto Protocol (which was valid until 2012) and its partial successor the Copenhagen Accord 2010 and associated sustainable development principles whereby emphasis is being placed on industries for 'cleaner' technology and production.
White Paper on the Energy Policy of the Republic of South Africa (1998)	Department of Minerals and Energy (DME)	The White Paper commits to government's focused support for the development, demonstration and implementation of renewable energy sources for both small and large-scale applications. With the aim of drawing on international best practice, specific emphasis is given to solar and wind energy sources, particularly for rural and often off-grid areas. While considering the larger environmental implications of energy production and supply, the White Paper looks into the future to adopting an integrated resource planning approach, integrating the environmental costs into economic analysis. It is with this outlook that the renewable energy, including solar energy, is seen as a viable, attractive and sustainable option to be promoted as part of South Africa's energy policy towards energy diversification.
National Energy Act (No. 34 of 2008) and Electricity Regulation Act (ERA) (No. 4 of 2006)	DoE	South Africa has two acts that direct the planning and development of the country's electricity sector: (i) The National Energy Act (No. 34 of 2008); and (ii) The ERA. In May 2011, the DoE gazetted the Electricity Regulations on New Generation Capacity under the ERA. The New Generation Regulations establish rules and guidelines that are applicable to the undertaking of an Independent Power Producer (IPP) Bid Programme and the procurement of an IPP for new generation capacity. They also facilitate the fair treatment and non-discrimination between IPPs and the buyer of the energy[2]. In terms of the New Generation Regulations, the Integrated Resource Plan (IRP) has been developed by the DoE and sets out the new

[2] http://www.eskom.co.za/c/73/ipp-processes/ (accessed 29/10/11)

Relevant policies		
Policies considered	**Relevant Organ of State / authority**	**Aspect of Project**
		generation capacity requirement per technology, taking energy efficiency and the demand-side management projects into account. This required, new generation capacity must be met through the technologies and projects listed in the IRP and all IPP procurement programmes will be undertaken in accordance with the specified capacities and technologies listed in the IRP[3]. In terms of the IRP 2010 6,925MW of renewable energy will be procured under the Renewable Energy Independent Power Producer Programme (REIPPP).[4] The REIPPPP has been designed to contribute towards socio-economic and environmentally sustainable growth, and to start and stimulate the renewable industry in South Africa[5]. The DoE has implemented a limit with regards to the capacity of renewable energy facilities to 75MW.
Integrated Energy Plan (IEP) for the Republic of South Africa (2003)	DME	Commissioned by DME in 2003, the IEP aims to provide a framework in which specific energy policies, development decisions and energy supply trade-offs can be made on a project-by-project basis. The framework is intended to create a balance in providing low cost electricity for social and economic developments, ensuring security of supply, and minimising the associated environmental impacts. The IEP concluded that, based on energy resources available in South Africa, coal would be the primary fuel source in the 20 year planning horizon, which was specified as the years 2000 to 2020, although other cleaner technologies continue to be investigated as alternatives in electricity generation options. Therefore, though the next two decades of energy generation are anticipated to remain coal-based, alternative technologies and approaches are available and need to be contextually considered
Integrated Resources Plan (IRP)		The IRP is a National Electricity Plan, which is a subset of the Integrated Energy Plan. The IRP is also not a short or medium-term operational plan, but a plan that directs the expansion of the electricity supply over the given period. The primary objective of the IRP 2010, as with its predecessors, is to determine the long-term electricity demand and detail how this demand should be met in terms of generating capacity, type, timing, and cost. The IRP is currently being updated.
Northern Cape Renewable Energy Strategy 2013		The Northern Cape Province has long recognised the need for renewable energy It has also acknowledged the need to develop its own Renewable Energy Strategy that would outline a plan to unlock the existing potential of the province to harness renewable energy to the benefit of its communities and economy. The Northern Cape aims to

[3] http://www.eskom.co.za/c/73/ipp-processes/ (accessed 29/10/11)

[4] http://www.engineeringnews.co.za/article/sas-renewables-procurement-programme-to-be-enlarged-by-a-further-3-200-mw-2012-10-09

[5] http://www.ipp-renewables.co.za/ (accessed 30/10/11)

Relevant policies		
Policies considered	**Relevant Organ of State / authority**	**Aspect of Project**
		become a net exporter of green electricity by 2020 and achieve a 24% energy savings by 2030. This vision is to be achieved by developing by utility-scale and non-utility market segment, where the former would focus on increasing the green electricity generating capacities while the latter aim to reduce the demand for electricity from the grid.

Relevant Guidelines

Guidelines considered

This EIA process is informed by the series of national Environmental Guidelines[6] where applicable and relevant:

- Integrated Environmental Information Management (IEIM), Information Series 5: Companion to the NEMA EIA Regulations of 2010 (DEA, 2010).
- Implementation Guidelines: Sector Guidelines for the EIA Regulations (draft) (DEA, 2010).
- IEIM, Information Series 2: Scoping (Department of Environmental Affairs and Tourism (DEAT), 2002).
- DEAT. 2002. IEIM, Information Series 3: Stakeholder Engagement (DEAT, 2002).
- IEIM, Information Series 4: Specialist Studies (DEAT, 2002).
- IEIM, Information Series 11: Criteria for determining Alternatives in EIA (DEAT, 2004).
- IEIM, Information Series 12: Environmental Management Plans (DEAT, 2004).
- Integrated Environmental Management Guideline Series, Guideline 4: Public Participation, in support of the EIA Regulations. Unpublished (DEAT, 2005).
- Integrated Environmental Management Guideline Series, Guideline 7: Detailed Guide to Implementation of the Environmental Impact Assessment Regulations. Unpublished (DEAT, 2007).
- Guideline for involving biodiversity specialists in EIA process (June 2005).
- Guideline for involving heritage specialists in the EIR process (June 2005).
- Guideline for involving visual and aesthetic specialists in the EIR process (June 2005).
- Guideline for Environmental Management Plans (June 2005).
- Guideline for determining the scope of specialist involvement in EIA Processes (June 2005).
- Guideline for the review of specialist input into the EIA Process (June 2005).

The following guidelines from the Department of Environmental Affairs and Development Planning (Western Cape) (DEA&DP) were also taken into consideration:

- DEA&DP. 2013. Generic Terms of Reference for EAPs and Project Schedules (DEA&DP, March 2013).
- DEA&DP. 2013. Guideline on Public Participation (DEA&DP, March 2013).
- DEA&DP. 2013. Guideline on Alternatives (DEA&DP, March 2013).
- DEA&DP. 2013. Guideline on Need and Desirability (DEA&DP, March 2013).
- DEA&DP. 2013. Guideline on Exemption Applications (DEA&DP, March 2013).
- DEA&DP. 2013. Guideline on Appeals (DEA&DP, March 2013).

[6] Note that these Guidelines have not yet been subjected to the requisite public consultation process as required by Section 74 of R385 of NEMA.

1.3 LISTED ACTIVITIES IN TERMS OF NEMA

The NEMA is the primary custodian of the environment and therefore focusses on the management of environmental resources and accordingly, identifies activities that require authorisation prior to commencement. The proposed PV facilities trigger a number of listed activities as listed in Table 3.

Table 3 | Applicable listed activities in terms of GN 544, GN 5454 and GN 546

Listing Notice 1, GN 544	Activity triggers
Activity No. 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 but less than 275 kilovolts;"	The capacity of the transmission lines would be 132kV and would be in a rural area. This activity will therefore be triggered.
Activity No. 11 "The construction of (x) buildings exceeding 50 square metres (m^2) in size; or (xi) infrastructure or structures covering 50m^2 or more where such construction occurs within a watercourse or within 32m of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line."	Some infrastructure and or buildings may be constructed within 32m of a watercourse.
Activity No. 18 "The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from: (i) a watercourse"	Attenuation ponds would need to be constructed in order to manage the onsite stormwater.

Listing Notice 2, GN 545	Activity triggers
Activity No. 1 "The construction of facilities or infrastructure for the generation of electricity where the electricity output is 20 megawatts or more."	The PV facilities would each have a generation capacity of 75MW AC, as such this activity is triggered.
Activity No. 15 "Physical alteration of undeveloped vacant or derelict land for residential retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more."	The predominant farming activity of the site is grazing. It is therefore assumed that this activity would be triggered as the DEA has indicated that it considers grazing land to be 'undeveloped' land.

Listing Notice 3, GN R 546	**Assumptions**
Activity No. 4 "The construction of a road wider than 4m with a reserve less than 13,5 metres. (a) In Northern Cape: ii. Outside urban areas, in: (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority.	An access road (6m wide), will be constructed. As De Aar is located within the Platberg-Karoo Conservancy, this activity will be triggered.
Activity No. 14 "The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for. a) In Northern Cape: (i). All areas outside urban areas."	Each project would clear an area of between 270 ha and 370 ha of indigenous vegetation
Activity No. 16 The construction of: (iii) buildings with a footprint exceeding 10m^2 in size; or (iv) infrastructure covering 10m^2 or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. (a) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape: ii. Outside urban areas, in: (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.	Buildings and infrastructure, exceeding 10m^2, would be constructed within 32 metres of a watercourse.

2 EIA APPROACH

The purpose of this chapter is to provide the reader with an overview of the proposed EIA methodology. It also provides a description of the public participation to date as engagement with the public and stakeholders forms an integral component of the EIA process. This is followed by a description on the assumptions and limitations and the independence of the environmental assessment practitioners.

2.1 APPROACH TO THE PROJECT

Due to the fact that all three proposed PV facilities would be constructed on one farm (i.e. Du Plessis Dam Farm), a combined EIA process has been undertaken, in other words one EIA process for Du Plessis Dam Farm, which will include the assessment for all three proposed PV facilities. This combined EIA process will not only streamline the EIA reporting and the specialist investigations, but it will also facilitate the individual and cumulative assessment of PV projects. A similar process is being proposed to assess the proposed PV facilities for Badenhorst Dam farm, also located close to De Aar (a separate EIA[7] will be submitted to DEA). As both projects are located within the same area, Aurecon has combined the respective public participation processes in order to communicate with the public more efficiently. The proposed approach to these processes is set out in Figure 2.

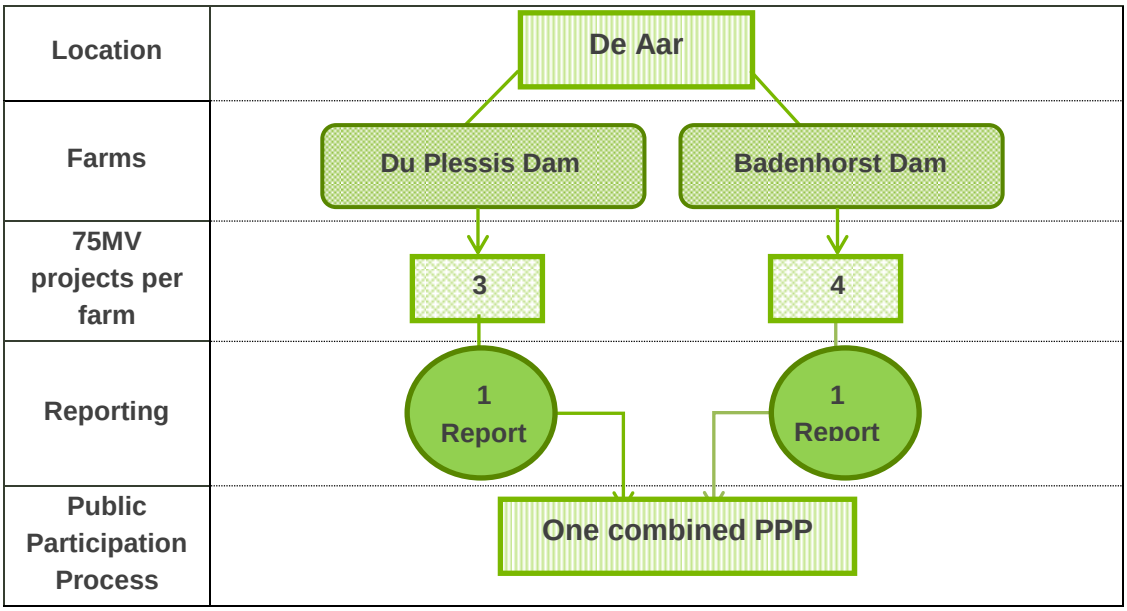


Figure 2 | Approach to undertake the EIA Processes

As outlined in Figure 3, there are three distinct phases in the EIA process namely the Initial Application Phase, the Scoping Phase and the EIA Phase. A description of the activities which have been, and will be, undertaken during each phase is provided in the following sections. Note that this report covers the third phase, viz. the EIA Phase.

[7] PV2: 14/12/16/3/3/2/504; DEA/EIA/0001751/2013; PV3: 14/12/16/3/3/2/483; DEA/EIA/0001750/2013, PV4: 14/12/16/3/3/2/506; DEA/EIA/0001752/2013 and PV5: 14/12/16/3/3/2/485; DEA/EIA/0001753/2013

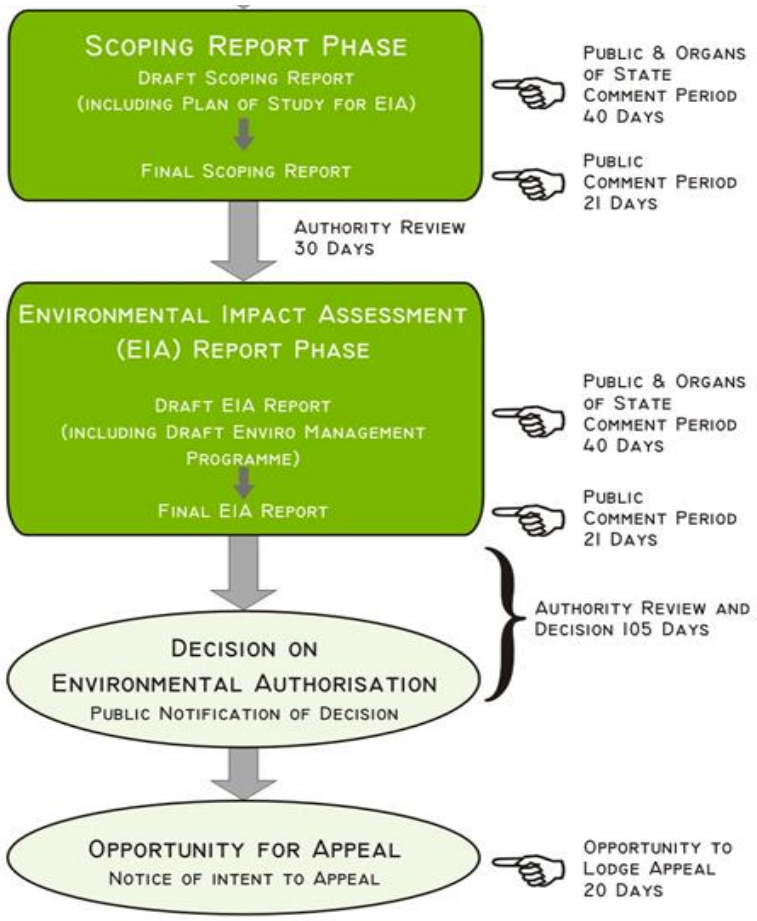


Figure 3 | Scoping and EIA process

2.2 INITIAL APPLICATION PHASE

The Initial Application phase entailed the submission of three signed EIA Application Forms to notify the DEA of the proposed facilities. The EIA Application Forms were submitted on 7 March 2013. Acknowledgement of receipt of the EIA Application Forms was received on 26 March 2013. The DEA reference numbers are listed in Table 4 below.

Table 4 | DEA Reference numbers of the proposed PV facilities

Proposed PV Facility	DEA Ref Nr	NEAS Ref Nr
PV2	14/12/16/3/3/2/454	DEA/EIA/0001774/2013
PV3	14/12/16/3/3/2/455	DEA/EIA/0001772/2013
PV4	14/12/16/3/3/2/456	DEA/EIA/0001773/2013

The Application Forms have since been revised three times to amend the listed activities applied for. The Amended Application Forms and the DEA's letters of acknowledgement are included in Annexure A.

2.3 THE SCOPING PHASE

Scoping is defined as a procedure for determining the extent of, and approach to, the EIA Phase and involves the following key tasks:

- Identification and involvement relevant authorities and Interested and Affected Parties (I&APs) in order to elicit their interest in the project;
- Identification and selection of feasible alternatives to be taken through to the EIA phase;
- Identification of significant issues/impacts associated with each alternative to be examined in the EIA Report; and
- Determination of specific terms of reference for any specialist studies required in the EIA Report (Plan of Study for the EIA Report).

To date the Scoping Phase involved a desktop review of relevant previous environmental studies in the area. These information sources included, inter alia, the following:

- Proposed photovoltaic facility on Du Plessis Dam Farm, near De Aar in the Northern Cape. Final Environmental Impact Assessment Report (Aurecon, 2012).
- Two Proposed 132kV transmission lines from the South and North Wind Energy facilities on the Eastern Plateau near De Aar, Northern Cape. Final Basic Assessment Report (Aurecon, 2013); DEA reference: 14/12/16/3/3/1/785; NEAS Reference: DEA/EIA/0001601/2012.
- Proposed Photovoltaic Facility on a site South-East of De Aar, Northern Cape Province. Draft Scoping Report (DSR) (Savannah Environmental, 2011).
- Groundwater Resources in the Northern Cape Province (Department of Water Affairs, 2008).
- Construction of a concentrated solar power (CSP) and concentrated photovoltaic (CPV) or PV Plant in De Aar, Northern Cape Province of South Africa. Final Environmental Impact Report (SiVest, 2011).

A bibliography is included at the end of this report, which provides reference to other studies and those are of relevance to this EIA process and referred to in this report.

The Environmental Assessment Practitioners (EAPs) undertook a field trip on 6 October 2011, as part of the previous EIA process (Aurecon, 2012). The main purpose of this site visit was to familiarise the EAPs with the site and to allow for a rapid survey of the site to identify potential areas of concern. Since the *status quo* assessed in the previous EIA process has not changed, a second site visit was not deemed necessary. The information gathered during the site visit was used in refining the Plan of Study for the EIA process and ToR for the specialist studies which will be undertaken during the EIA Phase.

The Scoping Phase culminated in the preparation of a Scoping Report which included the information gathered during the desktop study, as well as the previous site visit, and the Plan of Study for the EIA process and Terms of Reference (ToR) for the specialist studies which would commence during the EIA Phase. Following the required public consultation and authority review, the Final Scoping Report was accepted by the DEA on 12 August 2013 allowing the EIA process to proceed. A copy of the acceptance is included in Annexure B.

2.4 THE EIA PHASE

The Scoping Phase was followed by the EIA Phase. The following specialist investigations were undertaken in accordance to the Plan of Study for EIA as indicated in Table 5.

Table 5 | Specialist studies undertaken as per Plan of Study for EIA

Assessment	Company	Contact
Visual Impact Assessment	Visual Resources Management Africa	Steve Stead
Palaeontological Impact Assessments	Natura Viva	John Almond
Ecological Impact Assessment	David Hoare Consulting	David Hoare
Avian Impact Assessment	Avisense	Andrew Jenkins
Agricultural Impact Assessment	SiVEST	Kurt Barichievy
Heritage Impact Assessment	ACO Associates	Tim Hart
Aquatic Ecology Impact Assessment	Blue Science	Toni Belcher
Hydrology Impact Assessment	Aurecon	Nick Walker

In response to comments received on the Badenhorst Dam Farm project, it was deemed prudent to evaluate noise and air quality impacts. Based on the similarities of the proposed projects, the mitigation measures proposed by the specialists mentioned in the Table 6, were extrapolated and deemed applicable to both projects.

Table 6 | Additional qualitative assessments

Assessment	Company	Contact
Noise Impact Assessment	Airshed Planning Professionals	Nicolette von Reiche
Air Quality Impact Assessment	Airshed Planning Professionals	Hanlie Liebenberg-Enslin

The current EIA phase culminated in a comprehensive EIA report which documents the outcome of the abovementioned specialist investigations. The findings of the specialist investigations are summarised in Section 4 and the full reports are included in Annexure E.

2.5 THE PUBLIC PARTICIPATION PROCESS

Consultation with the public forms an integral component of this investigation and enables I&APs (e.g. directly affected landowners, national-, provincial- and local authorities, environmental groups, civic associations, and communities), to identify their issues and concerns, relating to the proposed activities, which they feel should be addressed in the EIA process. The Public Participation Process (PPP) has thus been structured to provide I&APs with an opportunity to gain more knowledge about the proposed projects, to provide input through the review of documents/reports, and to voice any issues of concern at various stages throughout the EIA process.

The objectives of public participation are to provide information to the public, identify key issues and concerns at an early stage, respond to the issues and concerns raised, provide a review opportunity, and to document the process properly. The PPP will be managed to meet these objectives throughout the EIA. The PPP to date is summarised in Table 7.

Table 7 | Summary of the PPP to date

Task	Details	Date
Stakeholders notification (relevant authorities and I&APs)		
Submission of Applications for Authorisation	The three applications for authorisation were submitted to DEA on 11 March 2013. Refer to Annexure A for proof of submission as well as the Acknowledgment of Receipt from DEA.	**11 March 2013**
Stakeholder identification	A stakeholder database was developed for the project by referring to the database of the previous projects undertaken on Du Plessis Dam farm. The initial database of I&APs included the landowner, the adjacent landowners, relevant district and local municipal officials, relevant national and provincial government officials, and organisations in the area. This database was updated during the EIA. A copy of the I&AP database is attached in Annexure B.	**March 2013**
Site notices	Site notices were put up to inform the general public of the proposed projects and the public participation process. One was placed at the entrance to the Du Plessis Dam Farm and one on the fence. Photos of the site notices are included in Annexure B.	**16 April 2013**
Newspaper Advertisements	An advert was placed in *Die Volksblad.* Copies of the advert and proof of placement are attached in Annexure B.	**30 April 2013**
Review of Scoping Reports		
I&APs and authorities	All potential I&APs were informed of the availability of the draft and final Scoping Reports by means of post and or email. Relevant state departments as listed in Annexure B were notified of the report and requested to submit comments. Copies of the Scoping Reports were made available for review at the following places: • De Aar public library located in Station Street, • The Emthanjeni Municipal Offices (Contact person: Mrs Kloppers). The reports were also available on the Aurecon website (http://www.aurecongroup.com- indicate “Current Location” as “South Africa” and click on the “Public Participation” link). Electronic copies of the reports were made available on request (on a CD). Authorities and I&APs were provided with 40-days to review the DSR and 21 days to review the final scoping report (FSR) and were invited to submit comments in writing to the Aurecon team. The closing date for comments was 10 June 2013 and 12 August 2013 respectively.	**Comment period for the DRS: 30 April 2013 to 10 June 2013** and Comment period for the FRS: **23 July 2013 to 12 August 2013**
Addressing comments received	All comments received on the DSR were collated into a Comments and Responses Report 1 (CRR1). The response to these comments from the proponent and the EAP was also provided in the CRR which was included in Annexure B of the FSR. All parties that submitted comments were provided with a copy of the CRR.	**30 April 2013 to 10 June 2013**

EIA Phase		
I&APs and authorities	All potential I&APs were informed of the availability of the draft EIA Report by means of post and or email. Relevant state departments, as listed in Annexure B, were notified of the report and requested to submit comments. Copies of the report were made available for review at the following places: • De Aar public library located in Station Street, • The Emthanjeni Municipal Offices (Contact person: Mrs Kloppers). The report was also available on the Aurecon website (http://www.aurecongroup.com- indicate "Current Location" as "South Africa" and click on the "Public Participation" link). Electronic copies of the reports were made available on request (on a CD). Authorities and I&APs were provided with 40-days to review the draft EIA report and were invited to submit comments in writing to the Aurecon team.	Comment period for the Draft EIA Report: **19 September 2013 to 29 October 2013**
Addressing comments received	All comments received on the Draft EIA Report will be collated into a Comments and Responses Report 2 (CRR2). The response to these comments from the proponent and the EAP will be included in the CRR 2 which will be annexe to the final EIA report. All parties that submitted comments will be provided with a copy of the CRR.	**October 2013**
Notification of DEA decision-making		
Notification of the Departments Decision	If DEA authorise the proposed projects, all registered I&APs would be notified of the decision within 12-days from the date of the decision. All registered I&APs will be notified of the Appeal process by means of letters sent by post or e-mail and an advert will be placed in *Die Volksblad*.	

2.5.1 Issues Raised

All issues raised by I&APs and key stakeholders during the respective comment periods of the Draft and FSR were recorded in CRRs, along with responses from Mulilo and the EAP. The CRR2 includes all comments raised on the FSR and is included in Annexure B.

To date, the following key issues and or comments were raised by I&APs and authorities:

- South African Heritage Resources Agency (SAHRA) - requested that the heritage reports be made available for comment. Aurecon responded that the heritage specialist studies will be incorporated into the Draft EIA Report. This Draft EIA Report and the Heritage Impact Assessment were provided to SAHRA for comment.
- The DoE indicated their support for the projects.

2.5.2 Authority involvement

Authorities have been involved with this project since the Initial Application Phase. It is anticipated that beyond providing key inputs into the EIA, the continued involvement of authorities will ultimately expedite the process by ensuring that the final documentation satisfies the respective

authority requirements and that the authorities are fully informed with respect to the nature and scope of the proposed PV solar energy facilities. The following authorities were requested to comment on the DSR and FSR:

- National Department of Agriculture, Forestry and Fisheries: Directorate: Land Use and Soil Management;
- Emthanjeni Local Municipality;
- Department of Environmental Affairs and Nature Conservation (DEA&NC);
- Eskom Holdings Limited;
- South African Heritage Resources Agency (SAHRA;
- Northern Cape Provincial Heritage: Boswa ya Kapa Bokone;
- Pixley ka Seme District Municipality;
- Department of Agriculture (Northern Cape); and
- Department of Water Affairs: Deputy Director Lower Orange WMA.

In addition to the abovementioned, the following authorities were also requested to provide comment during the EIA phase as requested by DEA:

- The South African Civil Aviation Authority;
- The Northern Cape Department of Transport;
- The South African National Roads Agency Limited; and
- The Square Kilometre Array.

2.6 ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

In undertaking this investigation and compiling the EIA Report, the following has been assumed:

- The strategic level investigations undertaken by the DoE regarding South Africa's proposed energy mix prior to the commencement of the EIA process are technologically acceptable and robust;
- The information provided by Mulilo is accurate and unbiased; and
- The scope of this investigation is limited to assessing the environmental impacts associated with the proposed PV facilities and associated infrastructures to enable connection to the grid.

The gaps in knowledge that were evident during the Scoping Phase include:

- Confirmation of service's capacity from the municipality.
- Clarity regarding exact accommodation of construction workers.
- Commencement date of construction phase.

The planning for the proposed projects is at a feasibility level and therefore some of the specific details are not available at this stage of the EIA process. This EIA process forms a part of the suite of feasibility studies, and as other studies progress, more information will become available to inform the EIA process. DEA, and other authorities, will be requested to issue their comments and ultimately their environmental decision to allow for the type of refinements that typically occur during these feasibility studies and detailed design phase of projects. Undertaking the EIA process in parallel with other feasibility studies does have a number of benefits. Such benefits include integrating environmental aspects into the layout and design and therefore ultimately encouraging a more environmentally sensitive and sustainable project.

2.7 INDEPENDENCE

The requirement for independence of the environmental consultant is aimed at reducing the potential for bias in the environmental process. Neither Aurecon nor any of its sub-consultants are subsidiaries of Mulilo nor is Mulilo a subsidiary to Aurecon. Furthermore, all these parties do not have any interests in secondary or downstream developments that may arise out of the authorisation of the proposed project.

Aurecon have selected a team of highly experienced specialists and multi-disciplinary practitioners in order to execute these projects as efficiently as possible. The Project Director, Mr Andries van der Merwe is appropriately qualified and registered with the relevant professional bodies. Mr van der Merwe is a certified Environmental Engineer registered with the Engineering Council of South Africa (*PrEng*) and holds a B Eng (Civil) degree. Mr van der Merwe has over 13 years' experience in the field of impact assessment.

The Project Reviewer, Miss Louise Corbett, an Associate in the Cape Town office, has a Bachelors of Science (Hons) Degree in Environmental and Geographical Science, specialising in Environmental Management, from the University of Cape Town. She has seven years' experience in the environmental field. Miss Corbett is a Registered *Professional Natural Scientist* with the South African Council for Natural Scientific Professions (SACNSP).

The Project Leader, Miss Karen Versfeld is a Senior Environmental Practitioner with over eight years' experience in the field. Miss Versfeld has a Master of Science Degree in Water Resource Management from the University of Pretoria and is registered as a *Candidate Natural Scientist* with SACNSP.

Mrs Karen de Bruyn, one of the project staff, is an Environmental Practitioner with three years' experience in the field. Mrs de Bruyn has a Masters of Philosophy in Environmental Management and is also a *Certified Natural Scientist* with SACNSP.

Miss Grace Shihepo, one of the project staff, is an Environmental Consultant with one years' experience in the field. Miss Shihepo has a Master of Science Degree in Environmental Science, specialising in Environmental Planning and Management.

Aurecon and the above environmental assessment practitioners (EAPs) are bound by the code of conduct for SACNSP. The Curriculum Vitae's of the key Aurecon staff is included in Annexure C.

3 DESCRIPTION OF THE PROPOSED PROJECTS

The purpose of this section is to provide a technical description of the activities associated with the proposed PV facilities. A motivation follows the introduction to the proposed projects, after which the feasible project alternatives are described. Furthermore, this section provides information relating to the potential impacts on the socio-economic and biophysical environment associated with all the phases of the proposed projects that were identified, in consultation with authorities, I&APs and specialists.

3.1 PROPOSED PROJECTS

Mulilo proposes to construct three PV facilities, each with a generation capacity of 75MW AC on Du Plessis Dam farm (Remainder of farm 179), near De Aar as indicated in Figure 4. The proposed layouts have taken cognisance of the environmental sensitive areas identified during the previous EIA undertaken for PV1 (Aurecon, 2012). PV1 is described Section 3.2.1. The total extent of the three proposed facilities would be approximately 859ha as set out in Table 8 below. The proposed areas include the area previously authorised for PV1.

Table 8 | Footprints, capacities and coordinates of the three proposed facilities (preferred alternatives)

Facility	Footprint	Capacity	Coordinates of middle point
PV2	273ha	75MW	30°38'11.38"S; 24° 4'22.75"E
PV3	212ha	75MW	30°37'53.03"S; 24° 3'28.26"E
PV4	374ha	75MW	30°37'27.44"S; 24° 2'31.14"E

Each of the proposed PV facilities would consist of numerous arrays of PV panels and associated support infrastructure. Ancillary infrastructure associated with the three proposed PV facilities would include onsite 132kV transmission lines and substations (one substation per PV facility), a boundary fence around each 75MW facility, onsite water supply infrastructure and stormwater management infrastructure. In addition, a connection building, control building, guard cabin and a solar resource measuring substation will be established.

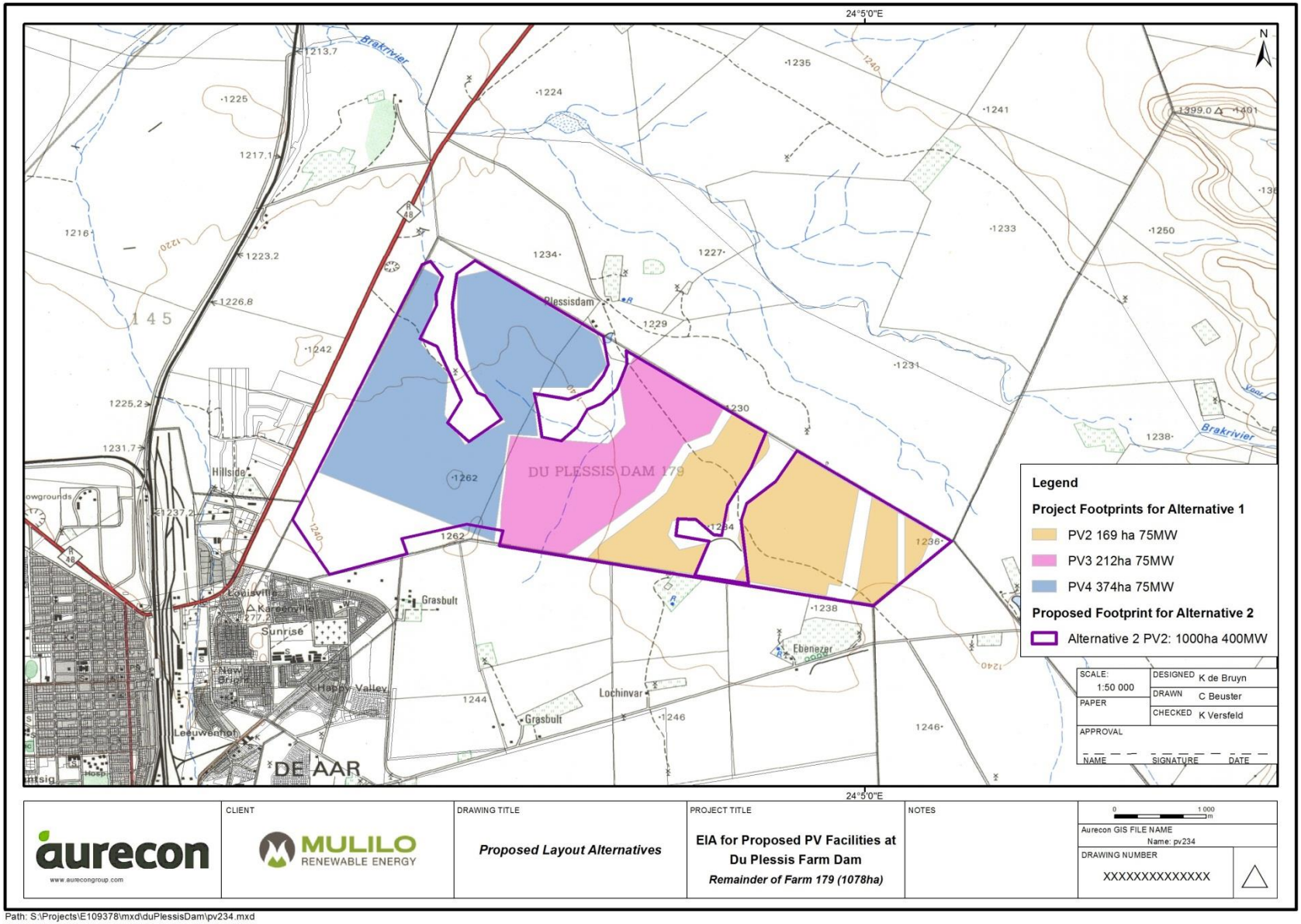


Figure 4 | Proposed PV layouts (PV2 to PV4 and extended PV2)

It is proposed that the following infrastructure be shared between the three facilities to lessen the impact on the surrounding environment:

- **Central substation:** One central 132kV substation and connection to Eskom grid. This central substation will connect the PV facilities with Eskom's De Aar substation via either an existing overhead 132kV Eskom line or the previously authorised 132kV overhead transmission line directly to the offsite De Aar substation.
- **Roads:** Access road and internal access roads for servicing and maintenance of the site.
- **Water supply infrastructure:** It is proposed that potable water be obtained from the Emthanjeni Municipality. Water will be transferred to the site via the municipal pipeline from the nearest municipal supply point and will be contained onsite in a jo-jo tank. However, the Municipality would need to confirm availability of capacity to do so[8].
- **Stormwater infrastructure:** Including drainage channels, berms, detention areas and kinetic energy dissipaters.
- **Buildings:** Buildings would likely include onsite substations, a connection building, control building, guard cabin, an electrical substation and solar resource measuring substation.

If all PV facilities are not approved and/ or constructed, the infrastructure mentioned above would still be required regardless of the number of PV facilities approved. However, the size and capacity of the infrastructure would be directly proportional to the number of PV facilities that would be constructed[9]. Each of the project components are described in further detail below.

3.1.1 Single axis tracking PV technology

Photovoltaic solar energy facilities use light energy from the sun to generate electricity through a process known as the PV effect. The PV cells absorb light energy which energises the electrons to produce electricity. Figure 5 depicts a typical PV facility in a landscape similar to De Aar.

Figure 5 | Example of a PV facility in a landscape similar to De Aar (image courtesy of Mulilo)

[8] The Municipality previously confirmed in excess of 15 times the amount of water required for construction of a 75MW facility and some 18 times the amount required for operations of a 75MW plant. Based on this excess allocation it can be confirmed that there will be no deficit in terms of municipal supply, however the municipality would have to confirm once preliminary design commences.

[9] A conservative approach was taken during the assessment of the proposed PV facilities and therefore the maximum capacity of the required infrastructure was assessed assuming that all three PV facilities would be authorised and/ or constructed.

The proposed PV panels are approximately 2m wide and 1m long. These panels are arranged into modules that are durable and can last up to 25 years due to the sturdiness of the structure and few moving parts. The PV modules (which will include a number of PV panels) will be physically mounted to a galvanized steel rotation tube, single axis tracking system to ensure ground connection from the module frames to the structure. The PV modules, fixed to the tracking system, are arranged into tracker blocks as indicated in Figure 6. These tracker blocks would be uniformly aligned to facilitate efficient sun-tracking.The dimensions of a tracker block range between 88m and 113m in an east to west direction and 35m to 38m in a north-south direction (Mulilo, 2013).

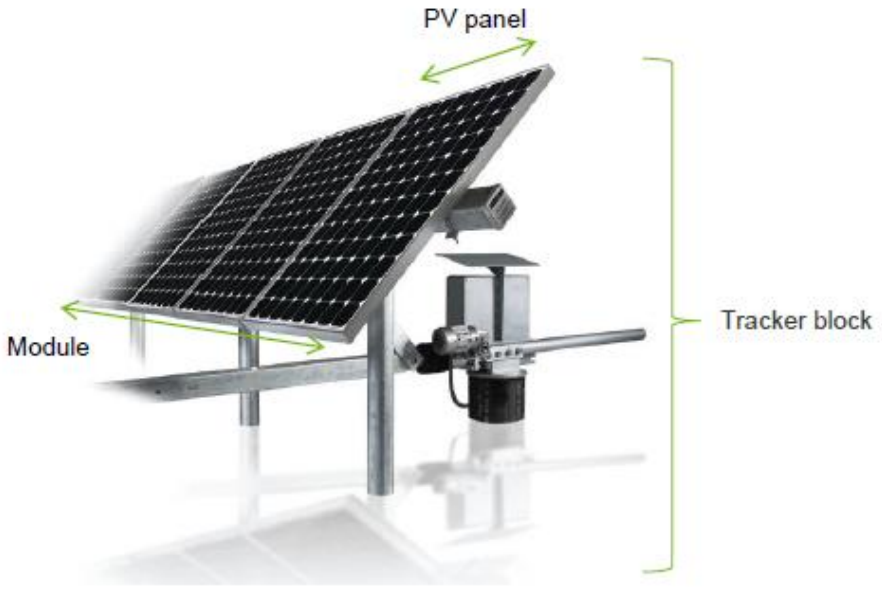


Figure 6 | Single axis tracking system (image courtesy of Mulilo)

The supports of the frame would be fixed on top of the steel piles. Since there is existence of rock (dolerite and siltstone) at shallow depths, the steel piles would be embedded into a concrete pile. However, the final design of the foundations will depend on the geotechnical conditions of the site which will be determined at a later stage.

3.1.2 Transmission lines and substations

It is envisaged that each PV facility would require an onsite substation specific to each PV facility i.e. three onsite substations. These substations would feed into one central onsite substation by means of onsite overhead 132kV transmission lines. The dimensions of all substations and buildings that would be required are indicated in Table 9.

Table 9 | Proposed substations

Substations	Dimensions
On Site Substations	~100m x 60m x 25m
Main Substations	~200m x 100m x 35m
Interconnection (Substation) Building	~25m x 15m x 5m
Interconnection Cabin	~15m x 4m x 5m
Operation and Maintenance Building	~30m x 15m x 4m
Inverter Cabins	~15m x 5m x 4m
Solar Structures	~30m x 7m x 5m

Based on the uncertainties regarding the capacity of Eskom's substations and transmission lines, it is proposed to assess a transmission line corridor instead of assessing the preliminary layouts which could still be subject to changes from Eskom. Two transmission corridors will be assessed as described in 3.2.4 and indicated in Figure 7.

Specialists have assessed the proposed transmission corridor as it contains the footprint of all of the proposed transmission lines and substations.

3.1.3 Additional infrastructures (road, buildings, stormwater, water pipeline)

An access road (6m in width and 6.8km long), would be constructed to access the PV facilities from the R48.

Internal access gravel roads from the main access roads to the proposed PV facilities would be required. The lengths of the proposed roads vary. Where it is possible, the layout of the road coincide with the existing dirt tracks. The proposed access and internal roads are shown in Table 10 and Figure 8.

Table 10 | Lengths of access roads

Access roads	Length
Main access road	5.57km
PV2 internal access road	0.42km
PV3 internal access road	0.18km
PV4 internal access road	0.16km

The natural water flow of the site would be interrupted by the execution of planned roads, and therefore new storm water drainage channels would be designed to facilitate natural water flow. The storm water drainage channels would guide water flow to one of several discharge points where rip-rap areas will slow down the velocity of water and disperse the flow to avoid any possible erosion issue at that discharge point. These mitigation measures are described in Section 4.5.5.

It is proposed that potable water be obtained from the Emthanjeni Municipality via a proposed underground pipeline (5km in length) from the nearest municipal supply point and would be contained onsite in a jo-jo tank. The Municipality still needs to confirm available capacity to facilitate this water requirement. The proposed water pipeline is depicted in Figure 8.

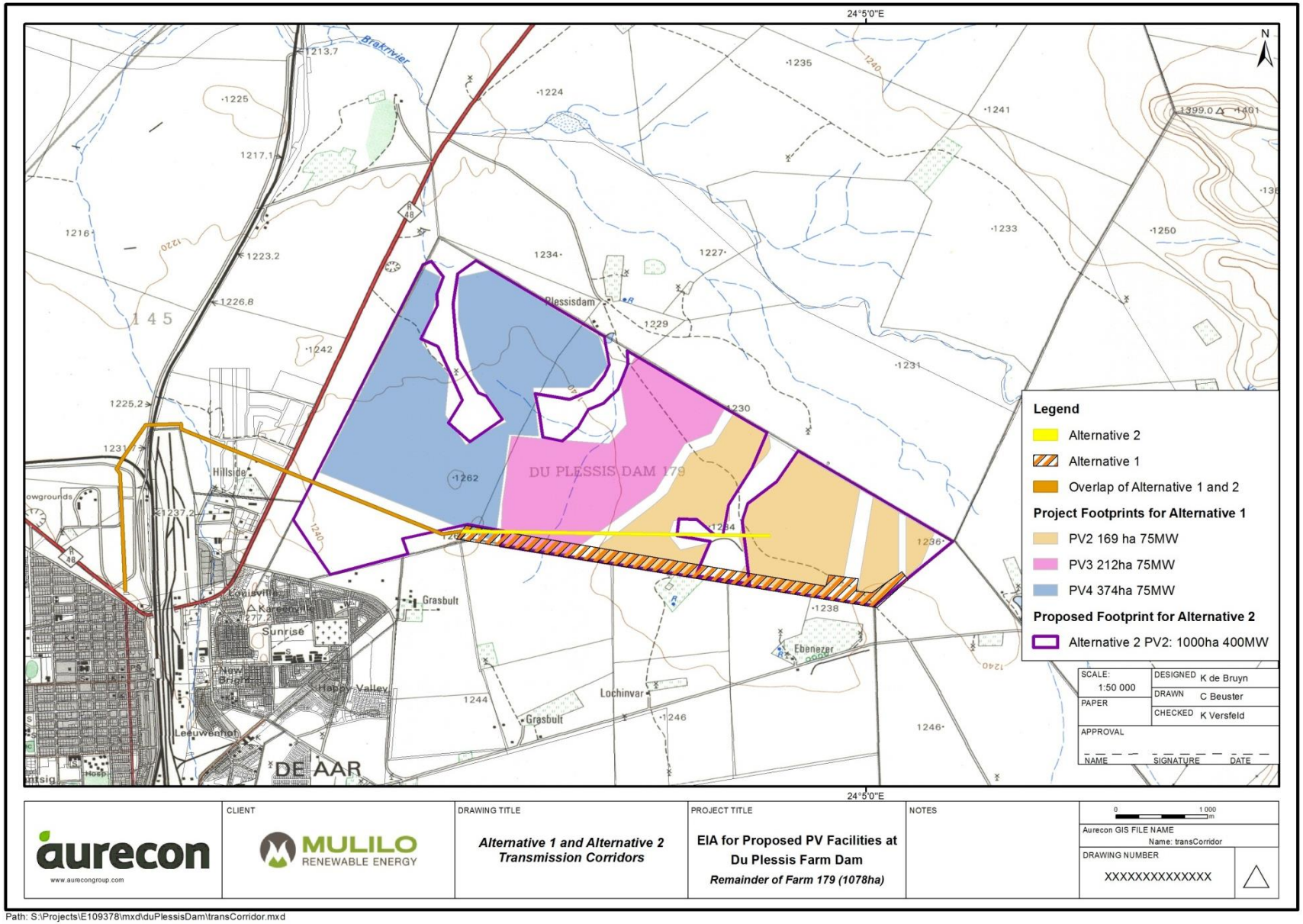


Figure 7 | Proposed transmission infrastructure corridor

3.1.4 Construction phase

The construction phase of each 75MW facility would last approximately 12 to 24 months per facility. Facilities on the same farm will be constructed consecutively depending on whether the projects are approved by the DoE and DEA.

Employment opportunities created by the construction phase equates to approximately 3,500 man months. These employment opportunities can be divided into the following employment categories:

- 80% would be created for South African citizens.
- 50% would be for black citizens.
- 15% would be skilled employees.
- 8% would be black skilled employees.
- 20% of the jobs created would be from the local community.

Accommodation will be provided for the non-local construction work-force, either in in temporary dwellings on site or in accommodation within De Aar. Approximately 500 workers per PV facility would require accommodation onsite or in the community. All onsite accommodation would be restricted to the laydown area, which has been assessed. A weekly municipal collection agreement would be established prior to construction commencing along with a private waste company who would be contracted for daily/ weekly servicing as required. Approximately 3,626kℓ of water would be required per 75MW facility per annum and 7,252kℓ per annum per 150MW facility during the duration of the construction phase.

One laydown area has been identified as indicated in Figure 9. This area will be used to store equipment and materials and house the construction camp. Temporary offices will also be constructed to manage construction activities form a central point. The extent of this area would be kept to a minimum. Septic tanks are to be constructed at offices and laydown area and will be serviced regularly.

Construction vehicles are likely to make use of the existing roads, including the N10 and R48, to transport equipment and material to the construction site. Approximately 450 truckloads transporting in total 900 40-foot containers would be required during the construction period. These deliveries would be distributed over the 12 to 24 month construction period.

During the construction phase the area would be cleared in order to construct the proposed facilities. Topsoil would be kept, temporarily stored on site and finally distributed over the surface of the site. During the construction phase, different types of control measures would be used to limit soil migration across the site. These mitigation measures are described in Section 4.11.4 and included in the Life-cycle Environmental Management Plan (LEMP) included in Annexure D. The disturbed areas would be rehabilitated to as natural a vegetative state as possible.

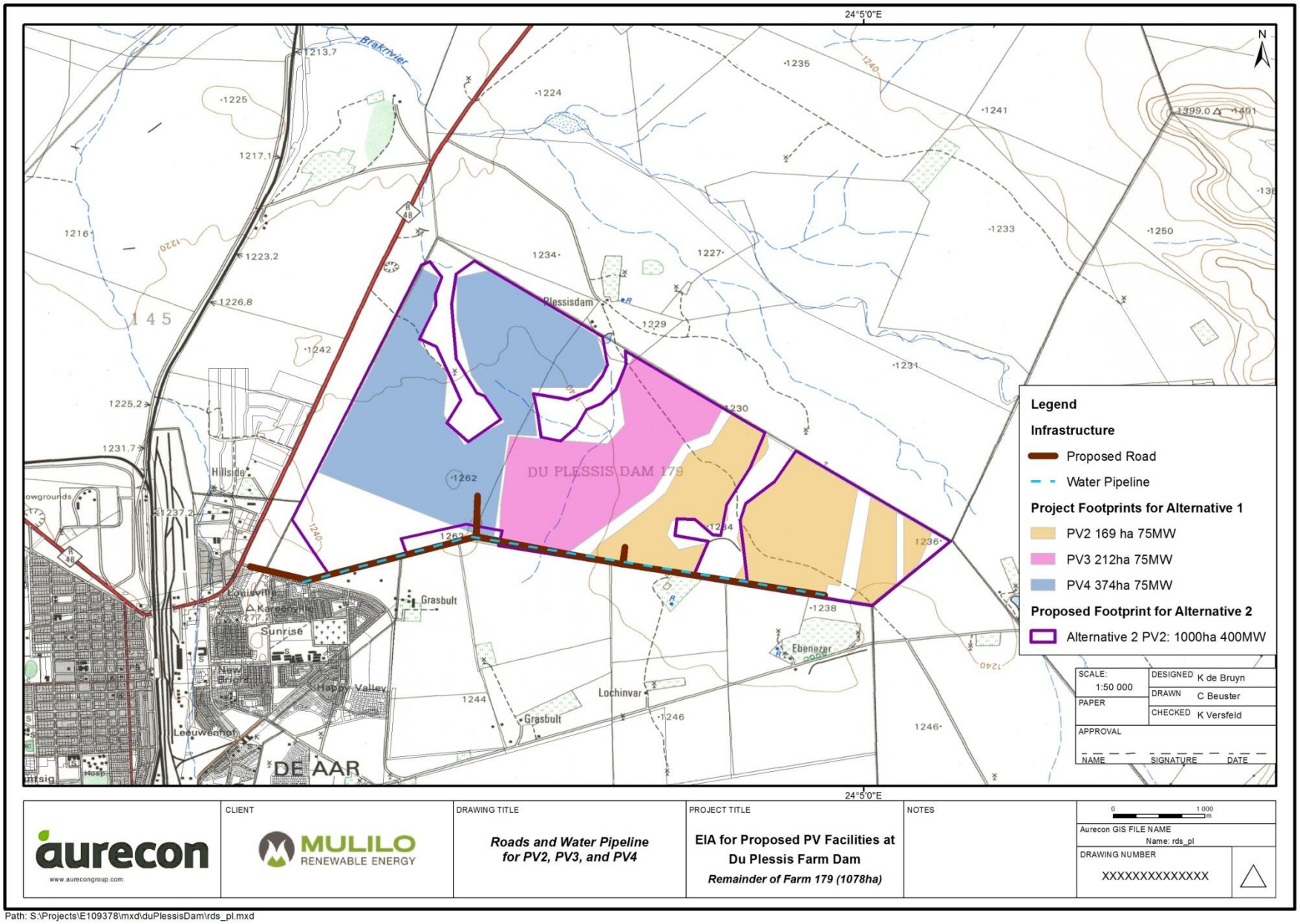


Figure 8 | Proposed water pipeline and access road

3.1.5 Operational phase

It is anticipated that the PV facilities would have a lifespan of approximately 20 years. During this time, the remainder of the farm will continue to be used as grazing fields.

Employment opportunities to be created during the operational phase equates to approximately 35 man months per annum. These employment opportunities can once again be divided into the following employment categories:

- 80% would be created for South African citizens.
- 50% would be for black citizens.
- 45% would be skilled employees.
- 14% would be black skilled employees.
- 54% of the jobs created would be from the local community.

Approximately 500litres (ℓ) of fuel and 50ℓ of lubrication oil would be stored on site. This volume falls well below the triggers as listed activity in terms of NEMA. However, the necessary precaution measures would be in place and have been included in the LEMP.

To ensure that maximum quantities of sunrays can be captured by the PV panels it is important to undertake regular cleaning. Dust, dirt, pollen, and bird droppings can reduce the efficiency of PV panels. The frequency of panel cleaning would depend on the site conditions. Panels would be washed approximately twice a year. Only water will be used with a squeegee and no detergents would be added. Water for the cleaning of the panels would either be sourced from the closest Emthanjeni municipal source. Approximately 348kℓ of water per annum would be required per 75MW facility.

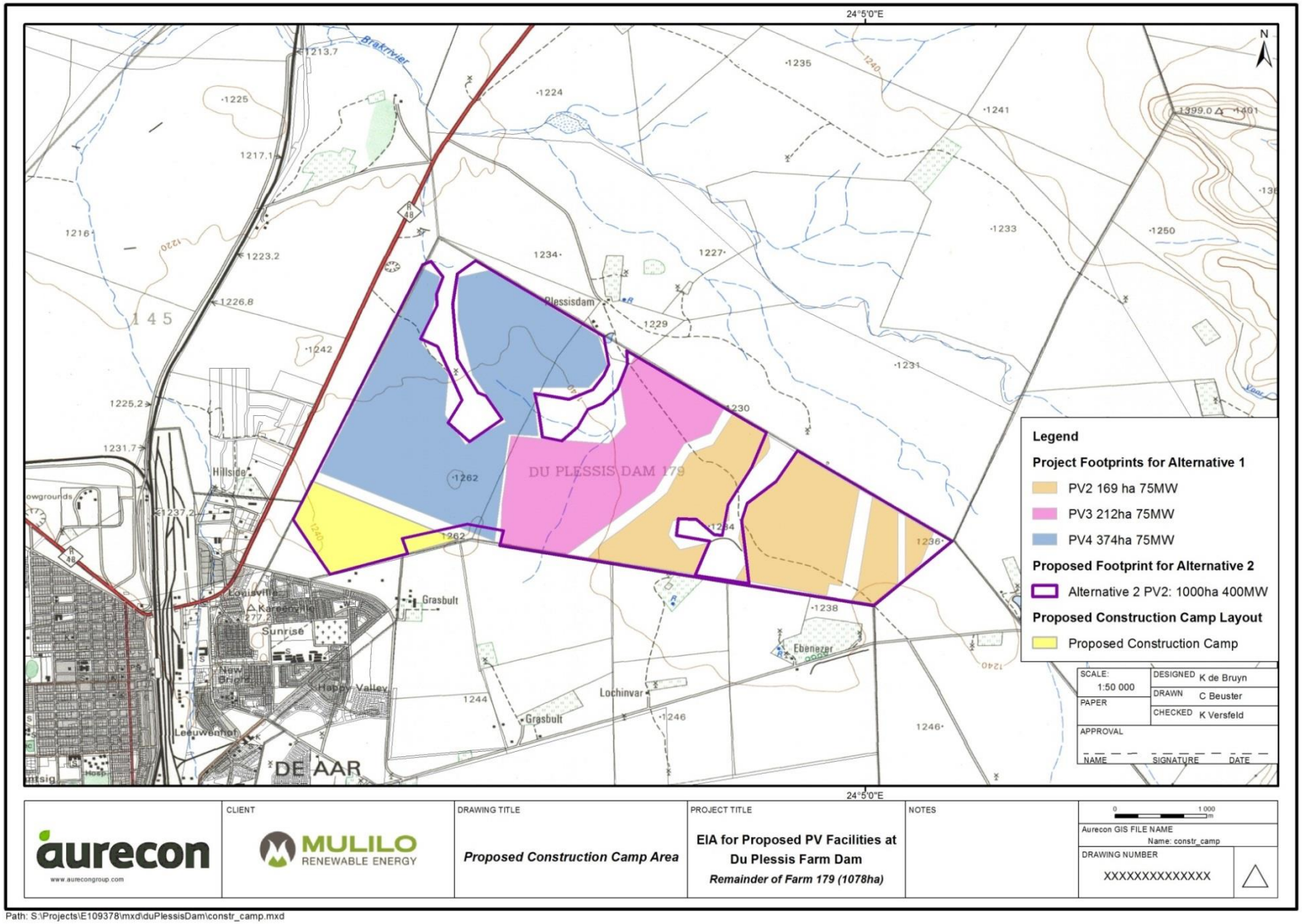


Figure 9 | Laydown area to be used for a construction camp and to store equipment and materials

3.1.6 Decommissioning phase

The PV site would potentially be decommissioned at the end of the Power Purchase Agreement (20 years from the date of commissioning). The possibility of upgrading the proposed facilities to more advantageous technologies would be investigated at the end of the Power Purchase Agreement. Should decommissioning be considered to be the favourable option, it would potentially take between 6 to 12 months per 75MW AC PV facility. After disconnecting the PV infrastructure from the electricity network, the module components would be removed and recycled as far as possible. The structures would be dismantled and the concrete pile foundations would be removed. All underground cables would be excavated and removed. The buildings would be demolished and removed by an authorised company.

The rehabilitation of the disturbed areas would form part of the decommissioning phase. The aim would be to restore the land to its original substratum characteristics (or as near as possible). The restoration activities would include the following:

- Sub-soiling[10] of the disturbed soil layer to reduce the density thereof;
- Distribution of a layer of topsoil (30cm) over the disturbed areas;
- Improvement of soil composition and possible application of fertilizers; and
- Replanting with indigenous seed mix.

3.2 ALTERNATIVES

NEMA requires that alternatives be considered during the EIA process. According to DEAT (2004) "*an alternative can be defined as a possible course of action, in place of another, that would meet the same purpose and need*".

The DEA&DP 2013 guideline for alternatives states that *"every EIA process must identify and investigate alternatives, with feasible and reasonable alternatives to be comparatively assessed. If, however, after having identified and investigated alternatives, no feasible and reasonable alternatives were found, no comparative assessment of alternatives, beyond the comparative assessment of the preferred alternative and the option of not proceeding, is required during the assessment phase. What would, however, have to be provided to the Department in this instance is proof that an investigation was undertaken and motivation indicating that no reasonable or feasible alternatives other than the preferred option and the no-go option exist."*

"Alternatives", in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to—

(a) the property on which or **location** where it is proposed to undertake the activity;
(b) the type of **activity** to be undertaken;
(c) the design or **layout** of the activity;
(d) the **technology** to be used in the activity;
(e) the **operational** aspects of the activity; and
(f) the option of not implementing the activity ("**No-Go**" alternative).

In addition to the list above, the 2013 Department of Environmental Affairs and Development Planning (DEA&DP) Guidelines on Alternatives also considers the following as alternatives:

[10] This involves drilling or removing material from this soil layer to a depth of 50 to 100 cm in order to air it and enable the agricultural plant species situated above to take root.

(a) **Demand alternative:** Arises when a demand for a certain product or service can be met by some alternative means (e.g. the demand for electricity could be met by supplying more energy or using energy more efficiently by managing demand).
(b) **Input alternative:** Input alternatives are applicable to applications that may use different raw materials or energy sources in their process (e.g. Industry may consider using either high sulphur coal or natural gas as a fuel source).
(c) **Routing alternative:** Consideration of alternative routes generally applies to linear developments such as power line servitudes, transportation and pipeline routes.
(d) **Scheduling and timing alternative:** Where a number of measures might play a part in an overall programme, but the order in which they are scheduled will contribute to the overall effectiveness of the end result.
(e) **Scale and Magnitude alternative:** Activities that can be broken down into smaller units and can be undertaken on different scales (e.g. for a housing development there could be the option 10, 15 or 20 housing units. Each of these alternatives may have different impacts).

The Scoping Phase screened alternatives to derive a list of feasible alternatives assessed in detail in the current EIA Phase. The following types of alternatives were considered to be the most pertinent to the proposed projects:

- Layout alternative dependent on the scale and magnitude alternative;
- Technology alternative;
- Transmission line routing alternative;
- Scale and magnitude alternative; and
- No-Go Alternative.

The alternative types pertinent to the projects are described in the subsequent sections.

3.2.1 Location alternative

It is proposed that the three PV facilities be constructed at Du Plessis Dam farm (Remainder of Farm 179). A previous EIA was undertaken at the same location for a single PV facility with a generation capacity of 19.9MW capacity (Aurecon, 2012). Specialist investigations found no fatal flaws at Du Plessis Dam Farm which would prevent the project from being authorised. As mentioned earlier, DEA authorised the facility and will hereafter be referred to as Du Plessis Dam PV1. Please see Figure 1 and Figure 10 for the approved layout of PV1 indicated in grey.

The preliminary design for this project (i.e. proposed three additional 75MW PV facilities) has taken into account the environmental sensitive areas that were identified in the previous EIA (Aurecon 2012). As indicated in Figure 10, various PV facilities are being assessed in close proximity to De Aar.

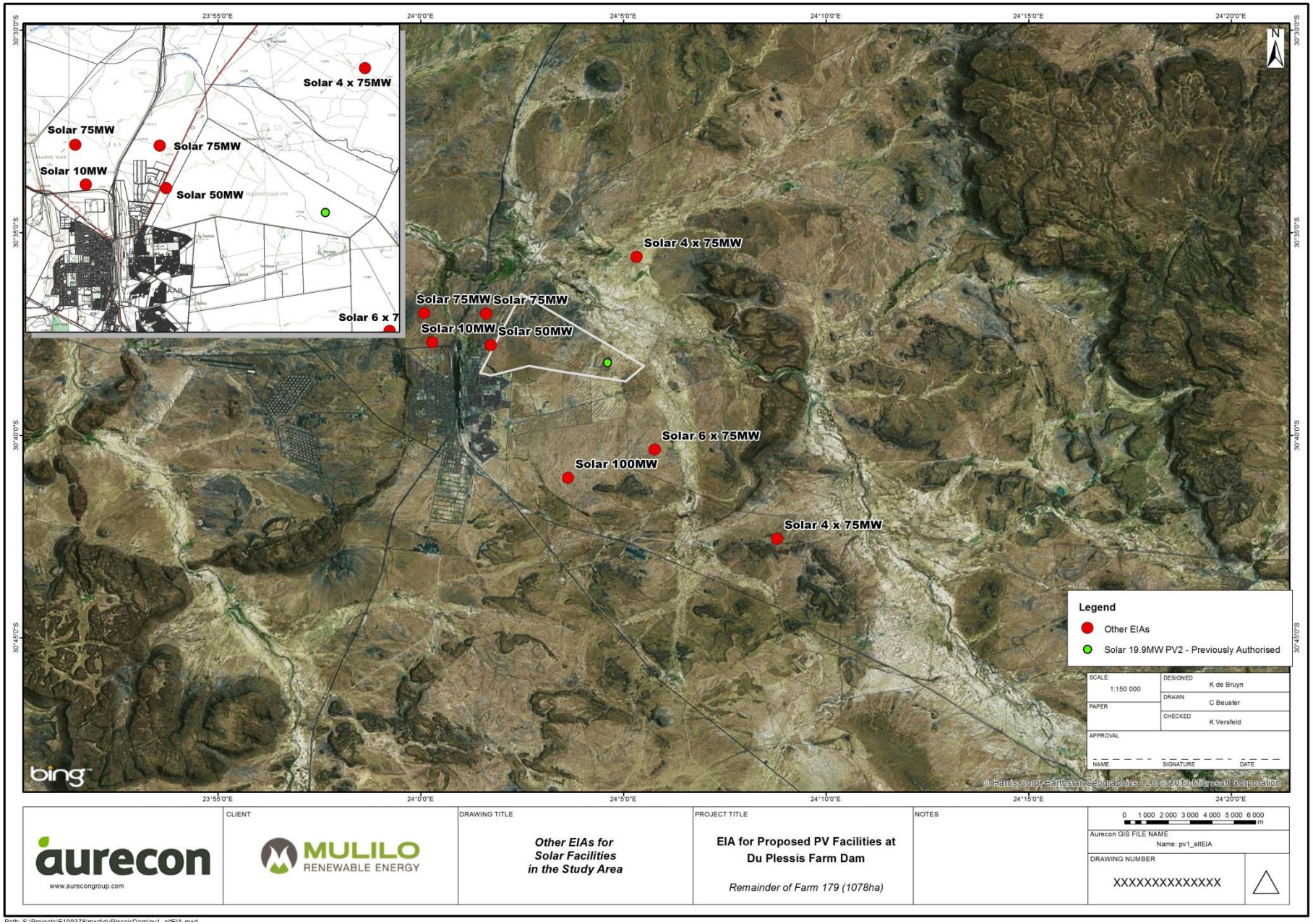


Figure 10 | Other EIAs for solar facilities in the study area

It is economically feasible to group developments on a site that is already well studied to promote infrastructure sharing. As mentioned, Mulilo already received an EA for one PV facility on this farm which is further motivation for this location alternative as it could result in the following benefits:

- Sharing of supply infrastructure including water, sewage and electricity;
- Reducing the impact on the environment due to combining infrastructure and footprints;
- Utilizing a single laydown area and construction camp minimizing traffic and associated impacts with multiple camps;
- Allowing phased approach to construction activities thereby extending the construction period for employment and creating more long term employment jobs;
- Reducing the need for multiple electricity grid connection points and transmission lines;
- Motivation for the creation of an industrial zone within De Aar whereby specialised services and manufacturing processes are able to develop in response to consistent demand; and
- Improved accuracy in terms of assessing cumulative impacts during the EIA phase.

The selection of this preferred and only location alternative was furthermore based on the following characteristics of the site:

- Solar resource potential based on historic satellite data;
- Grid connectivity and close proximity to strong grid access;
- Flat, level, and open land;
- Little environmentally and socially sensitive areas; and
- Non-arable or low arable potential of the land.

Based on the above motivation, it is proposed to only assess one location alternative namely Du Plessis Dam farm (Remainder of Farm 179), De Aar.

3.2.2 Layout alternative dependent on the scale and magnitude alternatives

The DoE introduced a capacity limit of 75MW for solar facilities. The proponent is hopeful that the DoE will realise the benefits of having combined facilities and are therefore proposing two scale and magnitude alternatives. In other words, the capacity (MW) of the facilities will determine the layout of the facilities.

Layout Alternative 1

This alternative consists of the three proposed 75MW PV facilities and associated infrastructure as indicated in Figure 4 (referred to as PV2, PV3 and PV4). These layouts take cognisance of the 75MW DoE cap and the environmentally sensitive areas as identified by Aurecon (2012).

Layout Alternative 2

This alternative consists of one 400MW PV facility. The layout for this alternative was developed by extending and combining the proposed 75MW facilities. This alternative is thus not limited to the DOE's 75MW cap per project. By increasing the capacity it has the benefit of utilising industries at scale thereby reducing associated development and construction costs which reduces lending rates and essentially lower the tariff of electricity sold.

As indicated in Figure 4 and Table 11 the layout of extended PV2 more or less overlaps with the Alternative 1 layouts.

Table 11 | Layout alternatives

Alternative 1	PV2	PV3	PV4
Alternative 2	**Extended PV2**		

Table 12 includes details of the proposed extended layout (referred to Layout Alternative 2).

Table 12 | Footprints, capacities and coordinates of the proposed extended layout

Facility	Footprint	Capacity	Coordinates of middle point
Extended PV2	1 068ha	400MW	30°37'51.78"S; 24°3'14.27"E

Layout of additional infrastructure

It is proposed that one layout for the proposed roads and water pipeline be assessed. The layouts provided took the environmentally sensitive areas into consideration and follows the shortest viable route as shown in Figure 8.

3.2.3 Technology alternative

The selection of Du Plessis Dam farm was based on the requirements for solar energy since the proponent aims to provide energy into the solar allocation allowed for by the IRP. Therefore, suitable solar sites were identified and Du Plessis Dam was deemed suitable. Therefore all of the technology alternatives considered revolves around the solar PV technologies.

3.2.3.1 Solar panel alternatives

Three solar panel types were considered for the proposed facilities namely:

- Concentrated photovoltaic (CPV);
- Concentrated solar power (CSP;) and
- Conventional PV solar cells.

Information gathered through previous EIAs (Aurecon, 2012), as well as the recent technology advances informed this investigation.

Figure 11 | CPV panel using optics to concentrate the sunlight (image courtesy of Mulilo)

CPV technology makes use of optics such as lenses or curved mirrors to concentrate sunlight onto a small area of solar PV cells to generate electricity as shown in Figure 11. This technology type converts the concentrated sunlight directly to electricity via the photovoltaic effect and is considered to be more cost effective than conventional PV solar cells in that it requires a smaller area of photovoltaic material which makes it cheaper per unit of energy produced. However, it does require active solar tracking to be effective.

Similar to CPV technology, CSPs use mirrors or lenses to concentrate sunlight onto a small area to generate electricity directly via a heat engine, e.g. a steam turbine. Conventional PV technology on the other hand does not make use of any mirrors or lenses and generates electricity by converting solar radiation energy into a DC current which then needs to be converted to an AC current to connect to the grid.

The conventional PV and CPV technologies require significantly less water (19ℓ/MWh of water per day) than the CSP system which needs approximately 3,420ℓ/MWh of water per day during the operational period. Therefore, due to the scarcity of water in this area, and the large volume of water required for the CSP system, only conventional PV and CPV technologies will be considered for the proposed solar facilities.

3.2.3.1 Mounting Alternatives

In terms of the mounting alternatives, single axis tracking systems will be considered along with fixed axis tracking systems. The preference for single axis tracking is based on the economic viability, water requirements, land requirements, efficiency and potential environmental impacts of the proposed solar panel types.

In a fixed axis tracking system the PV panels are installed at a set tilt and cannot move, whereas in a single axis tracking system the panels follow the sun to ensure maximum exposure to sunlight as indicated in Figure 12.

Figure 12 | Fixed axis tracking system (a) and single axis tracking system (b)

There is a slight height difference between the two tracking systems with fixed axis being 4m above the natural ground level and single axis tracking being 3.7m above the ground.

The photovoltaic single axis tracking technology, has the following benefits:

- The panels are the highest efficiency panels with the highest efficiency inverter, maximizing the system output. The installation costs are less as fewer panels are required.
- By minimising shading and grouping trackers closer together, this highly efficient technology produces the most energy per hectare of any tracking system. It requires up to 20% less land than conventional crystalline fixed tilt systems and up to 60% less than thin film technology. These highly efficient panels not only require less land, but also less concrete, steel and cabling per MW.
- The panel's anti-reflective glass and exceptional low-light performance characteristics enhances energy delivery.

The reflectivity of PV panels in relation to other building materials is indicated in Figure 13 below. The reflectivity of a PV panel is considered to be between asphalt and a forest.

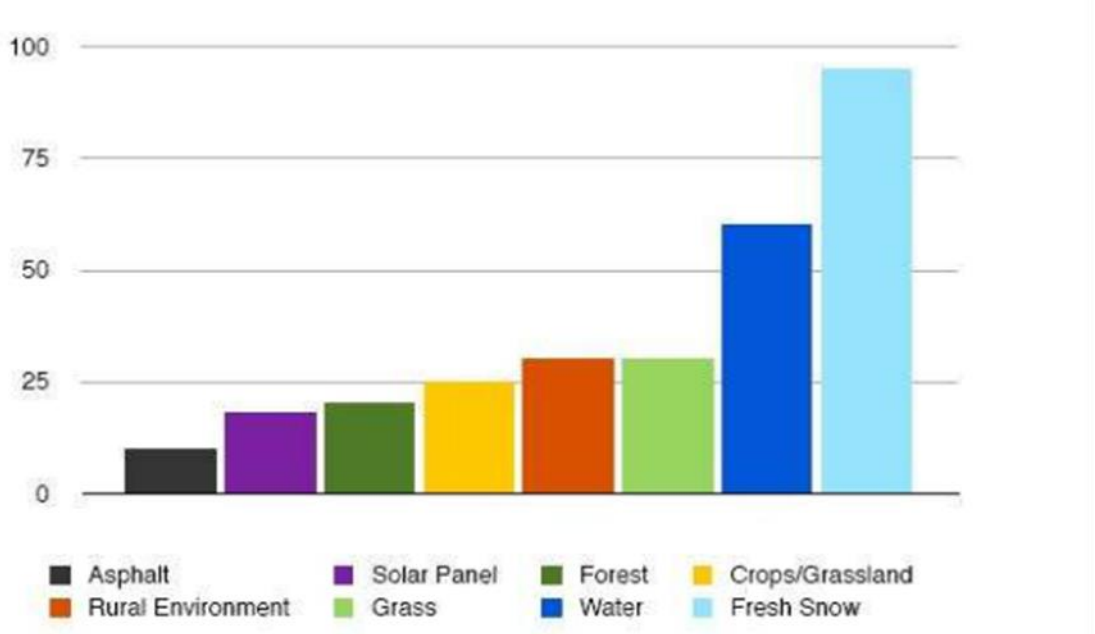


Figure 13 | Reflectiveness of PV panels (Albedo reflectance)

3.2.4 Transmission line routing and substations alternative

It is envisaged that each PV facility would require an onsite substation specific to each PV facility i.e. three onsite substations. These substations would feed into one central onsite substation by means of onsite overhead 132kV transmission lines.
As previously mentioned, it is proposed to assess two transmission corridors instead of assessing the preliminary layouts which could be subject to changes.

The first sections of the transmission line alternative corridors (from the De Aar substation to Du Plessis Dam Farm), as indicated in orange in Figure 7, would overlap. The width of the corridor overlapping section would be 31m in total. After approximately 5km of overlapping, the two corridors split into two separate layouts.

Alternative 1 transmission corridor

The proposed transmission corridor (alternative 1) would be approximately 10km. The width of first section of the corridor is 31m and the second section is 160m. The first section of the corridor is from the De Aar substation travelling north for approximately 1.7km before turning south-east, crossing the R48, and then entering Du Plessis Dam Farm. The second section of the corridor would follow the southern boundary of the farm. The proposed corridor would house overhead transmission lines and substations to connect the proposed PV facilities to existing Eskom infrastructures.

Alternative 2 transmission corridor

The proposed transmission corridor (alternative 2) would be approximately 8km in length. The width of the entire alternative 2 corridor is 31m. As mentioned above, the first section of alternative 1 and alternative 2 transmissions line corridors overlaps. The second section of the corridor would follow the layout of the approved transmission line[11] as indicated in Figure 7. The proposed corridor would house overhead transmission lines and substations to connect the proposed PV facilities to existing Eskom infrastructures.

[11] DEA Reference Number: 12/12/20/2498 and NEAS Reference Number: DEAT/EIA/0000609/2011

3.2.5 No-Go alternative

The assessment of alternatives must at all times include the "no-go" option as a baseline against which all other alternatives must be measured. The option of not implementing the activity must always be assessed and to the same level of detail as the other feasible and reasonable alternatives. The "no-go" option is taken to be the existing rights on the property, including the approved PV facility (PV1), and this includes all the duty of care and other legal responsibilities that apply to the owner of the property.

This alternative will also be assessed in the EIA phase.

3.2.6 Conclusion on Alternatives

Based on the investigations and reasons provided earlier, it is proposed that the following alternatives be assessed:

- **Location alternative:** Du Plessis Dam Farm (Remainder of Farm 179)
- **Layout alternatives as determined by scale and magnitude alternatives:** (Alternative 1 and Alternative 2)
- **Additional routing infrastructure:** One routing alternative for access roads and water pipeline
- **Technology alternatives:**
    - Solar Panel alternative: CPV and conventional PV
    - Mounting Alternatives: Fixed axis tracking system and single axis tracking system
- **Transmission line routing:** Two transmission corridors
- **No-Go alternative**

3.3 MOTIVATION FOR THE PROJECTS

The 2009 DEA&DP Guideline for Need and Desirability[12] highlights the obligation for all proposed activities which trigger the environmental regulations to be considered in light of (amongst others) the National Framework for Sustainable Development[13], the spatial planning context, broader societal needs, and financial viability. This information allows the authorities to contemplate the strategic context of a decision on the proposed activity. This section seeks to provide the context within which the need and desirability of the proposed activity should be considered.

The need for renewable energy is well documented and reasons for the desirability of solar energy include:

- Utilise the most abundant natural resource available to South Africa;
- Meeting nationally appropriate emission targets in line with global climate change commitments;
- Enhancing energy security by diversifying generation; and
- Creating a more sustainable economy.

[12]DEA&DP (2009) Guideline on Need and Desirability, NEMA EIA Regulations Guideline and Information Document Series. Western Cape Department of Environmental Affairs & Development Planning (DEA&DP).

[13]Republic of South Africa (2008) People – Planet – Prosperity: A National Framework for Sustainable Development in South Africa. Pretoria: Department of Environmental Affairs (DEA), Republic of South Africa [Internet]. Available from: http://www.environment.gov.za [Accessed 29 March2011].

3.3.1 Utilise resources available to South Africa

As illustrated in Figure 14, South Africa is subject to some of the highest levels of solar radiation in the world with an average daily solar radiation that varies between 4.5 kilo-watt hour per square kilometre (kWh/m^2) and 6.5kWh/m^2. This, in comparison to about 3.6kWh/m^2 for parts of the United States and about 2.5kWh/m^2 for Europe and the United Kingdom (Department of Minerals and Energy, 2003), reveals that South Africa has considerable solar resource potential which should be utilised.

South Africa currently generates the majority of its required electricity from coal of which there is a ready supply at the local level. However, national government is on the verge of augmenting the existing generation capacity of thermal and nuclear power plants with renewable energy power generation, thus creating the framework that will lead to an increase in the supply of clean energy for the nation.

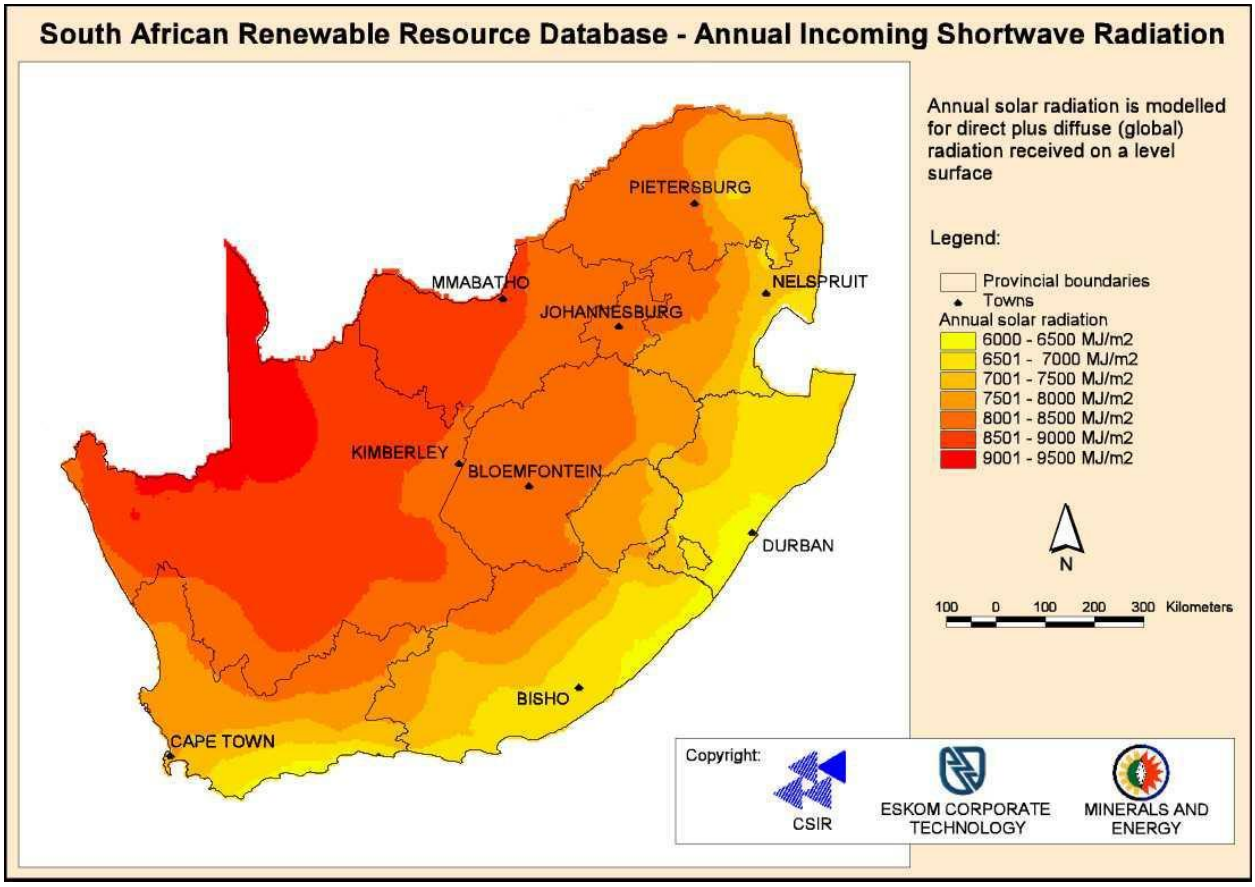


Figure 14 | Annual solar radiation for South Africa (Department of Minerals and Energy, 2003)

3.3.2 Meeting nationally appropriate emission targets in line with global climate change commitments

As can be seen by the numerous policies and legislation described in Section 1.2, the need for renewable energy is well documented. Due to concerns such as climate change, and the on-going exploitation of non-renewable resources, there is increasing international pressure on countries to increase their share of renewable energy generation. The proposed PV projects are expected to contribute positively towards climate change mitigation.

Renewable energy is recognized internationally as a major contributor in protecting the climate, nature and the environment, as well as providing a wide range of environmental, economic and social benefits that can contribute towards long-term global sustainability.

Solar energy is a source of "green" electricity as for every 1MWh of "green" electricity used instead of traditional coal powered stations, one can:

- Save water;
- Avoid Sulphur Dioxide (SO_2) emissions;
- Avoid Carbon Dioxide (CO_2) emissions including transmission losses;
- Avoid ash production; and
- Contribute to social upliftment[14]

3.3.3 Enhancing energy security by diversifying generation

The establishment of the proposed PV power generation facilities would strengthen the existing electricity grid for the area. Moreover, the projects would contribute towards meeting the national energy target as set by the Department of Energy (DoE). Should the proposed PV site and development identified by Mulilo be acceptable, it is considered viable that long term benefits for the community and society in De Aar would be realised as highlighted above.

The proposed projects would also have international significance as it contributes to South Africa being able to meet some of its international obligations by aligning domestic policy with internationally agreed strategies and standards as set by the United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, and United Nations Convention on Biological Diversity (UNCBD) all of which South Africa is a signatory to.

3.3.4 Creating a more sustainable economy

The Northern Cape has a semi-arid climate, and particularly the De Aar area, has large tracts of open land which are sparsely inhabited. The towns are generally small with limited job opportunities. The need to improve the quality of life for all, and especially for the poor, through job creation is critical in South Africa. It is expected that the proposed projects would contribute directly to the upliftment of the individuals and the societies in which they live. Skills development, and the transfer thereof, and local community involvement would be two of the priorities. Community involvement would either be through direct employment or indirectly through service industries. This would be enhanced as far as possible. It is anticipated that job opportunities amounting to approximately 3,500 man months would be created per construction phase per 75MW project, and 7,000 man months per 150MW facility depending on the procurement method and the primary contractor.

Additional potential benefits include:

- Reducing the demand on scarce resources, such as water as the generation of energy from PV facilities uses less water per MW/h than coal-fired facilities;
- Reducing pollution as the generation of energy from PV facilities produces far less pollution per MW/h than coal-fired facilities;
- Local economic development as indicated in Table 13; and
- Local skills development.

[14] http://www.ehow.com/facts_5858883_solar-energy-vs_-clean-coal.html Accessed on 2 September 2013

Numerous studies and reports have attempted to quantify the employment creation potential of renewable energy per unit of power installed or generated. AGAMA Energy (2003) established that solar PV has the largest creation potential of all the renewable technologies as indicated in Table 13.

Table 13 | Renewable energy employment potential in terms of the gross direct jobs created per GWh for the various technologies (Agama Energy, 2003)

Employment per GWh						
Technology	**Fuel /GWh**	**Manufacture /GWh**	**Installation /GWh**	**O&M /GWh**	**Other /GWh**	**Total /GWh**
Solar thermal	0	3	7	0.4	0	10.4
Solar PV	0	32.9	21.2	4.4	3.5	62
Wind	0	8.4	1.3	2.6	0.3	12.6
Bio-energy	0	3.55	3.55	7.2	0	14.3
Hydro	0	8.4	1.3	2.6	0.3	12.6

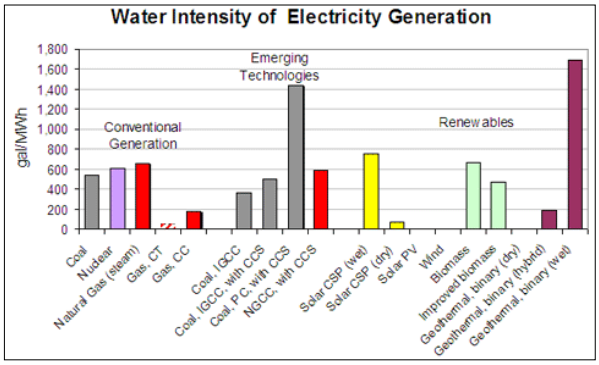
Table 14 indicates how the NEMA suitability principles are applicable to the proposed projects.

Table 14 | The applicability of NEMA Sustainability Principles to the proposed projects

NEMA Sustainable Development Principle	Consideration for these proposed projects and EIA Process
(1) The principles set out in this section apply throughout the Republic to the actions of all organs of state that may significantly affect the environment and – • Shall apply alongside all other appropriate and relevant considerations, including the State's responsibility to respect, protect, promote and fulfil the social and economic rights in Chapter 2 of the Constitution and in particular the basic needs of categories of persons disadvantaged by unfair discriminations; • Serve as the general framework within which environmental management and implementation plans must be formulated; • Serve as guidelines by reference to which any organ of state must exercise any function when taking any decision in terms of this Act; or any statute provision concerning the protection of the environment; • Serve as principles by reference to which a conciliator appointed under this Act must make recommendations; and • Guide the interpretation, administration and implementation of this Act, and any other law concerned with the protection of management of the environment.	All principles will be considered in the application and consideration for authorisation.
(2) Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental,	This EIA process will consider both the natural and socio-economic environment and mitigation measures will be provided in response to this

cultural and social interests equitably.	principle.
(3) Development must be socially, environmental and economically sustainable.	The need to improve the quality of life for all, and especially for the poor, through job creation is critical in South Africa. It is expected that the proposed projects would contribute directly to the upliftment of the individuals and the societies in which they live. The proposed project would also include the following benefits that would contribute to environmentally and social sustainability: • Reducing pollution as the generation of energy from PV facilities produces far less pollution per MW/h than coal-fired facilities; • Local economic development; and • Local skills development. • Construction industry businesses will benefit from an increase in the demand for their goods, materials and services. • Increased business productivity will directly result to improved spending power • Increase in the competitiveness of the region in terms of energy generation.
(4) (a) Sustainable development requires the consideration of all relevant factors including the following:	
That the disturbance of ecosystems and loss of biological diversity are avoided, or where they cannot be altogether avoided, are minimised and remedied;	Disturbance of the ecosystem and loss of biological diversity would be minimised through design measures and appropriate mitigation measures. The advantage of the developing Du Plessis Dam Farm, is that this site has already gone through intensive EIA investigations and environmentally sensitive areas have been identified. These sensitive areas have thus informed the design phase to ensure that sensitive areas are avoided to limit the disturbance of ecosystems. Furthermore, a LEMP was compiled to ensure that mitigation measures proposed in this EIA process are implemented during the planning, construction, operational and decommissioning phases.
That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied;	A LEMP were compiled to ensure that mitigation measures proposed in this EIA process are implemented during the planning, construction, operational and decommissioning phases.
That the disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or where is cannot be altogether avoided, is minimised and remedied;	A heritage and palaeontological impact assessments were undertaken and are summarized in Section 4.
That waste is avoided, or where it cannot be altogether avoided, minimised and re-	The projects shall generate the least amount of waste possible by properly planning material

used or recycled where possible and otherwise disposed of in a responsible manner;	procurement (ordering, transportation and delivery), ensuring proper material handling and storage to reduce the avoidable generation of wastage (i.e. broken and damaged materials) and reusing potential waste materials on site wherever possible. Of the inevitable waste that is generated, as many of the waste materials as economically feasible shall be recovered and sorted for donation, reuse elsewhere or stored separately for recycling.
That the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;	These projects will increase South Africa's generation capacity through renewable energy technologies and would not utilise non-renewable energy. Advantages of solar power are many. Although solar power is an energy source that we have only recently tapped into, it may easily become the most important energy source of the future. Solar energy systems have very little impact on the environment, making them one of the cleanest power-generating technologies available today. While they are converting the sun's rays into electricity or hot fluids, they produce no air pollution, hazardous waste, or noise. The more electricity and heat that we convert from the sun's rays decreases our reliance and dependence on fossil fuels and on imported sources of energy. Finally, solar energy can be an effective economic development driver. In addition, the following are benefits of solar energy: • Solar power is a renewable and natural resource. • Solar power is non-polluting. Unlike coal-fired power stations, solar power does not emit greenhouse gases or carcinogens into the air during operation. • Light and energy from the sun costs nothing. Once you purchase the equipment to capture and convert energy from the sun, the operational costs are limited. • Solar cells require little maintenance. • Solar cells are durable. • Solar power is silent.
That the development, use and exploitation of non-renewable resources and the ecosystems of which they are part do not	These PV projects would utilise solar energy to generate electricity. The most significant non-renewable resource being utilised is water, which

exceed the level beyond which their integrity is jeopardised. and equitable, and takes into account the consequences of the depletion of the resource;	would be required for the cleaning of the solar panels. The graph[15] below provides a comparative assessment of the water intensity of various types of electrical generation technologies. As can be seen from the graph below, the water intensity of solar PV facilities is so low that the value is not visible on the graph, in comparison to other energy generation technologies.  The removal of vegetation can also be seen as using of non-renewable resources. This is assessed in Section 4.1.
That a risk-averse and cautious approach is applied which takes into account the limits of current knowledge about the consequences of decisions and actions; and	Limitations and gaps in knowledge have been highlighted and taken into account in the EIA process. The information that is provided in the EIA are considered to be sufficient for decision-making purposes, and where there is uncertainty with predictions, monitoring were recommended.
That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.	The possible impacts on the people of De Aar were investigated throughout the EIA process, and mitigation measures proposed which aim at reducing negative impacts, were included in the LEMP.
(b) Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option.	The impacts on the people of De Aar were investigated and mitigation measures proposed which aim at reducing negative impacts, were included in the LEMP.
(c) Environmental justice must be pursued so that adverse environmental impacts shall not distribute in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons.	The EIA process, including the public participation process, outlined the possible impacts on the various groupings of people of De Aar and mitigation measures are proposed to reduce negative impacts, including the vulnerable and disadvantaged.
(d) Equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing must be pursued and	Environmental resources, such as ecology, freshwater ecosystems, and land use, were considered and avoidance or mitigation measures

[15] http://www.westernresourceadvocates.org/water/waterenergy.php

special measures may be taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination.	were provided in the LEMP to ensure that none of these resources are compromised thereby limiting access thereto.
(e) Responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life cycle.	The EIA process considered the environmental, health and safety consequences of the development through the construction and operational life of the projects.
(f) The participation of all interested and affected parties in environmental governance must be promoted, and all people must have the opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation by vulnerable and disadvantaged persons must be ensured.	Ample opportunity for public participation were provided to all I&APs throughout the EIA process as described in Section 2.5.
(g) Decisions must take into account the interests, needs and values of all interested and affected parties, and this includes recognising all forms of knowledge, including traditional and ordinary knowledge.	The EIA process has taken cognizance of all interests, needs and values adopted by all interested and affected parties.
(h) Community wellbeing and empowerment must be promoted through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means.	The EIA process has taken cognizance of all interests, needs and values espoused by all interested and affected parties. Ample opportunity for public participation were provided to all I&APs throughout the EIA process.
(i) The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment.	This was assessed and are summarized in Section 4.10
(j) The right of workers to refuse work that is harmful to human health or the environment and to be informed of dangers must be respected and protected.	The project area is subject to both the health and safety requirements of the Operational Health and Safety Act.
(k) Decisions must be taken in an open and transparent manner, and access to information must be provided in accordance with the law.	The EIA process has been thoroughly documented and all relevant information known to the EAP, as well as written comments received, have been included in the reporting for consideration by the authorities.
(l) There must be intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment.	The relevant authorities have been notified of the projects and provided with opportunity to comment. This authority involvement process has been documented in the EIA documentation.
(m) Actual or potential conflicts of interest between organs of state should be resolved through conflict resolution procedures.	There has been no conflict between Departments to date.
(n) Global and international responsibilities relating to the environment must be discharged in the national interest.	The establishment of the proposed De Aar PV power generation facilities would strengthen the existing electricity grid for the area. Moreover, the projects will contribute towards meeting the national energy target as set by the DoE. Renewable energy is recognized internationally as a major contributor in protecting the climate,

	nature and the environment, as well as providing a wide range of environmental, economic and social benefits that can contribute towards long-term global sustainability.
(o) The environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage.	The impacts were documented in the EIA process to inform decision-makers regarding potential ramifications of the proposed projects so that an informed decision can be taken in this regard. See Section 4.
(p) The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage, or adverse health effects must be paid for those responsible for harming the environment.	The mitigation measures recommended in this EIA report to minimise negative impacts and enhance positive ones are for the cost of the proponent.
(q) The vital role of women and youth in environmental management and development must be recognised and their full participation therein must be promoted.	Public participation of all I&APs has been promoted and opportunities for engagement been provided during the EIA process.
(r) Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems required specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.	Specialist assessments were undertaken to investigate the biophysical and social impacts that the projects may have. The outcome of the specialist's assessments indicated how significant impacts could be mitigated. Furthermore, the proposed development is not sited within a sensitive, vulnerable, highly dynamic, or stressed ecosystem.

The need and desirability of the projects are described in Table 15 below.

Table 15 | Specific questions as detailed in the Need and Desirability Guideline

NEED (TIMING) **Question**	**Response**
1. Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved Spatial Development Framework (SDF) agreed to by the relevant environmental authority i.e. is the proposed development in line with the projects and programmes identified as priorities within the Integrated Development Plan (IDP)?	The area proposed is currently zoned as Agricultural land. The portion which is being leased by the proponent from the landowner has relatively low agricultural potential (SiVest, 2012 and see Section 4.2.5). Therefore the development of the farm for renewable energy production would not result in the loss of high yielding agricultural land. Furthermore the additional income would safeguard the economic sustainability of the remainder of the farm portions. Even though the IDP does not specifically allow for renewable energy projects, solar energy was identified as one of the local municipality's strong points which should be developed. Solar energy has the ability to contribute to the other needs that were identified including sustainable developments (economically, socially and

	environmentally sustainable) and job creation. The Emthanjeni SDF (Macroplan, 2007) proposed that industrial development must continue a northerly direction, alongside the railway lines. The area proposed for the PV solar facility at Du Plessis Dam is located to the North of the railway line. The proposed PV facilities would create job opportunities for a wide range of skill levels. In addition, Mulilo has committed to developing a training strategy to train and employ people from the local community.
2. Should development, or if applicable, expansion of the town/ area concerned in terms if this land use (associated with the activity being applied for) occur at this point in time?	Yes, the activity is in line with the Pixley ka Seme District Spatial Development Framework which recognises the need for sustainable land management, job creation and the development of new skills.
3. Does the community/ area need the activity and the associated land use concerned (is it a societal priority)?	Yes. The De Aar region has an unemployment rate of 27.9% and limited employment opportunities. The proposed PV facilities would not only be a source of income for the landowner, but it would create job opportunities for the local community as the construction and operation of the PV plant require a wide range of skill levels. Secondary economic impacts may include an increase demand on the service industry through the demand for accommodation and other services. Renewable energy that is produced from sustainable natural sources will contribute to sustainable development not only in the Northern Cape, but throughout South Africa. The proposed facilities will contribute greatly to the pool of renewable energy projects to be implemented. The Northern Cape has some of the highest renewable energy resource levels in the world, making it highly suitable for solar power generation.
4. Are there necessary services with appropriate capacity currently available (at the time of application), or must additional capacity be created to cater for the development?	Eskom's Hydra Substation is located in close proximity from the site. Eskom has confirmed grid connection capacity for this proposed project. According to Eskom Transmission Development Plan 2013 to 2022, Hydra substation would receive an upgrade in transformer capacity which would allow the power to be injected in the National grid.

	It is anticipated that water requirements during the construction and operational phases would be met via the Emthanjeni Municipality in De Aar. However, the proponent still needs to confirm whether sufficient capacity is available. Estimated water requirements: • Construction Phase: 75MW would require roughly 3,626kℓ, and a 150MW facility would require 7,525 kℓ • Operational Phase: 75MW would require 348kℓ of water per year and a 150MW facility would require 696kℓ per annum.
5. Is this development provided for in the infrastructure planning of the municipality, and if not, what will the implication be on the infrastructure planning of the municipality (priority and placements of services)?	No. It should be noted that once the proposed PV facilities are operational, there would be a very limited requirement for municipal services excluding water which is noted above.
6. Is this project part of a national programme to address an issue of national concern or importance?	Yes. The establishment of the proposed De Aar PV facilities would strengthen the existing electricity grid. Moreover, the projects would contribute towards meeting the national energy target as set by the DoE.
DESIRABILITY (PLACING) **Question**	**Response**
1. Is the development the best practicable environmental option (BPEO) for this land/ site?	Yes. De Aar is a very arid region and farmers are challenged to make a living from the land. The area being proposed for the PV facilities has low agricultural potential which is why the proposed facilities are the best practicable environmental option for this site.
2. Would the approval of this application compromise the integrity of the existing approved Municipal IDP and SDF as agreed to by the relevant authorities.	No. The activity is in line with the Pixley ka Seme District SDF which recognizes the need for: • Sustainable developments; • New skills development; and • Economic development. The proposed PV facilities would not only be a source of income to the farmers, but it would also create job opportunities for the local community as the construction and operation of the PV facilities would require a wide range of skill levels.
3. Would the approval of this application compromise the integrity of the existing environmental management priorities for the area (e.g. as defined in Environmental Management Framework (EMF)), and if so, can it be justified from in terms of sustainability considerations?	No. The Emthanjeni municipality does not have an EMF in place.
4. Do location factors favour this land use (associated with the activity applied for) at this place?	Yes. The sites were selected based on the following criteria: • Solar resource potential based on historic satellite data; • Grid connectivity and close proximity to strong

	grid access; • Flat, level, and open land; and • Non-arable or low arable potential land.
5. How will the activity or the land use associated with the activity applied for, impact on sensitive natural and cultural areas (built and rural/ natural environment)?	Potential impacts associated with the proposed upgrade were discussed and assessed during the EIA phase. Refer to Section 4.
6. How will the development impact on people's health and wellbeing (e.g. in terms of noise, odours, visual character and sense of place, etc.)?	Potential impacts associated with the proposed upgrade were discussed and assessed during the EIA phase. Refer to Section 4.
7. Will the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs?	The socio-economic impacts were assessed and discussed in the EIA phase. Refer to Section 4.
8. Will the proposed land use result in unacceptable cumulative impacts?	No, potential cumulative impacts associated with the proposed PV facilities are discussed and assessed in Section 4.

3.4 POTENTIAL SOCIO-ECONOMIC AND BIOPHYSICAL IMPACTS IDENTIFIED DURING SCOPING PHASE

Various impacts on the biophysical and socio-economic environment are anticipated to occur throughout the construction, operational and decommissioning phases of the proposed projects. The following impacts were identified during the Scoping Phase and were therefore assessed in Section 4 of this EIA Report:

- Disturbance of flora;
- Impact on avifauna;
- Impact on agricultural resources;
- Impacts on surface water resources including riparian vegetation;
- Stormwater impacts, which include sedimentation and erosion;
- Impacts on palaeontology and heritage resources;
- Visual impacts;
- Social impacts (positive and negative) including impact on local economy (employment);
- Noise pollution;
- Dust pollution;
- Impact on energy production;
- Increased traffic; and
- Storage of hazardous substances on site.

4 BIOPHYSICAL AND SOCIO-ECONOMIC IMPACT ASSESSMENT

This section forms the focus of this EIA process. It contains a detailed assessment of the construction, operations and decommissioning impacts associated with the proposed project on the affected biophysical and socio-economic environment, using the methodology described in Annexure F. Mitigation measures to enhance positive impacts and reduce negative impacts are described.

As mentioned in Section 3.4, the Scoping Phase identified various impacts on the biophysical and socio-economic environment are anticipated to occur throughout the construction and operational phases. These impacts are described in the sections below in the following order:

- Impact on flora;
- Impact on avifauna;
- Impact on agricultural resources;
- Impacts on surface water resources including sedimentation and erosion;
- Impact on hydrology;
- Impacts on palaeontology and heritage resources;
- Visual impacts;
- Social impacts (positive and negative) including impact on local economy (employment);
- Noise pollution;
- Dust impacts;
- Impact on energy production;
- Increased traffic; and
- Storage of hazardous substances on site.

These impacts on the biophysical and socio-economic environment were assessed, in terms of the methodology outlined in the Plan of Study for EIA (for ease of reference the methodology is included in Annexure F). For each impact assessed, mitigation measures have been proposed to reduce and/ or avoid negative impacts and enhance positive impacts. These mitigation measures are also were incorporated into the LEMP to ensure that they are implemented during the planning, construction, operational and decommissioning phases. The LEMP forms part of the EIA Report, as such its implementation would become a binding requirement should this project be authorised.

Please note that Layout Alternative 1 includes PV2, PV3 and PV4 and Layout Alternative 2 includes extended PV2, extended PV3 and extended PV4 as indicated in Section 3.

4.1 IMPACT ON FLORA

Du Plessis Dam Farm falls within the Nama-Karoo Biome. Only one vegetation type occurs within or close to the site, namely Northern Upper Karoo. No other vegetation type occurs anywhere near to the site. Potential issues relevant to potential impacts on the ecology of the study area include impacts on biodiversity, impacts on sensitive habitats, and impacts on ecosystem function secondary and cumulative impacts on ecology and impacts on the economic use of vegetation. Layout Alternative 1 (PV2-PV4) would cover approximately 755ha and Layout Alternative 2

(extended PV2) would cover approximately 1,000ha. Hence, the footprint of the proposed facility would affect the vegetation cover of the proposed area.

Dr Hoare of David Hoare Consulting (cc) was appointed to undertake a Botanical Impact Assessment. The study considered a range of potential ecological impacts. A field assessment was undertaken on 7-8 May 2013. The BIA for Du Plessis Dam Farm is included in Annexure E. The findings and recommendations of the study are summarised below.

4.1.1 Description of the Environment

As mentioned above, Du Plessis Dam Farm area falls within the Nama-Karoo Biome with one vegetation type namely the Northern Upper Karoo. This vegetation type occurs in the northern parts of the Upper Karoo Plateau, with its southern extent ending near De Aar. It is a shrubland dominated by dwarf karoo shrubs, grasses and some low trees, including *Acacia mellifera* subsp. *detinens*.There are five known endemics in this vegetation, namely the succulent shrubs, *Lithops hookeri* and *Stomatium pluridens*, the low shrubs, *Atriplex spongiosa* and *Galenia exigua* and the herb, *Manulea deserticola*. At a national scale this vegetation type has been transformed only a small amount (approximately 4%) and none is conserved; it is considered to be Least Threatened.

Du Plessis Dam Farm is located on plains and the topography of the site is relatively gentle with a low, narrow ridge that cuts diagonally through the centre of the site. There is also a range of low hills on the eastern side of the site. The landcover of the site consists primarily of natural vegetation, classified as “shrubland and low fynbos”. The farm is used as grazing for domestic and wild livestock. The vegetation on site is dominated by grasses, with a significant number of karoo shrubs of low stature amongst the grasses. The vegetation on site is in moderate condition and there are no trees on site.

4.1.1.1 Red List plant species, protected plants and trees of the study area

Lists of plant species of conservation concern previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute (SANBI). These are listed in Appendix 1 of the BIA. Additional species that could occur in similar habitats, as determined from database searches and literature sources, but have not been recorded in these grids are also listed. Based on this review of plant species, it was determined that there are no threatened, near threatened, declining or rare plant species that could occur on site.

Two plant species that could potentially occur in the region, are *Hoodia gordonii* and *H. procumbens*, however they were not found during the field survey.

Tree species protected under the National Forest Act are listed in Appendix 2 of the BIA. The only one that has a geographical distribution that includes the study area is *Boscia albitrunca* (Shepherd’s Tree / Witgatboom / !Xhi). *Boscia albitrunca* occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils. This species is usually quite common where it is found, but was not recorded on site during the field survey.

4.1.1.2 Ecological sensitivity assessment

The sensitivity assessment identifies those parts of the study area that have high conservation value or that may be sensitive to disturbance. Areas of “medium-high” sensitivity are shown in Figure 15, and include non-perennial streams and drainage lines, which represents a number of ecological processes including groundwater dynamics, hydrological processes, nutrient cycling and wildlife dispersal. The majority of the site was deemed to be of “medium” sensitivity.

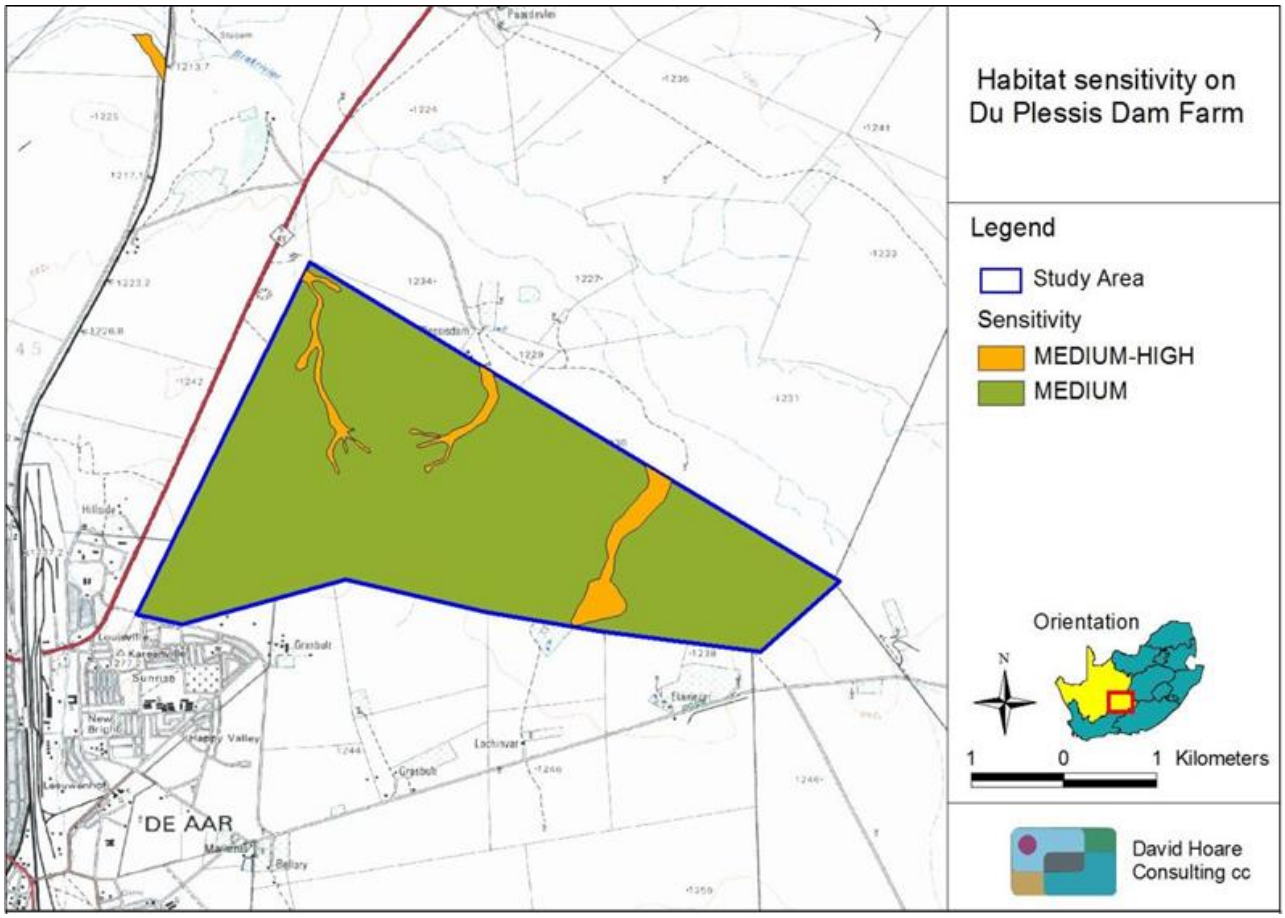


Figure 15 | Watercourses and drainage areas indicating sensitive areas in the study area

4.1.2 Impact Assessment

The following list of possible impacts of the proposed PV facilities was derived from previous projects of this nature and from a literature review. Each possible impact is briefly described and its relevance to this project is discussed.

- Loss or fragmentation of indigenous natural vegetation (terrestrial). The regional and local impact of the loss of Least Threatened Northern Upper Karoo.
- Loss of individuals of threatened plants. There are no threatened, near threatened or rare plant species that occur on site. This potential impact is therefore not applicable to the current proposal and is not evaluated further.
- Loss of individuals of protected tree species. One species has a geographic distribution that includes the study area, *B. albitrunca*. This species does not occur in any part of the study area. This potential impact is therefore not applicable to the current proposal and is not evaluated further.
- Loss of individuals of protected plant species. The species that have a geographic distribution that includes the study area are *H. gordonii* and *Harpagophytum procumbens*. No individuals were found during the field survey and it is considered unlikely that they

occur on site. This potential impact is therefore not applicable to the current proposal and is not evaluated further.

- Establishment and spread of declared weeds and alien invader plants. Potential weeds with a distribution centred on arid regions of the country include *Salsola kali*, *Atriplex lindleyi*, *Opuntia ficus-indica*, *Opuntia imbricata*, *Prosopis glandulosa*, *Prosopis velutina, Atriplex numularia*, and *Nicotiana glauca*. The shrub, *Prosopis glandulosa*, is potentially the most problematic in the study area and is widely distributed in the Northern Upper Karoo vegetation type. It was found at a relatively high frequency on site and in immediately adjacent areas. This species invades riverbeds, riverbanks and drainage lines in semi-arid and arid regions. There is therefore the potential for alien plants to spread or invade following disturbance on site. Species observed during the field survey on the three sites include *Agave americana*, *Prosopis glandulosa*, *Opuntia ficus-indica*, *Datura ferox*, *Argemone ochroleuca* and *Echinopsis spechiana*.

Based on the discussion provided above, only the following two impacts are deemed relevant to this project and were therefore assessed:

- Loss or fragmentation of indigenous natural vegetation (terrestrial); and
- Establishment and spread of declared weeds and alien invader plants.

4.1.2.1 Construction phase

The potential impacts to the ecosystems that could result from construction of the proposed solar facilities are described below.

Potential impacts that would result are assessed for each of the main infrastructure components of the proposed PV facilities. There is a separate assessment for the PV facilities (including alternative layouts), roads and water pipeline were assessed together, transmission lines and substations were assessed together, and the no-go alternative were assessed in Section 4.1.2.5.

For the purposes of undertaking this assessment, it is assumed that the entire footprint of the solar array area would be disturbed and or lost.

PV facilities (Alternative Layout 1 and Extended Layout 2): Loss or fragmentation of indigenous natural vegetation

The vegetation type on site that would be affected by construction of the PV facilities is Northern Upper Karoo. The impact would occur at the site of the proposed solar arrays. The construction of the arrays potentially affects a large proportion of natural vegetation on site, which would be greater for Layout Alternative 2 as it has a larger footprint than Layout Alternative 1. However, for both Layout Alternatives the impact is deemed to be site specific, high magnitude, long term with a **medium (-)** significance without and with mitigation.

Roads and water pipelines: Loss or fragmentation of indigenous natural vegetation

The proposed access road and water pipeline are relatively limited in extent. Therefore, the construction of the roads and water pipelines would result in loss of natural vegetation and is rated as site specific, low magnitude, long term with a **low (-)** significance with and without mitigation

Transmission lines and substations: Loss or fragmentation of indigenous natural vegetation

The proposed transmission lines (both transmission corridors) would, in most cases, be adjacent to existing Eskom overhead power lines. All of the proposed substations would affect only very small local areas of habitat. The construction of both transmission corridors and all proposed substations would result in loss of natural vegetation and is therefore rated as site specific, low magnitude, medium term with a **low (-)** significance without mitigation, which could be reduced to **very low (-)** with mitigation.

4.1.2.2 Operational impact

Potential ecological impacts that could result from operation of the proposed PV facilities are described below.

Impacts were assessed for each of the main infrastructure components of the proposed PV facilities. There is a separate assessment for the PV facilities (including both Layout Alternatives), roads and water pipeline were assessed together, transmission lines and substations were assessed together, and the no-go alternative were assessed in Section 4.1.2.5.

PV Facilities (Alternative Layout 1 and Extended Layout 2): Establishment and spread of declared weeds and alien invader plants

There are existing infestations of weeds on site and in immediately adjacent areas. There is therefore the potential that the disturbed site could enhance survival of and promote the spread of these infestations across the site and/ or into other natural areas. During the operational period, ecological conditions could potentially allow alien vegetation to establish on site. For both Layout Alternatives the impact is deemed to be local in extent, medium magnitude, long term with a **medium (-)** significance without mitigation. The significance could be reduced to **very low (-)** through implementing mitigation measures.

Roads and water pipelines: Establishment and spread of declared weeds and alien invader plants

The operation of the roads and water pipelines could potentially spread alien invasive species and is therefore rated as local, medium magnitude, long term with a **medium (-)** significance without mitigation. This significance could be reduced to **very low (-)** with mitigation.

Transmission lines and substations: Establishment and spread of declared weeds and alien invader plants.

The operation of the transmission lines (both transmission corridors) and all substations proposed could potentially spread alien invasive species and is rated as local, medium magnitude, long term with a **medium (-)** significance without mitigation. This significance could be reduced to **very low (-)** with mitigation.

4.1.2.3 Decommission impact

The potential impact to the ecosystems that could result from decommissioning of the proposed PV facilities is described below. Impacts are assessed for each of the main infrastructure components of the proposed PV facilities. There is a separate assessment for the PV facilities (including both Layout Alternatives), roads and water pipeline were assessed together, transmission lines (both transmission corridors) and substations (all substations proposed) were assessed together, and the no-go alternative were assessed in Section 4.1.2.5.

PV Facilities (Alternative Layout 1 and Extended Layout 2): Establishment and spread of declared weeds and alien invader plants

The decommissioning of the PV arrays could potentially provide ideal habitat for alien vegetation to establish on site. For both Layout Alternatives the impact is deemed to be local in extent, medium magnitude, long term with a **medium (-)** significance without mitigation. The significance could be reduced to **very low (-)** through implementing mitigation measures.

Roads and water pipelines: Establishment and spread of declared weeds and alien invader plants

The decommissioning of the roads and water pipelines could potentially spread alien invasive species and is rated as local, medium magnitude, long term with a **medium (-)** significance without mitigation. This significance could be reduced to **very low (-)** with mitigation.

Transmission lines and substations: Establishment and spread of declared weeds and alien invader plants.

The decommissioning of the transmission lines (both transmission corridors) and the proposed substations could potentially spread alien invasive species and is rated as local, medium magnitude, long term with a **medium (-)** significance without mitigation. This significance could be reduced to **very low (-)** with mitigation.

4.1.2.4 Cumulative impacts

Assessment of cumulative impacts[16] includes an assessment of the impacts of the proposed project (including all proposed alternatives) taken in combination with the impacts of other known PV projects for the area or secondary impacts that may arise from changes in the social, economic or ecological environment.

The cumulative impact of the loss of Northern Upper Karoo vegetation and the establishment and/ or spread of declared weeds and alien invader plants would occur at the site of the proposed PV facilities. The construction of the arrays potentially affects a high proportion of natural vegetation on site, which is aggravated by potential degradation of the remaining vegetation on site due to alien invasions. However, the site constitutes only a small proportion of the regional area (beyond 10 km of the site). The impact is assessed at a scale of regional, is of very low magnitude, long term with a **low (-)** significance without and with mitigation.

4.1.2.5 No-Go alternative

The 'no-go' option is what happens if current activities continue on site. This includes mostly animal husbandry.

No-Go: Loss or fragmentation of indigenous natural vegetation

The vegetation type on site is Northern Upper Karoo. This would remain intact, although local degradation due to over-utilization could potentially occur. Therefore the no-go alternative is rated as site specific, very low magnitude, long term with a **very low (-)** significance with and without mitigation.

[16] According to the DEAT Guidelines on 'Cumulative Effects Assessment' (2004, p: 3):
"*Cumulative effects are commonly understood as the impacts which combine from different projects and which result in significant change, which is larger than the sum of all the impacts*."

No-Go: Establishment and spread of declared weeds and alien invader plants

There are existing infestations of weeds on site and in immediately adjacent areas. There is therefore the potential that activities on site could promote the spread of these onto the site and/ or into other natural areas, although the lack of major earth disturbance due to existing activities means that any spreading of invasive species is likely to be slow. Therefore the no-go alternatives is rated as local, low magnitude, long term with a **low (-)** significance without mitigation. This significance could be reduced to **very low (-)** with mitigation.

4.1.3 Mitigation Measure

The following mitigation measures apply to all alternatives and are proposed to mitigate the loss or fragmentation of indigenous natural vegetation and the establishment and spread of declared weeds and alien invader plants throughout the project lifecycle:

- Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the solar array and other associated infrastructure as well as to the footprint of the tower structures and/or the servitude of the power line.
- Areas outside the construction footprint should be fenced and access to these areas should be limited as much as possible.
- Existing access roads must be used, where possible.
- Service roads in the servitude must be properly maintained to avoid erosion impacts.
- Disturbance of indigenous vegetation outside of the footprint of construction must be kept to a minimum.
- Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible.
- Any alien plants within the project area must be immediately controlled to avoid establishment of a soil seed bank. Control measures must follow established norms and legal limitations in terms of the method to be used and the chemical substances used.
- An on-going monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.
- Disturbance of indigenous vegetation outside of the footprint of construction must be kept to a minimum.
- Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible.
- Any alien plants within the control zone of the company must be immediately controlled to avoid establishment of a soil seed bank. Control measures must follow established norms and legal limitations in terms of the method to be used and the chemical substances used.
- An on-going monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

4.1.4 Botanical Impact Table

Table 16 and Table 17 indicates the significance of the various ecological impacts and how these were derived.

Table 16 | Impact rating of botanical impacts

	Project	Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Construction phase	Layout Alt.1 and Layout Alt. 2	Loss or fragmentation of vegetation	No mitigation	Site specific	High	Long term	Medium (-)	Definite	Sure	Irreversible
			Mitigation	Site specific	High	Long term	Medium (-)	Definite	Sure	Irreversible
	Roads and water pipeline		No mitigation	Site specific	Low	Long term	Low (-)	Definite	Sure	Irreversible
			Mitigation	Site specific	Low	Long term	Low (-)	Definite	Sure	Irreversible
	Overhead power lines		No mitigation	Site specific	Low	Medium term	Low (-)	Probable	Sure	Irreversible
			Mitigation	Site specific	Low	Medium term	Low (-)	Probable	Sure	Irreversible
Operational phase	Layout Alt.1 and Layout Alt. 2	Spread of alien plants	No mitigation	Local	Medium	Long term	Medium (-)	Probable	Sure	Reversible
			Mitigation	Site specific	Very low	Long term	Very low (-)	Probable	Sure	Reversible
	Roads and water pipeline		No mitigation	Site specific	Low	Long term	Low (-)	Definite	Sure	Irreversible
			Mitigation	Site specific	Very low	Long term	Very low (-)	Probable	Sure	Reversible
	Overhead power lines		No mitigation	Site specific	Low	Medium term	Low (-)	Probable	Sure	Irreversible
			Mitigation	Site specific	Very low	Long term	Very low (-)	Probable	Sure	Reversible
Decommissioning phase	Layout Alt.1 and Layout Alt. 2	Spread of alien plants	No mitigation	Local	Medium	Long term	Medium (-)	Probable	Sure	Reversible
			Mitigation	Site specific	Very low	Long term	Very low (-)	Probable	Sure	Reversible
	Roads and water pipeline		No mitigation	Site specific	Low	Long term	Low (-)	Definite	Sure	Irreversible
			Mitigation	Site specific	Very low	Long term	Very low (-)	Probable	Sure	Reversible
	Overhead power lines		No mitigation	Site specific	Low	Medium term	Low (-)	Probable	Sure	Irreversible
			Mitigation	Site specific	Very low	Long term	Very low (-)	Probable	Sure	Reversible
No-Go Option		Loss or fragmentation of vegetation	No mitigation	Site specific	High	Long term	Medium (-)	Definite	Sure	Irreversible
			Mitigation	N/A	-	-	-	-	-	-
		Spread of alien plants	No mitigation	Local	Low	Long term	Low (-)	Probable	Sure	Reversible
			Mitigation	N/A	-	-	-	-	-	-

*Mitigation measures are described in detail in Section 4.1.3

Table 17 | Cumulative botanical impacts

	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Without Mitigation	Regional	Very low	Long term	Low (negative)	Probable	Sure	Irreversible
With Mitigation	Regional	Very low	Long term	Low (negative)	Probable	Sure	Irreversible

4.1.5 Botanical Conclusions

In terms of the option between the two PV layout alternatives, either option is acceptable. However, Layout Alternative 1 is preferred as it has a smaller footprint than Layout Alternative 2 and therefore affects slightly less natural vegetation. Differences due to different technology alternatives, mounting alternatives and transmission line routings are considered to be irrelevant due to the fact that activities would extend beyond individual components of infrastructure.

4.2 IMPACT ON AVIFAUNA

The site falls within the Platberg-Karoo Conservancy Important Bird Area, which supports critical or regionally significant populations of a number of potentially collision prone or otherwise sensitive species.

The anticipated impacts of the PV facilities and associated infrastructures on avifauna include:

- Habitat destruction;
- Disturbance by construction and maintenance activities and possibly by the operation of the facilities;
- Possible displacement or disturbance of sensitive species; and
- Mortality caused by collision with the associated power line network, and electrocution of avifauna.

Avifauna specialists, Dr Andrew Jenkins and Johan du Plessis of Avisense Consulting, were appointed to undertake an avifauna impact assessment. The assessment included a desktop review of relevant literature and a two day site visit (conducted on 7 May 2013 and 11 May 2013) to determine first-hand the avian habitats present at the site and within the surrounding environment. A second avifauna monitoring session would be undertaken in six months' time. The avifaunal study is included in Annexure E. The findings and recommendations of the avifauna study are summarised below.

4.2.1 Description of the Environment

The broader impact zone of the proposed PV facilities is contained within an extensive tract of flat Nama Karoo, traversed by some minor drainage lines, while the immediate vicinity features degraded natural veld with some anthropogenic influences. Up to 220 bird species could occur within the anticipated, broader impact zone of the solar energy facilities, including 69 endemic or near-endemic species and 15 red-listed species. Of the 220 bird species four species as both endemic and red-listed namely: Ludwig's Bustard (*Neotis ludwigii)*, Blue Korhaan (*Eupodotis caerulescens)*, Blue Crane (*Anthropoides paradiseus)* and Black Harrier (*Circus maurus)*.

The birds of greatest potential relevance and importance in terms of the possible impacts of the PV facilities are likely to be visiting or resident large terrestrial birds including Blue Korhaan, Karoo Korhaan (*Eupodotis vigorsii)*, Northern Black Korhaan (*Afrotis afroides)* and Blue Crane, locally resident or passing raptors, especially red-listed species namely Martial Eagle (*Polemaetus bellicosus)*, Tawny Eagle (*Aquila rapax)*, Lesser Kestrel (*Falco naumanni)*, and possibly Peregrine Falcon (*Falco peregrines)*, Lanner Falcon (*Falco biarmicus)*, and regional endemics such as Jackal Buzzard (*Buteo rufofuscus)* and Southern Pale Chanting Goshawk (*Melierax canorus)*, and local populations of endemic passerines including Karoo Long-billed Lark (*Certhilauda subcoronata)*, Rufous-eared Warbler (*Malcorus pectoralis)*, and Black-headed Canary (*Serinus alario*).

Surveys of large raptors nesting in Eskom transmission pylons indicate that the closest nest of significance to the proposed development area is a recently active Tawny Eagle nest on the proximal section of the Hydra-Kronos 400kV line, about 11 km to the south-west of Du Plessis Dam Farm.

The on-site avian microhabitats comprise mainly of degraded areas of grassy Karoo Veld, with limited amounts of taller vegetation and low trees along drainage lines. The proposed site is already subjected to significant levels of human disturbance as it is located close to De Aar and the Eskom De Aar substation and there are a number of major transmission lines which run close to or through Du Plessis Dam Farm.

During the site visit only 34 species were recorded. On the basis of observations made during the site visit and information on the avifauna of the general area, 11 priority species are recognized as key in the assessment of avian impacts of the proposed Du Plessis Dam PV facilities. Overall, the avifauna of the development site itself is at best replicating that which occurs across huge areas of the Eastern Karoo and is thus largely replaceable.

4.2.2 Avifauna Impact Assessment

Specific impacts during the construction, operation and decommissioning phases of the proposed development are most likely to manifest in the flowing ways:

- Disturbance and displacement of seasonal influxes of large terrestrial birds (especially Blue Crane, Ludwig's Bustard and Kori Bustard) from nesting and/or foraging areas by construction and/or operation and/ or decommissioning of the facilities, and/ or mortality of these species in collisions with new power lines while commuting between resource areas.
- Disturbance and displacement of resident or visiting raptors (especially Martial Eagle, Tawny Eagle and Lesser Kestrel) from foraging areas by construction and/ or operation and/or decommissioning of the facilities, and/ or mortality of these species in collisions with new transmission lines or by electrocution when perched on power infrastructure.
- Disturbance and displacement of resident/breeding Karoo endemics.
- Injury or mortality of wetland birds (especially flamingos) using possible flight lines in and out of resource areas in the broader vicinity, in collisions with the PV infrastructure or associated new transmission lines.

The anticipated impacts of the proposed development on birds are not considered to be of any great significance. There would be some habitat loss for Karoo endemic species (although the general area at the site is already somewhat degraded and disturbed), some species (Karoo endemics, large terrestrial species, raptors) may be displaced from a broader area either temporarily by construction and maintenance activities, or more permanently by the PV panels, and some species (large terrestrial species, raptors, commuting wetland birds) may be killed in interactions (collisions, electrocutions) with the new power infrastructure, but again, numbers affected are likely to be low.

Should the PV facilities be authorised, there would be a number of birds which would most likely proliferate and become active around the PV facilities and possibly cause fouling problems. These birds include the Speckled Pigeon (*Columba guinea)*, Greater Kestrel (*Falco rupicolus)*, Southern Pale Chanting Goshawk, Cape Crow (*Corvus capensis)*, Pied Crow (*Corvus albus)*, Common Starling (*Sturnus vulgaris)*, Cape Sparrow (*Passer melanurus)*, and House Sparrow (*Passer domesticus*,) and possibly a variety of other perch-hunting hunting and insectivorous passerines.

The impacts are assessed below. The assessments for Layout Alternative 1 below include the impact of associated infrastructures including transmission corridor 1, access roads and the water pipeline. Layout Alternative 2 includes the impact of associated infrastructures including transmission corridor 2, access roads and the water pipeline. The technology alternatives did not influence the assessment rating for the Layout Alternatives as indicated below.

A report on potential glint and glare associated with the technology alternatives are provided in Annexure E.

4.2.2.1 Construction phase impact

The construction activities of the proposed Du Plessis Dam PV facilities would result in a negative direct impact on the avifauna of the area due to the displacement of threatened, rare, endemic or range-restricted species. The loss of vegetation and habitat affecting Karoo endemics, raptors and large terrestrial species, through site clearance, road upgrade, establishment of the camp, and assembly areas would contribute to these negative impacts.

Habitat loss
The construction of PV panels, substations, clearing of land for transmission line pylons, servitudes, pipeline and roadways would cause both temporary and permanent habitat destruction and disturbance.

For Layout Alternative 1 and associated infrastructures, the potential impact on birds as a result of habitat loss was considered to be of low to medium magnitude, local extent and short term and therefore of **low-medium (-)** significance without mitigation. The significance of this impact could be reduced to **low (-)** with mitigation.

For Layout Alternative 2 and associated infrastructures, the potential impact on birds as a result of habitat loss is considered to be of medium magnitude, local extent and short-term term and therefore of medium **(-)** significance without mitigation. The significance of this impact could be reduced to low-medium **(-)** with mitigation.

Disturbance
Construction is likely to cause some disturbance of Karoo endemics, raptors and large terrestrial species birds in the general surrounds of a solar facility.

For Layout Alternative 1 and associated infrastructures, the potential impact on birds as a result of disturbance is considered to be of medium magnitude, local extent and the duration is anticipated to continue throughout the construction period and therefore of **medium (-)** significance without mitigation. The significance of this impact could be reduced to **low - medium (-)** with mitigation.

For Layout Alternative 2 and associated infrastructures, the extent is considered to be of medium magnitude, regional extent and the duration is anticipated to continue throughout the construction period, therefore of **medium (-)** significance without mitigation. The significance of this impact could be reduced to low-medium (-) with mitigation.

4.2.2.2 Operational phase impact

Operational avifauna impacts might include habitat loss, disturbance and displacement of sensitive species by maintenance activities and operation of the PV facilities, and mortality caused by collision with the associated power line network, and electrocution of avifauna. These impacts are described and assessed below.

Habitat loss and disturbance

Operational activities, including maintenance, would result in a direct negative impact on the avifauna of the Du Plessis Dam PV sites due to loss of habitat for Karoo endemics. Temporary or permanent displacement of some raptors and large terrestrial species, and disturbance or displacement of these birds by routine maintenance activities would contribute to the negative impacts.

For Layout Alternative 1 and associated infrastructures, the potential impact on birds as a result of habitat loss and disturbance is considered to be of low-medium magnitude, local extent and long term and therefore of **low-medium (-)** significance with or without mitigation.

For Layout Alternative 2 and associated infrastructures, the potential impact on birds as a result of habitat loss and disturbance is considered to be of medium magnitude, local extent and long term and therefore of **medium (-)** significance with or without mitigation.

Mortality

Transmission lines pose a significant collision risk to birds, affecting a particular suite of collision prone species.

Avian electrocutions occur when a bird perches or attempts to perch on an electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components. Electrocution risk is strongly influenced by the voltage and design of the power lines erected (generally occurring on lower voltage infrastructure where air gaps are relatively small), and mainly affects larger, perching species, such as vultures, eagles and storks, easily capable of spanning the spaces between energised components. Operational activities might result in a negative direct impact on the avifauna of the Du Plessis Dam PV site including mortality of raptors, large terrestrials in collisions with solar panels and/or power lines, or by electrocution on new power infrastructure.

PV installations are characterized by arrays of PV panels which cover a large area. These panels would be coated with an anti-reflective glare coating, but it is possible that nearby or overflying birds may be disorientated by the reflected light and collide with the panels. There is also the possibility that waterbirds may mistake the PV panels for an expanse of water and attempt to land on the panels incurring injury and/or being disorientated in the process. Conversely other bird species may seek benefit from the PV facilities, using the structures as perches, sheltered roost sites or even nesting sites, and possibly foraging under the panels.

For Layout Alternative 1 and associated infrastructures, the potential on impact birds as a result of mortality is considered to be of medium-high magnitude, regional extent and long term and therefore of **medium-high (-)** significance without mitigation. The significance of this impact could be reduced to **low-medium (-)** with mitigation.

For Layout Alternative 2 and associated infrastructures, the potential impact on birds as a result of mortality is considered to be of medium-high magnitude, regional extent and long term and therefore of **medium-high (-)** significance without mitigation which could be reduced to **low-medium (-)** with mitigation.

4.2.2.3 Decommissioning phase impact

During the decommissioning phase the avifaunal impacts would arise from disturbance caused by vehicular and people traffic and displacement caused from habitat loss. Impacts arising from the associated infrastructure during the decommissioning phase could also include habitat destruction. Specific impacts during the decommissioning phase of the proposed development are most likely to manifest in the flowing ways:

- Disturbance and displacement of seasonal influxes of large terrestrial birds (especially Blue Crane, Ludwig's Bustard and Kori Bustard.
- Disturbance and displacement of resident or visiting raptors (especially Martial Eagle, Tawny Eagle and Lesser Kestrel).
- Disturbance and displacement of resident/breeding Karoo endemics.

For Layout Alternative 1 and associated infrastructures, the potential impact on birds as a result of disturbance is considered to be of low-medium magnitude, local extent and anticipated to continue throughout the decommissioning period and are therefore of **low- medium (-)** significance without mitigation. The significance of this impact could be reduced to **low (-)** with mitigation.

For Layout Alternative 2 and associated infrastructures, the potential impact on birds as a result of disturbance is considered to be of medium magnitude, regional extent and anticipated to continue throughout the decommissioning period and are therefore of **medium (-)** significance without mitigation. The significance of this impact could be reduced to **low-medium (-)** with mitigation.

4.2.2.4 Cumulative impacts

The negative impacts resulting from all projects proposed for the site would certainly be substantially amplified by the construction and operation of multiple renewable energy projects in the area. Relatively minor levels of disturbance at the individual project level would likely escalate to combined levels likely to cause complete and possibly long-term evacuation of the general area by more sensitive species. These disturbance effects are likely to be exacerbated by the loss or degradation of markedly more habitat to a much larger aggregate construction and operational footprint, possibly resulting in the permanent loss from the area of key components of the avifauna. Bearing this in mind, it is essential that the suitability of this single proposal is considered in the context of a broader development initiative in the area.

The negative impacts resulting from all phases of this proposed development would certainly be substantially amplified by the construction and operation of multiple renewable energy projects in the area. Relatively minor levels of disturbance at the individual project level would likely escalate to combined levels likely to cause complete and possibly long-term evacuation of the general area by more sensitive species. These disturbance effects are likely to be exacerbated by the loss or degradation of markedly more habitat to a much larger aggregate construction and operational footprint, possibly resulting in the permanent loss from the area of key components of the avifauna. Bearing this in mind, it is essential that the suitability of this single proposal is considered in the context of a broader development initiative in the area.

Note that the anticipated net impacts of this proposed development should ideally be considered in the context of accumulated impacts imposed by multiple other renewable energy projects proposed (and some already approved and under construction) within a 20km radius of De Aar. Furthermore, the project itself comprises a number of potentially independent PV installations, each of which has its own inherent impact profile, contributing to the net aggregate impact of the whole proposed development. While the impact potential of each separate PV array must, by definition, be less than the sum of all the components together, we have assumed here that each component has the same impact as the sum, partly in the interests of conservatism and pragmatism, and partly because the assessment criteria imposed on the study do not allow for a finer scale evaluation of relative impacts.

The negative impacts resulting from all phases of this proposed development (i.e. development to the extent of individual farms) would certainly be substantially amplified by the construction and operation of multiple renewable energy projects in the area (development to the extent of broader localities or even regions). Relatively minor levels of disturbance at the individual project level (i.e. farm) would escalate to combined levels likely to cause complete and possibly long-term evacuation of the locality or region by more sensitive species. These disturbance effects would be exacerbated by the loss or degradation of markedly more habitat to a much larger aggregate construction and operational footprint, possibly resulting in the permanent loss from the affected area of key elements of the avifauna. Bearing this in mind, it is essential that the suitability of this single proposal be considered in the context of broader renewable energy development plans for De Aar and surrounding areas.

4.2.2.5 No-Go impacts

The No-Go Alternative would have a neutral impact as the *status quo* would remain.

4.2.3 Mitigation Measures

The following mitigation measures apply to all alternatives and are recommended to mitigate all potential impacts to avifauna:

- Minimize the inclusive construction footprint of the development and abbreviate construction time.
- Minimize the noise and disturbance levels associated with maintenance activities at the plant once it becomes operational.
- Minimize the length of any new power lines installed and burying lines wherever possible. If lines cannot be buried, ensure that all new lines are marked with bird flight diverters along their entire length, and that all new power line infrastructures is adequately insulated and bird friendly in configuration[17]. In situations where new lines run in parallel with existing, unmarked power lines, this approach has the added benefit of reducing the collision risk posed by the older line.
- Minimize the amount of fencing used to enclose the development areas, given that these may present a collision risk for collision-prone birds.

[17] Note that current understanding of power line collision risk in birds precludes any guarantee of successfully distinguishing high risk from medium or low risk sections of a new line. The relatively low cost of marking the entire length of a new line during construction, especially quite a short length of line in an area frequented by collision prone birds, more than offsets the risk of not marking the correct sections, causing unnecessary mortality of birds, and then incurring the much greater cost of retro-fitting the line post-construction.

- Instituting a comprehensive impact monitoring scheme, and using the results of this scheme to (i) develop our collective understanding of the actual impact of solar PV developments on the region's birds, and (ii) to inform and refine a dynamic and pre-emptive approach to mitigation. Such a scheme should be quantitative and include both pre- and post-construction components, aimed at determining the net displacement effect of the development footprint on Karoo bird populations, measuring the ultimate impacts of construction and operation phase disturbance, and developing the means to minimise harmful impacts. These data may also be relevant to the effective and eco-friendly management of birds that use the new PV and associated infrastructure for nesting or roosting, allowing for the early identification of potential problem areas and the implementation of non-destructive methods to minimise fouling and other issues.

4.2.4 Avifauna Impact Table

Table 18 indicates how the significance ratings of the various impacts were derived.

Table 18 | Impact rating of avifauna impacts

	Project	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Construction phase	Layout Alt 1 Habitat loss	Without mitigation	Local	Low-Medium	Short- term	Low-Medium (-)	Definitely	Certain	Reversible
		With mitigation	Local	Low-Medium	Short- term	Low (-)	Definitely	Certain	Reversible
	Layout Alt 2 l Habitat loss	Without mitigation	Local	Medium	Short- term	Medium (-)	Definitely	Certain	Reversible
		With mitigation	Local	Low-Medium	Short- term	Low-Medium (-)	Definitely	Certain	Reversible
	Layout Alt 1 Disturbance	Without mitigation	Local	Medium	Construction	Medium (-)	Definitely	Certain	Reversible
		With mitigation	Local	Medium	Construction	Medium (-)	Definitely	Certain	Reversible
	Layout Alt 2 l Disturbance	Without mitigation	Regional	Medium	Construction	Medium (-)	Definitely	Certain	Reversible
		With mitigation	Local	Low-Medium	Long-term	Low-Medium (-)	Definitely	Certain	Reversible
Operational phase	Layout Alt 1 Habitat loss and disturbance	Without mitigation	Local	Low-Medium	Long-term	Low-Medium (-)	Definitely	Certain	Reversible
		With mitigation	Local	Low-Medium	Long-term	Low-Medium (-)	Definitely	Certain	Reversible
	Layout Alt 2 Habitat loss and disturbance	Without mitigation	Local	Medium	Long-term	Medium (-)	Definitely	Certain	Reversible
		With mitigation	Local	Medium	Long-term	Medium (-)	Definitely	Certain	Reversible
	Layout Alt 1 Mortality	Without mitigation	Regional	Medium-High	Long-term	Medium-High (-)	Probable	Unsure	Irreversible
		With mitigation	Local	Low-Medium	Long-term	Low-Medium (-)	Probable	Unsure	Irreversible
	Layout Alt 2 Mortality	Without mitigation	Regional	Medium-High	Long-term	Medium-High (-)	Probable	Unsure	Irreversible
		With mitigation	Local	Medium	Long-term	Low-Medium (-)	Probable	Unsure	Irreversible
Decommissioning phase	Layout Alt 1 Disturbance	Without mitigation	Local	Low-Medium	Decommissioning	Low-Medium (-)	Definitely	Certain	Reversible
		With mitigation	Local	Low	Decommissioning	Low (-)	Definitely	Certain	Reversible
	Layout Alt 2 l Disturbance	Without mitigation	Regional	Medium	Decommissioning	Medium (-)	Definitely	Certain	Reversible
		With mitigation	Local	Low-Medium	Decommissioning	Low-Medium (-)	Definitely	Certain	Reversible

*Mitigation measures are described in detail in Section 4.2.3.

Table 19 | Cumulative avifauna impacts

Key impacts	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Without Mitigation	High	Permanent	Very High (-)	Definite	Certain	Irreversible
With Mitigation	High	Permanent	High (-)	Definite	Certain	Irreversible

4.2.5 Avifauna conclusion

The avifaunal specialist preferred Layout Alternative 1. In terms of PV technology the specialists preferred the technology that would be least reflective. Transmission corridor 2 was preferred. This decision is based on the fact that this option is shorter in length and therefore decreases the risk to collision prone species.

4.3 IMPACT ON FAUNA

Fauna specialists, Dr David Hoare of David Hoare Consulting cc, were appointed during 2012 to undertake an ecology impact assessment. The assessment included a desktop review of relevant literature and a site visit. The findings and recommendations of the ecologystudy are summarised below.

4.3.1 Description of the environment

There is one mammal species of low conservation concern that could occur in available habitats in the study area. This is a species classified nationally as near threatened (NT), but globally as Least Concern, namely Geoffroy's Horseshoe Bat. This is a cave-dwelling species that emerges in the evening to catch flying insects. There are small rock crevices on the ridge adjacent to the site, but no caves were found on site or nearby. Based on the proposed distribution of infrastructure (flat areas) and the habitat preferences of this species (ridges), it was assessed as highly unlikely that this species would be affected by construction or operation of the proposed project. The species may forage over the site (low likelihood), but it will not roost there.

There are two small mammal species that could potentially occur on site that are protected under the NEMBA and any impacts on a specimen of this species or that may negatively affect the survival of the species would require a permit. These are the Black-footed Cat and the Cape Fox. It was assessed that it was possible that these species may traverse the site while foraging, but that it was unlikely that they would occur there as permanent residents. This is primarily due to the close proximity of the site to the town of De Aar. The proximity of humans and domestic animals, such as dogs, are factors that would lead to these animals moving away.

The Giant Bullfrog is the only amphibian species with a distribution that includes the study area and which could occur on site. This species is classified as Least Concern globally and Near threatened in South Africa. It is, however, protected under the National Environmental Management: Biodiversity Act. The Giant Bullfrog inhabits a variety of vegetation types where it breeds in seasonal, shallow, grassy pans in flat, open areas. It also utilises non-permanent vleis and shallow water on margins of waterholes and dams. It prefers sandy substrates although they sometimes inhabit clay soils. No individuals or favourable breeding habitats were found on site. Communication with a number of farmers in the area did not identify any local knowledge of the species occurring there. It was therefore assessed that there was a low probability of it occurring on site.

There are no reptile species of conservation concern that have a distribution that includes the study area.

There are therefore no threatened, near threatened or protected species of potential concern that are likely to occur on site.

4.3.2 Faunal Impact Assessment

4.3.2.1 Construction phase

Any affected fauna would generally be largely mobile and would relocate during the construction phase and are likely to recolonise the area, once the construction phase has been completed and the disturbed areas rehabilitated.

Based on the above the potential impact fauna during construction due to disturbance, habit loss and displacement is considered to be of low to medium magnitude, local extent and short term and therefore **low (-)** significance without mitigation. With the implementation of mitigation measures this is anticipated to reduce to **very low (-)** significance. There would be no difference in significance as a result of the proposed alternatives.

4.3.2.2 Operational phase

The density of the proposed projects would be very high, with projects components located close together. Operation and maintenance of the proposed projects would entail very few on site activities and as such disturbance of animals and / or habitats are likely to be very limited. Existing human activities in the area are likely to have habituated most animals to the presence of humans and as such it is anticipated that any disturbance would result in animals leaving an area for a short period, if at all, and returning once the disturbance has passed. As such the potential impact of the proposed projects on fauna is considered to be of low magnitude, local extent and long term and therefore of **low (-)** significance, with or without mitigation for all alternatives.

4.3.2.3 Decommissioning

Any affected fauna would generally be largely mobile and would relocate during the decommissioning phase and are likely to recolonise the area, once the decommissioning phase has been completed and the disturbed areas rehabilitated.

Based on the above the potential impact on fauna during decommissioning due to disturbance, habit loss and displacement is considered to be of low to medium magnitude, local extent and short term and therefore **low (-)** significance without mitigation. With the implementation of mitigation measures this is anticipated to reduce to **very low (-)** significance. There would be no difference in significance as a result of the proposed alternatives.

4.3.2.4 Cumulative impacts

Although a number of energy projects are proposed for the area, these are widely spaced apart and are unlikely to result in cumulative impacts on animals.

4.3.3 Mitigation measures

The following mitigation measures are recommended for the construction phase for all project alternatives:

- In all cases construction of access roads must be designed for minimal impact. All construction must take place within the footprint of the proposed PV facilities.
- Compile and implement a vegetation rehabilitation plan with the aid of a rehabilitation specialist, for inclusion in the LEMP.

- The construction phase must be closely monitored by an ECO who needs to identify any areas that would require rehabilitation in the post-construction phase. The restoration of those areas must follow the construction phase.
- The site must be cleared in sections as required for construction and not all at once.

The following mitigation measure is recommended for the operational phase (for all project alternatives):

- Small ground level openings, 20-30 cm in height, should be allowed for in the electrical fence to facilitate the movement of small mammals and reptiles through the site.

4.3.4 Fauna Impact Table

Table 23 indicate the various impacts and how their significance ratings were determined.

Table 20 | Impact rating of faunal impacts

Project	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Layout Alt. 1 and 2 (all project alternatives) Construction phase	Without mitigation	Local	Low-Medium	Short term	Low (-)	Probable	Unsure	Irreversible
	With mitigation	Local	Low	Short term	Very-low (-)	Probable	Unsure	Reversible
Layout Alt. 1 and 2 (all project alternatives) Operational phase	Without mitigation	Local	Low	Long term	Low (-)	Probable	Sure	Irreversible
	With mitigation	Local	Low	Long term	Low (-)	Probable	Sure	Irreversible
Layout Alt. 1 and 2 (all project alternatives) Decommissioning phase	Without mitigation	Local	Low- medium	Short term	Low (-)	Probable	Sure	Irreversible
	With mitigation	Local	Very Low	Long term	Very Low (-)	Probable	Sure	Reversible

*Mitigation measures are described in detail in Section 4.3.3.

Table 21 | Cumulative fauna impacts

Key impacts	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Cumulative fauna impacts	Local	Low	Long term	Medium (-)	Probable	Unsure	Reversible
	Local	Low	Long term	Medium (-)	Probable	Unsure	Reversible

4.3.5 Fauna Conclusion

The Layout Alternative 1 is preferred since a smaller area would be disturbed. In terms of line routing, there is no significant variance in faunal characteristics within the assessment corridor and as such, from a fauna perspective, the entire corridor is suitable to accommodate the proposed transmission line. There is no preference for the technology alternatives.

4.4 IMPACT ON AGRICULTURE

The Du Plessis Dam Farm is 1,236ha in extent and is zone as agricultural land. The farm borders the north eastern corner of the town De Aar and consists of flat grassy plains which are used as unimproved grazing land for cattle production. Access to the site is obtained via the R48 and there are few internal farm roads. Water is the major limiting factor to local agricultural enterprises and the farm does not contain, nor does it directly border, a perennial river or freshwater impoundment which could be used as a source of irrigation water.

From an agricultural perspective the loss of high value farm land and or food security production, as a result of the proposed activities, is the primary concern of this assessment. In South Africa there is a scarcity of high potential agricultural land, with less than 14% of the total area being suitable for dry land crop production. Consequently areas which could sustainably accommodate dry land production need to be protected from non-agricultural land uses. The proposed project would result in the loss of approximately 755ha (Layout Alternative 1) or 1,000ha (Layout Alternative 2) of grazing land on the Du Plessis Dam Farm as a result of the footprint of the proposed project.

Mr Kurt Barichievy of SiVEST (Pty) Ltd was therefore appointed to undertake a desktop Agricultural Impact Assessment. The study considered climate, geology, soils, terrain, land capability, current agricultural practices and agricultural potential. A detailed soil survey was conducted in late 2012 and May 2013. The 2013 desktop Agricultural Assessment for Du Plessis Dam Farm is included in Annexure E. The findings and recommendations of the study are summarised below.

4.4.1 Description of the Environment

Agricultural potential is described as an area's suitability and capacity to sustainably accommodate an agricultural land use. The soil information gained from the survey along with the land use assessment is combined with climate, water resources, crop information and topographic data in order to provide a spatial classification of the land based on its agricultural potential.

4.4.1.1 Climate

The study area has a semi-arid to arid continental climate with a summer rainfall regime. Most of the rainfall is confined to summer and early autumn. The Mean Annual Precipitation (MAP) is approximately 300mm per year[18]. Therefore without some form of supplementary irrigation natural rainfall for the study area is insufficient to produce sustainable harvests. This is reflected in the lack of dry land crop production within the study area De Aar typically experiences hot days and cold

[18] A MAP of 300 mm is deemed low as 500 mm is considered the minimum amount of rain required for sustainable dry land farming (Smith, 2006).

nights with the highest maximum temperature of approximately 40°C and the lowest minimum temperature of approximately -8°C). Evaporation is estimated to be in the region of 2,000mm per annum and thus the area is characterised by very severe moisture availability restrictions. In summary the climate for the study area is to severely restrictive to arable agriculture which is primarily due to the lack of rainfall and severe moisture availability restrictions.

4.4.1.2 Topography, geology and soil types

The slope or terrain (lie of the land) influences climate, soils characteristics, and therefore plays a dominant role in determining whether land is suitable for agriculture. The study area is characterised by flat and gently sloping topography with an average gradient of less than 5% making this area ideal for intensive agriculture with high potential for large scale mechanisation. From a developmental perspective, the flat topography would also allow for minimal earthworks and site preparation.

Du Plessis Dam Farm is completely underlain by shale. Shale is a clastic sedimentary rock and is formed by the settling and accumulation of clay rich minerals and other sediments. Due to the settling process this parent material usually takes the form parallel rock layers which lithifies over time. According to high level spatial databases, red Apedal soils, with a high base status, underlay the Du Plessis Dam Farm as indicated in Figure 16. These Apedal soils are weakly structured, tend to be freely drained, and due to overriding climate conditions these soils would tend to be Eutrophic (high base status).

The soils identified on the Du Plessis Dam site, during the site specific soil survey, are predominantly shallow and rocky with a low agricultural potential. Rocky soils (Mispah and Glenrosa Forms) cover 71% of the surveyed area while shallow duplex soils (Swartland) cover 24%. The entire study area is classified as having an effective soil depth, depth to which roots can penetrate the soil, of less than 0.45 m deep which is a limiting factor in terms of sustainable crop production. The proposed site is characterised by soils which are not suitable for arable agriculture but remain suitable to grazing as indicated in Figure 17. A severely restrictive climate rating, due to low rainfall and moisture / heat stress further reduces the agricultural potential of the project area. By taking all the site characteristics (climate, geology, land use, slope and soils) into account, the agricultural potential for the majority of the study area is classified as being extremely low for crop production while moderate to moderately low for grazing.

4.4.1.3 Land cover

The dominant veld type for the area is classified as Northern Upper Karoo vegetation type, which forms part of the *Nama-karoo* biome. The broad study area consists of a mix of natural veld and unimproved shrub-land which is used as grazing land for sheep, cattle and springbok. Vast grazing land is interspersed with incised river channels which flow intermittently and seasonal pans dot the landscape. Stocking rates are estimated at 1:4.5 (1 sheep per 4.5 hectares of land) for a small animal unit (sheep) and 1:18 for a large animal unit (cattle).

4.4.1.4 Agricultural Potential

The Du Plessis Dam Site is zoned as agricultural land, and is currently used as extensive grazing land for cattle production. Overall agricultural potential of the site is based on assessing a number of inter-related factors including climate, topography, soil type, soil limitations and current land use. The overriding climate is the major limiting factor for the site. The combination of low rainfall and an

extreme moisture deficit means that sustainable arable agriculture generally cannot take place without some form of irrigation. The site does not contain and is not bounded by a reliable surface water irrigation resource, and the use of borehole water for this purpose does not seem agriculturally and economically feasible. Furthermore the site is characterised by soils which are not suitable for arable agriculture but remain suitable to grazing as indicated in Figure 17. By taking all the site characteristics (climate, geology, land use, slope and soils) into account, the agricultural potential for the majority of the study area is classified as being extremely low for crop production while moderate to moderately low for grazing.

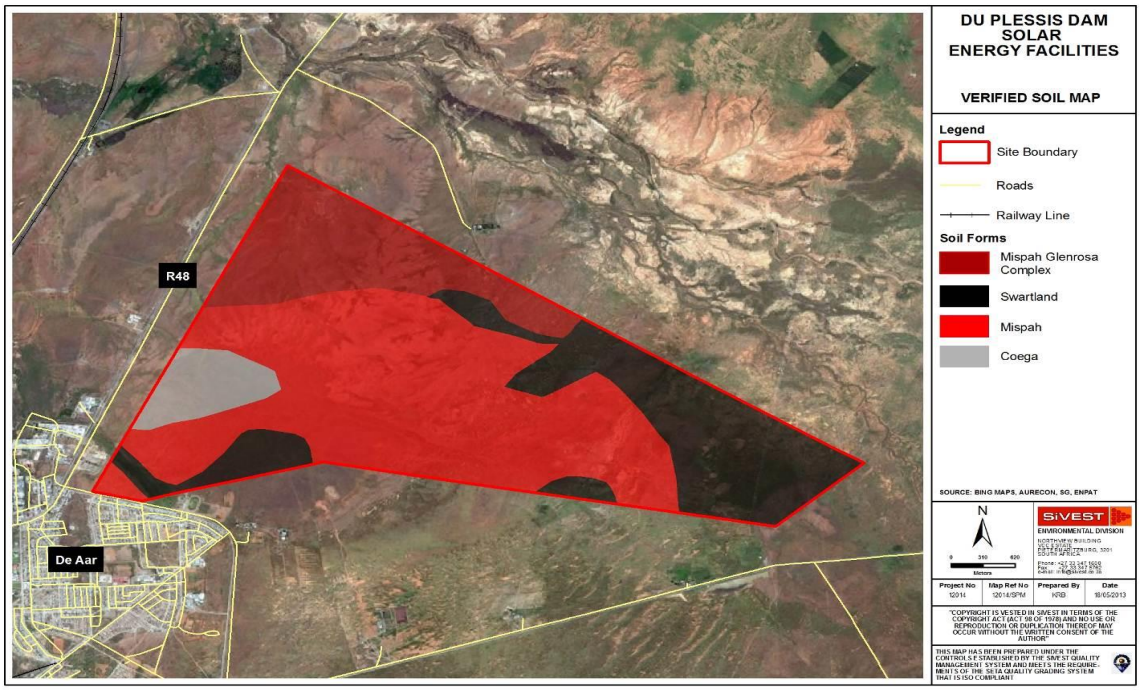


Figure 16 | Verified soil map for Du Plessis Dam Farm

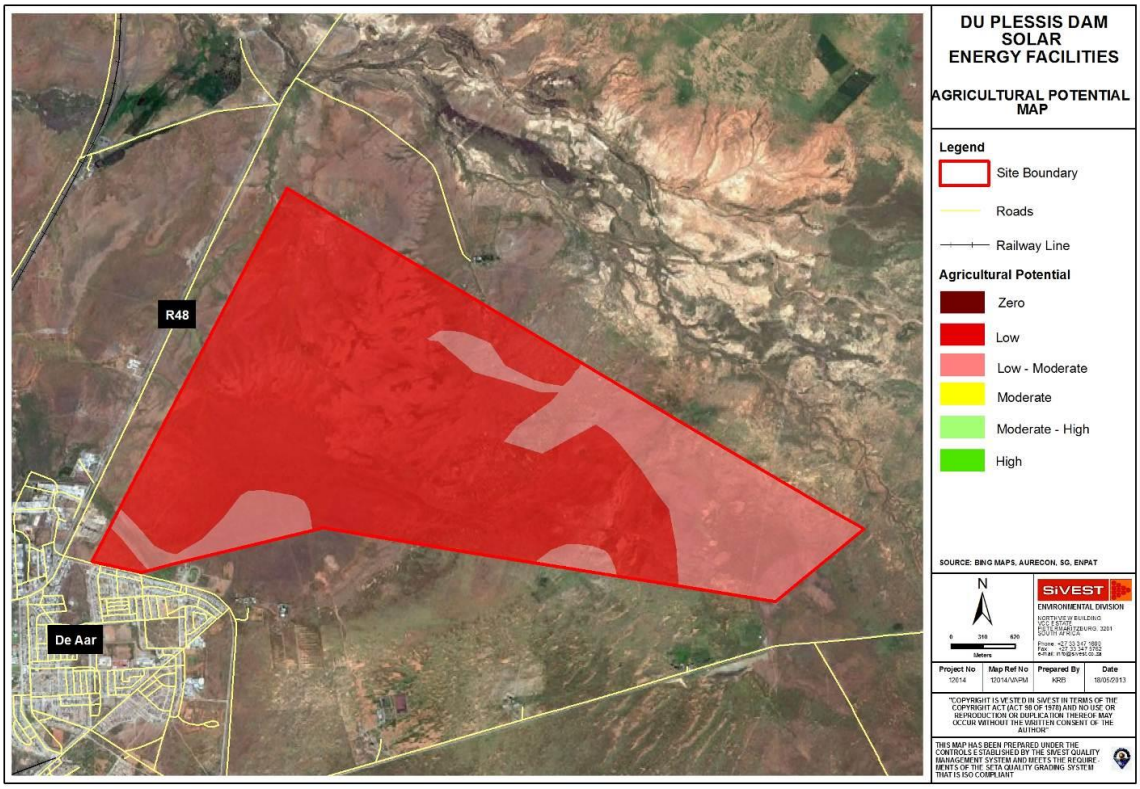


Figure 17 | Agricultural potential of Du Plessis Dam Farm

4.4.2 Agricultural Impact Assessment

Du Plessis Dam Farm has low agricultural value and is replaceable when assessed within the context of the proposed development. There are no centre pivots, irrigation schemes or active agricultural fields which would be influenced by the proposed development.

4.4.2.1 Construction phase impact

The proposed development's primary impact on agricultural activities includes the construction of the PV facilities and associated infrastructure, which entails the clearing of vegetation and levelling of the site. This would effectively eliminate the impacted land's agricultural potential in terms of grazing on Du Plessis Dam farm during the construction phase. It is estimated that this phase would last between 12 and 24 months per PV facility. The construction of the PV facilities would influence a portion of each of the farms total area as indicated in Table 22. The remaining land would continue to function as it did, prior to the development. The proposed PV facilities on the farm will be phased and constructed consecutively, depending on whether the projects are approved by the DoE and DEA. Stocking rates would need to be temporarily reduced during the construction phase in order to reduce the risk of overgrazing the remaining un-impacted areas.

Table 22 | Summary of the layout alternatives indicating the development and remaining footprint area

Facility	Individual Footprint (ha)	Cumulative Footprint (ha) and Remaining land (ha)	% of land remaining undeveloped
Layout Alternative 1 : PV 2	273	859 (377)	30%
Layout Alternative 1 : PV 3	212		
Layout Alternative 1 : PV 4	374		
Layout Alternative 2 Extended PV 1	1,000	1,000 (236)	19%

The loss of agricultural land and degradation of soil resources during the construction phase for Layout Alternative 1 (both technology alternatives), is considered to be of medium magnitude, site specific extent and the duration would be restricted to the construction phase and therefore of **low (-)** significance with and without mitigation. The significance of Layout Alternative 2 (both technology alternatives) impact in terms of the loss of agricultural land and degradation of soil resources during the construction phase was also deemed to be of **low (-)** significance with and without mitigation.

New 132kV transmission line would be constructed in order to connect the new solar PV facilities to the Eskom grid. Two routing alternatives have been proposed. According to spatial Land Use data and in-field verification, these routes are dominated by vacant land and peri-urban land uses. Owing to this, the crossing of this land by these transmission lines would have a very limited impact on agricultural production. Where the lines do cross farm land normal grazing could still take place under the transmission lines. The only loss of agricultural land would be directly below the tower's footprint. In terms of line routing, there is no significant variance between agricultural

characteristics within the assessment corridor and as such, from an agricultural perspective, the lines may be routed anywhere within this corridor.

The construction and operation of a 132kV transmission lines within the corridor for Layout Alternative 1 and Layout Alternative 2, is considered to be of very low magnitude, local extent and long-term. Therefore this impact is considered to be of **very low (-)** significance with and without mitigation.

4.4.2.2 Operational impact

After construction the land would need to be rehabilitated, including the re-vegetation of the solar fields. The shading of the panels could also influence the vegetation pattern within the PV fields.

The loss of agricultural land and degradation of soil resources during the operational phase for Layout Alternative 1 (both technology alternatives), is considered to be of medium magnitude, site specific extent and long-term. Therefore this impact is considered to be of **medium (-)** significance without mitigation. The significance of this impact could however be reduced to **very low (-)** with mitigation. The significance of Layout Alternative 2 (both technology alternatives) impact in terms of the loss of agricultural land and degradation of soil resources during the construction phase was also deemed to be of **medium (-)** significance with mitigation and without **very low (-)** with mitigation.

The impact of transmission corridors is considered to be the same as during the construction phase.

4.4.2.3 Decommission impact

Significant Loss of agricultural land and/ or production is not envisioned during this phase of the project for all alternatives. However, standard soil erosion mitigation measures should be implemented during decommissioning.

4.4.2.4 Cumulative impacts

A number of solar and renewable energy projects have been proposed in the De Aar area, and thus, the cumulative impact of these developments on surrounding farms could become detrimental to local agricultural resources if the loss of usable grazing land is not taken into account when determining optimum herd size. A phased approach in combination with erosion control and land rehabilitation, within each farm, would reduce this impact. The inherently low agricultural potential of the region also reduces the overall cumulative impact from **medium (-)** to **low (-)**.

4.4.2.5 No-Go impact

The No-Go Alternative would have a neutral impact as the *status quo* would remain.

4.4.3 Mitigation Measures

It is evident that if the proposed mitigation measures are implemented, then the proposed activities would have a low impact on current agricultural production and soil resources. When considering the agricultural assessment as a standalone specialist study, no areas were identified as No-Go areas as there are no problematic or fatal flaw areas for the proposed solar energy facilities.

4.4.3.1 Construction phase mitigation measures

The following mitigation measures are required during the construction phase to mitigate the loss of agricultural land and degradation of soil resources for all alternatives:

- A planned phased approach must be adopted.
- Allow normal agricultural activities to continue in unaffected areas.
- Stocking rates would need to be temporarily reduced during the construction phase in order to reduce the risk of overgrazing the remaining land portions.
- Initiate land rehabilitation and re-vegetation as soon as possible.
- Due to the overarching site characteristics, and the nature of the proposed development, the remaining viable mitigation measures are limited and would most likely revolve around erosion control:
    - The soil erosion plan and associated recommendations should be employed.
    - Clearing activities should be kept to a minimum.
    - In the unlikely event that heavy rains are expected, activities should be put on hold to reduce the risk of erosion.
    - If additional earthworks are required, any steep or large embankments that are expected to be exposed during the 'rainy' months should be armoured with fascine like structures (a fascine structure usually consists of a natural wood material and is used for the strengthening of earthen structures or embankments).
    - If earth works are required then storm water control and wind screening should be undertaken to prevent soil erosion.

4.4.3.2 Operational phase mitigation measures

The following mitigation measures are required during the operational phase to mitigate the loss of agricultural land and degradation of soil resources for all alternatives:

- Initiate land rehabilitation and re-vegetation as soon as possible and continue to visually monitor land degradation.
- It is recommended that more palatable species form part of the re-vegetation plan to enable faster stocking initiation. Pertinent plant species should be obtained from a vegetation specialist when the site specific EMP is compiled.
- Allow normal agricultural activities to continue in unaffected areas.
- Allow periodic grazing within the PV fields (sheep and wildlife). This mitigation would minimise the loss of grazing land and reduce the impact on agricultural production.
- Unfortunately cattle grazing would not be permitted within the PV fields as the animals could damage the PV panels. In order to overcome this limitation it is recommended that the farms convert back to sheep production and use the proposed PV facilities as rotational grazing camps.

Due to the overarching route characteristics of the 132kV transmission lines within the two proposed corridors, and the nature of the proposed development during construction and operational phases, viable mitigation measures are limited and would most likely revolve around erosion control:

- Clearing activities should be kept to a minimum.
- In the unlikely event that heavy rains are expected, activities should be put on hold to reduce the risk of erosion.
- If additional earthworks are required, any steep or large embankments that are expected to be exposed during the 'rainy' months should be armoured with fascine like structures. A

fascine structure usually consists of a natural wood material and is used for the strengthening of earthen structures or embankments.

- If earth works are required then storm water control and wind screening should be undertaken to prevent soil erosion.
- Interact with landowners during the routing process.

4.4.3.3 Soil Erosion Monitoring

A soil erosion management plan is included in Annexure E. Due to the proposed activities (for all alternatives) this management plan focuses primarily on soil erosion however generic soil contamination mitigations are also included. Below is a summary of the soil erosion management plan mitigation measures:

- Due to the size of the site and without rigorous scientific methods and equipment, soil erosion would need to be monitored visually by the appointed Environmental Control Officer (ECO). It is recommended that areas around roads, stockpiles and PV panels are visually monitored during audits. A photographic record of the on-site conditions would also aid in the identification of erosion problems. A quarterly (3 month) photographic frequency is recommended.
- Clearing activities should be kept to a minimum and must only be undertaken during agreed working times, as well as permitted weather conditions.
- If heavy rains are expected clearing activities should be put on hold. In this regard, the contractor must be aware of weather forecasts.
- The further unnecessary removal of groundcover vegetation from slopes must be prevented, especially on steep slopes.
- Following the clearing of an area, the surfaces of all exposed slopes must be roughened to retain water and increase infiltration (especially important during the wet season).
- Any steep or large embankments that are expected to be exposed during the 'rainy' months should either be armoured with fascine[19] like structures or vegetated. If a cleared area is not going to be built on immediately, the top layer (nominally 150 mm) of soil should be removed and stockpiled in a designated area approved by the ECO.
- Vegetation shall be stripped in a sequential manner as the work proceeds so as to reduce the time that stripped areas are exposed to the elements.
- Top-soiling and re-vegetation shall start immediately after the completion of an activity and at an agreed distance behind any particular work front.
- It is highly recommended that existing farm roads are used as much as possible, while the additional creation of access roads should be kept to a minimum.
- Storm water control and wind screening should be undertaken to prevent soil loss from the site.
- All embankments shall be protected by a cut off drain to prevent water from running down the face of the embankment, resulting in soil erosion. Typical erosion control measures such as the installation of silt fences, hay bales, EcoLogsTM and Bio JuteTM are recommended if erosion problems are noted during construction and operation phases (see Figure 25 of the Soil Erosion Management Plan) and pegged hay bale wall used to reduce runoff velocities.

[19] A fascine structure usually consists of natural wood material and is used for the strengthening earthen structures or embankments.

Every precaution must be taken to ensure that chemicals and hazardous substances do not contaminate the soil or groundwater on site for all alternatives. For this purpose the Contractor must:

- Ensure that the mixing /decanting of all chemicals and hazardous materials should take place on a tray or impermeable surface.
- Dispose of any generated waste at a registered landfill site.
- Ensure all storage tanks are designed and managed in order to prevent pollution of drains, groundwater and soils.
- Construct separate storm water collection areas and interceptors at storage tanks, and other associated potential pollution activities.
- Ensure the control of fuels and chemicals in order to prevent spillage potential ground leaching. Adequate spillage containment measures shall be implemented, such as cut off drains, etc. Fuel and chemical storage containers shall be set on a concrete plinth. The containment capacity shall be equal to the full amount of material stored, plus 10%.
- Appoint appropriate contractors to remove any residue from spillages from site. Handling, storage and disposal of excess or containers of potentially hazardous materials shall be in accordance with the requirements of the above-mentioned Regulations and Acts.
- Ensure that used oils/lubricants are not disposed of on/near the site, and that contractors purchasing these materials understand the liability under which they must operate. The ECO would be responsible for reporting the storage/use of any other potentially harmful materials to the relevant authority.
- Ensure that potentially harmful materials are properly stored in a dry, secure environment, with concrete or sealed flooring. The ECO would ensure that materials storage facilities are cleaned/ maintained on a regular basis, and that leaking containers are disposed of in a manner that allows no spillage onto the bare soil or surface water. The management of such storage facilities and means of securing them shall be agreed upon.
- Site staff shall not be permitted to use any stream, river, other open water body or natural water source adjacent to or within the designated site for the purposes of bathing, washing of clothing or for any other construction or related activities.
- Municipal water or another source approved by the ECO should be used for all activities such as washing of equipment, dust suppression, concrete mixing and compacting.

The following precautions are proposed to manage stockpiles for all alternatives:

- General requirements for stockpiles include that they should be situated in an area that should not obstruct the natural water pathways on site.
- Topsoil stockpiles would be kept separate from other stockpiles, shall not be compacted, and shall not exceed 2m in height.
- If exposed to windy conditions or heavy rain, stockpiles should be protected by re-vegetation using an indigenous grass seed mix or cloth.
- The construction of a berm consisting of sand bags, or a low brick wall, can be placed around the base of the stockpile for retention purposes.
- Stockpiles should be weeded regularly to ensure they are kept free of alien vegetation and shall be kept free of any contaminants whatsoever, including paints, building rubble, cement, chemicals, oil, etc.
- Subsoil and topsoil stockpiles would be moved to areas of final utilisation as soon as possible to avoid unnecessary erosion.

- Stockpiles not utilized within three months of the initial stripping process (or prior to the onset of seasonal rains) would be seeded with appropriate grass seed mixes, including indigenous grasses to further avoid possible erosion.

As mentioned earlier, disturbed areas would need to be rehabilitated. The following rehabilitation mitigation measures are therefore proposed for all alternatives:

- All rubble is to be removed from the site to an approved landfill site as per the construction phase requirements.
- No remaining rubble is to be buried on site.
- The site is to be free of litter, and surfaces are to be checked and cleared of waste products resulting from activities such as concreting or asphalting.
- After construction the land would need to be rehabilitated, which includes a re-vegetation plan. It is recommended that more palatable species are planted to enable faster stocking initiation.

In order to further mitigate the potential impacts it is highly recommended that periodic grazing within the PV fields is allowed. This mitigation minimizes the loss of grazing land and reduces the overall impact on agricultural production. Interestingly, the farmers around De Aar have changed from sheep to beef production due to the high prevalence of stock theft. Unfortunately, cattle grazing would not be permitted within the PV fields as the animals could damage the PV panels. In order to overcome this limitation, it is recommended that the farms convert back to sheep production and use the proposed PV facilities as rotational grazing camps. The problem of small stock theft should be mitigated by the additional security and fencing associated with the PV facilities. A simplified and generic phased construction approach and related mitigations are illustrated in Figure 18, where:

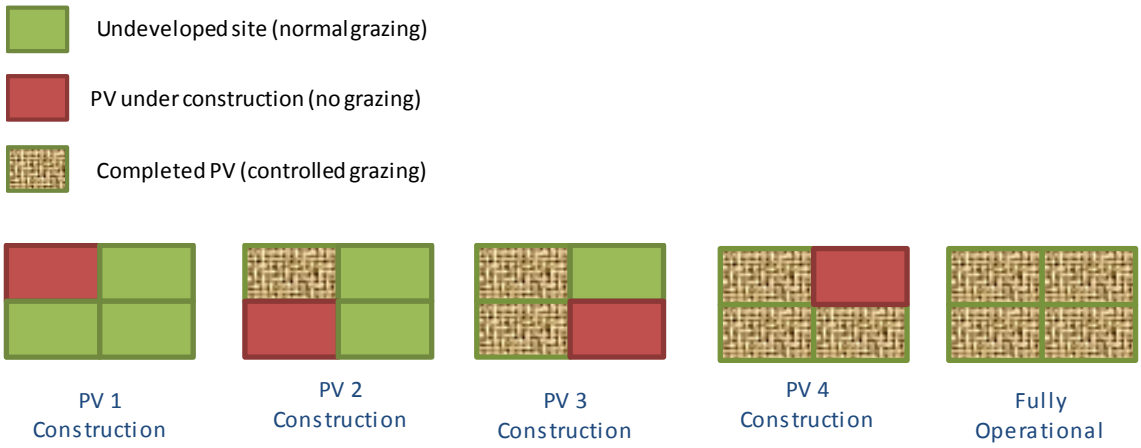


Figure 18 | The proposed phased construction approach and grazing schedule (This simplified example is based on the construction of 4 PV facilities but can be adapted to any number of proposed PV facilities)

4.4.4 Agriculture Impact Table

Table 23 and
Table 24 indicate the various impacts and how their significance ratings were determined.

Table 23 | Impact rating of agricultural impacts

	Project	Key impacts	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Construction phase	Layout Alternative 1 Loss of agricultural land and degradation of soil resources	without mitigation	Site specific	Medium	Construction	Low (-)	Definite	Sure	Irreversible
		with mitigation	Site specific	Low	Construction	Low (-)	Definite	Sure	Reversible
	Layout Alternative 2 Loss of agricultural land and degradation of soil resources	without mitigation	Site specific	Medium	Construction	Low (-)	Definite	Sure	Irreversible
		with mitigation	Site specific	Medium	Construction	Low (-)	Definite	Sure	Reversible
Operational phase	Layout Alternative 1 Loss of agricultural land and degradation of soil resources	without mitigation	Site specific	Medium	Long term	Medium (-)	Definite	Sure	Irreversible
		with mitigation	Site specific	Very Low	Long term	Very Low (-)	Definite	Sure	Reversible
	Layout Alternative 2 Loss of agricultural land and degradation of soil resources	without mitigation	Site specific	Medium	Long term	Medium (-)	Definite	Sure	Irreversible
		with mitigation	Site specific	Very Low	Long term	Very Low (-)	Definite	Sure	Reversible
	Transmission lines	without mitigation	Site specific	Very Low	Long term	Very Low (-)	Definite	Certain	Reversible
		with mitigation	Site specific	Very Low	Long term	Very Low (-)	Definite	Certain	Reversible
Decommissioning	Layout Alternative 1 Soil Disturbance, temporary disturbance to grazing regime	With and without Mitigation	Site specific	Very Low	Decommissioning	Very Low (-)	Definite	Sure	Reversible
	Layout Alternative 2 Soil Disturbance, temporary disturbance to grazing regime	With and without Mitigation	Site specific	Very Low	Decommissioning	Very Low (-)	Definite	Sure	Reversible

*Mitigation measures are described in detail in Section 4.4.3.

Table 24 | Cumulative agricultural impacts

Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Cumulative loss of agricultural production / grazing land (without mitigation)	without mitigation	Regional	Low	Long	Medium (-)	Probable	Unsure	Reversible
Cumulative loss of agricultural production / grazing land (with mitigation)	with mitigation				Low (-)			

4.4.5 Agriculture Conclusion

From an agricultural perspective, Layout Alternative 1 is preferable due to the phased approach and the smaller developmental footprint. Pre and post-mitigation scores in the construction phase are also lower for Alternative Layout 1.

Desktop and field data indicates that both Transmission Corridor Alternatives (1 and 2) share virtually identical agricultural potential and value, and are both suitable to accommodate the proposed transmission lines. However, Transmission Corridor Alternative 2 is recommended as it represents the shortest proposed power line route.

The specialist had no preference for the technology alternatives.

4.5 IMPACT ON SURFACE WATER INCLUDING SEDIMENTATION

The freshwater features on the farm Du Plessis Dam consist of ephemeral tributaries of the Brak River. These tributaries are considered to be in a largely natural ecological state, with a low ecological importance and sensitivity. Expected impacts of the proposed PV facilities on freshwater features would possibly include impacts on drainage lines and depressions.

Given the presence of the ephemeral tributaries of the Brak River on a combined desktop and field-based Freshwater Impact Assessment (FIA) was undertaken by Toni Belcher. The FIA was informed by a desktop review of information on the freshwater ecosystems located within the study area and the catchment, as well as a detailed assessment of the freshwater features at the site. Aquatic Ecosystem Health assessments were also conducted to provide information on the ecological condition and ecological importance and sensitivity of the river and wetland systems within the study area. A field site visit was conducted in January 2012 during the first EIA process and again in May 2013. The FIA is included in Annexure E.

4.5.1 Description of the Environment

The study area is situated in the Northern Cape, northeast of the town of De Aar. The main water feature within the study area is the Brak River, a seasonal tributary within the Orange River system. The river flows to the north of the study area with a number of its tributaries crossing the site as they flow in a northerly direction. Most of the small tributaries within the study area are ephemeral and are discernible only as slightly shallow depressions with no clear associated vegetation and slightly clayey soils as indicated in Figure 19. A small, shallow dam has been constructed within one of these drainage channels. The surrounding land is undeveloped and only utilised for grazing of sheep, cattle, goats, ostriches or game such as springbok. The broader landscape consists of predominantly flat lowlands along with few flat-topped hills.

Figure 19 | An ephemeral tributary of the Brak River at Du Plessis Dam Farm

In terms of the Freshwater Ecosystem Protected Areas[20] (FEPA) map, the Brak River is classified as having conservation importance as indicated in Figure 20.

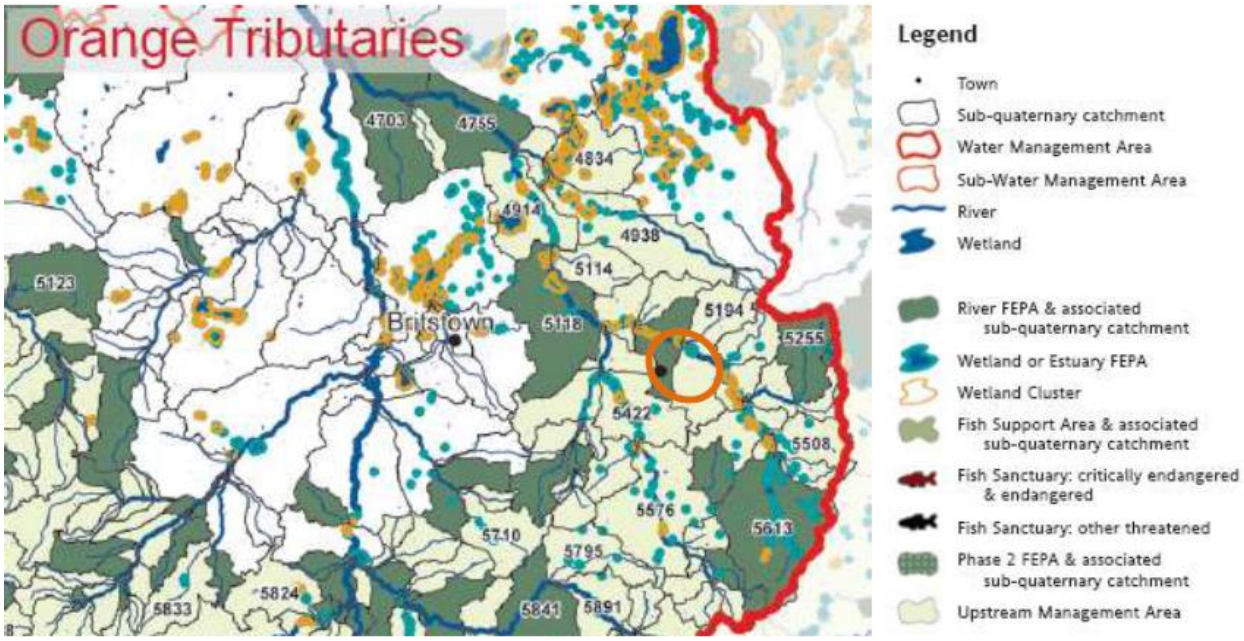


Figure 20 | Freshwater Ecosystem Priority Areas for the study area (orange oval)

The Brak River receives very low rainfall, has a predominantly sandy/ silty substrate and drains shrubland vegetation. This results in the water within the river system to be saline and turbid and seasonally flowing. The river is wide and lies within the Nama Karoo Ecoregion with the vegetation type of Bushmanland Nama Karoo. At the time of both field visits the river consisted of isolated pools and was not suited to an assessment of water quality or aquatic biota present. The Index for Habitat Integrity[21] (IHI) and a Site Characterisation were therefore used to provide information on the ecological condition of the Brak River and its tributaries within the study area. Results from the IHI assessment indicate that the instream habitat of the ephemeral streams at Du Plessis Dam is largely natural with the modification of the habitat occurring as a result of the surrounding farming activities (livestock grazing).

[20] FEPAs are strategic spatial priorities for conserving freshwater ecosystems and associated biodiversity.

[21] IHI provides a measure of the degree to which a river has been modified from its natural state and is based on an assessment of the riparian zone and instream habitat.

The Ecological Importance and Sensitivity (EIS) assessment considers a number of biotic and habitat determinants to indicate either importance or sensitivity. Results from the EIS indicate that the Brak River and its tributaries are all considered to be of low[22] EIS.

4.5.2 Surface Water Impact Assessment

This section provides an assessment of the overall potential impacts to freshwater ecosystems that are likely to be associated with the proposed activities. The impact assessments are grouped according to the various proposed activities, namely, PV facilities, the overhead transmission lines and, the access routes and pipeline.

4.5.2.1 Construction phase impacts

Due to the intensive nature of the construction activities for the PV facilities, they could be expected to have impacts on any freshwater features within the proposed development area. Clearing of the land of its covering vegetation could result in eroded areas which could extend into the freshwater features near the proposed construction areas. The disturbance of the site compaction of the soils would also impact on the surface and subsurface water flow on the site. In addition, the disturbance of habitat during and after the construction activities provides an opportunity for invasive alien plants to proliferate into the disturbed areas. Impairment of the surface water quality and an increase in turbidity could potentially occur, namely sedimentation during the construction phase, if activities are to take place during the wet season. The assessments of these impacts are provided below.

Proposed PV facilities and substations

For both Layout Alternative 1 and Layout Alternative 2 (both technology alternatives), the potential impact was considered to be of medium-high magnitude, site specific, taking place during the construction phase and therefore of **low (-)** significance without mitigation. The significance of this impact could be reduced **to very low (-)** with mitigation.

Disturbance of freshwater related habitats due to the construction of overhead transmission lines (both transmission corridors)

An impact of very limited significance is expected on the drainage characteristics of minor tributaries of the Brak River during and after the construction phase. This is due to the fact that the overhead transmission line corridors in general follow routes where overhead transmission lines are already in existence. For both Layout Alternative 1 and Layout Alternative 2 (both transmission corridor alternatives), the potential impact was considered to be of low magnitude, site specific, short term and therefore of **very low (-)** significance with and without mitigation.

Disturbance of freshwater related habitats due to the construction of access routes and water pipeline

An impact of limited significance is expected at the access route river crossings of ephemeral streams during and after the construction phase. For both Layout Alternative 1 and Layout Alternative 2 (access roads and water pipeline), the potential impact was considered to be of medium to low magnitude, site specific, short term and therefore of **low (-)** significance without mitigation. The significance of this impact could be reduced to **very low (-)** with mitigation.

[22] Quaternaries/delineations that are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.

Disturbance of habitat and possibly impedance/diversion of flow at river crossings due to the proposed laydown areas

The local short term impact is expected to have a moderate to low intensity with a **low (-)** significance. This could be reduced to **very low (-)** significance with mitigation.

4.5.2.2 Operational impact

During the operation phase regular access would be required to the site for maintenance and cleaning of PV panels which might impact on aquatic features.

Maintenance of PV facilities and all associated infrastructure

For all project components and alternatives, the potential impact was considered to be of low magnitude, site specific, long term and therefore of **very low (-)** significance with and without mitigation.

4.5.2.3 Decommissioning phase impacts

Existence of PV facilities and associated infrastructure

The longer term loss of freshwater related habitats for streams within PV facilities as a result on unmitigated erosion and invasive alien vegetation growth once the operation phase for the project has ceased is expected to be a localised impact and have a longer term impact of low intensity which is expected to have a **very low (-)** significance with and without mitigation.

4.5.2.4 Cumulative impacts

Should all the proposed renewable energy projects in and around De Aar be approved, it is likely that an impact on the aquatic features to occur. This is due to the fact that there would be an increased hardening of surfaces, change of land cover and an increase in the activities taking place within the Brak River catchment which could be expected to alter the flow, water quality and habitat of the streams within the river system. The proposed activities are outside of the identified freshwater features. Provided the construction and operation activities of the project remain contained within the allocated areas and any disturbed areas within the freshwater features rehabilitated, the overall impact should be limited and of a low significance.

4.5.2.5 No-Go alternative

The “no-go” option is taken to be the existing rights on the property, including the approved PV facility, and this includes all the duty of care and other legal responsibilities that apply to the owner of the property.

4.5.3 Mitigation Measures

4.5.3.1 Construction phase mitigation measures

The following mitigation measures are proposed for the construction phase for all project alternatives:

- A buffer of 30m should be maintained adjacent to the identified streams for the proposed PV footprint area as well as the substations.
- There should be minimal use of machinery within the drainage channels and disturbance within this area should be kept to a minimum.

- Disturbed areas within the riparian zones and stream beds should be rehabilitated as soon as possible after construction has been completed and revegetated with suitable indigenous vegetation.
- Invasive alien plant growth within the disturbed areas should be monitored and managed.
- Run-off over the exposed areas should be mitigated to reduce the rate and volume of run-off and prevent erosion occurring on the site and within the freshwater features and drainage lines.
- Construction activities for the proposed infrastructure that would need to take place within the river channels and riparian zone (i.e. linear development components – roads, transmission lines and water pipeline) should transect the streams at right angles and be limited as far as possible to ensure minimum disturbance of this area.
- Minimise duration and extent of construction activities in the river – construction should also preferably take place in the low flow season.
- Clearing of debris, sediment and hard rubble associated with the construction activities should be undertaken post construction to ensure that flow within the drainage channels are not impeded or diverted.
- Rehabilitate disturbed stream bed and banks and revegetation with suitable indigenous vegetation.
- All crossings over drainage channels or stream beds should be such that the flow within the drainage channel is not impeded.
- Any disturbed areas should be rehabilitated and monitored to ensure that these areas do not become subject to erosion or invasive alien plant growth.
- Contaminated runoff from the construction site(s) should be prevented from entering the rivers. All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located at least 100m away from the river systems/freshwater features and regularly serviced. These measures should be addressed, implemented and monitored in terms of the EMP for the construction phase.
- The laydown area should be cleaned and rehabilitated after construction is complete.
- Disposal of waste should be properly managed.
- Construction workers should be provided with ablution facilities at the construction site which are located at least 100m away from the river systems / freshwater features and regularly serviced.

4.5.3.2 Operational Phase mitigation measures

The following mitigation measures are proposed for the operational phase for all project alternatives:

- Disturbed areas should be visually monitored every three months and kept free of invasive alien plant growth.
- Storm water runoff from the constructed areas should be monitored to ensure that eroded areas do not develop, particularly within the drainage channels.

4.5.3.3 Decommissioning phase mitigation measures

The following mitigation measures are proposed for the decommissioning phase for all project alternatives:

- A decommission plan should be drawn up and approved for the site that addresses the removal of the PV facilities and infrastructure post operation phase. The decommission plan should address aspects such as monitoring and management of invasive alien plants and erosion of the site after the activities on the site are complete.

4.5.4 Surface Water Impact Table

Table 25 and Table 26 indicate how the significance ratings of the various impacts were derived.

Table 25 | Impact rating of surface water impacts

	Project	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Construction Phase	PV facilities (both layouts) and substations	No mitigation	Site specific	Medium-High	Short term	Low (-)	Probable	Certain	Reversible
		Mitigation	Site specific	Low	Short term	Very low (-)	Probable	Certain	Reversible
	Transmission corridors, access roads and water pipeline	No mitigation	Local	Low	Short term	Very low (-)	Probable	Certain	Reversible
		Mitigation	Local	Very Low	Short term	Very low (-)	Probable	Certain	Reversible
	Proposed Laydown Area	No mitigation	Site specific	Medium -Low	Short term	Low (-)	Probable	Certain	Reversible
		Mitigation	Site specific	Very low	Short term	Very low (-)	Probable	Certain	Reversible
Operation Phase	Maintenance of PV facilities and associated infrastructure	No mitigation	Site specific	Low	Long term	Very low (-)	Probable	Sure	Reversible
		Mitigation	Site specific	Very low	Long term	Very low (-)	Probable	Sure	Reversible
Decommissioning	Existence of PV facilities and associated infrastructure	With and without	Local	Low	Long term	Very low	Probable	Sure	Reversible

*Mitigation measures are described in detail in Section 4.5.3.

Table 26 | Cumulative surface water impacts

Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Impact to surface water ecosystem	No mitigation	Regional	Medium/ Low	Longer term	Low (-)	Probable	Sure	Reversible
	Mitigation	Regional	Low	Long term	Very Low (-)	improbable	Sure	Reversible

4.5.5 Surface Water Conclusions

While the likely significance of the proposed Layout Alternative 2 is similar to that of Layout Alternative 1, the Layout Alternative 1 is seen as the preferred option in terms of its potential impact on the freshwater features. There is no preference between the technology or transmission corridor alternatives.

4.6 IMPACT ON HYDROLOGY

In order to assess the impacts of the PV facilities on the hydrology of the project area and mitigate any adverse effects of the proposed development in relation to local stormwater runoff, a Conceptual Stormwater Management Report was compiled by Dr Nick Walker from Aurecon.

The pre- and post-development runoff was determined for each of the PV facilities. The potential flood risks have been assessed by analysing storm runoff generated by storms of 5-year and 20-year recurrence interval. The 5-year runoff data were used to assess storm drainage requirements on the PV facilities and the 20-year runoff data were used to assess the risks associated with external drainage paths. Based on the nature of the impact, it was not assessed using the standard assessment methodology provided in Annexure F and therefore no impact table is included for this impact. The report is included in Annexure E.

4.6.1 Description of the Environment

The proposed PV facility sites for both layout alternatives overlap two different catchments as indicated in Figure 22. Therefore the effect on stormwater runoff needs to consider the increase in runoff that would be generated of each layout alternative as it could impact the two catchments. In order to determine the anticipated stormwater runoff, climate and land-use, drainage characteristics, and flood peaks were investigated.

4.6.1.1 Climate and land-use

The study area has a Mean Annual Precipitation (MAP) of around 300mm. Figure 21 shows the annual precipitation for a gauge in De Aar (1921-1999). The study area has a semi-arid climate with a rainfall regime confined to summer and early autumn as shown in Figure 23.

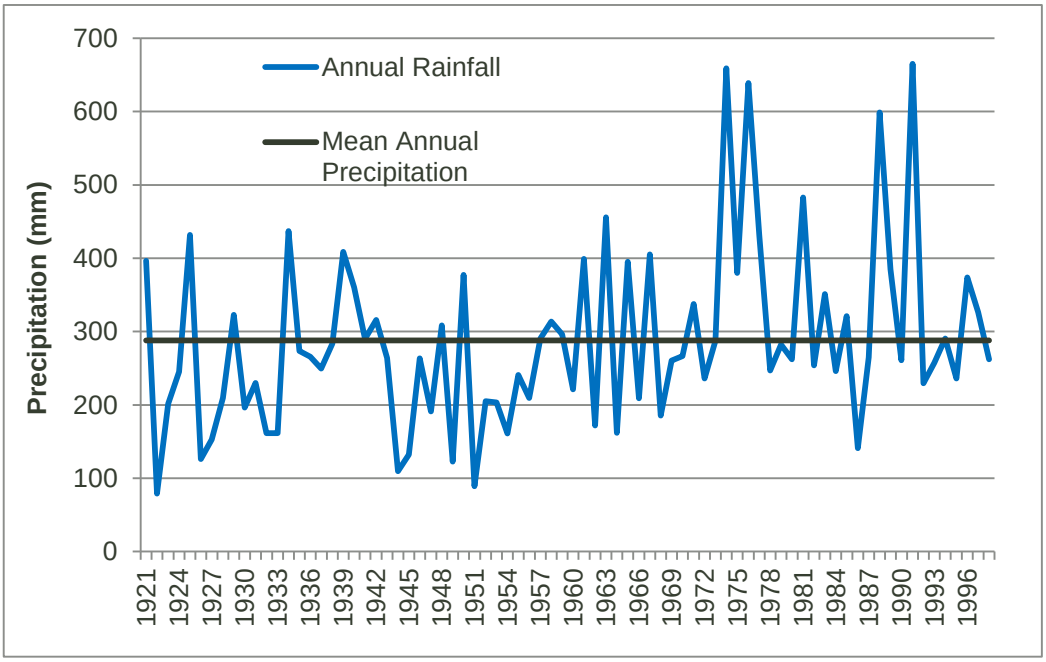


Figure 21 | Annual precipitation for De Aar (rainfall station 0170009 A)

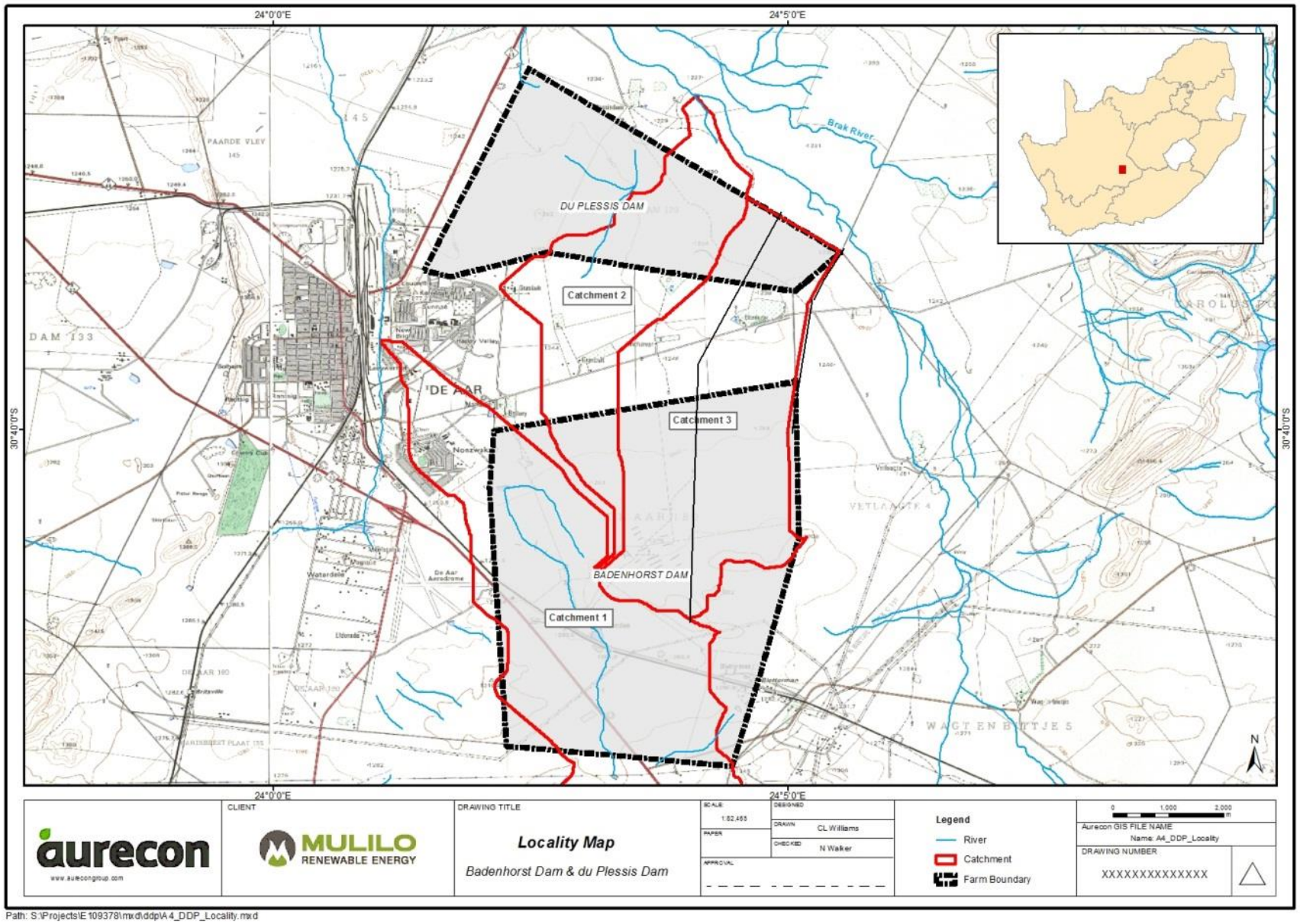


Figure 22 | Two catchments overlapping Du Plessis Dam Farm

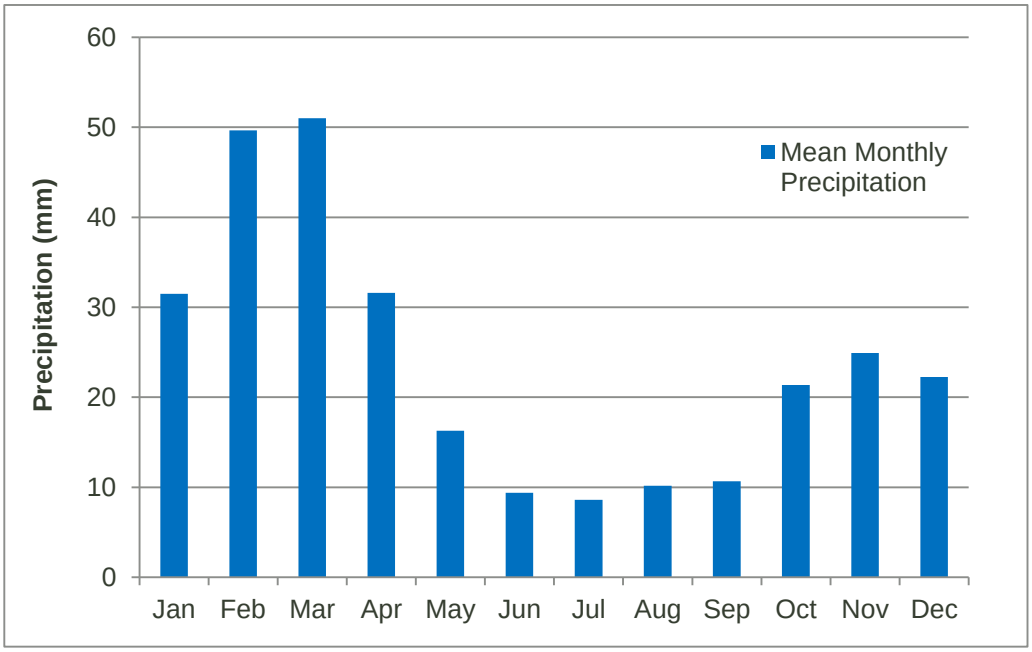


Figure 23 | Mean monthly precipitation for De Aar (rainfall station 0170009 A)

The site has an average catchment slope in the region of 2% (Aurecon, 2012b). The current use of the land is grazing and the soils are not suitable for arable agriculture (SiVest, 2012).

4.6.1.2 Drainage Characteristics

There is an ephemeral tributary of the Brak River to the north of the Du Plessis Dam Farm as indicated in Figure 24. There are also two drainage lines that begin on the higher ground in the west of the site. In addition, there are four other drainage lines in the eastern side of the farm which are not well defined and carry runoff from outside of the site boundary. These drainage lines have been previously identified by Belcher (2012 and 2013). The preliminary design of Layout Alternative 1 has taken the identified drainage lines into consideration and all PV facilities are outside of the buffer zones identified for the drainage channels.

Figure 24 | Ephemeral watercourse at Du Plessis Dam Farm

4.6.1.3 Flood peaks

The direction of flow through the different PV facilities is presented in Figure 25. The direction of flow is predominately towards the ephemeral tributary of the Brak River. Catchments 2 and 3 (see Figure 22) bring flow from the Badenhorst Dam Farm in the upper part of the catchment.

4.6.2 Hydrology Impact Assessment

The flood peaks for Catchment 2 and 3 are presented in Table 27. The development, for both Layout Alternative 1 and Layout Alternative 2 (all project alternatives), in Catchments 2 and 3 causes the hydrology of the site to change from predominately overland flow in the upper reaches to channelled flow. As a consequence of the change in hydrology the 1:20 year peak flow is increased as the velocity of runoff in the defined channels is higher than for overland flow. The major concern with the development in terms of stormwater is the increased likelihood erosion locally around the panels as well in the wider catchment. Erosion control measures are discussed in Section 4.6.3.

Table 27 | 1:20 year Flood Peak Estimates for Catchments 2 and 3

Condition	Catchment 2	Catchment 3
Pre-development flood peak (m^3/s)	7.3	12.8
Alternative 1 flood peak (m^3/s)	11.1	22.4
Alternative 1 and Badenhorst section* flood peak (m^3/s)	13.9	26.8
Alternative 2 flood peak (m^3/s)	13.2	22.2
Alternative 2 and Badenhorst section flood peak (m^3/s)	16.0	31.3

* Cumulative impacts of both the Du Plessis Dam Farm PV development and Badenhorst Dam Farm PV development.

The expected 1:5 year runoff from the individual PV sites of Alternative 1 and 2 are summarised in Table 28.

Table 28 | 1:5 year peak flows for the PV sites for Alternative 1 and 2

Catchment	1: 5 year peak pre-development (m3/s)	1: 5 year peak post-development (m3/s)
Alternative 1 PV2	4.8	9.8
Alternative 1 PV3	5.0	10.3
Alternative 1 PV4	8.0	16.4
Alternative 2 PV4	19.3	31.7

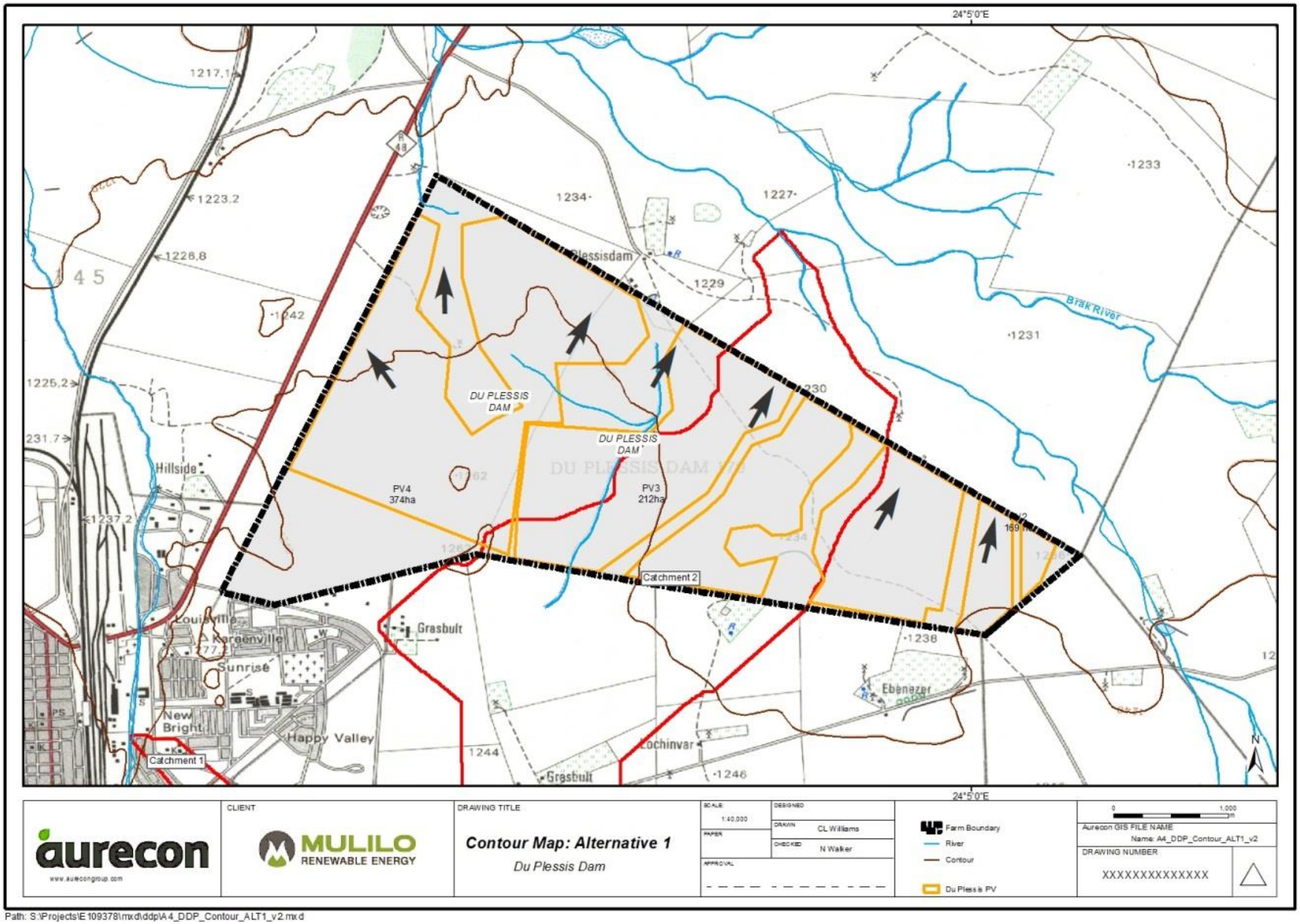


Figure 25 | Direction of flow (pre-development) through Du Plessis Dam Farm

The impacts were not assessed using the assessment methodology provided in Annexure F. However, the necessary precaution measures would be in place and have been included in the LEMP.

4.6.2.1 Construction phase impact

It is anticipated that the existing vegetation at the site would be removed (for all project components and all alternatives) which would result in erosion if not adequately managed. Mitigation measures are provided in Section 4.6.3.

4.6.2.2 Operational- and decommissioning phase impact

With the PV panels being impervious, rainwater would land on the panels and run off directly onto the ground below (for all project components and all alternatives). Therefore some erosion may occur beneath each PV panel as well as downstream of panels, as runoff is incremented and concentrated due to the site layout and topography. V-drains should be provided to intercept and convey the runoff.

4.6.2.3 No-Go Alternative

Should the no go alternative be authorised then the stormwater management assessment and plan prepared by Aurecon 2012b would be applicable. The 2012b stormwater management plan recommended that no mitigation measures would be required for PV1 as only a very low impact was anticipated.

4.6.2.4 Cumulative impacts

Cumulative impacts are not very easy to assess, since the evaluation of stormwater impacts, requires detailed designs and site specific information. Therefore, the cumulative impact of only Du Plessis Dam PV facilities and Badenhorst Dam Farm PV facilities was assessed, as the specialist had detailed information on the design and site characteristics. The increased runoff from the Du Plessis Dam Farm PV facilities and the Badenhorst Dam Farm PV facilities would not significantly impact the high flows in the Brak River.

4.6.3 Mitigation Measures

It is not recommended that the internal drainage system concentrate the flow from an area exceeding 200ha to one outlet. This would cause erosion and change the hydrology of the area from overland flow to channelled flow. Instead the area should be sub-divided into smaller sub-catchments, which would distribute the runoff, and have multiple outlets from the site as indicated in Figure 26.

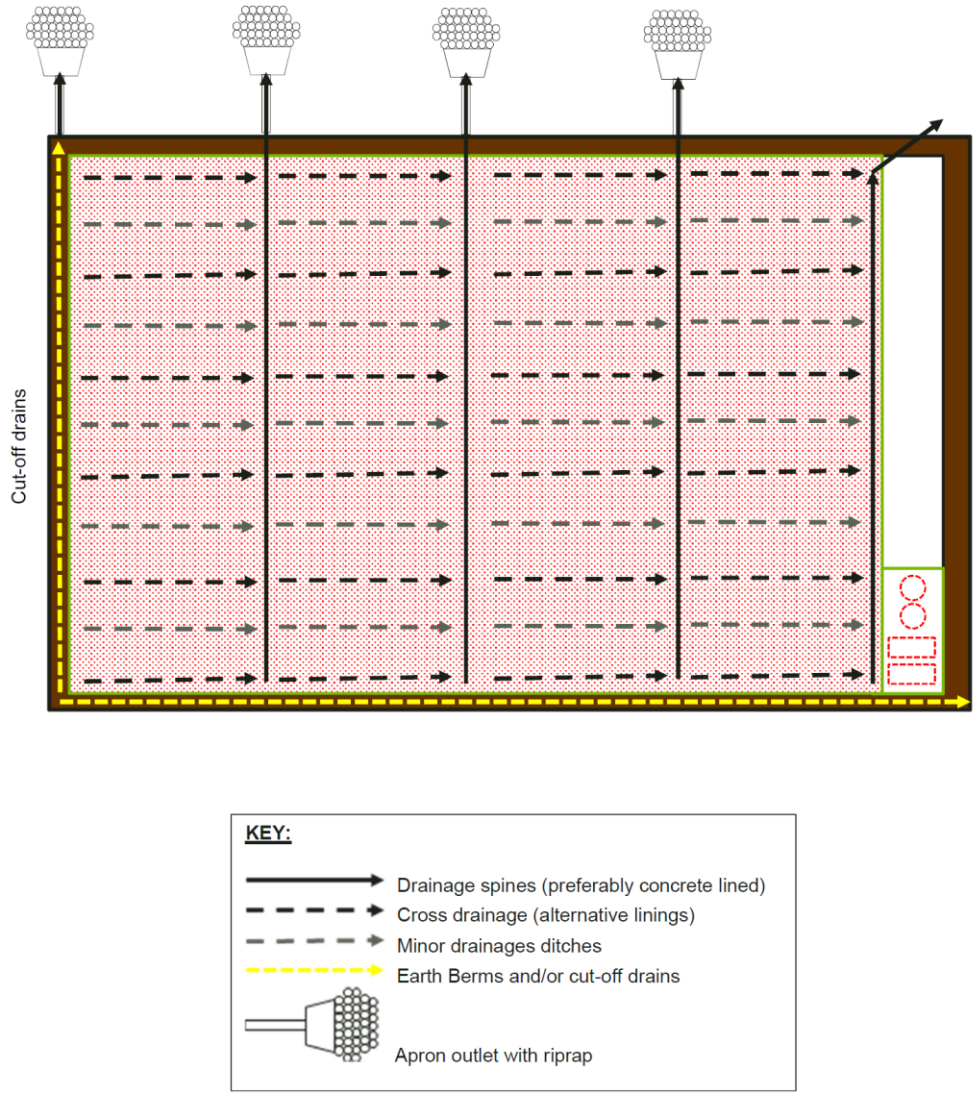


Figure 26 | A typical drainage scheme

The runoff from the Du Plessis site should in the most part should be directed to the tributary of the Brak River to the north of the site which follows the pre-development flow across the site. The runoff from the western side of the site (PV4 Alternative 1) should be directed away from the R48 north towards the Brak River. Should localised drainage within this area be a concern during the design phase, attenuation ponds may be required. The Brak River has a confluence with a tributary north of the site and the Brak River then flows under the R48. The Brak River has catchment of 2,090km^2 at this point with a 1:100 year flood peak of 1,060m^3/s.

Drainage spines

The following mitigation measures are recommended (for all project components and all alternatives):

- The topography would determine the actual placement of drainage spines indicated as solid lines in Figure 26. As such, a detailed survey is required to place the drainage spines.
- Cross drainage in the form of v-drains should be provided to intercept overland flow and to direct this to the spines. This is indicated as dashed lines in Figure 26. The cross drainage would also assist with erosion control. These v-drains can take the form of road side drains and must be lower than the surrounding area to intercept flows. The channels can be

compacted earth channels but would require maintenance on a regular basis and after each rainfall event due to possible scouring. Although more expensive, the construction of a concrete lined system is advised. A typical channel size is 300mm deep and v-shaped. This could, for example, have a left side slope of 1:1 and right side slope of 1:3 when water enters the channel from the right side and flows down the channel. The general slope of the surrounding ground would be right to left.

- Concrete aprons with rip-rap, no less than 12m long, should be used at the multiple outlets as indicated in Figure 27. This would prevent erosion, assist in moving the runoff from channelled flow back to overland flow and will dissipate energy.

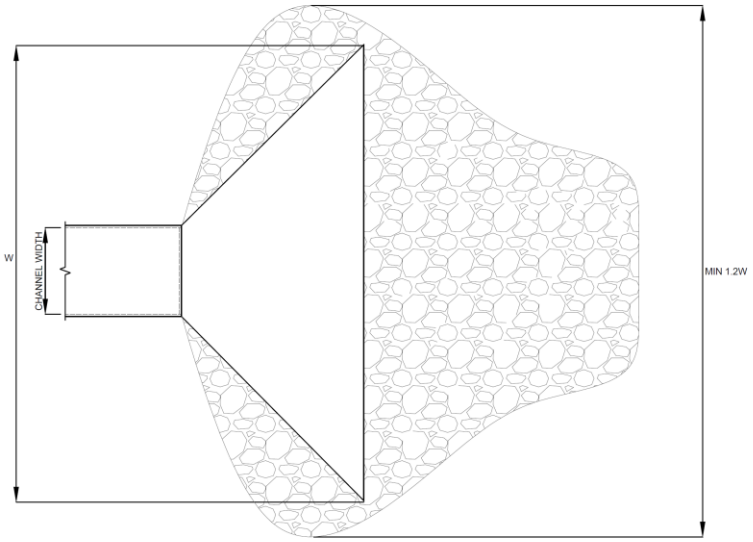


Figure 27 | A plan view of a drainage channel to concrete apron to rip-rap (after Caltrans, 2003)

Erosion control around plinths and supporting structures

Erosion around concrete plinths and supporting structures is a concern and is dependent on the erodibility of the material. The following mitigation measures are proposed to mitigate erosion (for all project components and all alternatives):

- It is recommended that the surfaces around plinths be compacted well graded gravel with a 38mm gravel capping.
- Erosion protection in the form of rip-rap with average diameters of 200mm is required at the drain outfalls from the solar facility for a distance of no less than 12m as indicated in Figure 27.

Access roads

There are planned gravel access roads for the site. Drainage is an important consideration of gravel road design. Any standing water on the road can quickly lead to erosion even with light traffic. The gravel roads should have the:

- a crowned driving surface,
- a shoulder area that slopes directly away from the edge of the driving surface, and
- a ditch.

Where the roads intersect drainage lines, a suitably sized culvert should be used. It is important that ditches and culverts be kept clear from obstructions. The stormwater impact on the existing N10 road and railway line (Alternative 2) would need to be investigated to ensure they are not

impacted in any way and that existing associated culverts and channels still meet accepted design criteria.

Erosion prevention and control measure (for all project components and all alternatives)
Due to the disturbances associated with construction activities it can be expected that soil erosion would occur, resulting in an increased loading of suspended solids into receiving waters. To mitigate the following measures should be taken, both as erosion prevention and control measure:

- Straw barriers should be installed in drainage paths to act as a check dam, i.e. to reduce velocity, and as a sediment trap during construction as indicated in Figure 28. These are erosion barriers placed at intervals of 25m to 50m apart, in the drainage paths, which would intercept suspended solids from entering the natural drainage paths.
    - The sediment and erosion control measures should remain in place until construction is complete.
    - The sediment traps would require regular monitoring during construction and reinstatement as necessary.
- A detailed drainage layout would need to be developed when a detailed topographic survey for the site is available. The minor drainage channel that starts in the south of the farm and exits in the south-east of the farm at Bletterman would have to be evaluated as part of the detailed design.
- Packed stone, also known as rip-rap, must be placed as liners for channel spines. These comprise packed stones with an average diameter of 100mm, packed in the channels as lining material to control flow velocities and hence erosion.
- Earth cut-off channels should be constructed at the boundaries of each of the proposed facilities. These would assist in directing flow away from the site and reduce the possibility of flooding from runoff origination from outside the site.
- Provide erosion protection at channel outfalls and positions of high flow concentration. These comprise packed stones with an average diameter of 200mm, packed in the drainage path to control flow velocities and hence erosion.

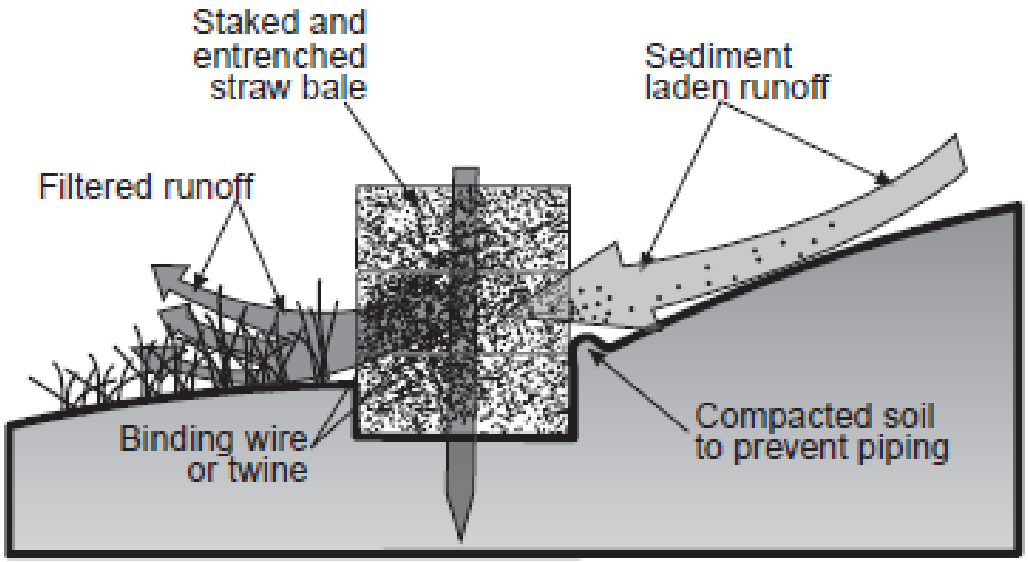


Figure 28 | Cross-sectional view of an installed straw bale

It is recommended that after the site has been surveyed the 1:100 year floodline should be re-determined before the PV areas are finalised.

A summary of the mitigation measures for each Alternative are presented in Table 29.

Table 29 | Summary of mitigation measure for the increased runoff

Condition	Impact	Mitigation
Catchment 2 Alternatives 1 and 2	Change in hydrology from overland flow to channel flow	Use of multiple apron outlets at the exit of the PV site.
Catchment 3 Alternatives 1 and 2	Change in hydrology from overland flow to channel flow	Use of multiple apron outlets at the exit of the PV sites and possible attenuation ponds on Badenhorst Dam Farm.
Alternatives 1 and 2 on the western side of the site	Increased flow towards the R48	Use of multiple apron outlets at the exit of the PV sites and possible attenuation ponds.

4.6.4 Hydrology Conclusion

The study indicates that there would be increases in runoff due to the proposed PV facilities. The flood peak estimations showed that Alternative 1 is the preferred option with regards to stormwater, as alternative 1 would cause smaller increases in runoff. Also the PV facilities of Alternative 1 are placed clear of any natural drainage lines across the farm. The increased runoff and erosion potential for Alternative 1 can be mitigated by using multiple stormwater outlets and energy dissipaters. However it should be noted that once a detailed survey and design of the stormwater infrastructure has been undertaken there may be a need for on-site attenuation of the flood peak for the volume that exceeds the predevelopment flow especially where increased runoff in the downstream watercourse could impact downstream dwellings, sensitive ecological areas, road and railway crossings and other infrastructure.

The specialist had no preference for the technology or transmission corridor alternatives.

4.7 IMPACT ON PALAEONTOLOGY

The proposed PV facilities on Du Plessis Dam Farm are located in an area of the Main Karoo Basin of South Africa that is underlain by potentially fossiliferous sedimentary rocks of the Karoo Supergroup that are of Permian age. The upper Ecca Group bedrocks in the De Aar area contain sparse to locally common petrified wood as well as low diversity trace fossil assemblages typical of the Waterford Formation. The proposed development may adversely affect potential fossil heritage within the study area by destroying, disturbing or permanently sealing-in fossils that are then no longer available for scientific research or other public good. The various categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act include, among others:

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

Given the presence of exposures of potentially fossiliferous Karoo Supergroup sediments within this study area, a combined desktop and field-based Palaeontological Impact Assessment (PIA) was undertaken by Dr J.E. Almond of Natura Viva. The PIA was informed by a review of the relevant scientific literature, geological maps, several previous palaeontological heritage assessments for alternative energy developments in the De Aar region and two one-day field

assessments of the study area carried out on 12 to 13 January 2012 and again on 1 June 2013. The PIA is included in Annexure E.

4.7.1 Description of the Environment

The Farm Du Plessis Dam 179 study area is a relatively featureless, flat-lying piece of land on the east side of the De Aar to Philipstown tar road (R48). It is situated at around 1,230m to 1,260 m above mean sea level (amsl) between the Brak River drainage system in the northeast and De Aar in the southwest. The area is almost entirely covered with reddish-brown alluvial soils with sparse karroid bossieveld vegetation and abundant grass in summer. Levels of bedrock exposure are very low. There are numerous surface scatters of fine downwasted surface gravels (mainly dolerite, hornfels, quartzite and ferruginous carbonate clasts), frequently reworked by sheetwash processes. The geology of the Du Plessis Dam PV study area near De Aar is outlined on the 1: 250 000 geology sheet 3024 Colesberg (Figure 29).

The study area is largely underlain by mudrocks and sandstones of the upper Ecca Group that are intruded by Jurassic dolerites, especially but not exclusively in the southwest. There is also an isolated kimberlite pipe mapped close to the R48, but as usual this does not have an obvious surface expression. According to the 1: 250 000 geological map the study area is largely underlain by sediments of the Tierberg Formation (Ecca Group). However due to the sedimentological characteristics of the bedrock and trace fossil assemblages, Dr Almond is of the opinion this area should be classified as Waterford Formation rather than Tierberg formation as mapped.

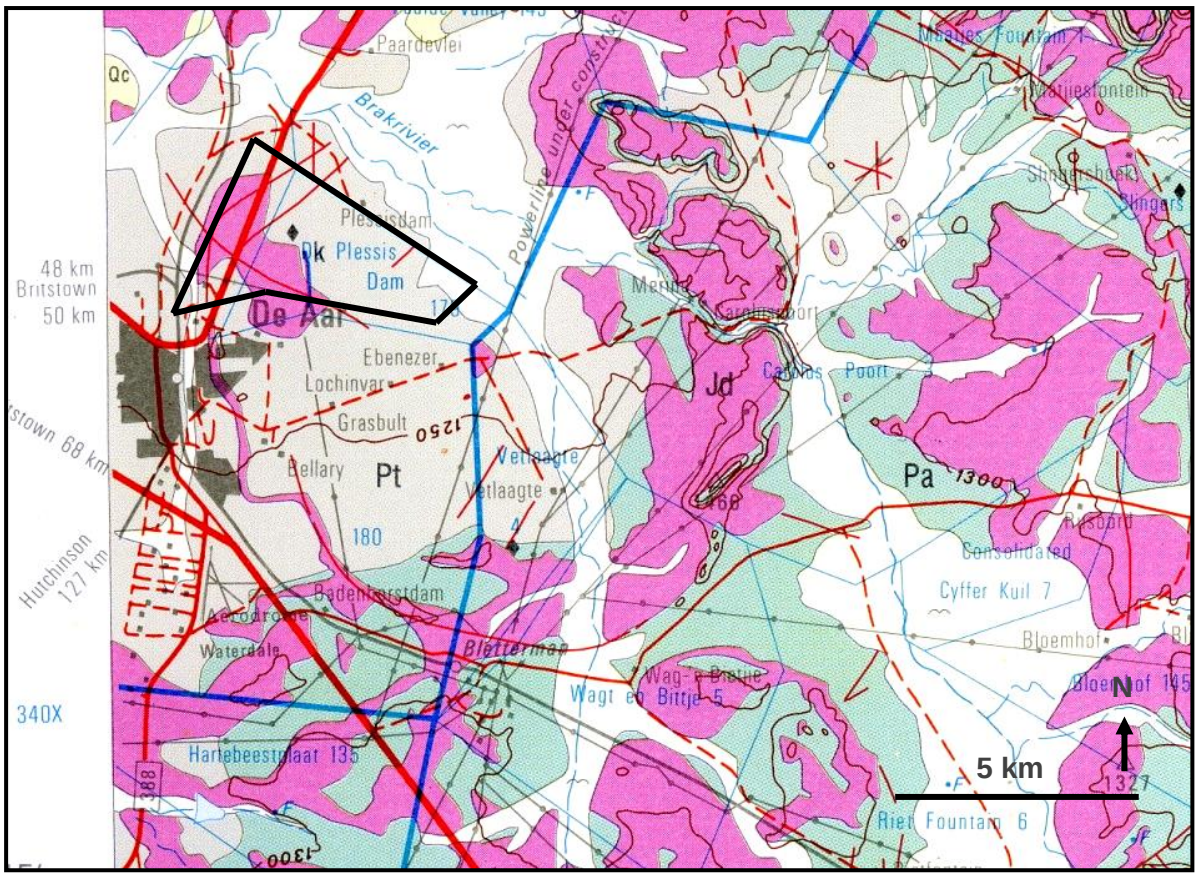


Figure 29 | Geological map of the region east of De Aar, Northern Cape, showing the approximate boundary of the Du Plessis Dam PV solar energy facility study area near De Aar (Abstracted from 1: 250 000 geology sheet 3024 Colesberg, Council for Geoscience, Pretoria)

The following rock units are mapped within or close to the PV study areas:

- grey (Pt) = Tierberg / Waterford Formation (Ecca Group)
- pale green (Pa) = Adelaide Subgroup (Lower Beaufort Group)
- pink (Jd) = intrusive dykes and sills of the Karoo Dolerite Suite
- dark yellow (T-Qc) = Neogene to Quaternary calcretes
- white = Quaternary to Recent superficial deposits (alluvium, colluvium *etc.*)
- small black diamond symbol = Kimberlite pipe

The great majority of the Ecca and dolerite outcrop area is obscured by superficial sediments of probable Pleistocene to Holocene age, as well as by abundant karroid shrub and grassy vegetation as seen in Figure 30 below.

Figure 30 | Geological general view of the well-vegetated Du Plessis Dam 179 study area looking towards the east

Furthermore bedding dips of the Karoo Supergroup sediments in the study region are horizontal to very shallow and therefore low levels of tectonic deformation and cleavage development are expected here, favouring good fossil preservation. However, extensive dolerite intrusion has compromised fossil heritage in the Karoo Supergroup sediments due to resulting thermal metamorphism in the study area affecting the palaeontological heritage. In addition, pervasive calcretisation of many near-surface bedrocks has further compromised their original fossil heritage. In addition, pervasive calcretisation of many near-surface bedrocks has further compromised their original fossil heritage.

4.7.1.1 Upper Ecca Group

It should be noted that the stratigraphic as well as palaeoenvironmental interpretation of the Ecca / Beaufort boundary rocks in the De Aar to Philipstown area is complex and unresolved. Firstly the Tierberg Formation (Pt) (Ecca Group, Karoo Supergroup) is a recessive-weathering, mudrock-dominated succession consisting of dark, well-laminated, carbonaceous shales with subordinate thin, fine-grained sandstones. Secondly the marine/ lacustrine, uppermost Ecca Group rocks, though mapped as offshore / basinal Tierberg Formation, have in fact many features in common with the shallow shelf, storm-dominated, sandstone-rich facies seen at the top of the Ecca

succession in the Carnarvon area to the west. These uppermost Ecca Group rocks were previously assigned to the Carnarvon Formation that has since been incorporated into the Waterford Formation. For the purpose of the fossil heritage study for Du Plessis Dam Farm, the upper Ecca Group sediments within the study area are assigned to the Waterford Formation, despite their attribution to the Tierberg Formation on the published 1: 250 000 geological map.

In the broader area good exposures of typical Carnarvon-type facies of the Waterford Formation are seen in several shallow riverine exposures in the De Aar region. They include tabular-bedded, well-jointed sandstones with wave rippled tops, well-developed low angle cross-lamination (hummocky cross-stratification), abundant bioturbation, convolute lamination (dewatering or load structures) and occasional large koffieklip ferruginous carbonate concretions. Ecca Group sediments are not at all well exposed in the Du Plessis Dam Farm study area. The Karoo Supergroup bedrocks are almost entirely mantled with shallow to deep silty to sandy soils of brownish to orange-brown hues, with rare patches of downwasted surface gravels (sandstone, mudrock, hornfels, quartzite, dolerite) and cream-coloured reworked calcrete as seen in Figure 31.

Figure 31 | Roadside gully exposure of thin-bedded, baked, dark-grey mudrocks containing flattened horizontal burrows on Du Plessis Dam Farm

Petrified wood and other plant material of the Glossopteris Flora (e.g. Glossopteris, Phyllotheca) is common in the Waterford Formation. Sheetwash and other surface gravels at the Du Plessis Dam Farm study area consistently contain small cherty fragments of silicified woods from the underlying Ecca Group bedrocks. Larger petrified wood samples also occur within subsurface gravels overlying Ecca bedrocks where these are exposed at surface as indicated in Figure 32. The woods typically show well-developed seasonal growth rings and preservation of original the original woody microstructure appears to be good; this should facilitate identification and possible dating of the samples. No other Ecca Group body fossils were observed within the study area.

Figure 32 | Locally abundant fragments of silicified fossil wood reworked from the Ecca Group in the south-eastern corner of the Du Plessis Dam Farm study area

4.7.1.2 Karoo Dolerites

The Karoo Dolerite Suite (Jd) is an extensive network of basic igneous bodies (dykes, sills) that were intruded into sediments of the Main Karoo Basin in the Early Jurassic Period, about 183 million years ago. These dolerites form part of the Karoo Igneous Province of Southern Africa that developed in response to crustal doming and stretching preceding the break-up of Gondwana. Hard cappings of blocky, reddish-brown to rusty-weathering dolerite are a very typical feature of the flat-topped koppies in the Great Karoo region. Bouldery ridges and low koppies of well-jointed, masonry-like dolerite, as well as zones of dolerite corestones emerging from the soil, are well seen in western portion of the Du Plessis Dam Farm study as indicated in Figure 33.

Figure 33 | A linear zone of dolerite boulders (Loc. 263) on Du Plessis Dam Farm, is the surface expression of a dolerite dyke

The dolerite outcrops in the study area are in themselves of no palaeontological significance due to high temperature igneous rocks emplaced at depth within the Earth's crust and they do not contain

fossils. However, as a consequence of their proximity to large dolerite intrusions in the Great Escarpment zone, some of the Ecca and Beaufort Group sediments in the study area would have been thermally metamorphosed, compromising their fossil heritage.

4.7.1.3 Kimberlite pipes

Numerous kimberlite pipes of Jurassic to Cretaceous age intrude the Karoo Supergroup rocks north of Victoria West, including several examples to the east of De Aar. These pipes do not contain diamonds. Ultramafic kimberlite pipe rocks are highly weathered with no obvious surface expression and they could usually be located only on the basis of characteristic mineral assemblages such as garnet and phlogopite mica found in ant heaps, termite mounds and prospecting holes. The only mapped example within the present study area comprises one example close to the western edge of Du Plessis Dam Farm.

4.7.1.4 Quaternary to Recent Superficial deposits

Various types of superficial deposits occur throughout the Great Karoo region. Thin horizons of fine to coarse, angular gravels mantle the Palaeozoic and Mesozoc bedrocks over much of Du Plessis Dam farm. Gravel clasts mostly consist of locally-derived Ecca Group sandstones, mudrocks, hornfels, quartzite, ferruginous carbonate nodule fragments and silicified wood as well as weathered to fresh dolerite, including small to large rounded dolerite corestone boulders as seen in Figure 34. In areas with a well-developed calcrete hardpan the surface gravels are rich in reworked calcrete clasts. No other trace or body fossils were observed within the Late Caenozoic superficial deposits of Du Plessis Dam Farm study area.

Figure 34 | Reddish-brown soils with downwasted surface gravels on Du Plessis Dam Farm

4.7.2 Impact Assessment

The construction phase of the development would entail excavations into the superficial sediment cover (soils, alluvial gravels etc.) and perhaps also into the underlying potentially fossiliferous bedrock. These notably include excavations for the PV panel support structures, buried cables, internal access roads, any new power line pylons and associated infrastructure. All these

developments may adversely affect potential fossil heritage within the study area by destroying, disturbing or permanently sealing-in fossils that are then no longer available for scientific research or other public good. Once constructed, the operational and decommissioning phases of the PV facilities would not involve further adverse impacts on palaeontological heritage.

4.7.2.1 Construction phase impact

The construction phase of the proposed PV facilities (all project alternatives) would not entail very substantial (i.e. deep and voluminous) excavations into the superficial sediment cover (soils, surface gravels etc.). In most cases the underlying bedrocks would not be directly impacted. No areas or sites of exceptional fossil heritage sensitivity or significance are identified within the Du Plessis Dam Farm study area. The fossil remains identified in this study (viz. low diversity trace fossil assemblages within Ecca sandstones and mudrocks, plus sparse, reworked silicified wood fragments within surface gravels) are of widespread occurrence within the rock units concerned (i.e. not unique to the study area).

There are no fatal flaws in the Du Plessis Dam Farm development proposal as far as fossil heritage is concerned. Extensive, deep bedrock excavations are not envisaged during the construction phase. Due to the general scarcity of fossil remains within the bedrocks and superficial deposits represented here, the high levels of bedrock weathering, the comparatively small development footprints, as well as the extensive superficial sediment cover observed within and close to the study area, the overall impact significance of the construction phase for both Layout Alternatives and all project alternatives are site specific, very low magnitude, long term and of low (-) significance with and without mitigation.

4.7.2.2 Operational and decommissioning phase

Once constructed, the operational and decommissioning phases of the PV facilities would not involve further adverse impacts on palaeontological heritage.

4.7.2.3 No-Go Alternative

The “no go” alternative to the proposed PV facilities would have a neutral (zero magnitude) impact significance on fossil heritage resources.

4.7.2.4 Cumulative impacts

A number of wind and solar energy projects have been proposed for the De Aar region, in addition to the Mulilo PV facilities proposed for Du Plessis Dam Farm. Potential impacts on palaeontological heritage resources for several of these other projects have been assessed by Dr Almond on the basis of desktop as well as field studies. The geology of the bedrocks as well as of the superficial deposits throughout the De Aar region is very similar as far as palaeontology is concerned and in all cases the impact significance of the proposed alternative energy developments was assessed as **low (-).**

The cumulative impacts of the three new PV solar energy facilities in terms of both local (< 10 km radius) as well as regional (> 10 km radius) fossil heritage resources is likewise assessed as **low (-)** because of:

- The low palaeontological sensitivity of the relevant bedrocks (Ecca Group, Karoo dolerite) throughout the De Aar region;

- Weathering, calcretisation and local baking of the near-surface bedrocks, further decreasing their palaeontological sensitivity;
- The very sparse occurrence of fossils within the extensive mantle of superficial sediments (soils, gravels, calcretes *etc*) in the De Aar region; and
- The limited amount of substantial (deep, voluminous) bedrock excavations envisaged and comparatively small development footprints in the case of the solar energy facility projects in particular.

4.7.3 Mitigation Measures

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

The following mitigation measures are proposed to mitigate the potential palaeontology impact (for all project developments):

- The ECO responsible for the development should be aware of the possibility of important fossils (*e.g.* petrified wood, mammalian bones, teeth) being present or unearthed on site and should monitor all substantial excavations into superficial sediments as well as fresh (*i.e.* unweathered) sedimentary bedrock for fossil remains.
- In the case of any significant fossil finds (*e.g.* fossil wood, vertebrate teeth, bones, burrows, petrified wood) during construction, these should be safeguarded - preferably *in situ* - and reported by the ECO as soon as possible to the relevant heritage management authority (SAHRA. Contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000. Tel: 021 462 4502. Email: cscheermeyer@sahra.org.za) so that any appropriate mitigation (*i.e.* fossil recording, sampling or collection) by a palaeontological specialist can be considered and implemented, at the developer's expense.
- The palaeontologist concerned with mitigation work would need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection).
- All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies recently developed by SAHRA (2013).

4.7.4 Palaeontology Impact Table

Table 30 and Table 31 indicate how the significance ratings of the various impacts were derived.

Table 30 | Impact rating of palaeontological impacts

Project	Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Layout Alt. 1, PV2	Disturbance, damage or destruction of fossils preserved at or below the ground surface	No mitigation	Site specific	Very low	Long term	Low (-)	Probable	Unsure	Irreversible
		Mitigation	Site specific	Very low	Long term	Low (-)	Probable	Unsure	Irreversible
Layout Alt. 1, PV3	Disturbance, damage or destruction of fossils preserved at or below the ground surface	No mitigation	Site specific	Very low	Long term	Low (-)	Probable	Unsure	Irreversible
		Mitigation	Site specific	Very low	Long term	Low (-)	Probable	Unsure	Irreversible
Layout Alt. 1, PV4	Disturbance, damage or destruction of fossils preserved at or below the ground surface	No mitigation	Site specific	Very low	Long term	Low (-)	Probable	Unsure	Irreversible
		Mitigation	Site specific	Very low	Long term	Low (-)	Probable	Unsure	Irreversible
Layout Alt. 2, Ext. PV2	Disturbance, damage or destruction of fossils preserved at or below the ground surface	No mitigation	Site specific	Very low	Long term	Low (-)	Probable	Unsure	Irreversible
		Mitigation	Site specific	Very low	Long term	Low (-)	Probable	Unsure	Irreversible
No-Go	Disturbance, damage or destruction of fossils preserved at or below the ground surface	No mitigation	Site specific	Zero	Long term	Neutral	Probable	Sure	n/a
		Mitigation	Site specific	Zero	Long term	Neutral	Probable	Sure	n/a
Off-site transmission lines	Disturbance, damage or destruction of fossils preserved at or below the ground surface	No mitigation	Site specific	Very low	Long term	Very low (-)	Probable	Unsure	Irreversible
		Mitigation	Site specific	Very low	Long term	Very low (-)	Probable	Unsure	Irreversible

*Mitigation measures are described in detail in Section 4.7.3.

Table 31 | Cumulative palaeontological impacts

Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Disturbance, damage or destruction of fossils preserved at or below the ground surface	No mitigation	Site specific	Very low	Long term	Low (-)	Definite	Unsure	Irreversible
	Mitigation	Site specific	Very low	Long term	Low (-)	Definite	Unsure	Irreversible

4.7.5 Palaeontology Conclusion

There is no preference on palaeontological heritage grounds for Layout Alternatives 1 vs. Layout Alternative 2, conventional PV versus CPV technology, between the transmission corridors, or single axis versus fixed axis tracking technology.

4.8 IMPACT ON HERITAGE

The proposed development site is located in the Northern Cape. This part of the Karoo has a long pre-colonial history as testified by the many thousands of stone artefacts that can be found among surface gravels in many areas. The vast majority of these artefacts are heavily weathered indicating great antiquity and relate to the Early (ESA) and Middle Stone Ages (MSA). However, of more significance, due to their better integrity, are the Later Stone Age (LSA) sites that occur from time to time. Concentrated areas of LSA indicate places where people actually camped. The assemblages also include distinctive retouched forms that could sometimes help to determine more precisely the age of the site. Probably the most significant aspect of Karoo archaeology is the presence of many prehistoric stone kraals. Most notably, the Seacow River valley to the east of the present study area has revealed many such kraals and enabled a kraal typology to be constructed.

Du Plessis Dam Farm 179 dates back at least to 1863. The railway junction dates to 1881 when Cape Town and Kimberley were linked by rail after diamonds were discovered at the latter town. The railway junction was very important to the British during the Anglo-Boer War since railway lines from Cape Town and Port Elizabeth met at this point. De Aar was also the site of the first use of wireless telegraphy in South Africa where the British employed it to maintain communications between their various columns operating in the area. Owing to the climatic conditions in the Karoo, the wireless sets, which were designed for shipboard use, could not perform properly and were soon withdrawn from inland service The town was laid out around the railway junction on the farm De Aar which was purchased in 1889 by Isaac and Wolf Friedlander, who ran a trading store and hotel at the railway junction). After the war, the brothers established the town. Its municipality was formed in 1904 and the first mayor, Dr Harry Baker, was elected in 1907.

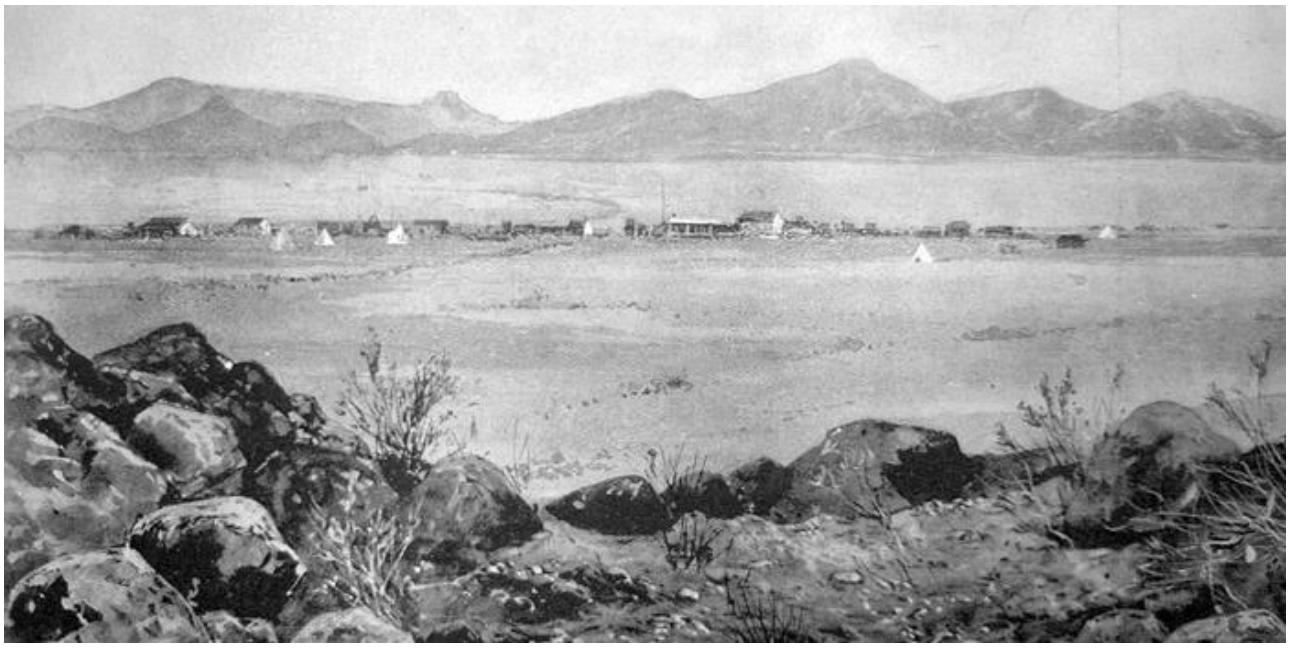


Figure 35 | View of De Aar around the time of the Anglo-Boer War indicating the railway line and station hotel at De Aar

Archaeological resources were encountered on the site and the proposed PV facilities could potentially result in a wide range of impacts that would affect the heritage qualities of Du Plessis Dam farm and surrounding areas. During the construction phase land clearing activities for laydown areas, PV arrays, access roads to the PV facilities, and cable trenches, may result in the following impacts on the archaeological heritage resources:

- Displacement of pre-colonial and colonial archaeological material; and
- Accidental damage and/or vandalism to the built environment, such as historical structures and ruins.

During the operational phase, the negative visual impact of solar energy generation facilities may impact on the cultural landscape, scenic quality and sense of place of De Aar.

In order to assess the impacts of the PV facilities on the heritage resources in the project area, a Heritage Impact Assessment (HIA) was undertaken by Mr Jayson Orton of ACO Associates cc (ACO). The HIA was informed by a literature survey and a field survey was conducted on 4 May 2013 to examine specific locations considered to be of heritage interest and also to conduct random examination of other areas. The HIA is included in Annexure E.

4.8.1 Description of the Heritage Environment

4.8.1.1 Archaeology

The proposed site is predominantly flat with low hills towards the western part. The landscape is covered in low bushes and dense grass with some bare patches. Some of these latter areas were quite large and, when free from gravel, tended to be very silty indicating areas where water formed ephemeral pans. Some power lines also traverse the eastern part of the farm.

Archaeological resources were found to be widely scattered across the land. Those of considerable value include several scatters of LSA stone artefacts, predominantly on high ground in the western part of the study area. The most significant site is one that may well have some depth to it and with excavation might be able to provide temporal data. Some burnt bone fragments were also preserved on this site. With just one exception, all the LSA scatters were either on top of low rises or else along the base of a rocky ridge. Figure 36 shows a view of a scatter of LSA artefacts and pottery.

Figure 36 | A scatter of LSA artefacts on hornfels (black items) and pottery (light brown items) at DPD2013/026 (J030). Inset: Fibre tempered pot sherd

A rare and possibly unique archaeological feature in the De Aar area is a ground patch of bedrock. Such occurrences are fairly common in Bushmanland, to the northwest and also on the Vredenburg Peninsula in the south-western Cape, where they manifest as deep grooves. Figure 37 shows a ground patch of bedrock at De Aar that was right next to an area where water would collect after a rainfall event. They are the result of using another stone to grind some sort of material, perhaps seeds or ochre.

Figure 37 | The ground surface at DPD2013/011 (J039)

Less significant are the scatters of older MSA artefacts noted in the proposed site. Most areas are very low in density and have little value but certain areas have higher density accumulations perhaps due to either the effects of erosion or because people lived very close to or on those spots. Two such dense scatters were recorded as being worthy of mitigation. Figure 38 shows that these older artefacts are characterised by the presence of red patina (weathering) on their outer surfaces.

Figure 38 | Atrfacts at DPD2013/013 (point J048). The artefact in the centre and that in the upper right hand corner are younger than the rest as evidenced by their lesser degree of patina.

A number of historical archaeological sites were also encountered on site. In some cases these overlapped with LSA sites in that both were found to occupy areas of high ground. Due to the frequent presence of gun cartridges, it is thought likely that many of the historical artefacts relate to the Anglo-Boer War. Figure 39 shows a musket cartridge from a rifle that was manufactured during the late 19th century. Figure 40 shows a stone feature, in this instance circular, from one of the sites which add knowledge about the strategies of the war in that they demonstrate that almost every low hill around the town was likely to have been used at some point during the war as a look out station.

Figure 39 | Musket cartridge

Figure 40 | Stone feature at DPD2013/009 (point J035)

The most significant site of all on Du Plessis Dam is the historical farmstead. The farmstead includes a main house, dump, kraal, four small outbuildings, two possible grave sites, and a quarry for building stone. The reason for the location of the farmstead is the occurrence of a spring (refer to Figure 41). Various artefacts were recorded around this farmstead and a buffer zone is proposed (refer to Figure 42).

Figure 41 | Artefacts from the general landscape around the historical farmstead at DPD2011/003-011

Figure 42 | The spring (although dry) that is close to the historic farmstead. Animals dug holes into the wet soil in the depression in the centre of the picture.

4.8.1.2 Built environment

The only “built” items that might be directly impacted are those ephemeral stone features covered under the archaeology section above. No highly significant buildings were noted in the study and no buildings would be directly affected.

4.8.1.3 Cultural landscape

The landscape around De Aar and on Du Plessis Dam has only been minimally altered by human activity, largely through the addition of power lines to it. The town of De Aar lies immediately alongside the site and is at this point entirely modern.

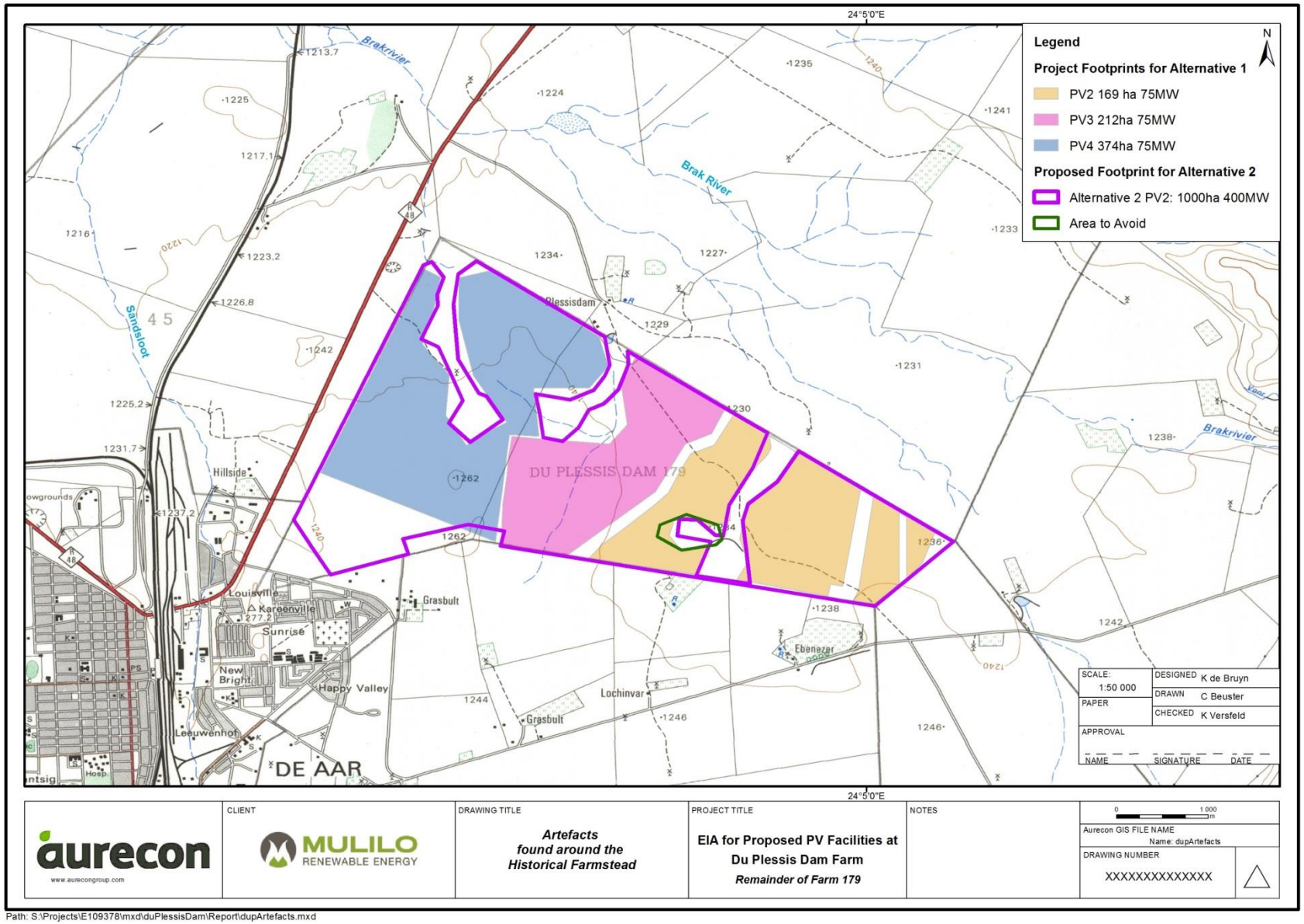


Figure 43 | This map indicated the locations of artefacts that were found around the historical farmstead. The red shading indicates the proposed development footprint (for both alternatives), the pink polygon indicates the proposed exclusion zone

4.8.1.4 Scenic routes and sense of place

The landscape around De Aar is one of great natural beauty (Figure 44) and has a very distinctive character with grasslands stretching for great distances and punctuated by typical flat-topped Karoo hills. Any road traversing the area could be considered a scenic route. The addition of solar panels to a predominantly rural landscape would alter the pervading sense of place and result in a loss of context. The western boundary of the site runs parallel to and about 300m distant from the R48 which links De Aar and Philipolis. This road could be considered a scenic route. However, other renewable energy projects, solar and wind energy, are also planned in the area and together these would produce a new cultural landscape with an industrial character.

Figure 44 | View from the Du Plessis Dam farm towards the north.

4.8.1.5 Graves

No clear graves were located during the study. A few suspicious mounds of rocks were noted in places, particularly at the very tail end of the old dam where two, or possibly three, elongated mounds of stones aligned east-west were recorded. The mounds were somewhat dispersed. They are located outside of the currently proposed development footprint. Pre-colonial graves are often completely unmarked and could be located anywhere where the soil is suitable for digging a grave.

4.8.2 Impact Assessment

Impacts to archaeological heritage resources primarily occur during the construction phase and thereafter remain unchanged through the operational and decommissioning phases. This is because once they are destroyed they cannot be recreated. For cultural landscapes impacts would be experienced during construction and operation but then, with rehabilitation, would revert to the status quo (assessed as the No-Go alternative) after decommissioning.

4.8.2.1 Construction phase impact

Archaeological impacts

Archaeological resources are widespread but of generally limited significance. Most with some research value are located in the central and far western parts of the site where PV3 (Layout Alternative 1) is planned. As such, it is only for this facility that significance ratings are elevated and for which mitigation is proposed. Both areas with potential graves are currently excluded from the Layout Alternative 1 development area, but the transmission line corridor (Alternative 1) does cover one potential grave (point J060). Layout Alternative 2 (extended PV2) covers the other potential grave (point L052), which should preferably be avoided.

For PV 2 (Layout Alternative 1), the archaeological impacts were considered to be of **medium (-)** significance without mitigation and **very low (-)** with mitigation. For PV 3 (Layout Alternative 1) the archaeological impacts were considered to be of **very low (-)** significance without and with mitigation. For PV 4 (Layout Alternative 1) the archaeological impacts were considered to be of **medium (-)** significance without mitigation and **very low (-)** with mitigation.

For Layout Alternative 2 (extended PV2) the archaeological impacts were considered to be of **medium (-)** significance before mitigation and **very low (-)** after mitigation.

Cultural landscape

Cultural landscape impacts would be experienced during construction and sustained through to the operational phase. Visual impacts to the local landscape would undoubtedly be the most significant heritage-related impacts that would be experienced through implementation of the proposed developments. The significance of this impact is to a large degree off-set by the similar facility currently being constructed in the area across which the proposed development would be viewed from the R48. This has resulted in a reduction in the significance of the impacts. Furthermore, the proposed Layout Alternative 2 (extended PV2) is far from the R48 and has thus been accorded lower significance.

For PV 2 (Layout Alternative 1), the cultural impacts on the landscape were considered to be of **low (-)** significance without and with mitigation. For both PV3 and PV4 (Layout Alternative 1) the cultural landscape impacts were considered to be of **medium (-)** significance without and with mitigation.

For Layout Alternative 2 (extended PV2) the cultural landscape impacts were considered to be of **medium (-)** significance with and without mitigation.

Scenic routes

Although the PV facilities would pose a negative visual impact to the context of the town, the part of town being impacted is entirely modern. At the smaller scale, the many small scatters of artefacts related to the Anglo-Boer War can be considered an archaeological cultural landscape because it is specific features of the landscape that have conditioned the placement of the sites to which the remains relate. However, far more significant Anglo-Boer War sites are known from across the Karoo and this aspect is thus not considered significant here.

Transmission line corridor

The De Aar area is a landscape strongly characterised by electrical infrastructure and many power lines traverse the landscape. The new set of transmission lines required to link to the De Aar substation would not introduce any new types of impacts. The open land that would be traversed is unlikely to contain many archaeological sites of value, as demonstrated by the field study of the proposed PV site. For both transmission corridor alternatives the impact on the archaeology and cultural landscape the significance ratings are deemed to be **low (-)** without and with mitigation.

4.8.2.2 Operational- and decommissioning phase impact

Impacts to archaeological heritage resources would occur at the construction phase and thereafter remain unchanged through the operational and decommissioning phases. This is because once they are destroyed they cannot be recreated. Cultural landscape impacts would remain through the

operational phase and revert to the *status quo* (assessed as the No-Go alternative) after rehabilitation and decommissioning.

4.8.2.3 No-Go Alternative

The No-Go alternative would result in maintenance of the status quo. Impacts to archaeological resources would continue at a very limited scale through trampling by grazing livestock and possibly collection of artefacts by visitors to the farm, while the cultural landscape of Du Plessis Dam would remain relatively unchanged and experience neutral impacts.

4.8.2.4 Cumulative impacts

Cumulative impacts are not very easy to assess, since archaeological resources, in particular, are point-specific. Each is unique and, while the general locations of archaeological sites can often be predicted, there is no guarantee that a site would be found in an expected location. For this reason one cannot be sure how many archaeological sites would be lost relative to the number and type of sites occurring in the local and wider regions. A review of reports conducted for other renewable energy projects in the area suggests that the MSA and LSA sites found on Du Plessis Dam are likely among the best in the area in terms of research quality. The significance of impacts has thus been kept the same at all scales as indicated in Table 33. The impact on archaeology can be reduced from **medium (-)** significance to **very low (-)** significance. The impact on the cultural landscape would however remain **medium (-)** significance with and without mitigation

4.8.3 Mitigation Measures

Figure 45 indicates the locations of the archaeological sites that would require mitigation and the farmstead that should be avoided.

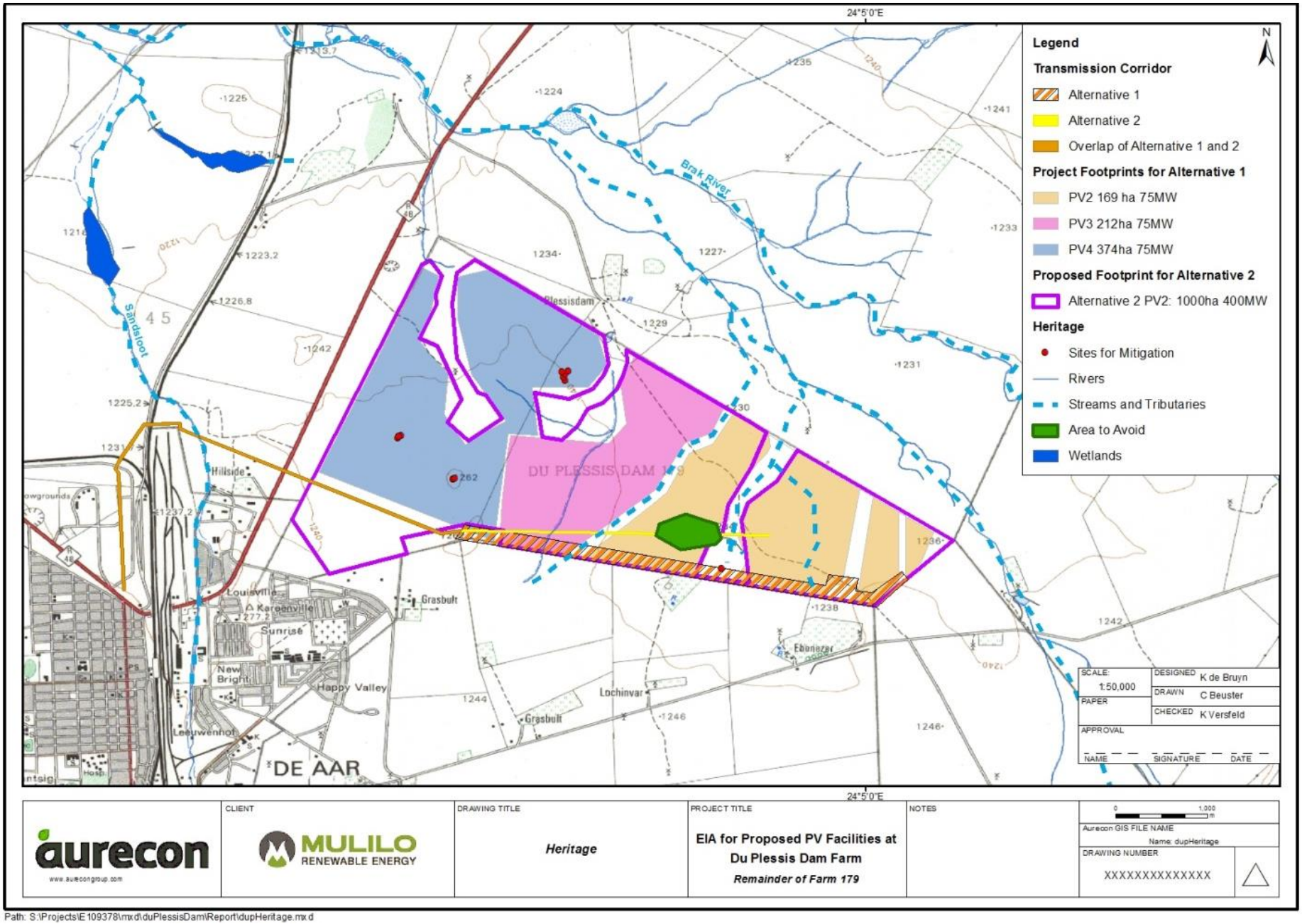


Figure 45 | Location of the archaeological exclusion zone around the historic farmstead

The following specific mitigation measures are recommended for the project components as mentioned in Section 4.8.2:

- For either alternative, the layout should avoid the historic farmstead and all its related features and artefacts (Refer to Figure 45). The historic farmstead site is too significant to be mitigated since an extensive excavation and recording program over several weeks would be required.
- For PV4 (Layout Alternative 1) the archaeological mitigation in the form of excavation, sampling and analysis should be carried out for the LSA sites that would be impacted (Figure 11). Radiocarbon dating may also be required, but this depends on the preservation of the appropriate organic materials that are needed for the dating process. An estimate on the amount of time required on site for each archaeological site is indicated in Appendix 2 of the specialist study. Note that avoiding and protecting these sites is always preferred when feasible, but they are not of such a nature that their protection should be required.
- Once the exact lines have been identified for the linear components of the project they should be examined from the desktop then subjected to a walk-down if deemed necessary. Where archaeological sites cannot be avoided, mitigation in the form of excavation and collection of artefacts should be carried out.
- If any human remains are encountered during the development they should be cordoned off and protected from further harm until they can be inspected and removed by an archaeologist under a permit issued for that purpose.
- All mitigation-worthy archaeological sites that are avoided by the development and are not mitigated should be protected from incidental damage (for example from vehicles driving over them or through the establishment of power line access tracks).
- Any dense subsurface concentrations of artefacts found during excavations should be protected *in situ* and immediately reported to an archaeologist for assessment.
- Any areas of the landscape that are not to be developed should be protected so as to minimise unnecessary landscape scarring.

4.8.4 Heritage Impact Table

Table 32 and Table 33 indicate how the significance ratings of the various impacts were derived.

Table 32 | Impact rating of heritage impacts

Project	Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Alt. 1, PV2	Archaeology	No mitigation	Local	Medium	Permanent	Medium (-)	Definite	Sure	Irreversible
		Mitigation	Site specific	Very low	Permanent	Very low (-)	Definite	Sure	Irreversible
	Cultural landscape	No mitigation	Local	Low	Long term	Low (-)	Definite	Sure	Reversible
		Mitigation	Local	Low	Long term	Low (-)	Definite	Sure	Reversible
Alt. 1, PV3	Archaeology	No mitigation	Site specific	Very low	Permanent	Very low (-)	Definite	Sure	Irreversible
		Mitigation	Site specific	Very low	Permanent	Very low (-)	Definite	Sure	Irreversible
	Cultural landscape	No mitigation	Local	Low	Long term	Medium (-)	Definite	Sure	Reversible
		Mitigation	Local	Low	Long term	Medium (-)	Definite	Sure	Reversible
Alt. 1, PV4	Archaeology	No mitigation	Site specific	Medium	Permanent	Medium (-)	Definite	Sure	Irreversible
		Mitigation	Site specific	Very low	Permanent	Very low (-)	Definite	Sure	Irreversible
	Cultural landscape	No mitigation	Local	Medium	Long term	Medium (-)	Definite	Sure	Reversible
		Mitigation	Local	Medium	Long term	Medium (-)	Definite	Sure	Reversible
Alt. 2, Ext. PV2	Archaeology	No mitigation	Local	Medium	Permanent	Medium (-)	Definite	Sure	Irreversible
		Mitigation	Site specific	Very low	Permanent	Very low (-)	Definite	Sure	Irreversible
	Cultural landscape	No mitigation	Local	Medium	Long term	Medium (-)	Definite	Sure	Reversible
		Mitigation	Local	Medium	Long term	Medium (-)	Definite	Sure	Reversible
No-Go	Archaeology	No mitigation	Site specific	Very low	Permanent	Very low (-)	Definite	Sure	Irreversible
		Mitigation	Site specific	Very low	Permanent	Very low (-)	Definite	Sure	Irreversible
	Cultural landscape	No mitigation	Local	Zero	Long term	Neutral	Definite	Sure	Reversible
		Mitigation	Local	Zero	Long term	Neutral	Definite	Sure	Reversible
Off-site transmission lines	Archaeology	No mitigation	Site specific	Low	Permanent	Low (-)	Probable	Sure	Irreversible
		Mitigation	Site specific	Very low	Permanent	Low (-)	Probable	Sure	Irreversible
	Cultural landscape	No mitigation	Local	Low	Long term	Low (-)	Definite	Sure	Reversible
		Mitigation	Local	Low	Long term	Low (-)	Definite	Sure	Reversible

*Mitigation measures are described in detail in Section 4.8.3.

Table 33 | Cumulative heritage impacts

Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Archaeology	No mitigation	Site specific	Medium	Permanent	Medium (-)	Definite	Sure	Irreversible
	Mitigation	Site specific	Low	Permanent	Very low (-)	Definite	Sure	Irreversible
Cultural landscape	No mitigation	Regional	Medium	Long term	Medium (-)	Definite	Sure	Reversible
	Mitigation	Regional	Medium	Long term	Medium (-)	Definite	Sure	Reversible

4.8.5 Heritage Conclusion

The proposed project could be allowed to proceed with either Alternative, although Layout Alternative 1 is strongly preferred. There is no preference on heritage grounds for conventional PV versus CPV technology or single axis versus fixed axis tracking technology.

Due to the relatively narrow width of the two proposed transmission corridors, the transmission lines would have the same level of impact no matter where in the corridors they are constructed.

4.9 VISUAL IMPACTS

The site is situated close to the town of De Aar in the Northern Cape where the dominant landscape feature is the open plains of the Karoo scrub and the Nama Karoo. Surrounding land use is agricultural, predominantly sheep farming. Vegetation is typical of that associated with the Nama Karoo landscape, which is strongly associated with South African cultural heritage. The potential therefore exists that the proposed PV facilities and associated infrastructure would be visible from many kilometres away. In order to assess the visual impacts, a Visual Impact Assessment (VIA) was undertaken by Mr Stephen Stead of Visual Resource Management Africa (VRM). A field survey was undertaken on 16 April 2013. The VIA included a desktop survey of various maps and aerial photography. A photographic survey of the site and parts of the surrounding areas was carried out and used to determine the extent of the visibility of the site. The findings and recommendations of the study are provided below. The VIA is included in Annexure E.

4.9.1 Description of the Environment

The proposed area for development is situated close to De Aar in the Northern Cape where the landscape character has been shaped by the uniform nature of the flat Nama Karoo plains with typical semi-desert and desert climatic conditions. Surrounding land use is agricultural, predominantly sheep farming.

De Aar has the largest Central Business District in the Emthanjeni Municipality due to excellent transport infrastructure. The N10, the main highway between the Cape and Johannesburg, is situated 5km to the south of the proposed site. The R48, a regional road, runs to the north adjacent to the proposed site. The railway line runs approximately 2km from the site, to the north-west and the De Aar Aerodrome lies 6km south of the site.

Figure 46 | View towards De Aar from R48 showing local sense of place

The existing landscape character is characterised by wide open plains, sparse settlements and open spaces and falls within the Lower Orange Water Management Area. The topography of the area is relatively flat, although there are a few ridge-shaped hills and larger flatter plateaus. Two perennial rivers are located near De Aar, with the Elandsfontein River running west of De Aar and the Brak River passing De Aar to the north. The other tributaries are smaller, ephemeral streams and only discernible as slightly shallow depressions with no clear associated vegetation, and slightly clayey soils. The site for the proposed PV facilities is located on the open plains and the entire site is gently sloping with a slightly raised area towards the south-western quadrant of the site. This elevation varies from 1,231m to 1,260 m above sea level. Community sensitivity to these landscapes would be medium as the wide open plains add value to the view and are a core element in the area's sense of place. The study area falls within the Nama-Karoo Biome and there is one vegetation type occurring within the study site, namely Northern Upper Karoo. This vegetation type occurs towards the northern parts of the Upper Karoo Plateau, with its southern extent ending near De Aar consisting of shrubland dominated by dwarf Karoo shrubs, grasses and some low trees.

The proposed Du Plessis Dam farm has low agricultural potential due to the lack of water. The farm does not contain, nor does it directly border, a perennial river or freshwater impoundment which could be used as a source of irrigation water. Other industry in the area is the very large abattoir located at De Aar who supplies all the major centres in South Africa with "Karoo" lamb and mutton. De Aar is the second most important railway junction in the country, as it is central to Gauteng, Cape Town, Port Elizabeth and Namibia and therefore is declared an industrial growth point in the Northern Cape. Furthermore De Aar has some of the highest renewable energy resource levels in the world, with good existing road infrastructure and accessibility to the national grid.

The visibility was determined through establishing viewshed areas. In terms of the specialist methodology, landscape character is derived from a combination of scenic quality, receptor sensitivity to landscape change, and the distance of the proposed landscape modification from key points. The relative value of the visual resources of an area could be defined as Classes I to Class IV, with the former being most valued and the latter of least value.

View North

View East

View South

View West

Figure 47 | Views from photo point 1: Proposed PV site

View south from R48 southbound towards proposed sites as seen from photo point 2 with the approximate location of the project indicated in black

Figure 48 | View: R48 southbound

View east from Happy Valley towards proposed site with the approximate extent of the proposed project indicated in black

The proposed landscape modification is large and would generate strong levels of visual contrast. As these sites have a rural landscape character, they were deemed to have a Class III[23] visual objective. The Class III visual objectives, to retain the existing rural landscape character, would however not be met and a change in the landscape character would take place to the site and the immediate surrounds. It must be noted that there are other energy-related projects proposed in the immediate surrounds which would significantly alter the surrounding landscape character.

4.9.2 Impact Assessment

The visibility of the proposed project, the visual absorption capacity (VAC)[24] of the area as well as the landscape character was determined in order to define the visual impact.

Through application of impact assessment criteria, a significance rating was undertaken for the following visual aspects which could occur during the construction, operation and decommissioning phases of the proposed development:

- Hauling and delivery of PV parts and construction materials.
- Location of access road off existing road.
- Visual disturbance of construction site and laydown area.
- Movement of construction vehicles with lights.
- Construction of trenches for cables.
- Construction of PV facilities and buildings.
- Construction of transmission lines.
- Completion of site works and fencing.
- Maintenance visit's using existing road access.
- Sit Impacts of the development on the receptors.
- Removal of the exiting road access.
- Removal of the PV structures.
- Removal of the site buildings.
- Removal of the transmission line from site to the adjacent Eskom line.

The status quo would include the development of PV 1 which has already been approved. Given that the landscape context of this development would change the sense of place, and the limited landscape value that the property holds for the surrounding areas, the landscape status quo could be changed without a significant visual impact to the surrounding areas. The impacts are described below.

4.9.2.1 Construction phase impact

The construction phase would have a strong degree of visual contrast and would not meet the visual objectives to maintain the existing rural landscape character, due to the strong and moderate-strong contrast created by the line, colour and texture of the proposed PV facilities.

[23] According to VRM's methodology landscape character is derived from a combination of scenic quality, sensitivity to landscape change, and the distance of the proposed landscape modification from key receptor points. Using these criteria, the relative value of the visual resources of an area can be defined by four classes. The site were defined as Class III, which has an objective to partially retain the existing character of the landscape, where the level of change to the characteristic landscape should be moderate. Management activities 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.

[24] The VAC is defined as the "physical capacity of the landscape to absorb proposed development activities and still maintain its inherent visual character and quality." *(www. fs.fed.us/publications/documents/psw_gtr035_04_yeomans)*

Hauling and delivery of PV parts and construction materials and construction of roads, Movement of construction vehicles with lights, Construction of trenches for cables
For both Layout Alternative 1 and Layout Alternative 2 , the potential visual impact was considered to be of medium magnitude, regional extent, taking place during the construction phase and therefore of **medium (-)** significance without mitigation. The significance of this impact could be reduced to **low (-)** with mitigation.

Visual disturbance of construction site and laydown area
For both Layout Alternative 1 and Layout Alternative 2, the potential visual disturbance was considered to be of medium magnitude, local extent, construction phase and therefore of **medium (-)** significance without mitigation. The significance of this impact could be reduced to **low (-)** with mitigation.

Construction of PV facilities and buildings
For Layout Alternative 1, the potential visual impact as a result of the construction of the PV facilities and buildings is considered to be of high magnitude, local extent, construction phase and therefore of **high (-)** significance without mitigation. The significance of this impact could be reduced to **medium (-)** with mitigation

For Layout Alternative 2, the potential visual impact as a result of the construction of the PV facilities and buildings is considered to be of high magnitude, local extent, construction phase and therefore of **high (-)** significance without mitigation. The significance of this impact could be reduced to **medium–high (-)** with mitigation.

Construction of transmission lines
For Layout Alternative 1 and Layout Alternative 2, the potential visual impact as a result of the construction of the transmission line is considered to be of low magnitude, local extent, construction phase and therefore of **low (-)** significance with and without mitigation.

Completion of site works and fencing
For both Layout Alternative 1 and Layout Alternative 2, the potential visual disturbance during completion of site works and fencing was considered to be of medium magnitude, local extent, construction phase and therefore of **medium (-)** significance without mitigation. The significance of this impact could be reduced to **low (-)** with mitigation.

4.9.2.2 Operational impact

The following operational impacts are anticipated.

Maintenance visit's using existing road access
For both Layout Alternative 1 and Layout Alternative 2, the potential visual disturbance due to maintenance visits using existing road access was considered to be of low magnitude, local extent, long term and therefore of **low (-)** significance with and without mitigation.

Site buildings and perimeter fence
For both Layout Alternative 1 and Layout Alternative 2, the potential visual disturbance due to site buildings and perimeter was considered to be of medium magnitude, local extent, long term and therefore of **medium (-)** significance without mitigation. The significance of this impact could be reduced to **low (-)** with mitigation.

Impacts of the development on the community

For both Layout Alternative 1 and Layout Alternative 2, the potential visual impacts was considered to be of high magnitude, local extent, long term and therefore of **high (-)** significance without mitigation. The significance of this impact could be reduced to **medium (-)** with mitigation.

4.9.2.3 Decommission impact

The following impacts are anticipated during the decommissioning phase.

Removal of the exiting road access

For both Layout Alternative 1 and Layout Alternative 2, the potential visual impacts due to the removal of the existing road access was considered to be of medium magnitude, local extent, short term and therefore of **medium (-)** significance for Layout Alternative 1 and **low (-)** significance for Layout Alternative 2 without mitigation. The significance of this impact for both layout alternatives could be reduced to **low (-)** with mitigation.

Removal of the PV structures

For both Layout Alternative 1 and Layout Alternative 2, the potential visual impacts due to the removal of the existing PV structures was considered to be of high magnitude, local extent, long term and therefore of **medium (-)** significance for Layout Alternative 1 and **high (-)** significance for Layout Alternative 2 without mitigation. The significance of this impact for both layout alternatives could be reduced to **low (-)** with mitigation.

Removal of the site buildings and transmission line

For both Layout Alternative 1 and Layout Alternative 2, the potential visual impacts due to the removal of the existing buildings and transmission lines was considered to be of medium magnitude, local extent, long term and therefore of **medium (-)** significance without mitigation. The significance of this impact for both layout alternatives could be reduced to **low (-)** with mitigation.

4.9.2.4 No-Go development

The No-Go Option would retain the status quo which would include the development of PV 1 which has already been approved. Given that the landscape context of this development would change the sense of place, and the limited landscape value that the property holds for the surrounding areas, the landscape status quo could be changed without a significant visual impact to the surrounding areas. It is therefore recommended that Alternative 1 with mitigation can be implemented.

4.9.2.5 Cumulative impacts

The visual impact of this proposed development must also be assessed in the context of the other renewable energy projects within the De Aar area that are in various stages of approval. De Aar has some of the highest renewable energy resource levels in the world, with good existing road infrastructure and accessible to the national grid.

A WEF project is approved for south of the town, on the Kasamberge/ Maanhaarberge plateau and the Swartkoppies ridge. This 100MW WEF would include 67 turbines, with those nearest De Aar on Swartkoppies, about 7km from the town, and those on the plateau about 15km away. The development would be shielded by the built form of the town and therefore the visual impact on De Aar would be limited. However, there would be a visual impact experienced by users of the N10 travelling in either direction.

Another WEF project was approved recently for two sites on the Eastern Plateau, about 23km away from De Aar to the north-east and east. The site lies between the towns of De Aar and Philipstown, in similar rural uplands. This project has two sub-projects, the North project providing for 145 turbines distributed over the plateau and adjacent hills, and the South Project comprising 105 turbines. Cumulatively, the 250 turbines would have a lesser impact on the N10 and fringes of De Aar and a greater impact on local receptors. The Solar Capital De Aar Solar Farm is a 2,300 hectare farm outside De Aar, which would have 1,000,000 solar panels erected in the initial phase. It would be one of the world's largest solar farms that would total 4,000,000 panels upon completion.

Consideration must be given to local residents in De Aar, the people who work there, people who live locally on the farmsteads, and people who drive through the area. To what degree would the proliferation of these developments visually impact upon these receptors and how would they be experienced.

Cumulative impacts would be generated by new transmission lines, substations and new access roads associated with the new developments. The construction periods may not run concurrently, with a consequential increased visual impact on local roads. The construction periods could also have an increased impact due to longer timeframes, road access junctions would be more impacted-upon and lay-down areas may be more visible.

Should all the proposed PV facilities be constructed, De Aar would have a more industrial (security fenced), and a more contemporary (hi-tech developments), appearance. Once operational, these facilities would probably not promote noticeable additional traffic movements, but they may begin to influence the character of the town. In a very populated area, with complex landscape patterns, the number of proposed developments could result in a high visual impact. In this context, the long views, exposed sites, roads with little traffic, and small to medium sized towns, all combine to increase cumulative impacts. However, as the area has been identified as a solar energy hotspot, the cumulative impacts of this project (with mitigation) would be **medium (-)** as this solar project would be one of many. The surrounding areas around the town, and the town itself, are not necessarily a tourist destination that is strongly associated with landscape and visual resources. This factor also mitigates the cumulative impacts of this project.

Mitigations would include encouraging the municipality to set up a planning committee which includes renewable developers, I&AP's and Local Authority which is tasked with addressing the issue of possible landuse conflicts related to rapid and large scale landscape change around De Aar.

4.9.3 Mitigation Measures

4.9.3.1 Construction phase

The following mitigation measures are proposed for all alternatives, to minimise dust:

- Access roads are to be kept clean, and measures taken to minimise dust from construction traffic on gravel roads.
- Surface material should be scraped off, conserved and used for rehabilitation. The remainder could be used for site development, and any surplus disposed of in a manner that appears natural.

- The laydown area should be screened with shade cloth and dust prevention mitigations needs to be implemented during use to prevent wind-blown dust.
- Site offices and structures should be limited to single-storey and they should be sited carefully to reduce visual intrusion. Colours should reflect shades of the surrounding vegetation and/or the ground. Roofs should be grey and non-reflective. Door and window frame colour should reference either the roof or wall colours.
- Litter is to be regarded as a serious offence and no contaminants are to be allowed to enter the environment by any means.
- Road construction and management must take run-off into consideration in order to prevent soil erosion.
- The top 50 - 100mm of naturally occurring substrate should be separated and then spread over finished levels.
- The developer would be required to ensure that the footprint areas of all impact sites utilised in the construction phase, are rehabilitated and restored as near as possible to previous natural vegetation during that phase, and not in the operational phase.
- The fencing should be grey in colour and located as close as possible around the PV site. If possible, natural waterways and drainage lines indicated as sensitive should not be fenced in.

The visual recommendation that pylons should be constructed of wooden poles is not in line with Eskom's requirements. Construction from wooden poles would require additional supports and infrastructure to support the weight of the power lines when compared to steel structures. A wooden structure would require at least two main ground supports followed by an additional three structural members to construct the H-frame required. Eskom now prefer specifying a single steel monopole structure which is more cost effecting, required less ground footprint and is less of an environmental disturbance. Therefore it is recommended that this mitigation measure as proposed by the visual specialist, should not be implemented.

4.9.3.2 Operational phase

Lights at night and movement of maintenance vehicles would result in a visual impact and therefore the following mitigation measures are proposed for all alternatives to reduce this impact:

- All lighting is to be kept to a minimum, within the requirements of safety and efficiency.
- Where such lighting is deemed necessary, low-level lighting, which is shielded to reduce light spillage and pollution, should be used.
- No naked light sources are to be directly visible from a distance. Only reflected light should be visible from outside the site.
- Any necessary aircraft warning lights are to be installed as per the relevant authority requirements.
- External lighting must use down-lighters shielded in such a way as to minimise light spillage and pollution beyond the extent of the area that needs to be lit.
- Security and perimeter lighting must also be shielded so that no light falls outside the area needing to be lit. Unnecessarily tall light poles are to be avoided.
- To limit the potential of sunlight reflecting off the panels creating glint and glare impacts, it is recommended that the Fixed Tilt structure is utilised. With the tilt access aligned north-south, the panels would always be facing towards the sun which reduces the potential for impacts of reflection and glint.

4.9.3.3 Decommissioning phase impact

Removal of all PV structures, associated structures and fencing, ripping of all internal roads and rehabilitation to natural state would result in a visual impact. Therefore the following mitigation measures are proposed for all alternatives to mitigate the decommissioning visual impacts:

- All PV structures, associated structures and fencing should be removed and recycled.
- Internal roads should be ripped and then rehabilitated.
- All impacted footprint areas should be rehabilitated and restored to indigenous, endemic vegetation.

4.9.3.4 Cumulative mitigation measures

In order to mitigate cumulative impacts the municipality should set up a planning committee which includes renewable developers, I&APs and Local authorities which is tasked with addressing the issue of possible landuse conflicts related to rapid and large scale landscape change around De Aar.

4.9.4 Visual Impact Table

Table 34 and Table 35 indicate how the significance ratings of the various impacts were derived.

Table 34 | Impact rating of visual impacts

Project	Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Layout Alt. 1 Construction phase	Hauling and delivery of PV parts, construction materials and the location of access road off existing roads	No mitigation	Regional	Medium	Construction	Medium (-)	Probable	Sure	Reversible
		Mitigation	Regional	Low	Construction	Low (-)	Probable	Sure	Reversible
	Visual disturbance of construction site and laydown area	No mitigation	Local	Medium	Construction	Medium (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Construction	Low (-)	Definite	Certain	Reversible
	Movement of construction vehicles with lights Construction of trenches for cables	No mitigation	Local	Medium	Construction	Medium (-)	Definite	Sure	Reversible
		Mitigation	Local	Low	Construction	Low (-)	Definite	Sure	Reversible
	Construction of PV facilities and buildings	No mitigation	Local	High	Construction	High (-)	Definite	Certain	Reversible
		Mitigation	Local	Medium	Construction	Medium (-)	Definite	Certain	Reversible
	Construction of transmission lines	No mitigation	Local	Low	Construction	Low (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Construction	Low (-)	Definite	Certain	Reversible
	Completion of site works and fencing	No mitigation	Local	Medium	Construction	Medium (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Construction	Low (-)	Definite	Certain	Reversible
	Construction Phase Summary Alt 1	No mitigation	Local	Medium	Construction	Medium (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Construction	Low (-)	Definite	Certain	Reversible
Layout Alt. 2 Construction phase	Hauling and delivery of PV parts	No mitigation	Regional	Medium	Construction	Medium (-)	Definite	Sure	Reversible
		Mitigation	Regional	Low	Construction	Low (-)	Probable	Sure	Reversible
	Hauling and delivery of construction materials Location of access road off existing roads Movement of construction vehicles with lights Construction of trenches for cables	No mitigation	Regional	Medium	Construction	Medium (-)	Definite	Sure	Reversible
		Mitigation	Regional	Low	Construction	Low (-)	Definite	Sure	Reversible
	Visual disturbance of construction site and laydown area	No mitigation	Local	Medium	Construction	Medium (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Construction	Low (-)	Definite	Certain	Reversible
	Construction of PV facilities and buildings	No mitigation	Local	High	Construction	High (-)	Definite	Certain	Reversible
		Mitigation	Local	Medium	Construction	Medium High (-)	Definite	Certain	Reversible
	Construction of transmission lines	No mitigation	Local	Low	Construction	Low (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Construction	Low (-)	Definite	Certain	Reversible
	Completion of site works and fencing	No mitigation	Local	Medium	Construction	Medium (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Construction	Low (-)	Definite	Certain	Reversible
	Construction Phase Summary Alt 2	No mitigation	Local	Medium	Construction	Medium (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Construction	Low (-)	Definite	Certain	Reversible

Project	Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Layout Alt. 1 operational phase	Maintenance visits using existing road access	No mitigation	Local	Low	Long term	Low (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Long term	Low (-)	Definite	Certain	Reversible
	Site buildings and perimeter fence	No mitigation	Local	Medium	Long term	Medium (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Long term	Low (-)	Definite	Certain	Reversible
	Impact of developments on community	No mitigation	Local	High	Long term	High (-)	Definite	Certain	Reversible
		Mitigation	Local	Medium	Long term	Medium (-)	Definite	Certain	Reversible
Layout Alt. 2 operational phase	Maintenance visits using existing road access	No mitigation	Local	Low	Long term	Low (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Long term	Low (-)	Definite	Certain	Reversible
	Site buildings and perimeter fence	No mitigation	Local	Medium	Long term	Medium (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Long term	Low (-)	Definite	Certain	Reversible
	Impact of developments on community	No mitigation	Local	High	Long term	High (-)	Definite	Certain	Reversible
		Mitigation	Local	Medium	Long term	Medium (-)	Definite	Certain	Reversible
Layout Alt. 1 decommissioning phase	Removal of existing road access	No mitigation	Local	Medium	Short term	Low (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Short term	Low (-)	Definite	Certain	Reversible
	Removal of PV structures	No mitigation	Local	High	Long term	Medium (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Short term	Low (-)	Definite	Certain	Reversible
	Removal of site buildings, perimeter fence and removal of transmission line from site to adjacent Eskom line	No mitigation	Local	Medium	Long term	Medium (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Short term	Low (-)	Definite	Certain	Reversible
Layout Alt. 2 decommissioning phase	Removal of existing road access	No mitigation	Local	Medium	Short term	Medium (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Short term	Low (-)	Definite	Certain	Reversible
	Removal of PV structures	No mitigation	Local	High	Long term	High (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Short term	Low (-)	Definite	Certain	Reversible
	Removal of site buildings, perimeter fence and removal of transmission line from site to adjacent Eskom line	No mitigation	Local	Medium	Long term	Medium (-)	Definite	Certain	Reversible
		Mitigation	Local	Low	Short term	Low (-)	Definite	Certain	Reversible

*Mitigation measures are described in detail in Section 4.9.3.

Table 35 | Cumulative visual impacts

Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Cumulative Visual Impacts	Without mitigation	Regional	Moderate	Long term	Medium (-)	Probable	Moderate	Reversible
	With mitigation	Local	Low	Long term	Low (-)	Probable	Moderate	Reversible

4.9.5 Conclusion on Visual Impacts

Due to the location of the site, and to the small number of potential affected community members, the visual recommendation is that Layout Alternative 1 (along with its associated infrastructures) could proceed. The conventional PV solar technology with tilt panel structure is preferred as the PV panel type would generate less potential for glint and glare than the CPV type which uses a reflective mirror to concentrate the sun. CSP is not recommended. Layout Alternative 2 is not recommended as it extends further to the south and abuts onto the Happy Valley residents' area. This generates high levels of visual intrusion which is not recommended.

4.10 SOCIAL IMPACTS INCLUDING IMPACT ON LOCAL ECONOMY AND EMPLOYMENT

4.10.1 Description of the environment

4.10.1.1Demographics

The project is located near De Aar which falls within the Emthanjeni Local Municipality (LM) within the Pixley ka Seme District Municipality (DM) in the south eastern quadrant of the Northern Cape Province, the largest Province in South Africa. The LM covers 13,472m^2 and the DM is 102,766m^2 in extent. The LM is home to 42,356 people and the DM has a total population of 186,351 (Census, 2011). The area is very sparsely populated as evident from the low population density measured in person per square kilometre which is three for the LM, two for the DM and three for the province. As a comparison the national average is 42 people per square kilometre (Census, 2011). The LM had a growth rate of 1.7% between 2001 and 2011 which is higher than the province, which is at 1.4%.

The majority of the LM is coloured (58%), with a smaller representation of black people (33.4%) and white people (8%) with very few Asians (0.6%). The demographic composition by age reflects a higher percentage of youth (15 to 25 years) at 34% of the population, with children (age 0-14 years) slightly lower at 32%, adults between 36 and 64 years at 29%, and the elderly, 64 years and above, at 6%. The proportion of youth is not as high as the average for the province which is 36%.

The average household size in the LM is 3.9 people, similar to the DM and the province at 3.7 (Census, 2011). More than a third of households are headed by females (39%) which is slightly less favourable than the DM (37%) and the same as the province (39%) (Census, 2011).

4.10.1.2Service Provision

In terms of services in the LM, 96% of households have access to piped water inside their dwelling or yard, with 2% having access within 200m. Less than 1% of the population has no access with the remainder having access to piped water further than 200m. This is slightly less than the provincial average of 97% and more so than the national average of 91%. The

Pixley ka Seme DM Integrated Development Plan (IDP) (2011) highlights the importance of water provision and availability as a constraint to economic activity in many of the towns.

With respect to sanitation, 85% of households in the LM have flush toilets, 5% have pit toilets, 3% have no toilets, 6% have bucket toilets with the remainder having chemical toilets or other. This exceeds the provincial average which is 66% and the national average of 57% in terms flushed toilets.

In terms of energy source for lighting, 93% of households have access to electricity, with 6% only having candles, less than 1% having solar, and the remainder having either paraffin, gas, other or no energy for lighting. This exceeds the DM and national average (both 85%).

The access to refuse removal in the LM is more favourable than the province as a whole with 86% of households having refuse removed by the council, compared to the provincial average (66%) and the national average (64%).

Overall the service provision in the LM is favourable, however there is still potential for improvement. The IDP notes that because of the sparsely distributed population, service provision is a challenge as long distances must be travelled (Pixley ka Seme DM, 2011).

Health facilities in De Aar include one hospital, a community health centre and three clinics (Pixley ka Seme DM, 2011). In terms of education facilities, De Aar has three crèches, eight primary schools, four secondary schools and one tertiary institution, the De Aar Campus which used to be a satellite of Northern Cape College in Kimberley and is the only tertiary institution in the district (Pixley ka Seme DM, 2011). There are three libraries and three community halls and some recreational facilities.

4.10.1.3Education

A critical factor affecting quality of life is the standard of education within a community. According to Census (2011), the population of the LM has a low level of education. As many as 11% of the population aged 20 and older have no schooling, 17% have some primary schooling, 7% have completed primary schooling and 34% have some secondary schooling. Only 25% have completed matric, with 7% completing some form of higher education as indicated in Figure 49.

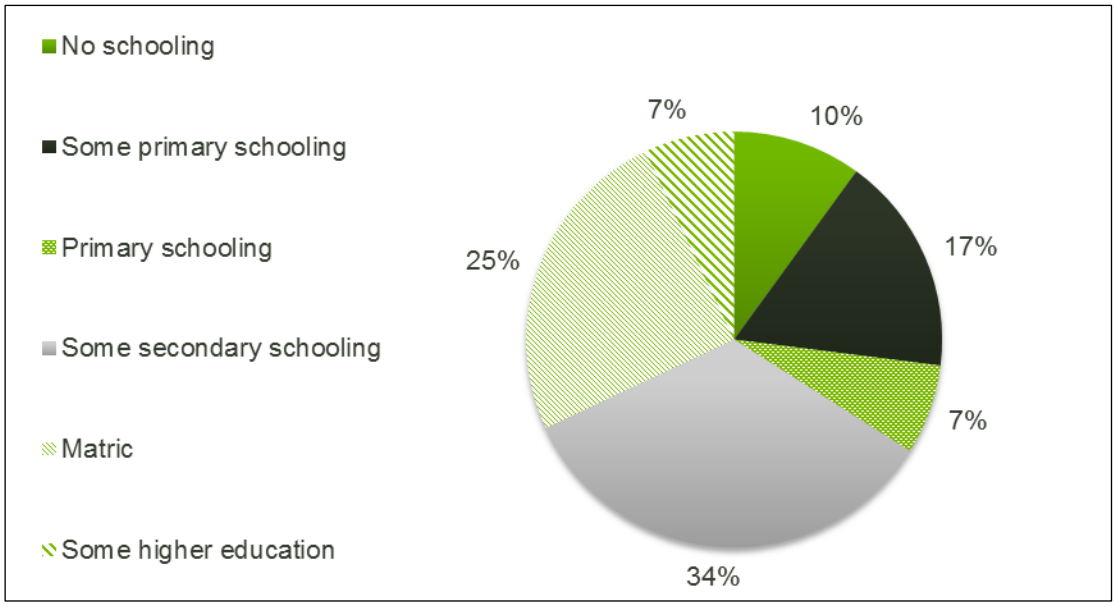


Figure 49 | Level of education of De Aar

This is slightly more favourable than the province which has 23% with a matric and the same portion (7%) with a higher education, but slightly less favourable than the national average at 28% with a matric and 12% with a higher education.

4.10.1.4Welfare

In 2010, the prevalence of Human Immunodeficiency Virus Infection and Acquired Immunodeficiency Syndrome (HIV/ AIDS) within the population of the DM was 6.5%. This rate is lower than the provincial rate which is at 7.6% and the country as a whole at 12.6% (Siyathemba LM, 2012).

The Pixley ka Seme IDP indicates that social ills in the district include high levels of domestic violence, substance and alcohol abuse, a rise in teen pregnancy, as well as theft and illegal activities which are coupled with a lack of capacity of the police (Pixley ka Seme DM, 2011). However, the Emthanjeni LM IDP reports that one of the strengths of the LM is that there is less crime and it is considered relatively safe (Emthanjeni LM, 2012). However, the area does still experience contact crime, mostly associated with taverns, as well as property crimes, with no particular hotspots existing (Emthanjeni LM, 2012). The predominant threats to the community have been identified as crime (especially house breaking), HIV/ AIDS (especially along N1) and alcohol abuse.

4.10.1.5Employment and Earnings

Lack of employment opportunities has been identified as a challenge within the DM. There is a high rate of unemployment in the LM which is 27.9%. This is slightly lower than the DM unemployment rate at 28.3%, the rate in the province 28.1% and the national rate of 39% (Census, 2011). The annual average household income is R88,244 which is slightly higher

than the DM at R75,237 and the province at R86,185, although still lower than the national average at over R100,000.

4.10.1.6Economy

According to the Pixley ka Seme DM IDP (2011), the economy of the District is founded on community services, agriculture, transport and tourism. Small towns function primarily as agricultural service centres, and the main economic activities are located in the main urban areas of De Aar, Colesberg, Victoria-West and Carnarvon. De Aar is the main town within the DM serving a total of 24 other towns and is a potential industrial growth point with favourable conditions for industry and its strategic location. The economy of the LM is dominated by agriculture which accounts for the majority of the labour force (Emthanjeni LM, 2012). Other economic sectors on which the LM depends include the services sector (government institutions, Non-Governmental Organisations, Community-based Organisations and Non-profit Organisations as well as banks); manufacturing (stone crushing and abattoirs); retail (Checkers, Shoprite etc); agriculture (game farming and sheep, goat, pig and cattle farming); transport (road and rail infrastructure); and tourism (recognised for its potential) (Emthanjeni LM, 2012).

In terms of agriculture, wheat, maize and lucerne are key crops, and irrigation farming also supports the production of peanuts, grapes, dry beans, soya beans, potatoes, olives, pecan nuts, pistachio nuts and cotton (Pixley ka Seme DM, 2011). Small stock farming is widespread and focusses on sheep and goats, with sheep farming producing mutton and wool. The LM specifically, is increasingly becoming the key centre for supplying the rest of South Africa with “Karoo” mutton and there are several abattoirs in De Aar. The IDP highlights that there are opportunities for benefaction of resources which are currently being lost as products are sent to other areas for processing (Pixley ka Seme DM, 2011 and Emthanjeni LM, 2012).

The District is well connected, with De Aar being the institutional capital of the LM and DM (Emthanjeni website, 2013). The DM is located along some of the major transport routes including:

- The N1 from the Northern Province, Pretoria and Johannesburg to Cape Town;
- The N9 from Colesberg joining the N10 to Port Elizabeth and the Eastern Cape; and
- The N12 from Johannesburg via Kimberley to Cape Town; and the N10 from Namibia via Upington linking Namibia to the Eastern Cape.

Furthermore, the railway network around De Aar is well developed and one of the largest in South Africa (Pixley ka Seme DM, 2011).

According the Emthanjeni Tourist Strategy, there is ‘immense untapped potential’ for tourism in the LM (Creative Harvest, 2010). De Aar as the principal town in the LM and DM has a number of attractions including war memorials and features such as the Garden Of Remembrance and associated Memorial Cemetery, the De Aar Town Hall and cannon and the St Pauls Anglican Church used during the war. As mentioned in Section 4.7.5, the Olive

Schreiner Monument and the House of Oliver Schreiner (24 March 1855 to 11 December 1920), who was a South African feminist and socialist author, is based in the town (Creative Harvest, 2010). The De Aar railway station used to be the second most important railway junction in the Southern hemisphere and the Railway Station and the Steam Trains are a tourist attraction which could be expanded through the development of a Museum. De Aar hosts a weather station which is considered a major but not well known tourist attraction and there is a paragliding school and facility that attract international visitors (Creative Harvest, 2010). In the more rural areas there is Khoisan Rock Art and hunting of game such as Springbok that are an attraction to outsiders.

In terms of the economy, the economic growth of the district was 0.6% in 2005, which was below the national average of 4% in 2007 (Pixley ka Seme DM, 2011). Key challenges faced include:

- The lack of diversification of the district economy;
- lack of investment in the region;
- lack of employment;
- opportunities; lack of skills;
- lack of entrepreneurship;
- small number of Small, Medium and Micro Enterprises active in the region;
- underutilization of the regions natural resources and economic opportunities; and
- Lack of water for irrigation farming (Pixley ka Seme DM, 2011).

Specific opportunities identified for growth and development include manufacturing, agro-processing, mining and semi-precious stones. It is also recognised that in order to attract investors to the district, the municipalities should focus on critical development activities that are taking place nationally and internationally (Pixley ka Seme DM, 2011). There is a recognition that sustainable projects must be identified that would enhance economic growth and long term job creation.

4.10.2 Socio-economic Impact Assessment

4.10.2.1 Construction phase impacts

Throughout the construction phase, various impacts are anticipated for all project alternatives as described below.

Direct Employment and Skills Development

The construction of the proposed PV facilities would require a workforce which would translate into direct employment. Employment opportunities created by the construction phase would equate to approximately 3,500 person months[25] over a period of 12 to 24 months per 75MW PV facility. As an example, as many as 700 workers per 75 MW facility

[25] Person months are the total number of Employees in each of the Contract Months, within the Construction Measurement Period and the Operating Measurement Period, as applicable, which are adjusted for the actual working time, compared to normal working time (40hrs per week).

could be on site at any point in time during construction. 20% of the jobs created would be filled from the local community. 80% would be allocated to South African citizens and 50% specifically for black citizens (Mulilo, 2013). 15% of the opportunities would require skilled employees of which 8% would be black.

Statistics set out in Section 4.10.1 indicate that in terms of education, the population has a low level of education with only 23% having completed matric. This is linked to a limited skills base coupled with a high level of unemployment. Of the skills required onsite, there would be potential opportunities for low skilled security staff and construction workers. Should these staff require training the developer is committed to providing training possibly through the De Aar local FET College.

The positions created that will require more highly skilled staff from outside the local area or region would have a positive impact on the wider economy. However this impact is less significant at the regional level due to the relatively small number of jobs created in comparison with the size of the regional labour force and is therefore considered in the assessment of cumulative impacts.

For both Layout Alternatives 1 and 2 the potential impact of each PV facility is considered to be of low magnitude, local and regional extent and limited to the construction phase and therefore of **low (+)** significance which can be increased to **low-medium (+)** with mitigation

Economic Multiplier Effects

Economic multiplier effects are the positive ripple effects in the economy as a result of direct expenditure through a development such as the proposed solar facility. Apart from direct job creation (considered above), multiplier effects could also include 'indirect effects' such as additional jobs and economic activity generated through the supply of goods and services to the development. 'Induced effects' includes employment and other economic activity generated by the re-spending of wages earned by those directly and indirectly employed in the industry; jobs created by the construction workers spending their wages in local shops as an example (United States Department of Energy, 1997).

The total capital expenditure for each 75MW PV facility is approximately 1.7 billion Rand. The PV cells will be sourced abroad and therefore imported, however the modules and inverters will be assembled locally with benefits for the local economy.

At a LM and DM level, there are likely to be economic multiplier effects from the use of local goods and services which includes, but is not limited to, construction materials and equipment and workforce essentials such as food, clothing, safety equipment, and other goods. The 20% of the workforce that would be employed from the local area would most likely spend their entire salaries within the local area or region. Although it is likely that onsite accommodation would be provided, it is likely that the non-local staff (80% of the workforce) would also visit De Aar during their free time and this additional spend would provide an indirect boost to the local economy. However, the extent to which these benefits can be

achieved would also depend on the location of the contractor and the subcontractors and their preferred suppliers and the behaviour of the staff.

For both Layout Alternatives 1 and 2 the potential impact of each PV facility is considered to be of low magnitude, local and regional extent and limited to the construction phase and therefore of **low (+)** significance which can be increased to **low-medium (+)** with mitigation.

Indirect effects of additional workers on site

Additional workers on the site during construction may have indirect effects, such as increased security issues for neighbouring farms and damage to property, the risk of veld fire and stock theft. It is estimated that each 75MW site would require 700 workers. Of these 500 will require overnight accommodation either onsite or in the community. It is possible that the site may accommodate as many as 80% of the workforce, which would indicate a potential risk. There is also an existing problem of stock theft in the district which could be exacerbated. Services would be provided and agreements with the municipality would ensure the environmental impacts on the property are limited.

For both Layout Alternatives 1 and 2, the potential impact of each PV facility is considered to be of low magnitude, local extent and limited to the construction phase and therefore of **medium (-)** significance which can be reduced to **low (-)** with mitigation.

Impacts of a non-local workforce on society

The introduction of a non-local workforce has the potential to result in social disruption both physical and emotional during construction. Such disruption could result in an increased demand on social infrastructure such as accommodation, health facilities, transport facilities and so forth. Social ills including the spread of diseases such as HIV/AIDS, crime and social conflict are also a potential risk.

However, the degree to which society is disrupted largely depends on the level of local employment achievable and in the case of this project, 20% of the workforce is expected to be sourced locally and the outsiders would be accommodated temporarily onsite or in De Aar.

Being a key node in the District, the infrastructure within De Aar is likely to have the capacity to absorb the additional people. In terms of social ills, however, there is an existing substance and alcohol abuse problem in the area which is often linked to crime and this has the potential to be exacerbated by newcomers. There is also the likelihood that many of the community members are unemployed and seeking alternative opportunities to subsist. The proximity to De Aar and the informal settlement in particular is also a potential risk as staff would have a greater level of access than a facility in a remote location. There is further potential for conflict with unemployed residents that feel resentment towards outsiders being selected for jobs they feel entitled to.

The potential impact for both layout alternatives and each PV facility is considered to be of low magnitude, local extent and limited to the construction phase and therefore of **low (-)** significance which could be reduced to **very low (-)** with mitigation.

Disruption or damage to adjacent properties

As a result of the construction activities described In Section 3.1.4, disruption or damage to adjacent properties (including access arrangements) is a potential issue and may include a temporary increase in noise and dust, or the wear and tear on private farm roads for access to the site.

Adjacent access roads however would not be impacted as an additional access road from the R48 would be constructed as well as internal access roads to connect to the PV facilities. These roads would coincide with the existing dirt tracks where possible. Construction vehicles utilising these roads would include trucks delivering containers, digger loaders for land clearing and trucks with cranes to assemble the plant. Dust arising from vehicles using the road as well as earthworks on the site would be worse in the dry winter months and could be managed through the LEMP, which would include procedures for dealing with dust pollution events including watering of roads.

The potential impact for both layout alternatives is considered to be of low magnitude, local extent and limited to the construction phase and therefore of **low (-)** significance which could be reduced to **very low (-)** with mitigation.

4.10.2.2Operational phase Impacts

Operational impacts anticipated for all project alternatives are described below.

Direct Employment and Skills Development

Maintenance would be carried out throughout the lifetime of the PV facility. Activities include washing of the panels, technical maintenance and fault finding if necessary. The operation of the project would require a workforce, which would however be smaller than the workforce required for the construction phase, and therefore direct employment would be generated. Operational employment has been calculated as 35 person months per annum over the design life of 20 years. Of these opportunities, 80% would be allocated to South African citizens and 50% specifically for black citizens (Aurecon, 2013).

In terms of skills, the project would create job opportunities for a wide range of skills, 45% would be skilled employees and 14% would be black skilled employees. In addition, 54% of the jobs created would be from the local community and the developer is committed to providing training for people from the local community possibly through the De Aar local FET College (Mulio, 2013).

For both layout alternatives, the potential impact is considered to be of low magnitude, local and regional extent and long term and therefore of **low (+)** significance which would remain **low (+)** with mitigation.

Economic Multiplier Effects

Economic multiplier effects generated from the supply of local goods and services to the project during operation would include maintenance tools, supplies and equipment which may be technology specific and therefore not necessarily available within the region or district. Depending on the selected technology, the PV modules and trackers used would be manufactured and assembled locally and all maintenance tools, supplies and equipment would be sourced from the Northern Cape and within the borders of South-Africa as far as possible (Mulilo, 2013).

Furthermore the operational wage bill per 75MW facility is estimated as R15,000 per month for highly-skilled employees, between R8,000 to R15,000 per month for skilled individuals and up to R8,000 per month for non-skilled employees over a period of 20 years (Mulilo, 2013). This could benefit the local economy through money spent on items such as basic essentials, namely food, clothing, and other goods. Leakage is the loss of income generated from the project to other economies. There is a lower potential for leakage from the local economy if employees are sourced locally as most of their salaries would be spent locally within the district or region.

Regardless of the layout alternative, the potential impact is considered to be of low magnitude, local and regional extent and long term and therefore of **low (+)** significance which would remain **low (+)** with mitigation.

Landowner revenue

The project would increase the profitability of the land leased from farmers and will provide an additional income for the landowner of Du Plessis Dam Farm. Although this direct financial benefit is fairly limited, as it will only profit the one landowner in question, this income could be used to reinvest in agricultural activities on this farm with benefits for the local economy, or it could enter the local economy through other investments or through additional spend.

For both layout alternatives the potential impact is considered to be of low magnitude, local extent and long term and therefore of **low (+)** significance without mitigation. No mitigation is recommended.

Diversification of the local economy

Increasing the contribution of the renewable energy sector to the local economy could assist with diversification and provide greater stability. The economy of the Pixley ka Seme DM is founded on community services, agriculture, transport and tourism, with the service sector supporting a large proportion of the labour force within Emthanjeni LM. It is recognised that diversification of the district economy is one of the key challenges that needs to be addressed in order to facilitate economic growth (Pixley ka Seme DM, 2011). In Emthanjeni specifically, diversification of the economy would reduce the current levels of employment vulnerability.

The growth in the renewable energy sector could therefore contribute towards diversification and stability of the economy, reducing the employment vulnerability with positive impacts for the local economy and communities. Therefore the potential impact is considered to be of low magnitude, local extent and long term and therefore of **low (+)** significance without mitigation regardless of the layout alternatives. No mitigation is recommended.

The cumulative impact for both Layout Alternative 1 and 2 would be the same and is considered to be of medium magnitude, local, regional and national in extent and long term to permanent and therefore of **high (+)** significance. No mitigation is recommended.

4.10.2.3Decommissioning phase impacts

Decommissioning and restoration activities are likely to have similar impacts as those identified for the construction phase. There are likely to be fewer skills and training opportunities available because at the end of the projected design life of 25 years, skills would already be established.

The only major difference would be that the removal of infrastructure would have an overall positive visual impact and should some infrastructure remain, it would be a lasting visual impact.

The impact from decommissioning for both Layout Alternative 1 and 2 would be the same and the impact on the local economy is considered to be of **low (+)** significance and the other general impacts on society in general as being of **very low (-)** significance.

4.10.2.4Cumulative Impacts

Construction phase

The sudden spate of renewable energy development proposals within the Northern Cape, and South Africa in general, has been driven by the National Government. The abundant solar resource in the Northern Cape led to a high concentration of solar energy facility proposals in this area with associated concerns regarding the potential cumulative impact on the environment. Of relevance to this project is the high number of renewal energy projects proposed in the De Aar area.

Although during construction the project itself would yield relatively minor benefits for the local economy, given the appropriate enabling environment and in combination with the projected capacity of renewable energy generation, the impacts could be significant. The number of construction jobs is a potential positive cumulative impact as many of these facilities could be developed simultaneously. However, it may be the case that the demand for low skilled labour could not be met with local people and a higher proportion of outsiders would be brought into the area. This non-local workforce brought in for multiple projects could increase the demand for social infrastructure such as accommodation and community services in De Aar which are already under pressure. Furthermore, any pre-existing social ills such as HIV/AIDS and crime, including contact crime which is already common around taverns, could be exacerbated as workers often engage in prostitution and alcohol abuse.

Cultural differences between the workers and the local communities could also be intensified and the influx could spark conflict.

The cumulative impact for both Layout Alternative 1 and 2 would be the same and is considered to be of medium magnitude, local and regional in extent and for the duration of the construction phase (although the impact of the other developments could continue thereafter depending on their scheduling) and therefore of **high (+)** significance.

Operational phase

Although during operation the project itself would yield relatively minor benefits for the local economy, given the appropriate enabling environment and in combination with the projected capacity of renewable energy generation, the impacts could be significant. Of importance is the fact that the renewable energy sector would require a wide range of skills to implement the various technologies (Agama Energy, 2003). Based on a US survey, the labour requirements for constructing, transporting, installing and servicing a PV system can be broken down as follows:

- professional, technical and management (36%);
- benchwork (15%);
- structural (14%);
- miscellaneous (12%);
- processing (11%);
- clerical and sales (7%); and
- machine trades (5%) (REPP, 2001, cited in Agama Energy, 2003).

Industry projections for the European Union suggest that every 100MW of PV power would provide 1,020 full-time equivalent manufacturing jobs, 3,190 contracting and installation jobs, and 48 annual jobs in Operations and Management (EPIA, 2008 and BMU 2008 cited in Rutovitz and Atherton, 2009). This highlights the significant potential in the contracting and installation sectors, followed by the opportunity to harness further economic benefits through manufacture of the PV components locally within South Africa.

The findings of the study undertaken by Agama Energy (2003) indicated that:
renewable energy technologies offer a quantifiable potential for creating and sustaining new and decentralised employment in South Africa, which can offset some of the employment attrition that is a current trend in the conventional energy sectors".

This has associated economic benefits as well as skills development and training opportunities.

4.10.3 Mitigation Measures

4.10.3.1 Construction Mitigation

The following mitigation measures are proposed to be implemented during the construction phase for all alternatives:

- It is recommended that the local employment policy, as stated by the proponent, be implemented, audited and accompanied by a training programme. The policy must be based on a 'local's first' policy, specifically for low skilled jobs and should aim to recruit at least 20% of the jobs from the local community. This should also apply to all contracting firms.
- A local procurement policy should be adopted by the applicant to maximise the benefit to the local economy.
- Implement a policy of "no employment at the gate" to prevent loitering.
- The site should be secured.
- A comprehensive employee induction programme would cover land access protocols and fire management. This was addressed in the LEMP.
- A comprehensive employee induction programme would address issues such as HIV/ AIDS and Tuberculosis, as well as alcohol and substance abuse. The induction should also address a code of behaviour for employees that would align with community values.
- The LEMP also addressed noise and dust control. A 24 hour system for receiving and addressing complaints should be established before the commencement of the construction phase. Local farmers and residents should be informed of the contact number.
- Housing has to be restricted to the approved laydown areas.

4.10.3.2 Operational Mitigation

The following operational mitigation measures are proposed for all project alternatives:

- It is recommended that the local employment policy as stated by the proponent is implemented, audited and accompanied by a training programme. The policy must be based on a 'local's first' policy, specifically for low skilled jobs and should aim to recruit at least 20% of the jobs from the local community. This should also apply to all contracting firms.
- It is recommended that the developer adopts a local procurement policy which would maximise the benefit to the local economy and minimise leakage.

4.10.4 Socio-economic Impact Table

Table 36 and Table 37 indicate how the significance ratings of the various impacts were derived.

Table 36 | Construction socio-economic impacts

Project	Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Alt 1 and Alt 2	Direct employment and skills development	Without mitigation	Local and Regional	Low	Construction	Low (+)	Probable	High	Reversible
		With mitigation	Local and Regional	Low-Medium (+)	Construction	Low-Medium (+)	Probable	High	Reversible
Alt 1 and Alt 2	Economic Multiplier Effects	Without mitigation	Local and Regional	Low	Construction	Low (+)	Probable	Low	Reversible
		With mitigation	Local and Regional	Low-Medium (+)	Construction	Low-Medium (+)	Probable	Low	Reversible
Alt 1 and Alt 2	Indirect effects of additional workers on site	Without mitigation	Local	Low	Construction	Low (-)	Probable	Medium	Irreversible
		With mitigation	Local	Very Low (-)	Construction	Very Low (-)	Probable	Medium	Irreversible
Alt 1 and Alt 2	Impacts of a non-local workforce on society	Without mitigation	Local	Low	Construction	Low (-)	Improbable	Medium	Irreversible
		With mitigation	Local	Very Low (-)	Construction	Very Low (-)	Improbable	Medium	Irreversible
Alt 1 and Alt 2	Disruption or damage to adjacent properties	Without mitigation	Local	Low	Construction	Low (-)	Probable	Medium	Irreversible
		With mitigation	Local	Very Low (-)	Construction	Very Low (-)	Probable	Medium	Irreversible
	Potential negative or positive cumulative effects	Without mitigation	Local and Regional	Medium	Construction	High (-)	Probable	Medium	Irreversible
		With mitigation	Local and Regional	Medium	Construction	High (-)	Probable	Medium	Irreversible

Table 37 | Operational socio-economic impacts

Project	Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Alt 1 and Alt 2	Direct Employment and Skills Development	Without mitigation	Local and Regional	Low	Long term	Low (+)	Probable	High	Reversible
		With mitigation	Local and Regional	Low	Long term	Low (+)	Probable	High	Reversible
Alt 1 and Alt 2	Economic Multiplier Effects	Without mitigation	Local and Regional	Low	Long term	Low (+)	Probable	Low	Reversible
		With mitigation	Local and Regional	Low	Long term	Low (+)	Probable	Low	Reversible
Alt 1 and Alt 2	Landowner revenue	Without mitigation	Local and Regional	Low	Long term	Low (+)	Probable	Low	Reversible
		With mitigation	Local and Regional	Low	Long term	Low (+)	Probable	Low	Reversible
Alt 1 and Alt 2	Diversification of the local economy	Without mitigation	Local and Regional	Low	Long term	Low (+)	Probable	Low	Reversible
		With mitigation	Local and Regional	Low	Long term	Low (+)	Probable	Low	Reversible
Alt 1 and Alt 2	Potential negative or positive cumulative effects	Without mitigation	Local, Regional and National	Medium	Long term / Permanent	Medium (+)	Probable	Medium	Reversible
		With mitigation	Local, Regional and National	Medium-High (+)	Long term / Permanent	Medium-High (+)	Probable	Medium	Reversible

*Mitigation measures are described in detail in Section 4.10.3.

4.10.5 Social Conclusions

From a social point of view, any of the proposed alternatives can proceed as the specialists did not have a preference.

4.11 NOISE IMPACTS

Noise is generally defined as unwanted sound transmitted through a compressible medium such as air. Noise is reported in decibels (dB). Sound in turn, is defined as any pressure variation that the ear can detect. The number of pressure variations per second is referred to as the frequency of sound and is measured in hertz (Hz).Human response to noise is complex and highly variable as it is subjective rather than objective. The hearing of a young, healthy person ranges between 20Hz and 20,000Hz.

In terms of sound pressure level, audible sound ranges from the threshold of hearing at 0 dB to the pain threshold of 130dB and above. Even though an increase in sound pressure level of 6dB represents a doubling in sound pressure, an increase of 8dB to 10dB is required before the sound subjectively appears to be significantly louder. Similarly, the smallest perceptible change is about 1dB.

Many factors affect the propagation of noise from source to receiver. The most important of these are:

- The type of source and its sound power;
- The distance between the source and the receiver;
- The extent of atmospheric absorption (attenuation);
- Wind speed and direction;
- Temperature and temperature gradient;
- Obstacles such as barriers or buildings between the source and receiver;
- Ground absorption;
- Reflections;
- Humidity; and
- Precipitation

Noise will be generated during the construction operation and decommissioning phases of the proposed projects. Construction and decommissioning activities are often similar. Potential sources of noise during the construction phase are increased traffic, operation of heavy machinery during the construction period and additional people in the area. In order to assess the noise impacts of the PV facilities, a qualitative noise assessment was undertaken by Mrs Nicolette von Reiche of Airshed Planning Professionals (Pty) Ltd. The Noise Assessment was informed by Meteorological data recorded at the De Aar airport weather station noise and noise levels typically found in rural, suburban and urban areas as reported in SANS 10103 (2008). The assessment is included in Annexure E.

4.11.1 Description of the Environment

De Aar is the main commercial distribution centre in the central Great Karoo and hosts a number of industries due to rail and road links. Livestock farming, including game farms, and wool production are the main activities in the region. Other noise sensitive community members include residences on surrounding farms. The closest of these are residences directly south of the PV5 area (Layout

Alternative 1) and on farm Wag-'n-Bietjie, located approximately 5.2 km east-southeast of the PV4 area (Layout Alternative 1).

Baseline noise levels within the project area are considered 'rural' with day and night-time noise levels of 45dBA and 35dBA respectively. Noise levels on the outskirts of De Aar are considered 'suburban' with day and night-time noise levels of 50dBA and 40dBA respectively. Noise levels within De Aar and along the N10 are considered 'urban districts with one or more of the following: business premises and/or main roads' with day and night-time noise levels of 60dBA and 50dBA respectively.

4.11.2 Noise Impact Assessment

4.11.2.1 Construction phase impacts

Construction related noise is mostly associated with the use of diesel mobile equipment, earthworks, concrete batching and building finishing operations. The level and character of the construction noise will be highly variable as different activities with different plant/ equipment take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site.

The construction phase is expected to have the most notable impact on environmental noise levels and may result in levels above the SANS guideline at the site boundaries. With mitigation in place, these impacts could be brought into compliance.

4.11.2.2 Operational and decommissioning phase impacts

It is expected that noise will be generated from the following operational phase installations and activities:

- PV arrays and support structures;
- Power inverters and electrical substations;
- Corona noise from overhead power lines;
- Washing system to clean PV panels;
- Ancillary works; and
- Traffic.

Whereas the PV arrays' tracking motors will generate some noise during the day, other operations such as the cleaning of the PV panels will occur during night-time. Transformers typically emit a predominant pure tone of 100Hz, which, although not loud in volume, has the potential to induce vibrations in nearby structures. It is expected that the slight increase in traffic would be immaterial in comparison with current traffic related noise.

4.11.2.3 Cumulative impacts

The potential for cumulative noise impacts exist near major roads. Other industrial type noise sources are distant enough from the Project that cumulative impacts are unlikely.

4.11.3 Mitigation Measures

4.11.3.1 Construction phase

The noise mitigation measures to be considered during the construction phase are as follows (for all alternatives):

- Construction site yards, workshops, concrete batching plants, and other noisy fixed facilities should be located well away from noise sensitive areas.
- Stationary noisy equipment such as compressors and pumps should be encapsulated in acoustic covers, screens or sheds where possible. Portable acoustic shields should be used in the case where noisy equipment is not stationary (i.e. angle grinders, chipping hammers).
- Vehicles should avoid unnecessary use of the reverse gear to minimise annoyance caused by reverse sirens. Consideration of alternative safety measures may be necessary when taking such a measure.
- All diesel powered equipment must be regularly maintained and kept at a high level of maintenance. This must particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment must serve as trigger for withdrawing it for maintenance.
- Truck traffic should be routed away from noise sensitive areas, where possible.
- Noisy operations should be combined so that they occur where possible at the same time.
- Instruction of employees on low-noise work methods, for example, the handling of structural steel and the use radiotelephony rather than shouting for communication.
- Machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum.
- Construction activities are to be contained to reasonable hours during the day and early evening.
- Night-time activities near noise sensitive areas should not be allowed. No construction should be allowed on weekends from 14h00 on Saturday afternoons to 06h00 the following Monday morning.
- With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor should liaise with local residents and owners on how best to minimise impact, and the local population should be kept informed of the nature and duration of intended activities.

4.11.3.2 Operational phase

The noise mitigation measures to be considered during the construction phase are as follows (for all alternatives):

- The design of all major plant components should incorporate all the necessary acoustic design aspects required to ensure that the generated noise level from the Project does not exceed the SANS 10103 maximum equivalent continuous day/night rating level (L_{Rdn}) of 70dBA for industrial areas at the project boundary.
- The design should also to take into account the maximum allowable equivalent continuous day and night rating levels of the potentially impacted sites outside the project boundary. Where the noise level at such an external site is presently lower than the maximum allowed, the maximum shall not be exceeded. Where the noise level at the external site is presently at or exceeds the maximum, the existing level shall not be increased by more than what is considered as acceptable in SANS 10103.

- The latest technology incorporating maximum noise mitigation measures for components of the project should be designed into the system. The sound power level of each piece of equipment should be such that the sound pressure level (L_P – i.e. the noise level) measured at 1m from the surface of the given plant/equipment should not exceed 85dBA. When ordering plant and machinery, manufacturers should be requested to provide details of the sound power level. Where possible, those with the lowest sound power level (most quiet) should be selected.
- The design process is to consider, inter alia, the following aspects:
    - The position and orientation of buildings on the site.
    - The design of the buildings to minimise the transmission of noise from the inside to the outdoors.
    - The insulation of particularly noisy plant and equipment.
    - All plant, equipment and vehicles are to be kept in good repair.
    - Where possible, very noisy activities should not take place at night.
    - Noise levels from the high-pressure hose system (compressor) on the trucks used for the cleaning of PV panels should be minimised.

4.11.3.3Noise monitoring

It is recommended that ambient noise measurements are conducted during the pre-construction, construction, operational and decommissioning phases to assess the Project's impact area. In addition to the measurement of sound pressure levels, the 3rd octave band frequency spectra should also be recorded. Frequency spectra data can provide useful insight into the nature of recorded sound pressure levels and assist with distinguishing between potential sources of noise that contribute to noise levels at a certain location. Source noise measurements could be conducted to confirm equipment manufacturer sound power data. All measurements should be conducted in accordance with SANS 10103 and be representative of day and night-time noise levels.

4.11.4 Noise Conclusions

The specialist had not preference for any alternative and based on noise impacts, any proposed alternative can proceed.

4.12 DUST IMPACTS

Solar technologies results in negligible emissions since no fuels are combusted. However, air pollution in the form of dust emissions will occur during the construction phase. Therefore a qualitative air quality assessment was undertaken by Mrs Hanlie Liebenberg-Enslin of Airshed Planning Professionals (Pty) Ltd. The study follows a qualitative approach, using available meteorological data and pollutants typically associated with the current and proposed activities to evaluate the potential for off-site impacts. The assessment is included in Annexure E.

4.12.1 Description of the Environment

Meteorological mechanisms govern the dispersion, transformation, and eventual removal of pollutants from the atmosphere. The prevailing wind field at the site is from the southeast and the northwest with the most frequent winds from the east-southeast. The monthly wind roses reflect similar wind fields with south-south-easterly winds dominating during the winter months of May to August. Frequent north-westerly winds occur primarily in the summer months. The strongest winds

occur in November (6 meter per second on average) with lower wind speeds associated with the winter months (average 4 meter second).

Air temperature is an important parameter for the development of the mixing and inversion layers. It also determines the rate of dissipation of pollutants before it reaches ground level. Incoming solar radiation determines the rate of development and dissipation of the mixing layer. Relative humidity is an inverse function of ambient air temperature, increasing as ambient air temperature decreases. On average, temperature range between 11°C (June and July), and 27°C (January).

Precipitation represents an effective removal mechanism of atmospheric pollutants and is therefore frequently considered during air pollution studies. Evaporation is a function of ambient temperature, wind and the saturation deficit of the air. Evaporation rates have important implications for the design and implementation of effective dust control programmes. The area falls within a summer rainfall belt with the annual mean rainfall recorded in the Northern Cape Province reported as 527mm, with the maximum value of 2,031mm and minimum value of 200mm (Schulze, 1997).

Particulates represent the main pollutant of concern at the construction operations of the PV facilities. Airborne particulate matter comprises a mixture of organic and inorganic substances, ranging in size, shape and density. These can be divided into Total Suspended Particulates (TSP), thoracic particles or PM10 (particulate matter with an aerodynamic diameter of less than 10 µm) and respirable particles or PM2.5 (particulate matter with an aerodynamic diameter of less than 2.5µm). PM10 and PM2.5 are associated with health impacts with TSP associated with dust fallout.

Gaseous emissions will derive from combustions sources such as construction equipment and vehicles. Sulphur dioxide (SO_2), carbon monoxide (CO), carbon dioxide (CO_2), oxides of nitrogen (NO_x) and hydrocarbons will derive from on-site trucks and heavy construction equipment. Vehicles on the N10 and R388 will also contribute to these gaseous emissions but it is expected that it is not a busy road and therefore the contribution is negligible.

No ambient monitoring data or dust fallout data are available to inform the background air quality. Typical background PM10 concentrations for South Africa as a country is given as 25µg/m³ (2008), 24µg/m³ (2009) and 18µg/m³ (2010), assumed to be presented as an annual average (http://data.worldbank.org/indicator). These concentrations represent between 50% and 38% of the current annual PM10 standard of 50µg/m³.

The main existing sources of particulate emissions in the area include a quarry to the southwest of the proposed solar energy site (4km), the N10 main road and R388 secondary road and agricultural livestock activities.

4.12.2 Dust Impact Assessment

Due to the lack of detailed information, emissions from the construction activities were estimated. It is anticipated that the following activities would result in dust generation.

Materials handling

The handling of topsoil and gravel for construction operations could be a potential significant source of dust generation at the various transfer points. The quantity of dust generated depends on various climatic parameters, such as wind speed and precipitation, in addition to non-climatic parameters such as the nature and volume of the material handled. Fine particulates are most

readily disaggregated and released to the atmosphere during the material transfer process, as a result of exposure to strong winds. Increases in the moisture content of the material being transferred will decrease the potential for dust emission, since moisture promotes the aggregation and cementation of fines to the surfaces of larger particles.

The number of transfer points, the quantify of material, the moisture content of the material and the hourly wind speed will determine the amount of TSP, PM10 and PM2.5 emissions deriving from the various transfer points. The construction operations are assumed to be a 24-hour, seven day a week operation for the 12 to 24 month period. Materials handling operations can be mitigated through water sprays that can result in a 50% reduction in dust generation.

Vehicle entrainment on paved and unpaved roads onsite

Vehicle-entrained dust emissions from paved and unpaved roads are significant sources of dust, especially where there are high traffic volumes on a road. The force of the wheels travelling on unpaved roads causes the pulverisation of surface material. Particles are lifted and dropped from the rotating wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from unpaved roads will vary linearly with the volume of traffic expected on that road.

The extent of particulate emissions from paved and unpaved roads is a function of the “silt loading” present on the road surface, and to a lesser extent of the average weight of vehicles travelling on the road. Silt loading refers to the mass of silt-size material (i.e. equal to or less than 75 microns in diameter) per unit area of the travel surface. Silt loading is the product of the silt fraction and the total loading. The amount of particulates (TSP, PM10 and PM2.5) can be estimated using the available EPA emission equations accounting for vehicle weight, number of trips and silt content (EPA, 1996). The capacity of the construction trucks is not known. The traffic on the temporary unpaved roads is likely to be significant sources of dust generation if uncontrolled. The trucks on the paved road are likely to contribute less to the dust load in comparison but could also be significant sources of dust generation depending on the silt loading on the road.

Windblown dust from stockpiles

Wind erosion is a complex process, including three different phases of particle entrainment, transport and deposition. It is primarily influenced by atmospheric conditions (e.g. wind, precipitation and temperature), soil properties (e.g. soil texture, composition and aggregation), land-surface characteristics (e.g. topography, moisture, aerodynamic roughness length, vegetation and non-erodible elements) and land-use practice (e.g. farming, grazing and mining).

Windblown dust generates from natural and anthropogenic sources. For wind erosion to occur, the wind speed needs to exceed a certain threshold, called the threshold velocity. This relates to gravity and the inter-particle cohesion that resists removal. Surface properties such as soil texture, soil moisture and vegetation cover influence the removal potential. Conversely, the friction velocity or wind shear at the surface, is related to atmospheric flow conditions and surface aerodynamic properties. Thus, for particles to become airborne, the wind shear at the surface must exceed the gravitational and cohesive forces acting upon them, called the threshold friction velocity (Shao, 2008).

The main sources of windblown dust are likely to be the proposed topsoil storage piles and cleared land that would be prone to wind-blown dust. Estimating the amount of windblown particles to be

generated from these sources is not a trivial task and requires detailed information on the particle size distribution, moisture content, silt content and bulk density.

Wind erosion will occur during strong wind conditions (neutral) when wind speeds exceed the critical threshold required to lift and suspend the dust particles. This threshold is determined by the parameters that resist removal such as the particle size distribution of the bed material, moisture content and vegetation. A typical wind speed threshold is given as 5.4m/s for storage piles. Wind data for De Aar have an average wind speed of 5 meters per second which indicates the likelihood for wind erosion to occur. Moisture will act as a binding agent and reduce wind erosion emission by around 50%, depending on the amount of water applied. Alternatives include vegetation of exposed surfaces that will not be constructed on.

The main findings from the qualitative assessment are as follows for all project alternatives:

4.12.2.1Construction phase

There is a possibility for high off-site dust fallout and PM10 and PM2.5 impacts due to the close proximity of the proposed site to the town of De Aar. With the current background PM10 concentrations already between 50% and 38% of the current NAAQS, the potential exists for exceedances of the ambient PM10 standard. Dust fallout may also exceed the Draft national standards outside the border of the site. With mitigation in place, primarily comprising of water sprays, these impacts could be halved and brought into compliance.

4.12.2.2Operational phase

Emissions to air associated with the operational phase would only result from maintenance vehicles and the trucks off-loading fuel. These are regarded as insignificant.

4.12.2.3Decommissioning phase

The decommissioning phase will mainly include materials handling activities, wind erosion and to a lesser extent vehicle and equipment movement on-site and on the access road.

4.12.3 Mitigation Measures

Based on the qualitative evaluation of the proposed PV facilities and associated infrastructures (all alternatives), generic management objectives are provided to address potential dust generation throughout the project lifecycle.

- Water sprays to be applied at the area to be cleared should significant amounts of dust be generated. Moist topsoil will reduce the potential for dust generation when tipped onto stockpiles.
- Ensure travel distance between clearing area and topsoil piles to be at a minimum.
- Ensure exposed areas remain moist through regular water spraying during dry, windy periods.
- Reshape all disturbed areas to their natural contours.
- Cover disturbed areas with previously collected topsoil and replant native species.

4.12.4 Dust Conclusions

The temporary nature of the construction activities, and the likelihood that these activities will be localised and on small areas at any given time, would reduce the potential for significant off-site impacts. Any of the proposed alternatives may proceed.

4.13 IMPACT ON ENERGY PRODUCTION

As noted in Section 3.3, South Africa aims to procure 6,925MW of capacity of renewable energy. The proposed project could therefore contribute positively towards this goal.

4.13.1.1Description of the Environment

Historical trends in electricity demand in South Africa have shown a consistent increase in demand. There have been some years where the demand levels off or decreases, but over the long term there has been an increasing trend on electricity demand. 10.4 GW has been allowed for solar energy and each of the proposed facilities would contribute 75 MW. The reserve margin remains extremely low and the supply capacity is still limited. The proposed PV facilities would be able to provide power to assist in meeting the energy demand within South Africa.

4.13.1.2Energy Impact Assessment

Since solar energy is a clean source of energy and given the need for increased production capacity in South Africa, the potential impact of the proposed project on energy production is considered to be of low magnitude, regional and long term and therefore of **low (+)** significance, without or with mitigation measures. No difference in significance would result from the proposed alternatives.

4.13.1.3Mitigation Measures

No mitigation measures are recommended.

4.13.1.4Energy Impact Table

Table 38 indicates how the significance rating for energy was determined.

Table 38 | Energy impact table

	Project	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Construction phase	Alt 1 and Alt 2	Without mitigation	Regional	Low	Long term	Low (+)	Definite	Uncertain	Reversible
		With mitigation	Regional	Low	Long term	Low (+)	Definite	Uncertain	Reversible

*No mitigation measures are proposed.

4.14 IMPACT ON TRAFFIC

Construction vehicles are likely to make use of the existing roads, including the N10, to transport equipment and material to the construction site. Approximately 450 truckloads transporting in total 900 40-foot containers would be required during the construction period. These truckloads would be distributed throughout the construction period (12 to 24 months per 75MW facility).

4.14.1 Description of the Environment

The N10, which is the main highway between Cape Town and Johannesburg, runs adjacent to the proposed farm, to the south and west and dissects the extended PV4 (Layout Alternative 2). A main access road is proposed to be constructed to access the PV facilities from the N10.

4.14.2 Traffic Impact Assessment

4.14.2.1Construction phase

On average 1-2 trucks would access the site daily (excluding weekends). The additional vehicles on the roads could potentially result in more accidents and or traffic congestion. The potential impact of the project on traffic during the construction phase is considered to be of medium magnitude, regional extent with duration limited to the construction phase and therefore of **medium (-)** significance, without mitigation. Through the implementation of mitigation measures the significance could be reduced to **low (-)**. No difference in significance would result from the proposed alternatives.

4.14.2.2Operational phase and decommissioning phase

The potential impact of the project on traffic during the operational phase is considered to very low since additional traffic would be limited to the transportation of staff to and from the site. It is therefore expected to be of very low magnitude, local extent with a long term duration and therefore of **very low (-)** significance, with and without mitigation. No difference in significance would result from the proposed alternatives.

The removal of structures during the decommissioning phase would result in a negative impact. It is expected to be of very low magnitude, local extent with a similar duration as the construction phase and therefore of **very low (-)** significance, with and without mitigation.

4.14.2.3Cumulative impacts

The cumulative potential impact of solar energy projects on transport is considered to be of medium magnitude, regional extent and short term and therefore of ***medium (negative)*** significance, with or without mitigation. No difference in impact significance would result from the proposed alternatives.

4.14.3 Mitigation Measures

The following mitigation measures are recommended:

- Ensure that road junctions have good sightlines;
- Transport the materials in the least amount of trips as possible;
- Adhere to the speed limit;
- Implement traffic control measures where necessary; and

- Transport components overnight as far as possible.

4.14.4 Traffic Impact Table

Table 39 indicates the impact rating for anticipated traffic impacts.

Table 39 | Traffic impact table

	Project	Key impacts	Mitigation	Extent	Magnitude	Duration	SIGNIFICANCE	Probability	Confidence	Reversibility
Construction phase	Alt 1 and Alt 2	Accidents and or traffic congestion	Without mitigation	Regional	Medium	Construction	Medium (-)	Probable	Sure	Reversible
			With mitigation	Regional	Low	Construction	Low (-)	Probable	Sure	Reversible
Operational and Decommissioning Phase	Alt 1 and Alt 2	Accidents and or traffic congestion	Without mitigation	Local	Very low	Long term	Very Low (-)	Probable	Sure	Reversible
			With mitigation	Local	Very low	Long term	Very Low (-)	Probable	Sure	Reversible
Cumulative	Alt 1 and Alt 2	Accidents and or traffic congestion	Without mitigation	Regional	Medium	Short term	Medium (-)	Probable	Unsure	Reversible
			With mitigation	Regional	Medium	Short term	Medium (-)	Probable	Unsure	Reversible

*Mitigation measures are described in detail in Section 4.14.3.

4.15 STORAGE OF HAZARDOUS SUBSTANCES ON SITE

Hazardous substances would be stored on site during the operational phase. These substances may include amongst other things, hydrocarbons (i.e. fuel), curing compounds, shutter oil, and cement. The use of hazardous substances at a site is controlled by various pieces of legislation. Approximately 500ℓ of fuel and 50ℓ of lubrication oil would be stored on site. This volume falls well below the triggers as listed activity in terms of NEMA. However, the necessary precaution measures would be in place and have been included in the LEMP.

4.15.1 Impact Assessment

The volume to be stored onsite falls well below the triggers of listed activity in terms of NEMA. Therefore the impacts were not assessed using the assessment methodology provided in Annexure F. However, the necessary precaution measures would be in place and have been included in the LEMP.

4.15.2 Mitigation Measures

The management and protection of the environment would be achieved through the implementation of the LEMP, which *inter alia* specify the storage details of hazardous compounds and the emergency procedures to follow in the event of a spillage.

Typical mitigation measures include storage of the material in a bunded area, with a volume of 110% of the largest single storage container or 25% of the total storage containers whichever is greater, refuelling of vehicles in designated areas that have a protective surface covering and utilisation of drip trays for stationary plant.

4.16 SUMMARY OF POTENTIAL IMPACTS

A summary of all the potential impacts from the proposed project assessed above is included in Section 3.2. While minor differences in the potential impacts would result from the proposed alternatives this difference was not considered to be significant for any of the potential impacts. As such, the table below applies to all proposed alternatives.

4.17 MULILO'S COMMITMENTS

Mulilo recognises that by constructing PV facilities near De Aar constitute a change in the predominant land-use and would result in impacts (both positive and negative) to the biophysical and social environment. Furthermore, as this is a long-term project Mulilo takes cognisance of the need to create a sustainable environment within the community. Part of the IPP bid application requirements to construct a renewable project requires a strict, comprehensive Economic Development Plan to be submitted. This plan would detail the various job creation, socio economic development, skills development, local content and ownership.

In order to create a sustainable environment, Mulilo proposes to:

- Create a local community trust which has an equity share in the project life to benefit historically disadvantaged communities.
- Initiate a training strategy to enable employment from the local community.
- Give preference to local suppliers of components for the construction of the facility.

- Put in place a maintenance plan to ensure that broken panels or materials are recycled or are disposed of in an environmentally sound manner.
- Recycle the panels following the decommissioning of the site.
- Rehabilitate the site to its original state prior to the construction of the PV facility, as far as possible.

5 RECOMMENDATIONS AND CONCLUSION

This section concludes the report and provides information on the way forward.

5.1 CONCLUSIONS

The proposed projects consist of three 75MW PV facilities each of which comprises numerous arrays of PV panels and associated support infrastructure and ancillary infrastructure.

As per the requirements of NEMA, this EIA investigation has contemplated and assessed the array of potential environmental impacts associated the following range of project alternatives:

- **Location alternative:** Du Plessis Dam Farm (Remainder of Farm 179)
- **Layout alternatives** as determined by scale and magnitude alternatives: (Layout Alternative 1 and Layout Alternative 2)
- **Additional routing infrastructure:** One routing alternative for access roads and water pipeline
- **Technology alternatives:**
  - Solar Panel alternative: CPV and conventional PV
  - Mounting Alternatives: Fixed axis tracking system and single axis tracking system
- **Transmission line routing:** two transmission corridors
- **No-Go alternative**

This Draft EIA Report provides a comprehensive assessment of the environmental issues associated with each of the abovementioned alternatives of the proposed projects. The environmental and social impacts and alternatives were derived in response to inputs from consultation with I&APs, provincial and local authorities, and the EIA project team. Table 40 provides a summary of the significance of the environmental impacts associated with this proposed projects.

Table 40 | Summary of significance of the potential impacts associated with the proposed development

IMPACTS			Construction		Operation		Decommissioning	
			No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
1	Impact on flora	Layout Alt.1 and Layout Alt. 2	Medium (-)	Medium (-)	Medium (-)	Very low (-)	Medium (-)	Very low (-)
2		Roads and water pipeline	Low (-)	Low (-)	Low (-)	Very low (-)	Low (-)	Very low (-)
3		Overhead power lines	Low (-)	Low (-)	Low (-)	Very low (-)	Low (-)	Very low (-)
4		No- Go	Medium-Low (-)	-	Medium-Low (-)	-	Medium-Low (-)	-
5	Impact on avifauna	Layout Alt. 1 habitat loss and disturbance	Medium-Low (-)	Medium-Low (-)	Medium-Low (-)	Medium-Low (-)	Medium-Low (-)	Low (-)
6		Layout Alt. 2 habitat loss and disturbance	Medium (-)	Medium-Low (-)	Medium (-)	Medium (-)	Medium (-)	Medium-Low (-)
7		Layout Alt. 1 and 2 Mortality	-		Medium-High (-)	Medium-Low (-)	-	
8	Impact on fauna	Layout Alt.1 and 2 (all alternatives)	Low (-)	Very low (-)	Low (-)	Low (-)	Low (-)	Very low (-)
9	Impact on Agriculture	Layout Alt.1 and 2	Low (-)	Low (-)	Medium (-)	Very low (-)	Very Low (-)	Very Low (-)
10		Transmission lines	-		Very low (-)	Very low (-)	-	
11	Surface water	Layout Alt.1 and Layout Alt. 2	Low (-)	Very low (-)	Very low (-)	Very low (-)	Very low (-)	Very low (-)
12		Transmission corridors, roads and pipeline	Very low (-)	Very low (-)	Very low (-)	Very low (-)	Very low (-)	Very low (-)
13		Proposed Laydown Area	Low (-)	Very low (-)	Very low (-)	Very low (-)	Very low (-)	Very low (-)
14	Impact on heritage	Layout Alt. 1 archaeology	Medium (-)	Very low (-)	-			
15		Layout Alt. 1 cultural landscape	Medium-Low (-)	Medium-Low (-)	-			
16		Layout Alt. 2 archaeology	Medium (-)	Very low (-)	-			
17		Layout Alt. 2 cultural landscape	Medium (-)	Medium (-)	-			
18		No- Go	Very low (-)	Very low (-)	-			
19		Transmission lines	Low (-)	Low (-)	-			
20	Impact on Palaeontology	Layout Alt.1 and 2	Low (-)	Low (-)	-			
21		Transmission lines	Very low (-)	Very low (-)	-			
22	Visual impacts	Layout Alt.1	Medium (-)	Low (-)	High-medium (-)	Medium-Low (-)	Medium (-)	Low (-)
23		Layout Alt.2	Medium (-)	Low (-)	High-medium (-)	Medium-Low (-)	High-medium (-)	Low (-)

IMPACTS			Construction		Operation		Decommissioning	
			No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
24	Social impacts	Layout Alt.1 and 2 Direct employment and skills development; Economic Multiplier Effects	Low (+)	Low-Medium (+)	Low (+)	Low (+)	-	-
25		Layout Alt.1 and 2 Additional workers on site	Low (-)	Very Low (-)	-	-	-	-
26		Layout Alt.1 and 2 Landowner revenue Diversification of the local economy	-	-	Low (+)	Low (+)	-	-
27	Impact on Energy production	Layout Alt.1 and 2	-		Low (+)	Low (+)	-	
28	Impact on traffic	Layout Alt.1 and 2	Medium (-)	Low (-)	Very Low (-)	Very Low (-)	Medium (-)	Medium (-)

Key

M-H	Medium to High Significance
M	Medium Significance
L-M	Low to Medium Significance
L	Low Significance
VL-L	Very Low to Low Significance
N	Neutral Significance
L-M+	Medium positive significance
L+	Low positive significance

5.1.1 Level of confidence in assessment

With reference to the information available at this stage of the proposed projects planning cycles, the confidence in the environmental assessment undertaken is regarded as being acceptable for the decision-making, specifically in terms of the environmental impacts and risks. The EAP believes that the information contained within the FSR and this EIA Report is adequate to inform DEA to be able to determine the environmental acceptability of the proposed alternatives.

It is acknowledged that the projects details will evolve during the detailed design and construction phases to a limited extent. However, these are unlikely to change the overall environmental acceptability of the proposed projects and any significant deviation from what was assessed in this EIA Report should be subject to further assessment. If this was to occur, an amendment to the EA may be required in which case the prescribed process would be followed.

5.1.2 Construction phase impacts

With reference to Table 41, no impacts of high significance were identified. The most significant (**medium (-)**) construction phase impacts to the biophysical and social environment, without mitigation was on flora, avifauna, visual heritage and traffic. With the implementation of the proposed mitigation measures, the impact significance could be reduced to **very-low (-)** or **low (-)**, with the exception of the impacts on flora and the heritage impact (cultural landscape) associated with Layout Alternative 2, which would remain **medium (-)** with mitigation.

It should be noted that two potential positive impacts on the local economy (employment) and social conditions would result and these would be of **low (+)** significance for all alternatives, without and with mitigation measures. Direct employment and skills development and economic multiplier effects can be enhanced to a **medium-low (+)** significance for all alternatives, with mitigation measures.

5.1.3 Operational phase impacts

The operational impacts were assessed and the potential visual impacts and impacts on avifauna (mortality) were rated to be of **medium-high (-)** significance for all alternatives, without mitigation measures. With the implementation of the recommended LEMP the significance of visual and avifauna impacts (mortality) is likely to be reduced to **medium-low (-)** for all alternatives. The operational phase impacts on flora, avifauna (Layout alternative 2) and agricultural land was deemed to be of **medium (-)** significance, which could be reduced to **very-low (-)** with the implementation of the LEMP for all alternatives. Avifaunal impacts associated with Layout alternative 2 were the exception as the significance would remain **medium (-)** for all alternatives, regardless of mitigation measures.

It should be noted that two potential positive impacts on local economy (employment) and energy production would be of **low (+)** significance, with and without mitigation measures for all alternatives.

5.1.4 Decommissioning phase

The decommissioning phase impacts were assessed and the potential visual impacts were rated to be of **medium-high (-)** significance, without mitigation measures for all alternatives. With the implementation of the recommended LEMP the significance is likely to be reduced to **low (-)**. The

decommissioning phase impacts on flora, avifauna, visual and traffic was deemed to be of **medium (-)** significance, which could be reduced to **very-low (-), medium-low (-), low (-) respectively** with the implementation of the LEMP for all alternatives. The impact on traffic would remain **medium (-)** with the implementation of the LEMP for all alternatives.

5.1.5 Recommendations

Section 4 outlines the mitigation measures which, if implemented, could significantly reduce the negative impacts and enhance positive impacts associated with the projects. These mitigation measures have also been incorporated in the LEMP (Annexure D). Where appropriate, the mitigation measures, and any others, identified by DEA could be enforced as Conditions of Approval in the EA, should DEA issue a positive EA.

5.1.6 Considerations in identification of preferred alternatives

In order to identify the preferred alternative, the EAP evaluated all the recommendations and impact assessments determined by the respective specialists. Based on the specialist findings, it was evident that Layout Alternative 1 was the preferred alternative as it has a smaller footprint which takes environmentally sensitive areas into consideration. Layout Alternative 1 (including PV2, PV3 and PV4 projects) was assessed on a worst case scenario in that the ratings provided are for the impacts associated with all of these projects together. In other words, it is a cumulative assessment of the three projects hence if not all the projects are approved the actual impacts would be of lower significance than assessed in this report. Therefore, based on the ratings provided by the specialists, all of these projects could be authorised since the impacts are of an acceptable level. The positive impacts would remain at least low (+), regardless of the number of projects authorised.

Only one routing alternative for access roads and the water pipeline was assessed, and this was deemed acceptable by all specialists since it avoids identified sensitive areas and could therefore be authorised. Alternative transmission route 1 should be authorised since it avoids the sensitive heritage area identified and described in Section 4.8.

There were no environmental differences between single axis tracking system or fixed axis tracking system. However, based on economic viability, single axis tracking system is preferred. Conventional PV was preferred from a visual perspective.

5.1.7 EAP's opinion with respect to authorisation

Regulation 32(2)(m) of the EIA Regulations requires that the EAP include an opinion as to whether the activity should be authorised or not.

Based on the outcome of this EIA, we are of the opinion that the proposed PV projects should be authorised as the incremental local and regional benefits outweigh negative impacts and the proposed project substantially meets the NEMA principles (Table 14) as well as the Need and Desirability criteria (Table 15). The significance of negative impacts can be reduced with effective and appropriate mitigation. If authorised, the implementation of an LEMP should be included as a Condition of Approval.

Based on the outcome of this EIA, we are of the opinion that the following project alternatives, which are more favourable, should be authorised:

- Location alternative: **Du Plessis Dam Farm (Remainder of Farm 180)**
- Layout alternatives as determined by scale and magnitude alternatives: **Alternative 1**
- Additional routing infrastructure: **One routing alternative for access roads and water pipeline**
- Technology alternatives:
  - Solar Panel alternative: **conventional PV**
  - Mounting Alternatives: **single axis tracking system**
- Transmission line routing: **transmission corridor route 1**

5.2 WAY FORWARD

The current phase of the PPP commenced on **19 September 2013** and I&APs were afforded 40-days to provide comments on this Draft EIA Report, until **29 October 2013**. The Draft EIA Report was lodged in the De Aar Public Library, Emthanjeni Municipal buildings and on the Aurecon website and potential I&AP's were notified of the availability of the report

Cognisance will be taken of all comments in compiling the final report, and the comments, together with the project team and proponent's responses thereto, will be included in the Final EIA Report. Where appropriate, the report will be updated.

Once the Final EIA Report has been completed, including the CRR, it will be submitted to the DEA for review. DEA must, within 60 days, do one of the following:

- Accept the report;
- Notify the applicant that the report has been referred for specialist review;
- Request amendments to the report; or
- Reject the report if it does not materially comply with regulations.

If the report is accepted, DEA must within 45 days:
(a) Grant authorisation in respect of all or part of the activity applied for; or
(b) Refuse authorisation in respect of all or part of the activity.

Once DEA issues their decision on the proposed project, all registered I&APs on the project database will be notified of the outcome of the decision within 12 calendar days of the date of the decision. I&APs will also be informed of the Appeal procedure.

6

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TABLE OF ANNEXURES

Annexure A

Application Form
Revised Application Forms
Acknowledgement from DEA
Additional information requested

Annexure B

Annexure B1- List of potential Interested and Affected Parties
Annexure B2- Site Notices
Annexure B3- Advertisements
Annexure B4- Letters distributed during the FSR phase
Annexure B5- Comments and Responses Report 1 and 2
Annexure B6- Comments received

Annexure C

CVs of Project Team

- Andries van der Merwe
- Louise Corbett
- Karen Versfeld
- Karen de Bruyn
- Grace Shihepo

Annexure D

Life-cycle Environmental Management Plan

Annexure E

Specialists Reports

- Botanical Impact Assessment
- Avifauna Impact Assessment
- Agriculture Impact Assessment
- Surface Water Impact Assessment
- Hydrology Impact Assessment
- Palaeontology Impact Assessment
- Heritage Impact Assessment
- Visual Impact Assessment
- Glint and Glare assessment
- Declarations and CVs

Annexure F

Assessment methodology

1 REPORT TRANSMITTAL NOTE

No of Hard-copies	No of E-copies	DISTRIBUTION RECORD (hard copy)			
		To (Name)	Organisation	Rev	Date sent
2	2	Thabile Sangweni	Department of Environmental Affairs	Draft	13 September 2013
0	1	Shaun Cloete	Department of Water Affairs: Deputy Director Lower Orange WMA	Draft	13 September 2013
1	0	Mev. C. Kloppers	Emthanjeni Local Municipality	Draft	13 September 2013
0	1	Thato Molese or Chamuwari J Ketano	Department of Environmental Affairs and Nature Conservation (DEANC)	Draft	13 September 2013
0	1	Jacoline Mans	National Department of Agriculture, Forestry and Fisheries: Directorate: Land Use and Soil Management	Draft	13 September 2013
0	1	Dr Kegaliwe	Department of Agriculture (Northern Cape)	Draft	13 September 2013
1	0	Martha Gweyi	De Aar public library	Draft	13 September 2013
1	2	John Geeringh or Wilson Mulaudzi	Eskom Holdings Limited	Draft	13 September 2013
0	1	Ivan Ermanus or Sam Diokpala	Pixley ka Seme District Municipality	Draft	13 September 2013
0	0 Upload to SAHRIS website	Dr Mariagrazia Galimberti	South African Heritage Resources Agency (SAHRA)	Draft	13 September 2013
0	1	Provincial Manager	Northern Cape Provincial Heritage: Boswa ya Kapa Bokone	Draft	13 September 2013
0	1	SP Mokuele	Department of Energy (Northern Cape): Regional Energy Director	Draft	13 September 2013
0	1	Mr Nogwili	Northern Cape Transport, Roads and Public Works	Draft	13 September 2013
0	1	R. C. Barlow	Department of Transport	Draft	13 September 2013
0	1	Adrian Tiplady	Square Kilometer Array (SKA)	Draft	13 September 2013
0	1	SANRAL	Ms René de Kock	Draft	13 September 2013
0	1	Civil Aviation Authority (CAA)	Mr Zimele Mtimkulu	Draft	13 September 2013
0	1	Warren Morse	Proponent	Draft	13 September 2013
0	1	Bridgette Engelbrecht	Aurecon Information Centre	Draft	13 September 2013

5	18	Total

Distributed by : **Karen de Bruyn**

(Full name) (Signature)

Unit/Office : Cape Town Delivery Centre **Date :** 14 September 2013