Prepared for:
ABO Wind Renewable Energies (Pty) Ltd

Scoping and Environmental Impact Assessment (EIA) Process
for the
PROPOSED DEVELOPMENT OF A SOLAR PHOTOVOLTAIC (PV) FACILITY (KUDU SOLAR FACILITY 4) AND ASSOCIATED INFRASTRUCTURE, NEAR DE AAR, NORTHERN CAPE PROVINCE

JULY 2023



FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Prepared by:
Council for Scientific and Industrial Research (CSIR)

PART A: MAIN REPORT



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SCOPING AND ENVIRONMENTAL IMPACT ASSESSMENT

for the

Proposed Development of a Solar Photovoltaic (PV) Facility (Kudu Solar Facility 4) and associated infrastructure, near De Aar, Northern Cape Province

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

July 2023

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ABO Wind renewable energies (Pty) Ltd

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Council for Scientific and Industrial Research (CSIR)

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Title:	Scoping and Environmental Impact Assessment (EIA) Process for the proposed development of a Solar Photovoltaic (PV) Facility (Kudu Solar Facility 4) and associated infrastructure, near De Aar in the Northern Cape Province: FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT	
Purpose of this report:	The purpose of this EIA Report is to: ▪ Present the details of and the need for the proposed project; ▪ Describe the affected environment at a sufficient level of detail based on specialist input to facilitate informed decision-making; ▪ Provide an overview of the EIA Process that has been followed, including public consultation; ▪ Provide an overview of the potential positive and negative impacts of the proposed project on the environment; ▪ Provide recommendations to avoid or mitigate negative impacts and to enhance the positive benefits of the project; and ▪ Provide an Environmental Management Programme (EMPr) for the relevant phases of the project. The Draft EIA Report was released to all Interested and/or Affected Parties (I&APs), Organs of State and relevant stakeholders for a 30-day review period extending from **2 June 2023 to 3 July 2023**, excluding public holidays. All comments submitted during the 30-day review period have been incorporated in the Comments and Responses Report, and addressed, as applicable and where relevant, and included as an appendix in this Final EIA Report. This Final EIA Report has been submitted to the National Department of Forestry, Fisheries and the Environment (DFFE) for decision-making.	
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Date:	July 2023	
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Key Changes made from the DRAFT EIA Report that was issued for I&AP, Stakeholder and Organ of State Review from 2 June 2023 to 3 July 2023

	Change made – Yes (denoted by ✓) or N/A (denoted by ■)																														
	Chapters																				Appendices										
Key change description	**Summary**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
The term “Draft EIA Report” has been updated to “Final EIA Report”, where applicable	✓	✓	✓	✓	✓	✓	■	■	■	■	■	■	■	■	■	■	■	■	■	■	✓	■	■	■	■	■	■	■	✓	✓	✓	■
Additional details on the applicability of relevant listed activities and project description details, where possible	■	■	■	■	✓	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Updated with additional information regarding the status and progress made on the EIA Process, the submission of the Amended Application for EA to the DFFE, as well as DFFE’s acknowledgment of receipt.	✓	✓	■	■	✓	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	✓	■	■	■	■	✓	■
Updated with details of the Public Participation Process undertaken thus far. Added proof of placement of the newspaper advertisements, correspondence and proof of correspondence sent to stakeholders for the Draft EIA Report release; proof of submission of the Draft EIA Report and Application Form to the DFFE; comments received from stakeholders during the 30-day review of the Draft EIA Report; and Comments and Responses Trail (Specifically Appendix H.3 to H.7).	✓	✓	■	■	✓	✓	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	✓	■	■	✓	■	✓	■
Updated the database of I&APs, Stakeholders and Organs of State to reflect stages of consultation, commenting, as well as additions to the database.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	✓	■	■	■	■	■	■
Updated the EMPr with recommendations provided by Stakeholders, where relevant	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	✓	✓	■
Project specific feedback on sensitivities added in Chapter 20, Table 20.1	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	✓	■	■	■	■	■	■	■	■	■	■	■
Summary feedback on the comments raised during the 30-day review period on the Draft EIA Report in relation to specific specialist assessments	■	■	■	■	■	■	✓	✓	✓	■	✓	■	■	✓	■	■	✓	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Note from the CSIR: If sections are not mentioned in the above table, this means that either there have been no changes or no major changes to these sections.

EXECUTIVE SUMMARY

INTRODUCTION AND PROJECT LOCALITY

The Project Developer, Kudu Solar Facility 4 (Pty) Ltd (hereafter "Project Applicant" or "Project Developer") is proposing to develop a Solar Photovoltaic (PV) power generation facility and associated Electrical Grid Infrastructure (EGI), north-east of the town of De Aar in the Renosterberg Local Municipality and Pixley Ka Seme District Municipality, in the Northern Cape Province. The proposed projects are located approximately 50 km from De Aar and 25 km from Petrusville. A total of 12 Solar PV Facilities are being proposed. Each project will have a specific Project Applicant. The proposed projects are referred to as the "Kudu project". A locality map is provided in Figure A.

ABO Wind renewable energies (Pty) Ltd (hereafter "ABO Wind") is involved in the development proposal stage, however the responsibility for the actual implementation of the project (should Environmental Authorisation (EA) and relevant approvals be granted) lies with the Project Developer / Project Applicant (i.e., Kudu Solar Facility 4 Pty) Ltd)).

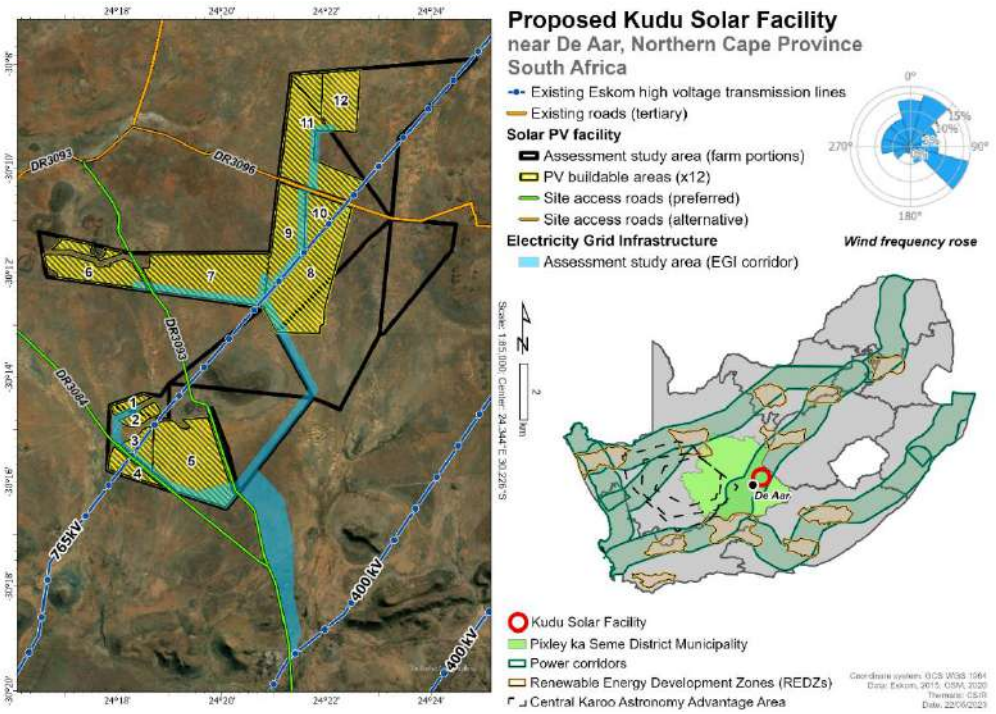


Figure A. Locality Map of the proposed Kudu Projects. Note that the EGI Projects are not part of the current application and report. The EGI Projects will be considered separately at a later stage. The EGI corridor indicated in this Figure is indicative.

The proposed Solar PV Facilities will make use of PV solar technology to generate electricity from energy derived from the sun. Each solar PV Facility will have a range of associated infrastructure, including, but not limited to, an on-site substation complex, Battery Energy Storage System (BESS), and is proposed to connect to the existing Hydra-Perseus 400 kV overhead power line via dedicated proposed 132 kV power lines, an independent Main Transmission Substation (MTS), and a 400 kV Loop-In-Loop-Out (LILO).

Each of the Solar PV Facilities would be its own project and would require its own, separate EA. The same applies to the EGI projects. The following projects are being proposed (illustrated in Figure B):

- **PROJECTS 1 TO 12**: The proposed development of 12 Solar PV Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 to Kudu Solar Facility 12[1]).
- **PROJECTS 13 TO 24**: The proposed development of switching stations and collector stations at each on-site substation complex at each of the 12 Kudu Solar Facilities, and up to 12 x 132 kV overhead power lines running from each Solar PV Facility to the proposed collector stations or up to the proposed MTS.
- **PROJECT 25**: The proposed development of an independent 400/132 kV MTS, including associated infrastructure at the MTS.
- **PROJECT 26**: The proposed development of a 400 kV LILO from the existing Hydra-Perseus 400 kV overhead power line to the proposed MTS.

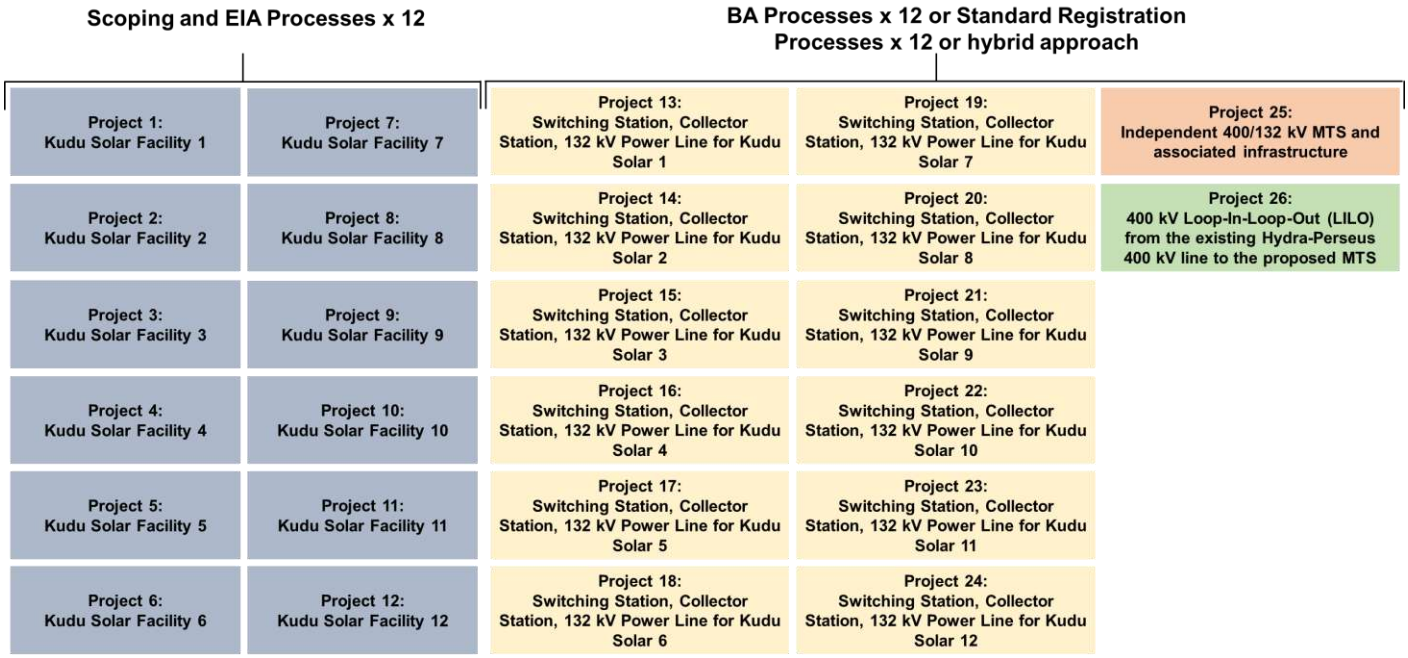


Figure B: Breakdown of the projects that comprise the Kudu Solar Facilities and EGI cluster.

[1] Note that throughout the report the term Solar Facility and PV are used synonymously. For example, Kudu Solar Facility 1 and Kudu PV1 are used interchangeably.

Projects 1 to 12 require Scoping and Environmental Impact Assessment (EIA) Processes in terms of the 2014 National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations (as amended). Projects 13 to 26 will require Basic Assessment (BA) Processes or will be subjected to separate registration processes in terms of the EGI Standard (Government Gazette (GG) 47095; Government Notice (GN) 2313, dated 27 July 2022).

Note that separate reporting will also be followed for Projects 13 to 26 based on the relevant environmental management instrument implemented at the time. Projects 13 to 26 are not the subject of this current EIA Report.

This EIA Report only addresses Kudu Solar Facility 4 (i.e., Project 4) (hereafter referred to as the "Kudu Solar Facility" or "proposed project"), and separate reports have been compiled for each of the Solar PV Facilities (i.e., Projects 1 to 12).

The proposed project is not located within any of the Renewable Energy Development Zones (REDZs) that were gazetted in GG 41445, GN 114 on 16 February 2018; and GG 44191, GN 144 on 26 February 2021, hence it is subjected to a full Scoping and EIA Process with a 107-day decision-making timeframe, as opposed to a BA Process and 57-day decision-making timeframe allowed for in the REDZs. The proposed project is located within the Central Strategic Transmission Corridor that was gazetted in GN 113 on 16 February 2018; however, the benefits only apply specifically to the EGI projects (Projects 13 – 26). This is depicted in Figure A.

The Competent Authority for this proposed project is the National Department of Forestry, Fisheries and the Environment (DFFE). It is intended that this project will be bid into a future bidding program of the Renewable Energy Independent Power Producer Programme (REIPPPP) [or another future process linked to the IRP].

Study Area and Buildable Areas

The study area or preferred site for all 12 of the Kudu Solar Facilities constitutes the full extent of the eight affected farm portions indicated in Table A. The total extent of the study area is approximately 8 150 hectares (ha). The preferred site serves as the study area for this Scoping and EIA Process.

Table A: Farm portions and SG codes for the Study Area.

FARM PORTION	SG CODE
Remaining Extent of the Farm Bas Berg No. 88	C05700000000008800000
Remaining Extent of Portion 3 of the Farm Bas Berg No. 88	C05700000000008800003
Portion 4 (Portion of Portion 3) of the Farm Bas Berg No. 88	C05700000000008800004
Remaining Extent of Portion 2 (Middel Plaats) (a Portion of Portion 1) of the Farm Grasspan No. 40	C05700000000004000002
Remaining Extent of the Farm Annex Wolve Kuil No. 41	C05700000000004100000
Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41	C05700000000004100001
Portion 2 of the Farm Wolve Kuil No. 43	C05700000000004300002
Remaining Extent of the Farm Wolve Kuilen No. 42	C05700000000004200000

At the commencement of this Scoping and EIA Process, the Original Scoping Buildable Areas were identified by the Project Developer following the completion of high-level environmental screening based on the Screening Tool.

Following the identification of sensitivities during the Scoping Phase, the Project Developer considered such sensitivities and formulated the Revised Scoping Buildable Areas. The Revised Scoping Buildable Areas were used to inform the design of the layout, and further assessed during this EIA Phase of the project in order to identify the preferred development footprint of the proposed project on the approved site as contemplated in the accepted Scoping Report.

PROJECT ENVIRONMENTAL IMPACT ASSESSMENT TEAM

In accordance with Regulation 12 (1) of the 2014 NEMA EIA Regulations (as amended), ABO Wind appointed the Council for Scientific and Industrial Research (CSIR) to undertake the required Scoping and EIA Process in order to determine the potential biophysical, social and economic impacts associated with undertaking the proposed development. The project team and the relevant specialists are indicated in Table B below.

Table B. Project Team for the Scoping and EIA Process.

NAME	ORGANISATION	ROLE/STUDY TO BE UNDERTAKEN
Environmental Management Services (CSIR)		
Paul Lochner *(Registered EAP (2019/745))*	CSIR	EAP, Technical Advisor and Quality Assurance
Rohaida Abed (*Pr.Sci.Nat.* and *Registered EAP (2021/4067))*	CSIR	EAP and Project Manager
Helen Antonopoulos	CSIR	Project Officer
Sonto Mkize	CSIR	Project Officer
Phindile Mthembu	CSIR	Project Officer
Luanita Snyman van der Walt *(Pr.Sci.Nat.)*	CSIR	GIS Specialist
Lizande Kellerman *(Pr.Sci.Nat.)*	CSIR	Public Participation Specialist
Specialists		
Johann Lanz (*Pr.Sci.Nat.)*	Private	Agriculture and Soils Compliance Statement
Corne Niemandt *(Pr.Sci.Nat.)* Samuel Laurence *(Pr.Sci.Nat.)*	Enviro-Insight cc	Terrestrial Biodiversity, Terrestrial Plant Species, and Terrestrial Animal Species
Toni Belcher *(Pr.Sci.Nat.)* Dana Grobler *(Pr.Sci.Nat)*	Private	Aquatic Biodiversity Impact Assessment
Chris van Rooyen Albert Froneman (*Pr.Sci.Nat.)*	Chris van Rooyen Consulting	Avifauna Impact Assessment
Quinton Lawson (*SACAP, 3686*) Bernard Oberholzer (*SACLAP, 87018*)	QARC and BOLA	Visual Impact Assessment
Dr Jayson Orton (*APHP: Member 43; ASAPA CRM Section: Member 233*)	ASHA Consulting (Pty) Ltd	Heritage Impact Assessment (Archaeology and Cultural Landscape)
Dr John Almond *(PSSA and APHP Member)*	Natura Viva cc	Palaeontology Site Sensitivity Verification Report
Tony Barbour and Schalk van der Merwe	Private	Socio-Economic Impact Assessment
Annebet Krige *(Pr Eng)*	Sturgeon Consulting	Traffic Impact Assessment
Debbie Mitchell *(Pr Eng)*	Ishecon cc	Battery Storage High Level Safety, Health and Environment Risk Assessment

NAME	ORGANISATION	ROLE/STUDY TO BE UNDERTAKEN
Dale Barrow (*Pr.Sci.Nat.)* Christel van Staden (*Cand.Sci.Nat.)* Shane Teek (*Cand.Sci.Nat.)* Louis Jonk *(Pr.Sci.Nat.)* Julian Conrad	GEOSS South Africa (PTY) Ltd	Geohydrology Assessment
Shane Teek (*Cand.Sci.Nat.)* Hardy Luttig Julian Conrad	GEOSS South Africa (PTY) Ltd	Geotechnical Assessment
Rohaida Abed *(Pr.Sci.Nat.* and *Registered EAP (2021/4067))* Helen Antonopoulos Lizande Kellerman *(Pr.Sci.Nat.)*	CSIR	Civil Aviation Site Sensitivity Verification
Rohaida Abed *(Pr.Sci.Nat.* and *Registered EAP (2021/4067))* Helen Antonopoulos Lizande Kellerman *(Pr.Sci.Nat.)*	CSIR	Defence Site Sensitivity Verification

The specialist assessments have been detailed during the EIA Phase and comply with Appendix 6 of the 2014 NEMA EIA Regulations (as amended), or the Assessment Protocols published in GN 320 on March 2020; or the Assessment Protocols published in GN 1150 on October 2020. However, the BESS High Level Safety, Health and Environment Risk Assessment serves as a technical report and the aforementioned legislation will thus not be applicable.

PROJECT DESCRIPTION

It is important to point out at the outset that the exact specifications of the proposed project components will be determined during the detailed design and engineering phase prior to construction (subsequent to the issuing of EA, should it be granted for the proposed project). A summary of the key components of the proposed project is provided in Table C below.

Table C. Summary of the proposed project components and associated infrastructure.

Component	Description
Solar Field	
Type of Technology	Solar Photovoltaic (PV) Technology
Generation Capacity (Maximum Installed)	▪ Up to 50 MWac
Total developable area that includes all associated infrastructure within the fenced off area of the PV facility	▪ Approximately 70 ha
PV Panel Structure (with the following possible tracking and mounting systems): ▪ Single Axis Tracking structures (aligned north-south); ▪ Dual Axis Tracking (aligned east-west and north-south); ▪ Fixed Tilt Mounting Structure; ▪ Mono-facial Solar Modules; or ▪ Bifacial Solar Modules.	▪ Height: Approximately 3.5 m (maximum)
Building Infrastructure	
Auxiliary Buildings	▪ Type: These include, but are not limited to, Operation and Maintenance (O&M) building / centre, site office, workshop,

Component	Description
	staff lockers, bathrooms/ablutions, warehouses, guard houses, etc. ▪ Cumulative Footprint: Approximately up to 5000 m^2 ▪ Height: Up to 10 m
Inverter/Transformer Stations	▪ Preliminary average number of stations: 27 ▪ Height: Approximately 3 m ▪ Footprint: Approximately 220 m^2 each
On-site Substation Complex	▪ Components of the on-site substation complex: o On-site Independent Power Producer (IPP) or Facility Substation (~1 ha)[2]. o Solid State Lithium Ion or Redox Flow Battery Energy Storage System. Refer to the details below. o Switching Station and Collector Station (~2 ha). **This forms part of Projects 13 – 24 and will be assessed as part of separate processes. It is important to mention here for contextualisation (it does not appear in the Application for EA or relevant listed activities).** ▪ Footprint of the on-site substation complex: Up to approximately 8 ha ▪ Height of the on-site substation complex: Up to 10 m ▪ Capacity of the on-site substation complex: This varies according to the detailed design and requirements from potential clients, however a capacity stepping up from 22 kV or 33 kV to 132 kV is estimated.
Associated Infrastructure	
Battery Energy Storage System (BESS)	▪ Technology: Solid State Lithium-Ion BESS or Redox Flow BESS (both options have been considered in the Scoping and EIA Process). Both technologies were deemed acceptable by the Environmental Assessment Practitioner (EAP) and specialists. However, the DFFE requested that preferred technology be selected. **Therefore, Solid State Lithium Ion BESS is selected as the preferred technology for authorisation**. However, should the need to change the technology arise in future, it is understood that an EA amendment process can be followed as both technologies have been assessed as part of the EIA Phase. ▪ Footprint: Approximately 1 ha ▪ Height: Up to 10 m ▪ Capacity: Up to 500 MW / 500 MWh

[2] As confirmed with the DFFE, the on-site substation complex can be included within the current Application for EA.

Component	Description
On-site medium voltage internal cables	▪ Placement: Underground or above ground in certain sections ▪ Capacity: 22 or 33 kV ▪ Depth: Maximum depth of 1.5 m
Underground low voltage cables or cable trays	▪ Depth: Maximum depth of 1.5 m
Access roads (including upgrading and widening of existing roads, where relevant)	▪ Details: Existing roads will be used as far as practically achievable to access the site. The Traffic Specialist has noted that the main roads leading to the proposed project site are of a sufficient width. However, upgrading of the main access point from the R48 will be required. This is specifically at the intersection of the TR38/01 (i.e. R48) and DR3093, which will require an existing island of approximately 60 m^2 to be removed and surfaced to accommodate the turning movements of vehicles.
Internal roads	▪ Details: New internal service roads will need to be established (i.e. new roads within the fenced off area of the PV Facility, and new roads between the closest existing road and the PV Facility to gain access). These would either comprise farm roads (compacted dirt/gravel) or paved roads. ▪ Width: o Within the PV Facility: Up to 5 m o Between the existing road and PV Facility: Up to 8 m
Fencing around the PV Facility Perimeter	▪ Type: Could be palisade, mesh or fully electrified. A single perimeter fence is proposed around the PV Facility. ▪ Height: Up to 3 m
Storm water channels	▪ Details to be confirmed once the Engineering, Procurement and Construction (EPC) contractor has been selected and the design is finalised. Where necessary, a detailed storm water management plan would need to be developed.
Panel cleaning and maintenance area	▪ The type of panels to be used (and panel cleaning) will be confirmed during detailed design/engineering phase. The panel cleaning and maintenance area will form part of the O&M Auxiliary Buildings (located at the on-site substation complex).
Work area during the construction phase (i.e. laydown area)	▪ Temporary Laydown: Up to 7 ha. ▪ The need for a permanent laydown area will be confirmed during the detailed design/engineering phase.
Water Requirements	▪ Approximately 9 000 m^3 of water is estimated to be required per year for the construction phase. ▪ Approximately 1 000 m^3 of water is estimated to be required per year for the operational phase. ▪ Water requirements during the decommissioning phase are unknown at this stage, however they are expected to be similar to the construction phase. ▪ Potential sources: Local municipality, third-party water supplier, existing boreholes or drilled boreholes on site.

Component	Description
Construction Period	▪ 12 – 18 months
Operational Period	▪ Once the commercial operation date is achieved, the proposed facility will generate electricity for a minimum period of 20 years.

APPROACH TO THE EIA PROCESS

As noted above, in terms of the 2014 NEMA EIA Regulations (as amended), a full Scoping and EIA Process is required for the proposed project. The need for the Scoping and EIA is triggered by, amongst others, the inclusion of Activity 1 listed in GN R325 (Listing Notice 2):

- *"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more, excluding where such development of facilities or infrastructure is for photovoltaic installations and occurs (a) within an urban area; or (b) on existing infrastructure".*

Chapter 4 of the EIA Report contains the detailed list of activities contained in GN R327, R325 and R324 which are triggered by the various project components and thus form part of this Scoping and EIA Process.

The Public Participation Process (PPP) for this Scoping and EIA Process is being undertaken in compliance with Chapter 6 of the 2014 NEMA EIA Regulations (as amended). An integrated PPP is being undertaken for all 12 proposed Solar PV facilities. The Scoping and EIA Process commenced in December 2022, and a pre-application meeting with the National DFFE was held on 26 April 2022 (Reference Number: 2022-04-0005). The Draft Scoping Report was made available for a 30-day comment period in December 2022, and the Final Scoping Report was submitted to the DFFE in February 2023, and thereafter accepted in March 2023.

The Draft EIA Report was made available to all Interested and/or Affected Parties (I&APs), Organs of State and relevant stakeholders for a 30-day review period, extending from **2 June 2023 to 3 July 2023.** The Draft EIA Report was uploaded to the project website (i.e., https://www.csir.co.za/environmental-impact-assessment) for potential and registered I&APs to access it. As a supplementary mechanism, the Draft EIA Report was also uploaded to an alternative web-platform i.e., Google Drive. Written notification of the commencement of the EIA Phase and the availability of the Draft EIA Report for comment was sent to all potential and registered I&APs, Organs of State and key relevant stakeholders included on the project database via email, where email addresses were available. This notification was sent at the commencement of the 30-day review period on the Draft EIA Report and included information on the proposed project and notification of the release and availability of the report. Various reminder emails were also sent to the stakeholders, and key stakeholders were called telephonically, followed by a confirmation of discussion email or text message. Refer to Appendix H.4 of this EIA Report for proof of such correspondence. Copies of all written comments received during the 30-day review of the Draft EIA Report have been incorporated into a detailed Comments and Responses Report, and addressed, as applicable and where relevant, and included in this Final EIA Report. The Final EIA Report (i.e., this report) has been submitted to the DFFE, in accordance with Regulation 23 of the 2014 NEMA EIA Regulations (as amended), for decision-making.

SUMMARY OF IMPACT ASSESSMENT FINDINGS AND RECOMMENDED MANAGEMENT ACTIONS

The findings and impact assessment of the detailed specialist assessments (included as Chapters 6 to 17), as well as other relevant project information are included and integrated into the EIA Report. An Environmental Management Programme (EMPr) for the Solar PV Facility and a Generic EMPr for the on-site substation are included in Appendix I and J of this EIA Report, respectively. The EMPr is based on the recommendations for mitigation measures and management actions provided by the specialist team for the planning and design, construction, operational and decommissioning phases of the proposed project.

This section provides a summary of the key impacts that were identified and assessed in detail by the specialists during the EIA Phase. Note that several mitigation measures have also been provided by the specialists, however only selected key measures are noted in Table D below.

Table D. Summary of Issues and Key Impacts that were identified and assessed during the EIA Phase as part of the Specialist Impact Assessments, including recommended mitigation measures and management actions.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
Chapter 6 – Agriculture Compliance Statement	**Negative Direct Impacts:** **Construction Phase**: • Loss of agricultural potential by occupation of land. • Loss of agricultural potential by soil degradation. Soil can be degraded by impacts in three different ways: erosion; topsoil loss; and contamination. • Loss of agricultural potential by dust generation. **Decommissioning Phase**: • Loss of agricultural potential by soil degradation. Soil can be degraded by impacts in three different ways: erosion; topsoil loss; and contamination. • Loss of agricultural potential by dust generation. **Positive Indirect Impacts (mainly during operations):** • Increased financial security for farming operations. • Improved security against stock theft and other crime due to the presence of security infrastructure and security personnel at the energy facility.	**Design Phase:** ▪ Design an effective system of stormwater run-off control, where it is required - that is at any points where run-off water might accumulate. The system must effectively collect and safely disseminate any run-off water from all accumulation points and it must prevent any potential down slope erosion. This is included in the stormwater management plan. **Construction and Decommissioning Phases:** ▪ Implement an effective system of stormwater run-off control, where it is required (as specified above). ▪ Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize disturbed soil against erosion. ▪ If an activity will mechanically disturb the soil below surface in any way, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. **Operational Phase:** ▪ Maintain the stormwater run-off control system. Monitor erosion and remedy the stormwater control system in the event of any erosion occurring. ▪ Facilitate re-vegetation of denuded areas throughout the site.
Chapter 7: Terrestrial Biodiversity, Terrestrial Plant Species, and	**Negative Direct Impacts:** **Construction Phase:** • Habitat loss and fragmentation • Loss of protected species • Increased alien invasive species	**Construction Phase:** ▪ No development should take place within High sensitivity areas or buffer zones. Accordingly, the Koppies habitat (where relevant) should be avoided. The Watercourse habitats of medium sensitivity

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
Terrestrial Animal Species Assessment	• Increased erosion and soil compaction • Littering and general pollution **Operational Phase:** • Loss of species composition and diversity • Increased alien invasive species • Littering and general pollution **Decommissioning Phase:** • Loss of habitat • Increased alien invasive species **Cumulative Impacts – Construction Phase and Negative:** • Loss of habitat and vegetation	should be avoided, as recommended by the Aquatic specialist. ▪ No construction related activities, such as the site camp, storage of materials, temporary roads or ablution facilities may be located in the high sensitivity areas. ▪ Where the approved layout designs impact on individuals, permit applications are required for either the relocation or destruction of provincially protected species (Northern Cape Nature Conservation Act No.9 of 2009) and for protected trees in terms of the National Forests Act No. 84 of 1998. ▪ Alien invasive species establishment and spreading should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with such plants. ▪ Utilise existing access routes as far as possible. Confine the movement of vehicles to the access routes to and from the site and to the construction areas. ▪ Rehabilitate new vehicle tracks and areas where the soil has been compacted as soon as possible. ▪ Monitor the entire site for signs of erosion. ▪ General good housekeeping in terms of spills, refuelling and waste management. These have been included in the Environmental Management Programme. **Operational Phase:** ▪ The loss of species composition and diversity cannot be mitigated due to a permanent structure which will change microclimatic conditions for the life of the facility operation. ▪ Implement appropriate rehabilitation measures to restore each habitat to a natural state that is representative of the respective vegetation type after construction. ▪ Follow an alien and invasive species control and monitoring plan. ▪ General good housekeeping in terms of spills, refuelling and waste management. These have been included in the Environmental Management Programme. **Decommissioning Phase:** ▪ The loss of vegetation is unavoidable within the approved layout development footprint, but sensitive areas must be avoided. ▪ Rehabilitation and alien invasive management as per the construction and operational phase.
Chapter 8: Aquatic Biodiversity	**<u>Negative Direct Impacts:</u>** **Construction Phase:** ▪ Disturbance of aquatic habitat and impact on aquatic biota; ▪ Removal of indigenous aquatic vegetation and associated loss of aquatic ecological integrity and functionality;	**Construction Phase:** ▪ Ensure the final layout of the PV facility and associated infrastructure avoids watercourses and recommended buffers as far as possible; utilisation should be made of existing disturbed areas where possible. The medium sensitivity aquatic habitats should be avoided in the layout design, with only low-sensitivity habitats being disturbed during construction. Note that this has

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
	▪ Water supply for construction and stress on available water resources; ▪ Road crossing structures may impede flow in the aquatic features; ▪ Alien vegetation infestation within the aquatic features due to disturbance; and ▪ Increased sedimentation and contamination of surface water runoff may result from construction activities. **Operational Phase:** ▪ Ongoing disturbance of aquatic features and associated vegetation along access roads or adjacent to the infrastructure that needs to be maintained; ▪ Modified runoff characteristics from hardened surfaces has the potential to result in erosion of adjacent watercourses; and ▪ Water supply and water quality impacts (e.g. contamination from sewage) as a result of the operation of the proposed Solar Facility and associated infrastructure. **Decommissioning Phase:** ▪ Increased disturbance of aquatic habitat due to the increased activity; and ▪ Increased sedimentation and contamination of surface water runoff. **<u>Negative Cumulative Impacts:</u>** **Construction and Decommissioning Phases:** ▪ Increased disturbance of aquatic habitat due to the increased activity in the wider area. **Operational Phases:** ▪ Degradation of ecological condition of aquatic ecosystems	been achieved in the EIA Phase, whereby the recommended development setbacks (i.e. recommended buffer of at least 35 m for the smaller drainage features; and setback from the wider floodplain adjacent to the larger rivers) have been adopted in the identification of the development footprints. The recommended avoidance areas have been avoided. ▪ Clearing of indigenous vegetation should not take place within the aquatic features and the recommended buffers. ▪ Rehabilitate disturbed aquatic habitats by revegetating them with suitable local indigenous vegetation. ▪ Water use for construction should be minimised as much as possible. The water should be obtained from an existing water allocation or other viable water sources for construction purposes. ▪ The road crossing structures should be designed to not impede flow in watercourses - low water crossing is preferred. Use existing crossings, as best as possible and where allowable. ▪ The existing road infrastructure, particularly within the floodplain, should be utilised as far as possible to access new infrastructure to minimise the overall disturbance. It is recommended that any new linear type of infrastructure crossings over watercourses be placed where there are existing structures or road crossings within the watercourse corridors, where possible. ▪ Undertake monitoring for the growth of alien vegetation. **Operational Phase:** ▪ Implement avoidance setbacks as recommended above the for the construction phase. ▪ Develop a stormwater management plan for the proposed development that addresses the stormwater runoff from the developed areas. ▪ Stormwater run-off infrastructure must be designed to mitigate both the flow and water quality impacts of any stormwater leaving the developed areas. The runoff should rather be dissipated over a broad area covered by natural vegetation or managed using appropriate shaping of the road with berms or channels and swales adjacent to hardened surfaces where necessary. Should any erosion features develop, they should be stabilised immediately. ▪ Sewage generated within the site should be discharged to a conservancy tank that is properly serviced and regularly evacuated to nearby wastewater treatment works. **Decommissioning Phase:** ▪ Minimise works within aquatic ecosystems. If the project layout avoided these areas, the decommissioning works would also be able to avoid aquatic habitats as delineated. Note that all aquatic areas recommended for avoidance have been avoided in the EIA phase layout identification.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
		▪ Rehabilitate and revegetate disturbed areas, where required. ▪ Decommissioning activities within aquatic features should be undertaken in the dry season where possible.
Chapter 9: Avifauna Assessment	**<u>Negative Direct Impacts:</u>** **Construction Phase:** ▪ Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure. **Operational Phase:** ▪ Displacement due to habitat transformation associated with the presence of the solar PV plant and associated infrastructure. ▪ Collisions with the solar panels. ▪ Entrapment in perimeter fences. ▪ Electrocutions in the onsite substation complex. ▪ Electrocution of priority species on the internal 33kV powerlines. **Decommissioning Phase:** ▪ Displacement due to disturbance associated with the decommissioning of the solar PV plant and associated infrastructure. **<u>Negative Cumulative Impacts:</u>** **Construction and Decommissioning Phases:** ▪ Displacement due to disturbance associated with the construction and decommissioning of the solar PV plants and associated infrastructure. **Operational Phase:** ▪ Displacement due to habitat transformation associated with the presence of the solar PV plants and associated infrastructure. ▪ Collisions with the solar panels. ▪ Entrapment in perimeter fences. ▪ Electrocutions in the onsite substation complexes. ▪ Electrocution of priority species on the internal 33kV powerlines.	**Construction Phase:** ▪ Activity should as far as possible be restricted to the footprint of the infrastructure. ▪ Measures to control noise and dust should be applied according to best practice in the industry at the time. ▪ Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical. ▪ Access to the rest of the property must be restricted. ▪ The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned. ▪ A 1km all infrastructure exclusion zone around the Verreaux's Eagle nest at -30.227660° 24.329773° must be implemented to provide unhindered access to the nest. The development footprint assessed in this report does not infringe on this buffer. **Operational Phase:** ▪ The recommendations of the botanical specialist must be strictly implemented, especially as far as limiting the vegetation clearance to what is absolutely necessary, and rehabilitation of transformed areas are concerned. ▪ Where possible, surface water (pans, dams and water troughs) must be buffered by a minimum of 50m to ensure unhindered access of priority species to the water. No PV panels should be constructed in this zone. Note that some of the waterpoints in the development footprint will be removed, however, since the minimum circular solar panel exclusion zone of 50m will be applied, the removal of some of the waterpoints will therefore not be a significant impact. ▪ A single perimeter fence should be used. ▪ The hardware within the proposed substation yard is too complex to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded once operational, site-specific mitigation (insulation) be applied reactively. This is an acceptable approach because Red List priority species are unlikely to frequent the substation and be electrocuted. ▪ Use underground cabling as far as possible. Where the use overhead lines are unavoidable due to technical constraints, a bird-friendly pole design must be used. The avifaunal specialist must sign off on the pole design. **Decommissioning Phase:** ▪ Activity should as far as possible be restricted to the footprint of the infrastructure.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
		▪ Measures to control noise and dust should be applied according to best practice in the industry at the time. ▪ Maximum use should be made of existing access roads during the decommissioning phase and the construction of new roads should be kept to a minimum as far as practical. ▪ The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned.
Chapter 10: Visual Impact Assessment	**<u>Negative Direct Impacts:</u>** **Construction Phase:** ▪ Potential effect of dust and noise from trucks and construction machinery during the construction period, and the effect of this on nearby farmsteads and visitors to the area. ▪ Potential visual effect of haul roads, access roads, stockpiles and construction camps in the visually exposed landscape. **Operational Phase:** ▪ Potential visual intrusion of solar arrays and related infrastructure on receptors including glint and glare. ▪ Potential visual impact of an industrial type activity on the pastoral / rural character and sense of place of the area. **Decommissioning Phase:** ▪ Potential visual effect of any remaining structures, platforms and disused roads on the landscape. **<u>Negative Cumulative Impacts:</u>** **Construction, Operational and Decommissioning Phases:** ▪ Potential combined visual effect of the proposed 12 solar PV facilities in the study area, seen together with other existing and proposed renewable energy facilities in the area, and could potentially increase the overall cumulative visual impact.	**Construction Phase:** ▪ Locate construction camps, batching plants and stockpiles in visually unobtrusive areas, away from public roads. ▪ Implement EMPr with ECO during construction. **Operational Phase:** ▪ Substation and BESS to be located in an unobtrusive low-lying area, away from public roads. ▪ Muted natural colours and non-reflective finishes to be used for structures generally. ▪ Internal access roads to be as narrow as possible, and existing roads or tracks used as far as possible. ▪ Outdoor/ security lighting to be fitted with reflectors to obscure the light source, and to minimise light spillage. ▪ Internal powerlines (i.e. 22 kV or 33 kV) to be located underground where possible. (In some cases, such as stream crossings, internal powerlines may need to be above ground). ▪ Outdoor signage to be discrete and commercial / billboard signage avoided. **Decommissioning Phase:** ▪ Solar arrays and infra-structure to be removed and recycled. ▪ Access roads no longer required to be ripped and regraded. ▪ Exposed or disturbed areas to be revegetated to blend with the surroundings.
Chapter 11: Heritage Impact Assessment (Archaeology and Cultural Landscape)	**<u>Negative Direct Impacts:</u>** **Construction Phase:** ▪ Potential impacts to archaeology; ▪ Potential impacts to graves; and ▪ Potential impacts to the cultural landscape. **Operational Phase:** ▪ Potential impacts to the cultural landscape. **Decommissioning Phase:** ▪ Potential impacts to the cultural landscape.	**Construction Phase:** ▪ Report any chance finds of dense clusters of artefacts to SAHRA and/or an archaeologist. Protect in situ and appoint archaeologist to sample as needed. ▪ Report any chance finds of graves to SAHRA and/or an archaeologist. Protect in situ and appoint archaeologist to exhume. ▪ Minimise the duration of construction period. ▪ Ensure effective rehabilitation, at the end of the construction period, of areas not needed during operation.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
	Negative Cumulative Impacts: **Construction, Operational and Decommissioning Phases:** ▪ Potential impacts to the cultural landscape. **Construction Phase:** ▪ Potential impacts to archaeology; and ▪ Potential impacts to graves.	**Operational Phase:** ▪ Ensure that all maintenance vehicles and operational activities stay within designated areas. ▪ Paint buildings in earthy colours to reduce contrast. ▪ Make use of motion detectors and downlighting to reduce night-time light pollution. **Decommissioning Phase:** ▪ Minimise duration of decommissioning period ▪ Ensure effective rehabilitation of the entire site once the infrastructure has been removed.
Chapter 12: Palaeontology Site Sensitivity Verification Report	▪ The study area has been confirmed as low to very low palaeo-sensitivity. Provided that the Chance Fossil Finds Protocol is incorporated into the EMPrs and fully implemented during the construction phase of the solar PV facility, there are no objections on palaeontological heritage grounds to authorisation of the proposed project. Pending the discovery of significant new fossil finds before or during construction, no further specialist palaeontological studies, reporting, monitoring or mitigation are recommended for the proposed project.	▪ The Chance Fossil Finds Protocol has been incorporated into the project EMPrs (Appendix I and Appendix J of this EIA Report).
Chapter 13: Socio-Economic Assessment	**Direct Negative Impacts** **Construction Phase:** ▪ Impacts associated with the presence of construction workers on local communities. ▪ Impacts related to the potential influx of job seekers. ▪ Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site. ▪ Increased risk of grass fires associated with construction related activities; ▪ Nuisance impacts, such as noise, dust, and safety, associated with construction related activities and vehicles. ▪ Impact on productive farmland. **Operational Phase:** ▪ Visual impacts and associated impacts on sense of place. ▪ Potential impact on property values. ▪ Potential impact on tourism. **Decommissioning Phase:** ▪ Social Impacts associated with retrenchment, including loss of jobs and source of income. **Direct Positive Impacts** **Construction Phase:** ▪ Creation of employment and business opportunities, and opportunity for skills development and on-site training.	Note that several mitigation and enhancement measures have been identified in the assessment. The list below is only a summary of some of the recommendations. **Positive Impacts – Enhancement Measures:** **Construction Phase:** ▪ Where reasonable and practical, the proponent should appoint local contractors and implement a 'locals first' policy, especially for semi and low-skilled job categories. However, due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area. ▪ Where feasible, efforts should be made to employ local contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria. ▪ Before the construction phase commences the proponent should meet with representatives from the Renosterberg Local Municipality (RLM) and the Emthanjeni Local Municipality (ELM) to establish the existence of a skills database for the area. If such as database exists, it should be made available to the contractors appointed for the construction phase. ▪ The local authorities, community representatives, and organisations on the interested and affected party database should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that the proponent intends following for the construction phase of the project. ▪ Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase. ▪ The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
	Operational Phase: ▪ Establishment of infrastructure to improve energy security and support renewable sector. ▪ Creation of employment opportunities. ▪ Benefits associated with socio-economic contributions to community development. ▪ Benefits for local landowners. **<u>Cumulative impacts:</u>** ▪ Negative: Cumulative impacts on sense of place ▪ Negative: Cumulative impact on local services and accommodation ▪ Positive: Cumulative impact on local economy.	▪ The proponent and contractor should develop a Code of Conduct (CoC) for construction workers. The code should identify which types of behaviour and activities are not acceptable. Construction workers in breach of the code should be subject to appropriate disciplinary action and/or dismissed. All dismissals must comply with the South African labour legislation. The CoC should be signed by the proponent and the contractors before the contractors move onto site. The CoC should form part of the CHSSP. **Operational Phase:** ▪ Maximise the number of employment opportunities for local community members. ▪ Implement training and skills development programs for members from the local community. ▪ Maximise opportunities for local content and procurement. ▪ Implement agreements with affected landowners on which the PV facility will be constructed. **Negative Impacts – Mitigation Measures:** **Construction Phase:** ▪ Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase. ▪ Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase. ▪ All farm gates must be closed after passing through. ▪ Contractors appointed by the proponent should provide daily transport for low and semi-skilled workers to and from the site. ▪ Timing of construction activities should be planned to avoid / minimise impact on key farming activities. ▪ All areas disturbed by construction related activities, such as access roads on the site, construction platforms, workshop area etc., should be rehabilitated at the end of the construction phase. **Operational Phase:** ▪ The recommendations of the Visual Impact Assessment should be implemented. **Decommissioning Phase:** ▪ The proponent should ensure that retrenchment packages are provided for all staff retrenched when the plant is decommissioned. ▪ All structures and infrastructure associated with the proposed facility should be dismantled and transported off-site on decommissioning.
Chapter 14: Traffic Impact Assessment	**<u>Direct Negative Impacts</u>** **Construction and Decommissioning Phases:** ▪ Potential congestion and delays on the surrounding road network. ▪ Potential impact on traffic safety and increase in accidents with other vehicles or animals.	**Construction and Decommissioning Phases:** ▪ Stagger delivery trips and schedule trips, including staff trips outside of peak hours where possible. ▪ Implement speed control by means of a stop and go system and speed limit road signage within the construction and decommissioning site.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
	▪ Potential change in the quality of the surface condition of the roads. ▪ Potential noise and dust pollution. **Operational Phase:** ▪ The traffic generated during the operational phase are mainly related to the staff that will be transported to and from the sites and are not anticipated to have a significant traffic impact on the surrounding road network. **<u>Cumulative Negative Impacts</u>** **Construction and Decommissioning Phases:** ▪ Potential congestion and delays on the surrounding road network. ▪ Potential impact on traffic safety and increase in accidents with other vehicles or animals. ▪ Potential change in the quality of the surface condition of the roads. ▪ Potential noise and dust pollution.	▪ Ensure all vehicles are roadworthy, visible, adequately marked, and operated by an appropriately licenced operator. ▪ Regular maintenance of internal farm access roads by the contractor. ▪ Ensure private access roads that are impacted on by the proposed development are restored to original pre-construction road condition. ▪ Implement dust control on gravel roads within the construction and decommissioning site.
Chapter 15: Battery Energy Storage System High Level Safety, Health and Environment Risk Assessment	Various risks were identified in terms of safety, health and the environment due to the proposed BESS. The BESS High Level Safety, Health and Environment Risk Assessment identified risks, hazards, and consequences, such as, but not limited to: ▪ Human Health - chronic exposure to toxic chemical or biological agents. Causes - Construction materials such as cement, paints, solvents, welding fumes, truck fumes etc. Consequences - Employee / contractor illness. ▪ Human Health - exposure to noise. Causes - Drilling, piling, generators, air compressors. Consequences - Adverse impact on hearing of workers. Possible nuisance factor in near-by areas. ▪ Human and Equipment Safety - exposure to fire radiation Causes – ▪ Involvement in an external fire. Fire involving fuels used in construction vehicles or vehicles themselves (e.g., tyre fire). Fire due to uncontrolled welding or other hot-work. Consequences - Injuries due to radiation especially amongst first responders and bystanders. Fatalities unlikely from the heat radiation as not highly flammable nor massive fire. ▪ Human and Equipment Safety - exposure to explosion over pressures. Transformer shorting / overheating / explosion. Consequences - Potential fatalities, e.g., amongst first responders. Damage to nearby equipment.	▪ There are numerous different battery technologies but using one consistent battery technology system for the BESS installations associated with all the proposed Kudu Solar Facilities would allow for ease of training, maintenance, emergency response and could significantly reduce risks. ▪ Where reasonably practicable, state-of-the-art battery technology should be used with all the necessary protective features e.g., draining of cells during shutdown and standby-mode, full Battery Management System (BMS) with deviation monitoring and trips, leak detection systems. ▪ Ensure that the technical and system suggestions for reducing risks, as specified in the assessment, specifically in terms of preventative and mitigative measures are included in the design. ▪ The overall design should be subject to a full Hazard and Operability Study (HAZOP) prior to finalisation of the design. ▪ For Redox Flow systems, an end of life (and for possible periodic purging requirements) solution for the large quantities of hazardous electrolyte should be investigated, e.g., can it be returned to the supplier for re-conditioning. ▪ Prior to importing any solid-state battery containers into the country, the contractor should ensure that: o An Emergency Response Plan is in place that would be applicable for the full route from the ship to the site. This plan needs to include details of the most appropriate emergency response to fires both while the units are in transit and once they are installed and operating. o An End-of-Life Plan is in place for the handling, repurposing or disposal of dysfunctional, severely damaged batteries, modules and containers. ▪ The site layout and spacing between lithium solid-state containers should be such that it mitigates the

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
		risk of a fire or explosion event spreading from one container to another. ▪ In order to limit the possibility of domino failures the BESS should be separated from the substation by at least 20 m. ▪ Where there is a choice of alternative locations for the BESS, those that are further from water courses would be preferred. Redox Flow BESS hazards are mostly related to possible loss of containment of electrolyte and solid-state systems may experience fires that may result in loss of containment of liquids or the use of large amounts of fire water which could be contaminated. The run-off should not enter water courses directly. ▪ Finally, it is suggested once the BESS technology has been chosen and more details of the final design are available, the necessary updated Risk Assessments should be in place (prior to commencement, after EA and other necessary approvals are granted (should such be granted)).
Chapter 16: Geohydrology Assessment	**Direct Negative Impacts:** **Construction Phase:** ▪ Potential lowering of the groundwater level from construction requirements; ▪ Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages. **Operational Phase:** ▪ Potential lowering of the groundwater level from operational requirements. ▪ Potential impact of groundwater quality as a result of using cleaning agents for cleaning the solar panels. ▪ Groundwater quality deterioration as a result of electrolyte that will be used for the BESS. **Decommissioning Phase:** ▪ Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages. ▪ Potential lowering of the groundwater level from decommissioning requirements. **Cumulative Negative Impacts:** ▪ Potential lowering of groundwater level during the construction, operational and decommissioning phase for all 12 of the Kudu PV facilities. ▪ Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages from the construction and the decommissioning phase for all 12 Kudu facilities. ▪ Potential of impact on groundwater quality as a result of using cleaning agents for cleaning	**Construction and Decommissioning Phases:** ▪ Adhere to the borehole's safe yield and to monitor water levels and flow. ▪ Boreholes must be correctly yield tested according to the National Standard (SANS 10299-4:2003, Part 4 – Test pumping of water boreholes). This includes a Step Test, Constant Discharge Test and recovery monitoring. ▪ Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. ▪ Diesel fuel storage tanks, if required, should be above ground on an impermeable surface in a bunded area. ▪ Vehicles and equipment should also be refuelled on an impermeable surface. A designated area should be established at the construction site camp for this purpose, if off-site refuelling is not possible. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, and reported. **Operational Phase:** ▪ Borehole's safe yield, monitoring and yield testing as per the construction phase. ▪ Use environmentally safe cleaning agents that breakdown naturally and do not cause adverse effects. ▪ Ensure that all electrolyte or chemicals stored or used on site have secondary containment systems in place with reliable leak detection, annunciation in place. Ensure that all chemicals are handled on concrete bunded surfaces and not on bare soil. ▪ Wastewater produced by fire hydrants should not be allowed to runoff into the environment. ▪ It is recommended that all BESS's are placed a minimum of 50m from any borehole.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
	the solar panels during the operational phase for all the 12 Kudu facilities. ▪ Potential impact on groundwater quality as a result of electrolyte that will be used for the BESS. ▪ Other wind and solar, and EGI projects within a 30 km radius.	
Chapter 17: Geotechnical Assessment	**<u>Direct and Cumulative Negative Impacts:</u>** **Construction Phase:** ▪ Displacement of geologic materials. ▪ Contamination of geologic materials as a consequence of the construction activities. **Operational and Decommissioning Phase:** ▪ Increased unnatural hard surfaces. ▪ Contamination of geologic materials as a consequence of typical maintenance and decommissioning activities.	**Construction Phase:** ▪ Favour dolerite as an aggregate (as opposed to Karoo sandstones and mudstones). Subject to investigation. ▪ Any road cuttings should be designed by an appropriately qualified professional. ▪ Drainage in the region should be designed and managed appropriately. ▪ Investigate and confirm the geotechnical suitability of each structure (or other appropriate level of investigation) prior to construction (i.e., determine that soil with an adequate bearing capacity is obtained beneath each footing). Such investigations would not be required to fulfil the requirements of this EIA process. However, it would be necessary prior to construction. ▪ Only strip vegetation necessary for the next phase of construction. ▪ Install temporary drainage to divert stormwater away from active construction activities, where required. ▪ Where impacted through construction-related activities, all sloped areas must be stabilised to ensure proper rehabilitation is affected and erosion is controlled. **Operational Phase:** ▪ Install drainage to divert stormwater away from activities, roads/tracks, structures, where required. ▪ During the execution of the operations, appropriate measures to prevent pollution and contamination of the riparian environment must be implemented e.g. including ensuring that construction equipment is well maintained; **Decommissioning Phase:** ▪ Land rehabilitation to near natural state, i.e., removal of foundations and backfilling of any resultant voids within the soil, as well as removal of hard surfaced areas. Replacement soil should be sourced locally to ensure homogeneity. ▪ Reinstate natural topography where cut-to-fill embankments have been constructed.

SUMMARY OF KEY IMPACT ASSESSMENT FINDINGS

Based on the findings of the detailed specialist impact assessments, which are included in Chapter 6 to 17 of this EIA Report, the proposed project is considered to have an **overall Moderate to Very Low negative environmental impact** and an **overall High to Moderate positive socio-economic impact** (with the implementation of respective mitigation and enhancement measures). Table E below provides a summary of the impact assessment for the proposed project post mitigation for direct impacts. Table F provides the same information for the cumulative impacts.

As indicated in Table E, the direct negative impacts were rated with an overall **Low to Very Low** post-mitigation impact significance for the **construction phase**, with only Terrestrial Biodiversity impacts being rated as Moderate. In terms of the **operational and decommissioning phases**, the majority of the direct negative impacts were rated with a **Low to Very Low** post-mitigation impact significance. In terms of direct positive impacts, the Socio-Economic impacts are rated as having a **Moderate** impact significance post-mitigation for the construction phase; and **Moderate to High** impact significance post-mitigation for the operational phase.

Based on Table F, the majority of the cumulative negative impacts were rated with a **Low** post-mitigation impact significance for the **construction phase**, with the exception of Terrestrial and Socio-Economic impacts, which were respectively rated with a Moderate and Moderate to Low post-mitigation impact significance. A similar trend is applicable to the **operational phase**, with Visual and Avifauna impacts being rated as **Moderate**; and Socio-Economic impacts being rated as **Moderate to Low**.

During the **decommissioning phase**, the majority of cumulative impacts were rated with a **Low to Very Low** post-mitigation impact significance, whereas some were not identified, or are considered insignificant, or could not be measured empirically at the time of assessment. In terms of cumulative positive impacts, the Socio-Economic impacts were rated with an overall **Moderate** post-mitigation impact significance.

Table E: Overall Impact Significance with the Implementation of Mitigation Measures for Direct Negative and Positive Impacts.

Specialist Assessment	Construction Phase	Operational Phase		Decommissioning Phase
DIRECT NEGATIVE IMPACTS				
Agriculture and Soils	Low	Low		Low
Terrestrial Biodiversity, Terrestrial Plant Species, and Terrestrial Animal Species	Moderate	Low		Low
Aquatic Biodiversity	Very Low	Very Low		Very Low
Avifauna	Low	Very Low	Low	Low
Visual	Low	Low		Very Low
Heritage (Archaeology and Cultural Landscape)	Low	Low		Low

Specialist Assessment	Construction Phase		Operational Phase		Decommissioning Phase	
Palaeontology	Insignificant and/or not identified and/or not applicable		Insignificant and/or not identified and/or not applicable		Insignificant and/or not identified and/or not applicable	
Socio-Economic	Low		Low		Low	
Traffic	Low	Very Low	Insignificant		Low	Very Low
Geohydrology	Low	Very Low	Low	Very Low	Very Low	
Geotechnical	Very Low		Very Low		Very Low	
DIRECT POSITIVE IMPACTS						
Socio-Economic	Moderate		Moderate	High	Insignificant and/or not identified and/or not applicable	

Table F: Overall Impact Significance with the Implementation of Mitigation Measures for Cumulative Negative and Positive Impacts.

Specialist Assessment	Construction Phase		Operational Phase		Decommissioning Phase	
CUMULATIVE NEGATIVE IMPACTS						
Agriculture and Soils	Low		Low		Low	
Terrestrial Biodiversity, Terrestrial Plant Species, and Terrestrial Animal Species	Moderate		Low		Low	
Aquatic Biodiversity	Very Low		Very Low		Very Low	
Avifauna	Low		Moderate		Low	
Visual	Low		Moderate		Very Low	
Heritage (Archaeology and Cultural Landscape)	Low		Low		Low	
Palaeontology	Insignificant and/or not identified and/or not applicable		Insignificant and/or not identified and/or not applicable		Insignificant and/or not identified and/or not applicable	
Socio-Economic	Low	Moderate	Low	Moderate	Insignificant and/or not identified and/or not applicable	
Traffic	Low		Insignificant		Low	Very Low
Geohydrology	Low	Very Low	Low	Very Low	Very Low	
Geotechnical	Low		Low		Low	
CUMULATIVE POSITIVE IMPACTS						
Socio-Economic	Moderate		Moderate		Moderate	

OVERALL ENVIRONMENTAL IMPACT ASSESSMENT AND REASONED OPINION FROM THE EAP

The information presented above, contributes to this overall environmental impact statement and reasoned opinion from the EAP as to whether the proposed project should or should not be authorised, including any conditions that should be made in respect of the authorisation (should it be granted).

Based on the findings of the detailed specialist assessments and technical studies, which all recommend that the proposed project can proceed and should be authorised by the DFFE, the proposed project is considered to have an **overall Moderate to Very Low negative environmental impact, and an overall Moderate to High positive socio-economic impact** (with the implementation of respective mitigation and enhancement measures).

The proposed project will take place within the development footprint on the preferred and approved project site, as contemplated in the accepted Final Scoping Report. The development footprint and buildable areas will avoid the "no-go" sensitive features identified and mapped by the respective specialists, where relevant and applicable.

This EIA has considered the nature, scale and location of the development as well as the wise use of land. The need for new solar PV generation capacity is specified in the energy planning for the country. The proposed project will therefore assist in generating additional electricity that is urgently required to address the shortage of generation capacity in the country.

The proposed project will be in line with the objective of the PKSDM IDP in terms of creating more job opportunities. The proposed Solar PV Facility will assist in local job creation during the construction and operational phases of the project (if approved by the DFFE). It should be noted that employment during the construction phase will be temporary and provided for a period of 12 to 18 months.

Section 24 of the Constitutional Act states that "*everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures, that prevents pollution and ecological degradation; promotes conservation; and secures ecologically sustainable development and use of natural resources while promoting justifiable economic and social development*". Based on this, this EIA was undertaken to ensure that these principles are met through the inclusion of appropriate management and mitigation measures, and monitoring requirements. These measures will be undertaken to promote conservation by avoiding the sensitive environmental features present on site and through appropriate monitoring and management plans (refer to the EMPr in Appendix I and Appendix J of this EIA Report).

The outcomes of this project therefore succeed in meeting the environmental management objectives of protecting the ecologically sensitive areas and supporting sustainable development and the use of natural resources, whilst promoting justifiable socio-economic development in the towns nearest to the project site. The findings of this EIA show that all natural resources will be used in a sustainable manner (i.e., this project is a renewable energy project, and the majority of the negative site specific and cumulative environmental impacts are considered to be of low significance with mitigation measures implemented), while the benefits from the project will promote justifiable economic and social development. Furthermore, additional specialist studies (not recommended by the Screening

Tool) have been undertaken as part of the EIA Process to ensure that all potential environmental impacts are addressed and assessed.

Provided that the specified mitigation measures and management actions are applied effectively throughout, it is recommended that the proposed project receive EA in terms of the 2014 NEMA EIA Regulations (as amended), promulgated under the NEMA. It is recommended that the **EA be valid for a period of 10 years.** It is understood that the information contained in this EIA Report and appendices is sufficient to make a decision in respect of the activity applied for.



CHAPTER 1:
Introduction



CSIR
Touching lives through innovation



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1. INTRODUCTION

The Project Developer, Kudu Solar Facility 4 (Pty) Ltd (hereafter "Project Applicant" or "Project Developer") is proposing to develop a Solar Photovoltaic (PV) power generation facility and associated Electrical Grid Infrastructure (EGI), north-east of the town of De Aar in the Renosterberg Local Municipality and Pixley Ka Seme District Municipality, in the Northern Cape Province. The proposed project is located approximately 50 km from De Aar and 25 km from Petrusville. A total of 12[1] Solar PV Facilities are being proposed. Each project will have a specific Project Applicant. The proposed projects are referred to as the "Kudu project".

ABO Wind renewable energies (Pty) Ltd (hereafter "ABO Wind") is involved in the development proposal stage, however, the responsibility for the actual implementation of the project (should Environmental Authorisation (EA) and relevant approvals be granted) lies with the Project Developer / Project Applicant (i.e. Kudu Solar Facility 4 (Pty) Ltd).

The proposed Solar PV Facilities will make use of PV solar technology to generate electricity from energy derived from the sun. Each solar PV Facility will have a range of associated infrastructure, including, but not limited to, an on-site substation complex, battery energy storage system (BESS), and is proposed to connect to the existing Hydra-Perseus 400 kV overhead power line via dedicated proposed 132 kV power lines, an independent Main Transmission Substation (MTS), and a 400 kV Loop-In-Loop-Out (LILO).

Each of the Solar PV Facilities would be its own project and would require its own, separate EA. The same applies to the EGI projects. The following projects are being proposed (Figure 1.1):

- **PROJECTS 1 TO 12**: The proposed development of 12 Solar PV Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 to Kudu Solar Facility 12[2]).
- **PROJECTS 13 TO 24**: The proposed development of switching stations and collector stations at each on-site substation complex at each of the 12 Kudu Solar Facilities, and up to 12 x 132 kV overhead power lines running from each Solar PV Facility to the proposed collector stations or up to the proposed MTS.
- **PROJECT 25**: The proposed development of an independent 400/132 kV MTS, including associated infrastructure at the MTS.
- **PROJECT 26**: The proposed development of a 400 kV LILO from the existing Hydra-Perseus 400 kV overhead power line to the proposed MTS.

Projects 1 to 12 require Scoping and Environmental Impact Assessment (EIA) Processes. Projects 13 to 26 will require Basic Assessment (BA) Processes or will be subjected to separate registration processes in terms of the EGI Standard (Government Gazette (GG) 47095; Government Notice (GN) 2313, dated 27 July 2022), or may require a hybrid approach depending on the sensitivities found within the EGI corridor. With specific reference to Projects 25 and 26, if the proposed Eskom

[1] Initially, the Project Developer identified the Original Scoping Buildable Areas within the study area, and these contained up to 14 Solar PV Facilities (as noted in the Background Information Document). Following the identification of sensitivities during the Scoping Phase, as well as various considerations such as the capacities of the Bidding Window 6 and the requirements of landowners, the Project Developer took such sensitivities and considerations into account and formulated the Revised Scoping Buildable Areas, which resulted in up to 12 Solar PV Facilities.

[2] Note that throughout the report the term Solar Facility and PV are used synonymously. For example, Kudu Solar Facility 4 and Kudu PV 4 are used interchangeably.

Hydra B Substation is built by Eskom, then additional upgrades of this Eskom substation would be undertaken to ensure that the substation can accommodate the power generated by the proposed 12 Kudu Solar Facilities. This would be undertaken based on engagements with and approval from Eskom. Additional detail will be provided as the separate BA or registration processes progress.

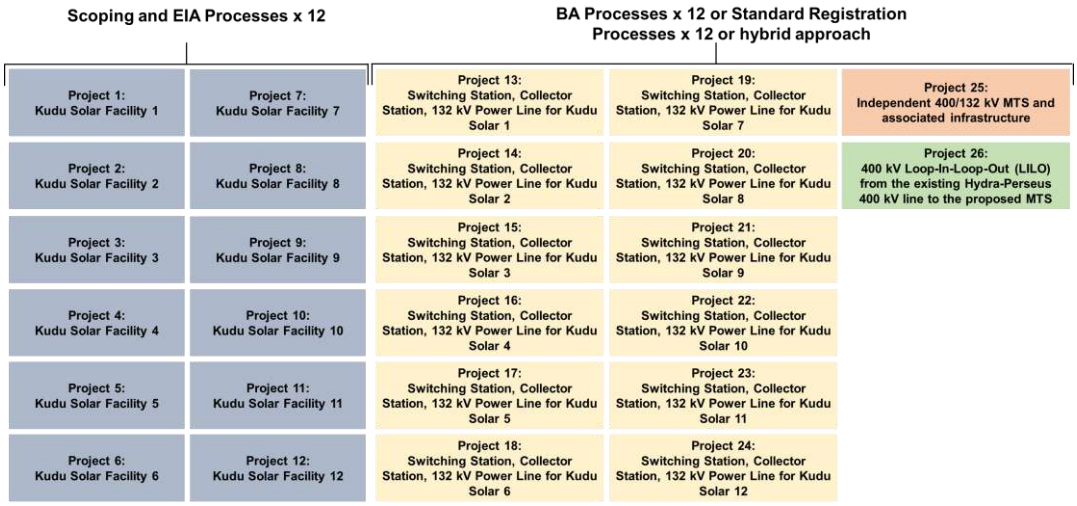


Figure 1.1: Breakdown of the projects that comprise the Kudu Solar Facilities and EGI cluster.

This EIA Report only addresses **Kudu Solar Facility 4** (i.e. Project 4) (hereafter referred to as the "Kudu Solar Facility" or "proposed project"), and separate reports have been compiled for each of the Solar PV Facilities (i.e. Projects 1 to 12). Separate reporting will also be followed for Projects 13 to 26 based on the relevant environmental management instrument implemented at the time. Therefore, the EGI Projects (Projects 13 to 26) are not the subject of this current EIA Process.

In terms of reporting, note that a request to submit combined Applications for EA in terms of Regulation 11 (4) of the 2014 National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations (as amended) and the issuing of multiple EAs in terms of Regulation 25 (1) and (2) of the 2014 NEMA EIA Regulations (as amended) was not accepted by the Department of Forestry, Fisheries and the Environment (DFFE). Refer to Appendix D.6 of this EIA Report for a copy of this correspondence from the DFFE.

This chapter provides an introduction of the proposed project, and includes the following:

- An overview of the proposed Solar PV Facility and associated infrastructure;
- Project Motivation;
- The legal requirements for an EIA;
- Information on the Project Developer and Project Applicant;
- The Competent Authority and EIA Project Team;
- Details and Expertise of the CSIR EIA Project Management Team;
- Need and Desirability;
- The objectives of the EIA Report; and
- Requirements for an EIA Report in terms of Appendix 3 of the 2014 NEMA EIA Regulations (as amended).

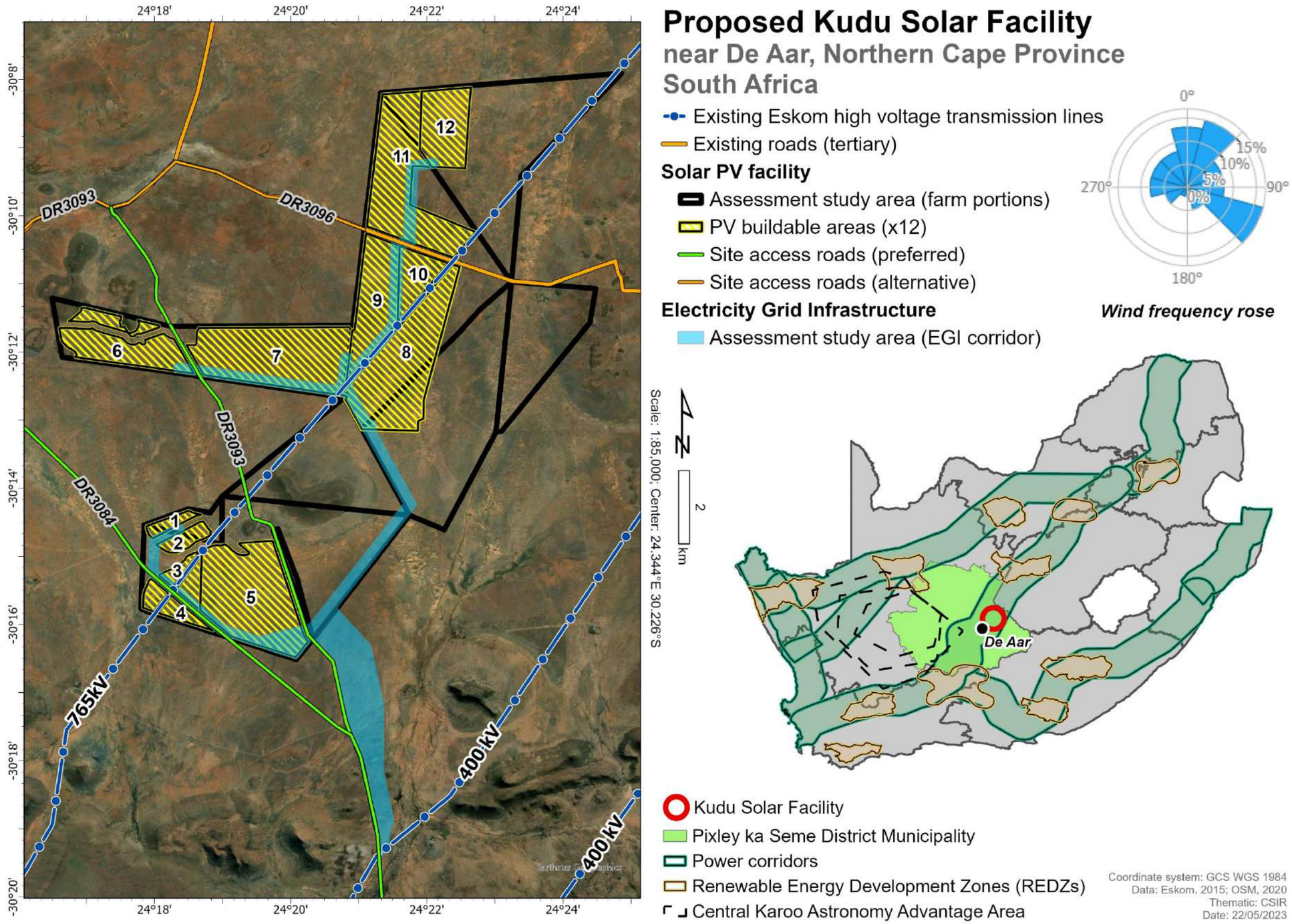


Figure 1.2: Locality map for the proposed Kudu Solar Facilities 1 to 12 and EGI near De Aar in the Northern Cape. Note that the EGI Projects are not part of the current application and report. The EGI Projects will be considered separately at a later stage. The EGI corridor indicated in this Figure is indicative.

1.1. Overview of the Proposed Kudu Solar Facility 4

The proposed Solar PV Facility will consist of the key components listed in Chapter 2 of this EIA Report, as summarised below:

- Solar Field, comprising Solar Arrays with a maximum height of approximately 3.5 m.
- Building Infrastructure (e.g. on-site substation complex; offices; operational and maintenance building and control centre; warehouse/workshop; ablution facilities; Inverter-Transformer stations; and guard house).
- An on-site substation complex including the following:
    - On-site Independent Power Producer (IPP) or Facility Substation.
    - Solid State Lithium Ion or Redox Flow BESS[3].
    - Switching Station and Collector Station. This forms part of Projects 13 – 24 and will be assessed as part of separate processes. It is important to mention here for contextualisation (it does not appear in the Application for EA or relevant listed activities).
- Associated Infrastructure (e.g. temporary construction laydown area; internal roads up to 8 m wide; upgrading of existing access roads (where required); fencing; storm water channels; panel maintenance and cleaning area; underground low voltage cables or cable trays; and 22 or 33 kV internal underground power lines[4]).

The generation capacity for Kudu Solar Facility 4 is estimated at 50 Megawatts alternating current (MWac). The construction period is estimated to extend 12 to 18 months. Once the commercial operation date is achieved, the proposed facilities will generate electricity for a minimum period of 20 years.

1.2. Project Motivation

The need for renewable energy is clear, in both a local and international context, with South Africa becoming an integral part of the global transition towards renewable sources of electricity generation. South Africa is one of the highest per capita producers of carbon emissions in the world. These emissions are largely a result of an energy-intensive economy and high dependence on coal-based electricity generation to meet more than 90% of its energy needs. Consequently, the South African government is committed to supplementing 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. The development of renewable energy is important for South Africa to reduce its overall environmental

[3] Both technologies were both options have been considered in the Scoping and EIA Process and deemed acceptable by the Environmental Assessment Practitioner (EAP) and specialists. However, the DFFE requested that preferred technology be selected. Therefore, Solid State Lithium Ion BESS is selected as the preferred technology for authorisation. However, should the need to change the technology arise in future, it is understood that an EA amendment process can be followed as both technologies have been assessed as part of the EIA Phase.

[4] The internal reticulation would be 22 or 33 kV, and most likely underground. In the isolated event of crossing a feature hindering underground cabling (e.g. a road, topographical or environmental constraint) the reticulation line may better be suited to be above ground in certain sections. Therefore, both below and above ground routings need to be covered in this Application for EA. This does not trigger Activity 11 of Listing Notice 1, as the internal reticulation will not have “a capacity of more than 33 kV”. This is also noted in Chapter 2 of the EIA Report.

footprint from power generation (including externality costs), and thereby to steer the country on a pathway towards sustainability.

Commitment toward decarbonisation of the economy is clearly illustrated in the South Africa's National Development Plan (NDP) Vision 2030 published in 2012. Chapters 4 and 5 of the NDP advocates for increased investment in an energy sector that is both economically inclusive and environmentally sustainable – with renewable energy at the core of enabling this transition. The plan identifies, as a priority, the production of sufficient energy to support industry at competitive prices, ensuring access for poor households, while reducing the carbon intensity of the economy.

In addition, due to the current constrained energy landscape and frequent loadshedding, the South African Government has articulated a plan to address the energy crisis. The President of South Africa delivered a speech on 25 July 2022 to inform the public of the plan towards achieving a reliable, affordable and sustainable energy supply (The Presidency, 2022[5]). In addition, the Minister of Forestry, Fisheries and the Environment also held a stakeholder engagement session on 21 July 2022 during which she highlighted proposed mechanisms for streamlining environmental approvals for solar energy development in low and medium sensitivity areas throughout the country; as well as power line and substation development within low and medium sensitivity areas within the gazetted EGI corridors (DFFE, 2022[6]). One of those mechanisms has already been gazetted for implementation, as noted above (i.e. the EGI Standard published in GG 47095; GN 2313, dated 27 July 2022).

Further, the Integrated Resource Plan (IRP) for South Africa for the period 2010 to 2030 (referred to as "IRP2010") was released by government in 2010, and an updated report was published in 2013, which proposed to secure 17 800 MW of renewable energy capacity by 2030 (including solar, wind and other energy sources). In August 2011, the Department of Energy (DoE) (currently operating as the Department of Mineral Resources and Energy (DMRE)) launched the Renewable Energy Independent Power Producer Programme (REIPPPP) and invited potential IPPs to submit proposals for the financing, construction, operation and maintenance of the first 3 725 MW of onshore wind, solar thermal, PV, biomass, biogas, landfill gas or small hydropower projects. On 18 August 2015, an additional procurement target of 6 300 MW to be generated from renewable energy sources was added to the REIPPPP for the years 2021 - 2025, as published in GN 733, GG 39111. Of this, the additional target allocated for solar PV was 2 200 MW.

The most recent update to the IRP i.e. the IRP 2019, was gazetted by the Minister of Mineral Resources and Energy, Gwede Mantashe, in October 2019. The update revised the energy forecast for South Africa to the year 2030. Provision has been made for new additional capacity by 2030 including in particular 14 400 MW of wind and 6 000 MW of solar PV. In terms of the REIPPPP, submitted proposals are then evaluated according to a Request for Proposal (RFP). Bidding Window 5 had the same two main evaluation criteria for compliant proposals as the previous Bidding Windows 1-4, namely price and economic development. However, for Bidding Window 5, the point allocation changed to 90/10 compared to 70/30 for the previous Bidding Windows.

[5] The Presidency (2022). *Address by President Cyril Ramaphosa on actions to address the electricity crisis, Union Buildings, Tshwane.* Accessed online: https://www.thepresidency.gov.za/speeches/address-president-cyril-ramaphosa-actions-address-electricity-crisis%2C-union-buildings%2C-tshwane [August 2022]

[6] DFFE (2022). *Minister Creecy announces improved environmental assessment processes for solar energy.* Accessed online: https://www.dffe.gov.za/creecy_environmentalassessmentprocesses_solarenergy [August 2022]

The overview summary document (DMRE, 2022[7]) on the RFP issued for Bidding Window 6 notes that Bid responses will be assessed firstly in terms of Functional and Qualification Criteria to determine if they are compliant. These criteria include the structure of the project; legal aspects; land acquisition and land use; environmental; financial; technical; economic development; and value for money. Secondly, the compliant Bids are proposed to be evaluated on a comparative basis (out of 100 points) in terms of price (maximum of 90 points) and economic development (maximum of 10 points). Therefore, economic development has been retained as a qualification criterion based on the RFP for Bidding Window 5, but it is also considered in the comparative scoring (DMRE, 2022). The bidders whose responses rank the highest (according to the aforementioned criteria) generally have the greatest potential to be appointed as "Preferred Bidders" by the DMRE.

Bidding Window 5 was conducted during 2021 with an allocation of 2 600 MW for new wind and solar energy. The successful bidders were announced on 28 October 2021. Bidding Window 6 was announced in April 2022 with an allocation of 4200 MW of renewable energy of which solar comprises 1000 MW. Six preferred bidders have been selected for Bidding Window 6.

Should this proposed project be acceptable and authorised, it is considered viable that long-term benefits for the community and society in the De Aar area would be realised. The proposed project will provide an opportunity for additional employment in an area where job creation is identified as a key priority. Approximately 150 employment opportunities will be created during the construction phase, and approximately 8 during the operational phase of the proposed project. The proposed project will make use of local labour as much as possible.

The project is intended to address the current energy shortages in South Africa and assist in meeting the need for additional renewable energy generation capacity, as required by the IRP of 2019. The total generation capacity of the entire project (i.e. should all 12 Solar Facilities be authorised) would be in the order of approximately 2 180 MWac. As a means of comparison, for 2022 the municipal area of Kimberley in the Northern Cape has a total electricity load forecast of 643 MW and the total load forecast for the Northern Cape is 897 MW (Eskom, 2021[8]). The total provincial peak load forecast for the Northern Cape is expected to increase to about 1 313 MW by 2031 (Eskom, 2021).

The proposed project 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), the Paris Agreement on Climate Change, Kyoto Protocol, and United Nations Convention on Biological Diversity (UNCBD), all of which South Africa is a signatory to. Renewable energy is critical to South Africa as this source of energy is recognised as a major contributor to climate protection, has a much lower environmental impact significance, as well as advancing economic and social development.

[7] DMRE (2022). Overview of the Request for Qualification and Proposals for New Generation Capacity under Sixth Bid Submission Phase of the Renewable Energy Independent Power Producer Procurement Programme. Accessed online: https://www.ipp-renewables.co.za/ [June 2022]

[8] Eskom (2021). *Transmission Development Plan (2022 – 2031)*. Accessed online: https://www.eskom.co.za/eskom-divisions/tx/transmission-lines/transmission-development-plans/ [May 2022]

It is intended that this project will be bid into a future bidding program of the REIPPPP [or another future process linked to the IRP]. To submit a Bid in terms of the REIPPPP, the Project Applicant is required to have obtained an EA in terms of the 2014 NEMA EIA Regulations (as amended), as well as several additional authorisations or consents.

1.3. Legal Requirements for an EIA

Section 24(1) of the NEMA, states that "In order to give effect to the general objectives of integrated environmental management laid down in this Chapter, the potential impact on the environment of listed activities must be considered, investigated, assessed and reported to the competent authority charged by this Act with granting the relevant EA". The reference to "listed activities" relates to the regulations promulgated in GN R982, R983, R984 and R985 in GG 38282, dated 4 December 2014, which came into effect on 8 December 2014. These were amended on 7 April 2017, specifically promulgated in GN R326, R327, R325 and R324 in GG 40772; and further amended on 11 June 2021 in GN 517; and on 3 March 2022 in GN 1816. GN R327 and GN R324 includes listed activities that trigger the need for a BA Process, whereas GN R325 includes listed activities that trigger the need for a full Scoping and EIA Process. Additional detail is provided in Chapter 4 of this EIA Report.

In terms of the NEMA and the 2014 NEMA EIA Regulations (as amended), a full Scoping and EIA Process is required for the proposed project.

The proposed project is not located within any of the Renewable Energy Development Zones (REDZs) that were gazetted in GG 41445, GN 114 on 16 February 2018; and GG 44191, GN 144 on 26 February 2021, hence it is subjected to a full Scoping and EIA Process with a 107-day decision-making timeframe, as opposed to a BA Process and 57-day decision-making timeframe allowed for in the REDZs. The proposed project is located within the Central Strategic Transmission Corridor that was gazetted in GN 113 on 16 February 2018; however, the benefits only apply specifically to the EGI projects (Projects 13 – 26), as discussed above.

The need for the full Scoping and EIA is triggered by, amongst others, the inclusion of Activity 1 listed in GN R325 (Listing Notice 2):

- ***"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more, excluding where such development of facility or infrastructure is for photovoltaic installations and occurs (a) within an urban area; or (b) on existing infrastructure".***

Chapter 4 of this EIA Report contains the detailed list of activities contained in GN R327, R325, and R324, which may be triggered by the various project components and thus form part of the Scoping and EIA Process.

1.4. Background on ABO Wind

ABO Wind AG is a Europe based company, which was formed in 1996. The company has since established subsidiaries in 13 countries. ABO Wind, the South African subsidiary, was founded in 2017. The company focuses on wind, solar and biogas technologies and works with landowners, technology providers, regulators and investors to source and develop renewable energy projects.

ABO Wind acts as the project developer and project interface, coordinating the research and studies, the site identification, the project structure, BAs, EIAs, selecting the strategic partners and arranging financing.

ABO Wind is committed to developing renewable energy in South Africa, and thus investing in the country. The company is currently working on a pipeline of around 5 GW of wind and solar projects as well as storage projects with batteries or hydrogen. As of 2021, 200 MW were sold during development; and 3 600 MW was under development by the company in South Africa.

1.5. Project Applicant

Each Solar PV Facility will have a dedicated Project Applicant. The Project Applicant for the Kudu Solar Facility 4 is Kudu Solar Facility 4 (Pty) Ltd.

1.6. Competent Authority and EIA Project Team

In accordance with Regulation 12 (1) of the 2014 NEMA EIA Regulations (as amended), ABO Wind has appointed the Council for Scientific and Industrial Research (CSIR) to undertake the Scoping and EIA Process to determine the potential biophysical, social and economic impacts associated with the proposed project, and to identify how such negative impacts can be avoided, remedied, mitigated or managed; and how positive impacts can be enhanced. Public participation forms an integral part of the Scoping and EIA Process and assists in identifying issues and possible alternatives to be considered. The CSIR is also undertaking the Public Participation Process (PPP) for this Scoping and EIA Process, via an integrated approach including all 12 proposed projects. Details on the PPP are included in Chapter 4 of this EIA Report.

The 2014 NEMA EIA Regulations, as amended in GN 517 on 11 June 2021 states that the Competent Authority (CA) in respect of the listed activities "*is the CA in the province in which the activity is to be undertaken, unless: (a) it is an application for an activity contemplated in Section 24C(2) of the Act, in which case the CA is the Minister or an organ of state with delegated powers in terms of Section 42(1) of the Act; or (b) the application is a mining application in which case the CA is the Minister responsible for mineral resources*".

With relevance to the proposed project, Section 24C (2) (a) (i) of NEMA states "*(2) the Minister must be identified as the competent authority in terms of subsection (1), unless otherwise agreed to in terms of section 24C (3), if the activity (a) has implications for international environmental commitments or relations, and where (i) it is identified by the Minister by notice in the Gazette*".

Related to this, GN 779 states that, in terms of Sections 24C(1), 24C(2)(a)(i) and 24D of the NEMA, the Minister of Environmental Affairs (now Forestry, Fisheries and the Environment) is the CA for activities which are identified as activities in terms of Section 24(2)(a) of NEMA, which may not commence without an EA, and which relates to the IRP 2010 - 2030 and any updates thereto. The proposed project triggers various listed activities and thus requires EA. As noted above, the proposed project will be bid into a future bidding program of REIPPPP.

Based on the above, the National DFFE serves as the CA for the proposed project.

The project team, which is involved in this Scoping and EIA Process, is listed in Table 1.1 below. This team includes several specialists who have extensive experience in conducting specialist studies for renewable energy projects in South Africa.

Table 1.1: The EIA Project Team

NAME	ORGANISATION	ROLE/STUDY TO BE UNDERTAKEN
Environmental Management Services (CSIR)		
Paul Lochner (*Registered EAP* (2019/745))	CSIR	EAP, Technical Advisor and Quality Assurance
Rohaida Abed (*Pr.Sci.Nat.* and *Registered EAP* (2021/4067))	CSIR	EAP and Project Manager
Helen Antonopoulos	CSIR	Project Officer
Sonto Mkize	CSIR	Project Officer
Phindile Mthembu	CSIR	Project Officer
Luanita Snyman van der Walt *(Pr.Sci.Nat.)*	CSIR	GIS Specialist
Lizande Kellerman *(Pr.Sci.Nat.)*	CSIR	Public Participation Specialist
Specialists		
Johann Lanz (*Pr.Sci.Nat.)*	Private	Agriculture and Soils Compliance Statement
Corne Niemandt *(Pr.Sci.Nat.)* Samuel Laurence *(Pr.Sci.Nat.)* Luke Verburgt	Enviro-Insight cc	Terrestrial Biodiversity, Terrestrial Plant Species, and Terrestrial Animal Species
Toni Belcher *(Pr.Sci.Nat.)* Dana Grobler *(Pr.Sci.Nat)*	Private	Aquatic Biodiversity Impact Assessment
Chris van Rooyen Albert Froneman (*Pr.Sci.Nat.)*	Chris van Rooyen Consulting	Avifauna Impact Assessment
Quinton Lawson (*SACAP, 3686*) Bernard Oberholzer (*SACLAP, 87018*)	QARC and BOLA	Visual Impact Assessment
Dr Jayson Orton (*APHP: Member 43; ASAPA CRM Section: Member 233*)	ASHA Consulting (Pty) Ltd	Heritage Impact Assessment (Archaeology and Cultural Landscape)
Dr John Almond *(PSSA and APHP Member)*	Natura Viva cc	Palaeontology Site Sensitivity Verification Report
Tony Barbour and Schalk van der Merwe	Private	Socio-Economic Impact Assessment
Annebet Krige *(Pr Eng)*	Sturgeon Consulting	Traffic Impact Assessment
Debbie Mitchell *(Pr Eng)*	Ishecon cc	Battery Storage High Level Safety, Health and Environment Risk Assessment
Dale Barrow (*Pr.Sci.Nat.)* Christel van Staden (*Cand.Sci.Nat.)* Shane Teek (*Cand.Sci.Nat.)* Louis Jonk *(Pr.Sci.Nat.)* Julian Conrad	GEOSS South Africa (PTY) Ltd	Geohydrology Assessment
Shane Teek (*Cand.Sci.Nat.)* Hardy Luttig Julian Conrad	GEOSS South Africa (PTY) Ltd	Geotechnical Assessment
Rohaida Abed *(Pr.Sci.Nat.* and *Registered EAP (2021/4067))* Helen Antonopoulos Lizande Kellerman *(Pr.Sci.Nat.)*	CSIR	Civil Aviation Site Sensitivity Verification
Rohaida Abed *(Pr.Sci.Nat.* and *Registered EAP (2021/4067))* Helen Antonopoulos Lizande Kellerman *(Pr.Sci.Nat.)*	CSIR	Defence Site Sensitivity Verification

The specialist studies commissioned as part of this Scoping and EIA Process are included in Chapters 6 to 17 of this EIA Report. Chapter 4 also includes motivation for not undertaking certain studies identified by the Screening Tool.

1.7. Details and Expertise of the CSIR EIA Project Management Team

This section provides information on the expertise of the CSIR EIA Project Management Team and Environmental Assessment Practitioner (EAPs).

Paul Lochner (*Registered EAP*; Technical Advisor and Quality Assurance):
Paul Lochner is an EAP at the CSIR in Stellenbosch, with more than 30 years of experience in a wide range of environmental assessment and management studies. Paul commenced work at CSIR in 1992, after completing a B.Sc. degree in Civil Engineering and a Masters in Environmental Science, both at the University of Cape Town. His initial work at focused on wetlands and estuarine management; environmental engineering in the coastal zone; and coastal zone management plans. Since 2008, Paul has been the leader and manager of the Environmental Management Services (EMS) group within CSIR that has been at the forefront of advancing environmental assessment in South Africa. This group currently consists of approximately 10 environmental scientists, planners and engineers, with offices in Stellenbosch, Cape Town and Durban. Paul's particular experience is in environmental planning and assessment for renewable energy, EGI, desalination, oil and gas, wetlands and coastal zone management, and industrial and port development. He has been closely involvement in the research and application of Strategic Environmental Assessment (SEA) in South Africa, and also has wide experience in Environmental and Social Impact Assessment, Environmental Management Programmes (EMPRs) and Environmental Screening Studies. He has been the project leader for over 40 SEAs and EIAs. He also served as project leader for a suite of SEAs commissioned by the DFFE from 2014 to 2020. Paul is a Registered EAP (2019/745) with the Environmental Assessment Practitioners Association of South Africa (EAPASA).

Rohaida Abed (*Pr. Sci. Nat*. and *Registered EAP*, Project Manager):
Rohaida Abed is an EAP in the EMS group of the CSIR. She has 13 years of experience in the Environmental Management field, and has been involved in various transport infrastructure related projects as an Environmental Control Officer. She has also been involved in BAs and EIAs relating to renewable energy, port infrastructure and bulk liquid storage facilities in the capacity of Project Manager. She also worked on the SEA for Gas Pipeline and EGI Expansion from 2017 to 2019, which was commissioned by the National Departments of Environmental Affairs, Energy and Public Enterprises. She is a registered Professional Natural Scientist (400247/14) with the South African Council for Natural Scientific Professions (SACNASP), and a Registered EAP (2021/4067) with the EAPASA.

Helen Antonopoulos (Project Officer):
Helen Antonopoulos is an Environmental Consultant in training in the EMS group of the CSIR and holds BSc, BSc Honours, and MSc degrees in Environmental and Geographical Science from the University of Cape Town. She has assisted with compiling BAs and Scoping and EIAs for Solar Facilities in various provinces. She is interested in using renewable energy projects to promote sustainable development in South Africa.

Sonto Mkize (Project Officer):
Sonto holds a BSc and BSc Honours in Urban and Regional Planning from the University of the Witwatersrand, and a MSc in Sustainable Urban Planning and Design from KTH Royal Institute of Technology. She is an Environmental Consultant in training at the CSIR EMS group. She has assisted in compiling BA, Scoping and EIA Reports for wind and solar energy facilities in various provinces. Her key interests lie in maximising the opportunities presented by advancements in technological innovations to build inclusive smart cities and to enable a just energy transition using renewable resources.

Phindile Mthembu (Project Officer):
Phindile holds a BSS and BSc Honours in Geography and Environmental Management from the University of KwaZulu-Natal, and a MSc in Geography from the University of KwaZulu-Natal. She has experience in reviewing BA, Scoping and EIA Reports for various projects for Provincial Government. She is an Environmental Consultant in training at the CSIR EMS group. At the CSIR, she has assisted in compiling BA, Scoping and EIA Reports for wind and solar energy facilities in various provinces. Her area of interests includes reviewing and conducting EIAs.

1.8. Need and Desirability

It is an important requirement in the EIA Process to review the need and desirability of the proposed project. Guidelines on Need and Desirability were published by the Department of Environmental Affairs (DEA) [now operating as the DFFE] in 2017[9]. These guidelines list specific questions to determine need and desirability of proposed developments. This checklist is a useful tool in addressing specific questions relating to the need and desirability of a project and assists in explaining that need and desirability at the provincial and local context. Need and desirability answer the question of whether the activity is being proposed at the right time and in the right place.

Table 1.2 includes a list of questions based on the DEA's Guideline to determine the need and desirability of the proposed project. This table is informed by the outcomes of the Scoping and EIA Process, including the Specialist Assessments. Note that the Specialist Assessments are included in Chapters 6 to 17 of this EIA Report, and where relevant, the findings of these studies have been integrated into Table 1.2.

[9] DEA (2017), Guideline on Need and Desirability, Department of Environmental Affairs (DEA), Pretoria, South Africa. ISBN: 978-0-9802694-4-4.

Table 1.2: The Guideline on the Need and Desirability's list of questions to determine the "Need and Desirability" of a proposed project

NEED	
Question	**Response**
1. How will this development (and its separate elements/aspects) impact on the ecological integrity of the area?	
1.1. How were the following ecological integrity considerations taken into account?: 1.1.1. Threatened Ecosystems, 1.1.2. Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure, 1.1.3. Critical Biodiversity Areas ("CBAs") and Ecological Support Areas ("ESAs"), 1.1.4. Conservation targets, 1.1.5. Ecological drivers of the ecosystem, 1.1.6. Environmental Management Framework, 1.1.7. Spatial Development Framework, and 1.1.8 Global and international responsibilities relating to the environment (e.g. RAMSAR sites, Climate Change, etc.).	The ecological sensitivities present within the study area have been assessed in detail in the Terrestrial Biodiversity and Plant and Animal Species, Aquatic Biodiversity, and Avifauna Impact Assessments during the EIA Phase. These assessments are included in Chapters 7, 8 and 9 of this EIA Report. The specialists have identified aquatic, terrestrial and avifaunal sensitive areas within the study area that need to be avoided by the proposed development, as well as other ecologically sensitive areas and how to suitably develop within these areas so that the ecological integrity is maintained. These Specialist Assessments have identified sensitivities within the study area[10] that should be avoided, based on desktop assessments and field work. The Aquatic Biodiversity Assessment determined the following: ▪ The aquatic features within the study area comprise ephemeral unnamed tributaries of the Orange River. The catchments of these tributaries are not within any National Freshwater Ecosystem Priority Area (FEPA) river sub-catchments. ▪ The larger watercourses flow along the eastern and western extents of the study area, flowing in a northerly direction to join the Orange River downstream of Van der Kloof Dam. Associated with these larger watercourses are wide floodplains. Smaller watercourses and drainage features drain into the larger river corridors. ▪ The ephemeral streams and floodplains provide aquatic habitat to a diverse array of faunal species. ▪ The present ecological condition of the aquatic features within the study area is rated as **largely natural to moderately modified**. ▪ The recommended ecological condition of the watercourses within the study area is **largely natural to moderately modified**.

[10] The preferred site for the proposed Kudu Solar Facility comprises the full extent of the affected farm portions which cover a combined footprint of 8 150 ha, which serves as the study area for this Scoping and EIA Process. Therefore, the terms "site" and "study area" are used synonymously in the report. The Buildable Areas informed the identification of the "development footprint" and fall within the preferred site (or study area).

NEED	
Question	**Response**
	▪ The larger watercourses (unnamed tributaries of the Orange River) and associated floodplains, as well as wetland areas within the study area, are deemed to be of **medium aquatic ecological sensitivity**. ▪ The smaller feeder streams/watercourses and drainage lines, and dams are considered to be of **low aquatic ecological sensitivity**. ▪ Buffers have been recommended to protect the aquatic ecosystems. The Terrestrial Biodiversity and Plant and Animal Species Assessment determined the following: ▪ Identified Ecological Support Areas (ESA) according to the Northern Cape Critical Biodiversity Area (CBA) Map (2016) extend over a wide area in this specific region of the Northern Cape. The entire site / study area, and thus all identified buildable areas and development footprints, are located within the ESA. The ESA is due to the site being in the Platberg-Karoo Conservancy (not formally protected), the vegetation units and important wetland and river features. The specialist notes that the vegetation itself is not considered sensitive but do provide important feeding and breeding habitat for fauna. Important river and wetland features occur in the landscape, which are vital for ecosystem services, maintaining connectivity in the landscape, and act as important habitats for many fauna species. However, the recommendations of the Aquatic and Avifauna Specialists have been taken into consideration in the layout planning, and sensitive areas have been avoided accordingly. The specialist has noted that the overall sensitivity of the site is considered Medium, with some landscape features, including the Koppies, as medium sensitivity. The specialist confirms that the ESA within the site cannot be regarded as very high sensitivity as it is not irreplaceable areas, and depending on what ecological features it is based on, can be regarded as Medium or High. ▪ Four main habitats were identified based on species composition and structure, namely ‘White Grassland’, ‘Shrubby Grassland’, ‘Watercourse’, and ‘Koppies’. In addition, ‘Transformed’ areas were included which consists of existing roads, homesteads and bare soil. ▪ The following sensitive features are rated with a **high sensitivity**:

NEED	
Question	**Response**
	○ The **Koppies** habitat are high sensitivity features which must be avoided by development activities. Only limited development activities of low impact will be acceptable. Linear infrastructure such as roads and overhead powerlines should not cross the Koppies, and pylons should not be constructed in this habitat. No buffer applies to the Koppies. ▪ The following sensitive features are rated with a **medium sensitivity**: ○ The **White and Shrubby Grasslands** are considered moderately sensitive owing to its pristine nature with limited major impacts, mostly concentrated at homesteads, cattle camps and watering holes. Restoration efforts post-construction for temporary laydown areas are critical, as well as after the decommissioning of the project. ○ The Watercourse sensitivity is medium. ▪ Existing Transformed areas are rated as **very low sensitivity**. The Avifauna Assessment noted the following: ▪ The study area is located in the Platberg-Karoo Conservancy Important Bird Area. ▪ The study area is not located within any Protected Areas and National Protected Areas Expansion Strategy (NPAES) focus areas. ▪ A total of 85 species could potentially occur within the Broader Area where the project is located. Of these, 21 are classified as priority species for solar developments. Of the 21 priority species, 17 were recorded during the monitoring, and 15 priority species have a medium to high probability of occurring regularly in the Study Area. Five Species of Conservation Concern (SCC) species were recorded during the site surveys, namely Blue Crane, Martial Eagle, Verreaux's Eagle, Cape Vultures and White-backed Vulture. ▪ Based on the desktop analysis and the Site Sensitivity Verification undertaken, various buffers have been recommended (e.g. 1 km all infrastructure exclusion zone for a Verreaux's Eagle nest found within the study area to prevent the displacement of the breeding pair during the construction phase due to disturbance; as well as solar panel exclusion zones (other infrastructure allowed) around certain waterpoints)).

NEED	
Question	**Response**
	The feature and sensitivity map for the study area, and the combined layout and sensitivity map are included in Chapter 20 of this EIA Report. **The sensitivities identified by the various specialists, as highlighted above, have been taken into consideration and avoided where possible in order to identify the Buildable Areas / development footprint.** These specialists concluded that the proposed project could proceed provided that the recommended mitigation measures and management actions provided are implemented.
1.2. How will this development disturb or enhance ecosystems and/or result in the loss or protection of biological diversity? What measures were explored to firstly avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	The ecological sensitivities present within the study area have been assessed in detail in the Terrestrial Biodiversity and Plant and Animal Species, Aquatic Biodiversity, and Avifauna Impact Assessments during the EIA Phase. The specialists have identified aquatic, terrestrial and avifaunal sensitive areas within the study area that need to be avoided by the proposed development, as well as other ecologically sensitive areas and how to suitably develop within these areas so that the ecological integrity is maintained. Refer to the response to Question 1.1 regarding the sensitivities identified in the Terrestrial Biodiversity and Plant and Animal Species, Aquatic Biodiversity, and Avifauna Specialist Assessments. The feature and sensitivity map for the study area, and the combined layout and sensitivity map are included in Chapter 20 of this EIA Report. **The sensitivities identified by the various specialists, as highlighted above, have been taken into consideration and avoided where possible in order to identify the Buildable Areas / development footprint.** The Terrestrial Biodiversity and Plant and Animal Species Assessment has identified various potential impacts, which are listed below: ▪ Construction Phase: ○ Fragmentation and loss of habitat and sensitive features. ○ Loss of protected species.

NEED	
Question	**Response**
	○ Introduction and spread of alien invasive species. ○ Increased erosion and soil compaction. ○ Littering and general pollution. ▪ Operational Phase: ○ Increase in alien invasive species. ○ Loss of species composition and diversity. ○ Littering and general pollution. ▪ Decommissioning Phase: ○ Increase in alien invasive species. ○ Loss of habitat. Various mitigation measures have been identified to reduce the significance of or manage the impact. These measures are documented in the Specialist Assessment, and include, for example: ▪ No construction related activities, such as the site camp, storage of materials, temporary roads or ablution facilities may be located in the high sensitivity areas. ▪ No development should take place within High sensitivity areas or buffer zones. Accordingly, the Koppies habitat (where relevant) should be avoided. ▪ Where the approved layout designs impact on individuals, permit applications are required for either the relocation or destruction of provincially protected species (Northern Cape Nature Conservation Act 9 of 2009) and for protected trees in terms of the National Forests Act (Act 84 of 1998). Measures to avoid, remedy, mitigate and manage impacts are included in the Environmental Management Programme (EMPr), included in Appendix I and Appendix J of this EIA Report. In summary, the potential disturbance of ecosystems, and potential loss or protection of biological diversity have been identified as potential impacts in the Terrestrial Biodiversity and Plant and Animal Species Assessment. In addition, avoidance mechanisms have been adopted, whereby the highly sensitive ecological features have been avoided in the

NEED	
Question	**Response**
	Buildable Areas. In addition, mitigation measures have been provided to minimise and remedy the potential impacts. All the potential impacts have been assessed in the EIA Phase.
1.3. How will this development pollute and/or degrade the biophysical environment? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	Various Specialists Assessments have been compiled and are included in this EIA Report. These assessments have identified sensitivities within the study area that should be avoided, based on desktop assessments and field work. This has informed the identification of the Buildable Areas / development footprint. In addition, the assessments have identified various potential negative impacts that the proposed project may result in, such as degradation to the biophysical environment and potential pollution. The associated mitigation measures have also been identified. Refer to the detailed specialist assessments in Chapters 6 to 17 of this report. Measures to avoid, remedy, mitigate or manage biophysical impacts are included in the EMPr.
1.4. What waste will be generated by this development? What measures were explored to firstly avoid waste, and where waste could not be avoided altogether; what measures were explored to minimise, reuse and/or recycle the waste? What measures have been explored to safely treat and/or dispose of unavoidable waste?	Waste will mostly be generated during the construction and decommissioning phases of the proposed project. Approximately 50 m^3 and 1.92 m^3 of solid waste is estimated to be generated per month during the construction phase and operational phase, respectively for the proposed project. The following waste materials are expected during the construction phase: ▪ Packaging material, such as the cardboard, plastic and wooden packaging and off-cuts; ▪ Hazardous waste from empty tins, oils, soil containing oil and diesel (in the event of spills), and chemicals; ▪ Building rubble, discarded bricks, wood and concrete; ▪ Domestic waste generated by personnel; and ▪ Vegetation waste generated from the clearing of vegetation. During the operational phase, the facility will produce minor amounts of general waste (as a result of the offices or maintenance). Waste generated on site will be disposed of at a

NEED	
Question	**Response**
	licenced landfill site. Refer to Chapter 2 (Project Description) of this EIA Report for a detailed description of the waste to be generated by the proposed project. Measures to avoid, remedy, reduce, mitigate or manage waste are included in the EMPr.
1.5. How will this development disturb or enhance landscapes and/or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	A Heritage Impact Assessment (HIA) was undertaken during the EIA Phase to assess potential archaeological and cultural impacts resulting from the proposed project. This HIA (included in Chapter 11 of this EIA Report) has identified the following potential impacts: ▪ Construction Phase: ○ Potential impacts on archaeology. ○ Potential impacts on graves. ○ Potential impacts on the cultural landscape. ▪ Operational Phase: ○ Potential impacts on the cultural landscape. ▪ Decommissioning Phase: ○ Potential impacts on the cultural landscape. ▪ Cumulative Impacts: ○ Construction and Decommissioning Phases: ▪ Potential impacts on archaeology. ▪ Potential impacts on graves. ○ Operational Phase: ▪ Potential impacts on the cultural landscape. Overall, with the recommended mitigation measures being implemented, the potential impacts have been rated with a low significance. The HIA has also been sent to the South African Heritage Resources Agency (SAHRA) for comment during the 30-day review of the Draft EIA Report during the EIA Phase. SAHRA has provided comments, which are included in Appendix H.6 of this EIA Report, and responded to accordingly in the Comments and Responses Report (Appendix H.7 of this EIA Report).

NEED	
Question	**Response**
	A Palaeontology Site Sensitivity Verification Report has been completed and included in Chapter 12 of this EIA Report. The Site Sensitivity Verification Report notes that the Screening Tool depicts a Medium to High palaeo-sensitivity for the majority of the study area. However, the specialist has recommended, based on a 2-day palaeontological site visit and several previous field-based and desktop Palaeontology Impact Assessment (PIA) studies in the broader De Aar – Kimberley region, that the study area is of Low to Very Low palaeo-sensitivity in general. If any fossiliferous deposits are exposed by surface clearance or excavations during the construction phase, the Chance Fossils Finds Protocol should be fully implemented. Provided that the Chance Fossil Finds Protocol is incorporated into the EMPr and fully implemented during the construction phase, there are no objections on palaeontological heritage grounds to authorisation of the proposed project. Pending the discovery of significant new fossil finds before or during construction, no further specialist palaeontological studies, monitoring or mitigation are recommended for this proposed project. The Chance Fossil Finds Protocol has been included in the EMPr (Appendix I and Appendix J of the EIA Report).
1.6. How will this development use and/or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	Measures to avoid, remedy, mitigate or manage impacts on non-renewable natural resources have been included in the EMPr (Appendix I and Appendix J of the EIA Report). However, the proposed project is focused on the use of renewable natural resources (i.e. a Solar PV Facility).
1.7. How will this development use and/or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and/or impact on the ecosystem jeopardise the integrity of the resource and/or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts? 1.7.1. Does the proposed development exacerbate the increased dependency on increased use of resources to maintain economic	South Africa has heavily relied on coal as a source of electricity for decades. Due to the nature of coal as a non-renewable resource that causes major environmental degradation, there is a need to identify alternative resources that could promote sustainable energy as well as cleaner energy production mechanisms. The proposed project aims to harness the solar resources available in the area for the generation of electricity. This project is seen as a source of 'clean energy' and reduces the dependence on non-renewable sources. The proposed project is intended to form part of the Renewable Energy Independent Power Producer Programme (REIPPPP), and therefore aims to contribute to the energy mix of South Africa, in line with the Integrated Resource Plan (IRP). The

NEED	
Question	**Response**
growth or does it reduce resource dependency (i.e. de-materialised growth)? (note: sustainability requires that settlements reduce their ecological footprint by using less material and energy demands and reduce the amount of waste they generate, without compromising their quest to improve their quality of life) 1.7.2. Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used (i.e. what are the opportunity costs of using these resources of the proposed development alternative?) 1.7.3. Do the proposed location, type and scale of development promote a reduced dependency on resources?	need for renewable energy is clear, with South Africa becoming an integral part of the global transition towards renewable sources of electricity generation. An assessment of the project alternatives including the site suitability for the proposed project is included in Chapter 5 of this EIA Report. The proposed project is a sustainable option for the area and the development footprint and buildable areas have avoided areas of very high environmental sensitivity. No fatal flaws were identified that could prevent the proposed project from being realised, should such authorisation be granted. In addition, various Specialist Assessments have been compiled and are included in Chapters 6 to 17 of this EIA Report. These assessments have identified various potential negative impacts that the proposed project may result in. The associated mitigation measures have also been identified in these studies.
1.8. How were a risk-averse and cautious approach applied in terms of ecological impacts? 1.8.1. What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)? 1.8.2. What is the level of risk associated with the limits of current knowledge? 1.8.3. Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	The precautionary approach has been adopted for this study, i.e. assuming the maximum development scenario will occur and then identifying ways to mitigate or manage these impacts. In addition, the specialist assessments that have been compiled during the EIA Phase have provided detailed feedback on any uncertainties, assumptions, and risks associated with limits of current knowledge.
1.9. How will the ecological impacts resulting from this development impact on people's environmental right in terms following: 1.9.1. Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	A detailed Socio-Economic Impact Assessment is included in this EIA Report that considers the impact of the proposed project from a socio-economic perspective. The Socio-Economic assessment (Chapter 13 of this EIA Report) has identified the following impacts: ▪ Construction Phase: ○ Potential positive impacts: ▪ Creation of employment and business opportunities, and opportunity for skills development and on-site training. ○ Potential negative impacts:

NEED	
Question	**Response**
1.9.2. Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	▪ Impacts associated with the presence of construction workers on local communities. ▪ Impacts related to the potential influx of job-seekers. ▪ Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site. ▪ Increased risk of grass fires associated with construction related activities. ▪ Nuisance impacts, such as noise, dust, and safety, associated with construction related activities and vehicles. ▪ Impact on productive farmland. ▪ Operational Phase: o Potential positive impacts: ▪ The establishment of infrastructure to improve energy security and support the renewable sector. ▪ Creation of employment opportunities. ▪ Benefits to the affected landowners. ▪ Benefits associated with the socio-economic contributions to community development. o Potential negative impacts: ▪ Visual impacts and associated impacts on sense of place. ▪ Impact on property values. ▪ Impact on tourism. ▪ Decommissioning Phase: o Potential negative impacts: ▪ Social impacts associated with retrenchment including loss of jobs, and source of income. The findings of the Socio-Economic Assessment indicate that the proposed project will result in several social and socio-economic benefits. The enhancement measures listed

NEED	
Question	**Response**
	in the assessment should be implemented in order to maximise the potential benefits. The significance of this impact is rated as High Positive. The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the negative environmental and socio-economic impacts associated a coal-based energy economy and the challenges created by climate change, represents a significant positive social benefit for society as a whole. The findings also indicate that the potential negative impacts associated with both the construction and operational phase are likely to be Low Negative with mitigation. The potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented. The study concluded that the establishment of the proposed project is supported by the findings of the Socio-Economic Assessment. The no-go option is not supported by the findings of the Socio-Economic Assessment.
1.10. Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	Linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area are considered as part of the relevant specialist assessments, such as the Socio-Economic Assessment, Visual Impact Assessment, HIA, and Battery Energy Storage System (BESS) High Level Safety, Health and Environment Risk Assessment.
1.11. Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives / targets / considerations of the area?	The impacts on ecological integrity objectives of the area are considered as part of the Terrestrial Biodiversity and Plant and Animal Species, Aquatic Biodiversity, and Avifauna Impact Assessments. Refer to the responses provided to Questions 1.1 to 1.10 regarding the sensitivities identified in these Specialist Assessments, as well as the potential impacts identified on terrestrial biodiversity.
1.12. Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?	Chapter 5 of this EIA Report includes a full description of alternatives assessed during the EIA Phase. The no-go alternative and technology alternatives (relating to the BESS) were assessed during the EIA Phase. Note that the specialists have assessed Solid State Lithium Ion and Redox Flow BESS technologies, and both are deemed acceptable. The preferred technology is discussed in Chapter 20 of this EIA Report (Conclusions and Recommendations). The approach followed to identify the buildable areas was to use environmental and social constraints to avoid sensitive features, thus applying mitigation hierarchy thinking. This approach replaces the need to rank alternative sites and locations, as it leads to the selection of the least sensitive development footprint.

NEED	
Question	**Response**
1.13. Describe the positive and negative cumulative ecological/biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?	Each specialist assessment has taken into consideration and has assessed the potential cumulative impacts of this proposed project. Refer to Chapters 6 to 17 of this EIA Report where the potential cumulative impacts are discussed for this project. Note that no residual cumulative impacts of very high significance were rated by the specialists, and no fatal flaws are present.
2.1. What is the socio-economic context of the area, based on, amongst other considerations, the following considerations?	
2.1.1. The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks of policies applicable to the area.	The proposed project is entirely located within the Renosterberg Local Municipality (RLM) and Pixley Ka Seme District Municipality (PKSDM). The Integrated Development Plan (IDP) for the RLM could not be sourced during the Scoping and EIA Process. This is corroborated by the Socio-Economic Specialist Assessment (Chapter 13), which notes that this is likely linked to the dissolution of RLM by the Northern Cape Provincial Government on 7 September 2020. However, the Final IDP (2022 – 2027) for the PKSDM that was adopted in June 2022 is available. The vision for the PKSDM is "*Sustainably Developed District for future Generations*" (PKSDM, 2022, Page 23[11]); and the mission is: ▪ "*Supporting our local municipalities to create a home for all in our towns, settlements and rural areas to render dedicated services;* ▪ *Providing political and administrative leadership and direction in the development planning process;* ▪ *Promoting economic growth that is shared across and within communities;* ▪ *Promoting and enhancing integrated development planning in the operations of our municipalities; and* ▪ *Aligning development initiatives in the district to the National Development Plan*." (PKSDM, 2022, Page 23).

[11] Pixley Ka Seme District Final Integrated Development Plan (IDP) 2022 – 2027. 2022. Available: https://www.pksdm.gov.za/idps/PKSDM%20Final%20Integrated%20Development%20Plan%20(IDP)%202022-2027.pdf. [online] Accessed: November 2022.

NEED	
Question	**Response**
	The 2019-2020 IDP notes that the economy in the PKSDM is characterized by: ▪ High levels of poverty and low levels of education. ▪ Low levels of development despite the strategic location in terms of the national transport corridors. ▪ High rate of unemployment, poverty and social grant dependence. ▪ Prone to significant environmental changes owing to long-term structural changes (such as climate change, energy crises and other shifts). The IDP recognises renewable energy projects as potential sustainable economic development opportunities. The development of the proposed project will therefore also be in line with the vision of the PKSDM to diversify the job market by creating and supporting sustainable economic growth and development opportunities. The proposed project will create job opportunities and economic spin offs during the construction and operational phases (if an EA is granted by the DFFE). Approximately 150 employment opportunities will be created during the construction phase, and approximately 8 during the operational phase of the proposed project. It should, however, be noted that employment during the construction phase will be temporary, whilst the employment opportunities during the operational phase will be long-term. Therefore, the proposed project would help to address the need for increased electricity supply to the national grid while also providing advanced skills transfer and training to the local communities and creating contractual and permanent employment in the area. These factors are linked to the REIPPPP.
2.1.2. Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.)	This is not applicable as the proposed project is located within a rural area and the site is zoned for agricultural use.
2.1.3. Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.)	The Terrestrial Biodiversity and Plant and Animal Species Specialist Assessment (Chapter 7) notes that the land within the study area is currently being used for livestock grazing, with some game animals such as springbok. Infrastructure such as homesteads, livestock pens, windpumps, waterpoints, gravel farm roads and fences are located on the

NEED	
Question	**Response**
	affected properties. Furthermore, existing overhead powerlines run through the study area. An HIA (Chapter 11) has been undertaken during the EIA Phase to assess potential archaeological and cultural impacts resulting from the proposed project. Refer to the response to Question 1.5 for detailed feedback on the impacts identified on Archaeology and Cultural Heritage, as well as feedback on the palaeontology. Should the proposed project proceed, it is not expected that the agricultural activities present on site will be significantly threatened. An Agricultural Compliance Statement has been included as Chapter 6 of this EIA Report. The compliance statement considers the impact of the proposed project in terms of the land capability and agricultural potential. As noted in Chapter 6, the proposed site is identified as being of predominantly low and medium sensitivity for agricultural resources. As noted, an EMPr has been compiled for the proposed project to ensure that all potential negative impacts identified are suitably managed and mitigated, and potential positive impacts are enhanced. The impact on the sense of place is difficult to predict and would potentially be ambiguous. This is due to the subjective nature of perceptions regarding the relative attraction or disturbance of the solar facilities in a rural landscape. The visual impact and considerations were assessed as part of the Visual Impact Assessment (Chapter 10) undertaken during the EIA Phase. The Visual Impact Assessment has provided more accurate mapping of landscape features at the detailed project scale, being a refinement of the Screening Tool Landscape Sensitivity Map. No significant landscape or scenic features would be affected by the proposed project. The Socio-Economic Assessment (Chapter 13) also addresses sense of place. No fatal flaws have been identified from a sense of place perspective. Recommended mitigation measures have been included in the EMPr, as required and where relevant.

NEED	
Question	**Response**
	The feature and sensitivity map for the study area, and the combined layout and sensitivity map are included in Chapter 20 of this EIA Report. The sensitivities identified by the various specialists have been taken into consideration and avoided where possible in order to identify the Buildable Areas.
2.1.4. Municipal Economic Development Strategy ("LED Strategy").	The LED Strategy has been considered in the Socio-Economic Assessment (Chapter 13 of the EIA Report). However, the Final IDP (2022 – 2027[10]) for the PKSDM notes that one of the thrusts in the National LED Strategy is focused on renewable energy development and enhancing efficiency in the energy sector.
2.2. Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area? 2.2.1. Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	This has been addressed in detail in the Socio-Economic Impact Assessment (Chapter 13 of the EIA Report). The assessment considers the impact of the proposed project from a socio-economic perspective. The REIPPPP has contributed significantly towards meeting South Africa's Greenhouse Gas emission targets and, at the same time, supporting energy security, economic stability, and environmental sustainability. The establishment of renewable energy facilities, such as the proposed project, therefore, not only address the environmental issues associated with climate change and consumption of scarce water resources, but also creates significant socio-economic opportunities and benefits, specifically for historically disadvantaged, rural communities. A socio-economic profile is included in Chapter 3 of this EIA Report. Refer to the response provided to Question 1.9 for a description of the impacts identified.
2.3. How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	These needs and interests of the relevant communities has been addressed in the Socio-Economic Assessment. Issues raised by Interested and Affected Parties (I&APs) to this effect are addressed in the relevant specialist assessments (i.e. summary of issues raised during the Scoping Phase, and adequate responses). An Issues and Responses Trail is also included in Appendix F.5 of this EIA Report, which includes all comments raised during the release of the Background Information Document (BID), with responses provided by the EIA Project Team. Appendix F.11 includes the Issues and Responses Trail for all issues raised by I&APs during the 30-day review of the Draft Scoping Report, as well as corresponding responses. Comments raised have been addressed where relevant during the EIA Phase.

NEED	
Question	**Response**
	All comments submitted during the 30-day review period of the Draft EIA Report have been incorporated in the Comments and Responses Report, and addressed, as applicable and where relevant, and is included as an appendix in this Final EIA Report, specifically Appendix H.7.
2.4. Will the development result in equitable (intra- and inter-generational) impact distribution, in the short- and long term? Will the impact be socially and economically sustainable in the short- and long-term?	This has been addressed in the Socio-Economic Impact Assessment that is included in the EIA Report. The assessment considers the impact of the proposed project from a socio-economic perspective. Refer to the response provided to Question 1.9 for a description of the impacts identified.
2.5. In terms of location, describe how the placement of the proposed development will:	
2.5.1. result in the creation of residential and employment opportunities in close proximity to or integrated with each other	Local employment opportunities will be provided as far as possible. Approximately 150 employment opportunities will be created during the construction phase, and approximately 8 during the operational phase of the proposed project. It should, however, be noted that employment during the construction phase will be temporary, whilst the employment opportunities during the operational phase will be long-term.
2.5.2. reduce the need for transport of people and goods	This is not applicable as the proposed project is located within a remote rural area and the site is zoned for agricultural use. This project is a renewable energy project proposal. Nevertheless, traffic related impacts of the proposed project are addressed in the Traffic Impact Assessment and has been provided as Chapter 14 in this EIA Report.
2.5.3. result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms public transport)	This is not applicable as the proposed project is located within a remote rural area and the site is zoned for agricultural use. This project is a renewable energy project proposal. Refer to the response provided to Question 2.5.2.
2.5.4. compliment other uses in the area	As noted above, the land within the study area is currently being used for livestock grazing. The Agricultural Compliance Statement (Chapter 6) notes the following: ▪ The proposed project will occupy land that is of very limited land capability, which is insufficient for crop production. There is no scarcity of such agricultural land in South Africa and its conservation for agricultural production is not therefore a priority. ▪ The amount of agricultural land used by the proposed project is well within the allowable development limits prescribed by the Agricultural Protocol of GN 320. ▪ The proposed project offers positive impact on agriculture by way of improved financial security for farming operations, as well as security benefits against stock theft and other crime.

NEED	
Question	**Response**
	▪ The proposed development will also have the wider societal benefits of generating additional income and employment in the local economy. Based on the above, the proposed project is understood to compliment other uses in the area. Furthermore, relevant impacts on sense of place, property values, and tourism have been addressed in the Socio-Economic Assessment, and recommendations for mitigation have been included in the EMPr.
2.5.5. be in line with the planning for the area	The Final IDP (2022 – 2027[10]) for the PKSDM identifies solar energy as a development opportunity in the RLM. Based on the Socio-Economic Assessment (Chapter 13 of this EIA Report), the 2017 PKSDM Spatial Development Framework (SDF) notes the establishment of a Renewable Energy Hub stretching from the west coast up to De Aar region. Furthermore, the proposed project is also located within the Central Strategic Transmission Corridor that was gazetted in February 2018. This facilitates large scale transmission and distribution EGI, which would be needed to support the proposed project. Therefore, the proposed project is in line with the planning for the area.
2.5.6. for urban related development, make use of the underutilised land available with the urban edge	This is not applicable as the proposed project is located within a remote rural area and the site is zoned for agricultural use.
2.5.7. optimise the use of existing resources and infrastructure	The proposed project is planned to connect to the existing Hydra-Perseus 400 kV overhead power line via dedicated proposed 132 kV power lines and an independent Main Transmission Substation (MTS). However, if the proposed Eskom Hydra B Substation is built by Eskom, then additional upgrades of this Eskom substation would be undertaken to ensure that the substation can accommodate the power generated by the proposed 12 Kudu Solar Facilities. This is being considered as to minimise impacts and make use of existing infrastructure. Separate Basic Assessment (BA) and/or EGI Standard Registration Processes will be undertaken for the EGI Projects (Projects 13 – 26).
2.5.8. opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for	The proposed project is a renewable energy project and not related to bulk infrastructure expansion.

NEED	
Question	**Response**
the settlement that reflects the spatial reconstruction priorities of the settlement)	
2.5.9. discourage "urban sprawl" and contribute to compaction/densification	This has been addressed in the Socio-Economic Impact Assessment (Chapter 13 of the EIA Report). The assessment considers impacts such as those associated with the presence of construction workers on local communities; and the impacts related to the potential influx of job seekers.
2.5.10. contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs	This is not applicable as the proposed project is located within a remote rural area and the site is zoned for agricultural use.
2.5.11. encourage environmentally sustainable land development practices and processes	The development of a renewable energy facility is a sustainable land development practice provided it is constructed and operated in an environmentally conscious manner.
2.5.12. take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.)	Refer to Chapter 5 of this EIA Report for a description of the process undertaken to identify the study area as the preferred site for the solar PV facility.
2.5.13. the investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential)	This has been addressed within the Socio-Economic Impact Assessment (Chapter 13 of the EIA Report).
2.5.14. impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area	An HIA (Chapter 11 of this EIA Report) has been undertaken during the EIA Phase to assess potential archaeological and cultural impacts resulting from the proposed project. Refer to the response to Question 1.5 for detailed feedback on the impacts identified on Archaeology and Cultural Heritage, as well as feedback on the palaeontology. The visual impact and considerations, including sense of place, have been further assessed as part of the Visual Impact Assessment (Chapter 10 of this EIA Report). Refer to the response provided to Question 2.1.3 for additional feedback on the potential visual impacts.
2.5.15. in terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	Several renewable energy projects have been granted EA in the vicinity of De Aar and the surrounding region. Chapter 4 of this EIA Report includes a list of other renewable energy and electricity grid infrastructure (EGI) projects within a 30 km radius that have received EA or are currently going through an Environmental Assessment process.

NEED	
Question	**Response**
2.6. How were a risk-averse and cautious approach applied in terms of socio-economic impacts?	
2.6.1. What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	The precautionary approach has been adopted for this study, i.e. assuming the maximum development scenario will occur and then identifying ways to mitigate or manage these impacts. In addition, the specialist assessments compiled for the EIA Phase provide detailed feedback on any uncertainties, assumptions, and risks associated with limits of current knowledge. The Socio-Economic Specialist Assessment included as Chapter 13 of this EIA Report provides input on the assumptions and limitations.
2.6.2. What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?	
2.6.3. Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	
2.7. How will the socio-economic impacts resulting from this development impact on people's environmental right in terms following:	
2.7.1. Negative impacts: e.g. health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	A detailed Socio-Economic Impact Assessment is included in this EIA Report that considers the impact of the proposed project from a socio-economic perspective. A preliminary socio-economic profile is included in Chapter 3 of this EIA Report. Refer to the response provided to Question 1.9 for a description of the impacts identified in the Socio-Economic Scoping Level assessment. In addition, measures to avoid, remedy, mitigate or manage negative socio-economic impacts and enhance positive socio-economic impacts are included in the EMPr that is included in Appendix I and Appendix J of this EIA Report. Linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area, as well as how the potential socio-economic impacts will result in ecological impacts are considered as part of the relevant specialist assessments. With regards to the best practicable environmental option, Chapter 5 of this EIA Report includes a full description of alternatives that have been assessed during the EIA Phase. Refer to the response provided to Question 1.12 above for additional information on the alternatives considered.
2.7.2. Positive impacts. What measures were taken to enhance positive impacts?	
2.8. Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socioeconomic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	
2.9. What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	
2.10. What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)? Considering the need for social equity and justice, do the alternatives identified,	

NEED	
Question	**Response**
allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	
2.11. What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?	
2.12. What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle?	
2.13. What measures were taken to:	
2.13.1. ensure the participation of all interested and affected parties	The supporting documentation of the Public Participation Process (PPP) that was undertaken during the Scoping Phase is included as Appendix F of this EIA Report, and the PPP undertaken during the EIA Phase is described in Chapter 4, with supporting documentation in Appendix H. The PPP complies with the 2014 NEMA EIA Regulations (as amended). Various methods have been employed to notify potential I&APs of the proposed project, namely, through newspaper advertisements, site notices boards, notification letters and communication via email, as well as text messages, and telephonic discussions where possible.
2.13.2. provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation	
2.13.3. ensure participation by vulnerable and disadvantaged persons	
2.13.4. promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means	The EIA Process aims to take cognisance of all interests, needs, and values espoused by all I&APs. Opportunity for public participation have been provided to all I&APs throughout the EIA Process in terms of the 2014 NEMA EIA Regulations (as amended).
2.13.5. ensure openness and transparency, and access to information in terms of the process	The supporting documentation of the PPP undertaken during the Scoping Phase is included in Appendix F of this EIA Report, and the PPP undertaken during the EIA Phase is described in Chapter 4, as well as supporting documentation in Appendix H. Refer to the responses provided to Questions 2.13.1 – 2.13.3 above.
2.13.6. ensure that the interests, needs and values of all interested and affected parties were taken into account and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge	The EIA process takes cognisance of relevant interests, needs and values adopted by I&APs.

NEED	
Question	**Response**
2.13.7. ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein was promoted	Public participation of all I&APs has been promoted and opportunities for engagement have been provided during the EIA process.
2.14. Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?	This is addressed in the Socio-Economic Impact Assessment that is included in the EIA Report. Refer to the responses provided to Questions 1.9, 2.2 and 2.3.
2.15. What measures have been taken to ensure that current and/or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected?	An EMPr was developed during the EIA Phase to address environmental, health and safety concerns. An Environmental Control Officer (ECO) will be appointed to monitor compliance with the EMPr and EA (should such authorisation be granted) during the construction and operational phases.
2.16. Describe how the development will impact on job creation in terms of, amongst other aspects:	
2.16.1. the number of temporary versus permanent jobs that will be created	This is addressed in the Socio-Economic Impact Assessment that is included in the EIA Report. Refer to the response provided to Question 1.9 for a description of the impacts identified from a socio-economic perspective, and also the responses to Questions 2.1.1 and 2.5.1 for feedback on potential employment opportunities.
2.16.2. whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area)	
2.16.3. the distance from where labourers will have to travel	
2.16.4. the location of jobs opportunities versus the location of impacts (i.e. equitable distribution of costs and benefits)	
2.16.5. the opportunity costs in terms of job creation (e.g. a mine might create 100 jobs, but impact on 1000 agricultural jobs, etc.).	
2.17. What measures were taken to ensure:	
2.17.1. that there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment	Various government departments have been listed as I&APs and were given the opportunity to comment on the Draft Scoping Report and have also been given the opportunity to comment on the Draft EIA Report during the 30-day public participation period (i.e. current phase). Comments received are included in Appendix H.6 of this EIA Report, and responded to, as relevant, in the Comments and Responses Report in Appendix H.7

NEED	
Question	**Response**
2.17.2. that actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures?	No conflicts of interests between organs of state were identified during the EIA Process.
2.18. What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?	The proposed project aims to adhere to the principles of environmental management in NEMA. Measures taken to ensure adherence to the principles of NEMA are essentially addressed through the management actions and monitoring recommendations included in the EMPr. In addition, the outcomes of this Scoping and EIA Process and the associated conditions of the EA (should it be received) serve to address this question.
2.19. Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	The proposed mitigation measures included in the EMPr were informed by the specialist assessments that were undertaken. This includes a detailed assessment of the environment as well as the impacts associated with the proposed project. Detailed specialist assessments have all concluded that the project can proceed, with no fatal flaws or unacceptable impacts identified as part of the proposed project. Therefore, the mitigation measures are deemed to be realistic and practical. The EMPr is included in Appendix I and Appendix J of this EIA Report.
2.20. What measures were taken to ensure that 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 will be paid for by those responsible for harming the environment?	The EMPr for the proposed project will form part of the contractual agreement and must be adhered to by the contractors, construction workers and the Project Applicant. The EMPr includes measures to ensure that the costs to potentially remedy pollution, environmental degradation and consequent adverse health effects will be paid for by those responsible for the relevant environmental impacts. The EMPr accordingly includes measures to ensure that the costs to potentially prevent, control or minimise further pollution, environmental damage or adverse health effects will be paid for by those responsible for the relevant environmental impacts. Roles and responsibilities for the implementation of management actions, and monitoring thereof are included in the EMPr.
2.21. Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socio-economic considerations?	Agriculture on site is influenced by climatic variables and limitations. Renewable energy development is a suitable land use option for the site. The proposed project would be more robust in terms of economic viability and profitability while also being largely uninfluenced by climate change variables. The proposed project would also provide the farm owners (i.e. of the land on which the PV project is being proposed) with additional income by way of lease agreements and will also contribute to local socio-economic upliftment through job creation.

NEED	
Question	**Response**
	Chapter 5 of this EIA Report includes a full description of alternatives that have been assessed during the EIA Phase. Refer to the response provided to Question 1.12 above for additional information on the alternatives to be considered.
2.22. Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope, and nature of the project in relation to its location and other planned developments in the area?	The potential cumulative impacts resulting from the proposed project have been assessed as part of the EIA Phase. Refer to Chapter 4 of this EIA Report where the list of other renewable energy and EGI projects within a 30 km radius considered in the cumulative impact assessment are discussed. The Socio-Economic Specialist Assessment (Chapter 13) identified the following cumulative impacts: ▪ Cumulative impact on sense of place (negative impact). ▪ Cumulative impact on services (negative impact). ▪ Cumulative impact on local economies (positive impact). None of the above negative impacts were identified with a high or very high significance after mitigation.

1.9. Objectives for this EIA Report

This EIA Report was preceded by a comprehensive Scoping Process. During the Scoping Phase, the Scoping Report was made available to Interested and Affected Parties (I&APs) and stakeholders for a 30-day comment period extending from 9 December 2022 to 30 January 2023. Issues raised in response to the Draft Scoping Report were captured in an Issues and Responses Trail. The Final Scoping Report was submitted to the DFFE in February 2023 for consideration (i.e. acceptance or refusal of EA) in line with Regulation 21 (1) of GN R326. The DFFE accepted the Final Scoping Report and Plan of Study for EIA in March 2023. Refer to Appendix G of this EIA Report for a copy of this acceptance letter. This acceptance marked the end of the Scoping Phase after which the EIA Process moved into the impact assessment and reporting phase.

For the purpose of completeness and continuity, the documentation associated with the Public Participation Process undertaken in the Scoping Phase, and comments received from I&APs during the Scoping Phase, are included in Appendix F of this EIA Report. The Issues and Responses Trail for the comments received during the review of the Background Information Document and Draft Scoping Report are respectively included in Appendix F.5 and Appendix F.11 of this EIA Report. For background on the Scoping Process, the reader is referred to the Final Scoping Report (CSIR, 2023).

The EIA Phase of this Scoping and EIA Process is shaped by the findings of the Scoping Phase. The 2014 NEMA EIA Regulations (as amended) stipulates that the EIA Process must be undertaken in line with the approved Plan of Study for the EIA[12], and that it must include a description of the potential environmental impacts, mitigation, and closure outcomes, as well as the residual risks of the proposed activity. In broad terms, the objectives of the EIA Process in terms of the 2014 NEMA EIA Regulations (as amended) are to:

- determine the policy and legislative context within which the activity is located and note how the proposed activity complies with and responds to the policy and legislative context;
- describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the development footprint on the approved site as contemplated in the accepted scoping report;
- identify the location of the development footprint within the approved site as contemplated in the accepted scoping report based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;
- determine the nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and the degree to which these impacts (a) can be reversed; (b) may cause irreplaceable loss of resources, and (c) can be avoided, managed or mitigated;
- identify the most ideal location for the activity within the development footprint of the approved site as contemplated in the accepted scoping report based on the lowest level of environmental sensitivity identified during the assessment;

[12] The Plan of Study for the EIA was detailed in Chapter 7 of the Final Scoping Report, which was accepted by the DFFE in March 2023.

- identify, assess, and rank the impacts the activity will impose on the development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity;
- identify suitable measures to avoid, manage or mitigate identified impacts; and
- identify residual risks that need to be managed and monitored.

In terms of legal requirements, a crucial objective of the EIA Report is to satisfy the requirements of Appendix 3 of the 2014 NEMA EIA Regulations (as amended). This section regulates and prescribes the content of the EIA Report and specifies the type of supporting information that must accompany the submission of the EIA Report to the Competent Authority. An overview of where the requirements of Appendix 3 of the 2014 NEMA EIA Regulations (as amended) are addressed in this EIA Report is presented in Table 1.3 below.

As required in Regulation 23 (4) of the 2014 NEMA EIA Regulations (as amended), the EMPr that is required as part of the EIA Process is provided in Appendix I and Appendix J of this EIA Report. The EMPr for the Solar PV and associated infrastructure (Appendix I of the EIA Report) has been structured to comply with the requirements outlined in Appendix 4 of the 2014 NEMA EIA Regulations (as amended). The EMPr for the on-site substation complex (Appendix J of the EIA Report) complies with the Generic EMPr for substations published in GN 435 in March 2019.

Furthermore, this process has been designed to satisfy the requirements of Regulations 41, 42, 43 and 44 of the 2014 NEMA EIA Regulations (as amended) relating to the PPP and, specifically, the registration of and submissions from I&APs.

As noted above, the Draft EIA Report was being made available to registered I&APs, Organs of State and key relevant stakeholders for a 30-day comment period extending from 2 June 2023 to 3 July 2023 (excluding public holidays). All comments received during the 30-day comment period on the Draft EIA Report have been incorporated into the Comments and Responses Report and addressed, as applicable and where relevant, and is included in Appendix H.7 of this Final EIA Report that has submitted to the DFFE for decision-making (i.e. approval or refusal) in line with Regulation 24 of GN R326.

Table 1.3: Compliance with Appendix 3 of the 2014 NEMA EIA Regulations (as amended)

Section of the EIA Regulations	Requirements for an Environmental Impact Assessment Report in terms of Appendix 3 of the 2014 NEMA EIA Regulations (GN R982, as amended in GN R326)	Chapter / Appendix
Appendix 3 - (3) (1) (a)	Details of - i. the EAP who prepared the report; and ii. the expertise of the EAP, including a curriculum vitae;	Chapter 1, Appendix A and Appendix B
Appendix 3 - (3) (1) (b)	The location of the development footprint of the activity on the approved site as contemplated in the accepted scoping report, including - i. the 21-digit Surveyor General code of each cadastral land parcel; ii. where available, the physical address and farm name; iii. where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	Chapter 1, Chapter 2, Chapter 3, Chapter 20, Appendix C
Appendix 3 - (3) (1) (c)	A plan which locates the proposed activity or activities applied for as well as the associated structures and infrastructure at an appropriate scale, or, if it is - i. a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or ii. on land where the property has not been defined, the coordinates within which the activity is to be undertaken;	Chapter 1, Chapter 2, Chapter 3, Chapter 20, Appendix C

Section of the EIA Regulations	Requirements for an Environmental Impact Assessment Report in terms of Appendix 3 of the 2014 NEMA EIA Regulations (GN R982, as amended in GN R326)	Chapter / Appendix
Appendix 3 - (3) (1) (d)	A description of the scope of the proposed activity, including – i. all listed and specified activities triggered and being applied for; ii. a description of the associated structures and infrastructure related to the development;	Chapter 2 and Chapter 4
Appendix 3 - (3) (1) (e)	A description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context;	Chapter 4 and Chapters 6 to 17
Appendix 3 - (3) (1) (f)	A motivation for the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred development footprint within the approved site as contemplated in the accepted scoping report;	Chapter 1 and Chapter 5
Appendix 3 – (3) (1) (g)	A motivation for the preferred development footprint within the approved site as contemplated in the accepted scoping report;	Chapter 5
Appendix 3 – (3) (1) (h)	A full description of the process followed to reach the proposed preferred activity, site and location of the development footprint within the site, including - i. details of all the alternatives considered; ii. details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; iii. a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them; iv. the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; v. the impacts and risks which have informed the identification of each alternative, including the nature, significance, consequence, extent, duration and probability of such identified impacts, including the degree to which these impacts (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated; vi. the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks; vii. positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; viii. the possible mitigation measures that could be applied and level of residual risk; ix. if no alternative development footprints for the activity were investigated, the motivation for not considering such; and x. a concluding statement indicating the location of the preferred alternative development footprint within the approved site as contemplated in the accepted scoping report;	Chapter 5
Appendix 3 - (3) (1) (i)	A full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity, including – i. a description of all environmental issues and risks that were identified during the environmental impact assessment process; and i. an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;	Throughout Chapters 6 - 19
Appendix 3 – (3) (1) (j)	An assessment of each identified potentially significant impact and risk, including (i) cumulative impacts; (ii) the nature, significance and consequences of the impact and risk; (iii) the extent and duration of the impact and risk; (iv) the probability of the impact and risk occurring; (v) the degree to	Throughout Chapters 6 – 19

Section of the EIA Regulations	Requirements for an Environmental Impact Assessment Report in terms of Appendix 3 of the 2014 NEMA EIA Regulations (GN R982, as amended in GN R326)	Chapter / Appendix
	which the impact and risk can be reversed; (vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and (vii) the degree to which the impact and risk can be mitigated;	
Appendix 3 – (3) (1) (k)	Where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report;	Chapter 20
Appendix 3 – (3) (1) (l)	An environmental impact statement which contains: i. a summary of the key findings of the environmental impact assessment: ii. a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred development footprint on the approved site as contemplated in the accepted scoping report indicating any areas that should be avoided, including buffers; and iii. a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	Chapters 6 to 19, Chapter 20 and Appendix I and Appendix J
Appendix 3 – (3) (1) (m)	Based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation;	Chapters 6 to 19, Chapter 20 and Appendix I and Appendix J
Appendix 3 – (3) (1) (n)	The final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment;	Chapters 5 to 19, Chapter 20 and Appendix I and Appendix J
Appendix 3 – (3) (1) (o)	Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	Chapters 6 to 17 and Chapter 20
Appendix 3 – (3) (1) (p)	A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;	Chapters 6 to 17 and Chapter 20
Appendix 3 – (3) (1) (q)	A reasoned opinion as to whether the proposed 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;	Chapter 20
Appendix 3 – (3) (1) (r)	Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised;	Not Applicable
Appendix 3 - (3) (1) (s)	An undertaking under oath or affirmation by the EAP in relation to - ii. the correctness of the information provided in the reports; iii. the inclusion of comments and inputs from stakeholders and interested and affected parties; iv. the inclusion of inputs and recommendations from the specialist reports where relevant; and v. any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;	Appendix B
Appendix 3 – (3) (1) (u)	An indication of any deviation from the approved scoping report, including the plan of study, including - i. any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and ii. a motivation for the deviation;	Not applicable
Appendix 3 - (3) (1) (v)	Any specific information that may be required by the competent authority; and	Information requested by the DFFE during comment periods, and acceptance of the Final Scoping Report have been addressed throughout the report, as relevant

Section of the EIA Regulations	Requirements for an Environmental Impact Assessment Report in terms of Appendix 3 of the 2014 NEMA EIA Regulations (GN R982, as amended in GN R326)	Chapter / Appendix
Appendix 3 - (3) (1) (w)	Any other matters required in terms of section 24(4)(a) and (b) of the Act.	Throughout the report
Appendix 3 - (3) (2)	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to an environmental impact assessment report the requirements as indicated in such notice will apply.	Not applicable in terms of the actual EIA Report, but various gazetted assessment and reporting protocols have been complied with for the specialist assessments. Refer to Chapter 4, Chapters 6 to 19, and Chapter 20 of this EIA Report.



CHAPTER 2:
Project Description



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2. PROJECT DESCRIPTION

This chapter provides an overview of the conceptual project design and technology for the proposed Kudu Solar Facility 4 and associated infrastructure.

The purpose of this chapter is to present sufficient project information on the proposed project to inform the Scoping and Environmental Impact Assessment (EIA) Process in terms of design parameters applicable to the project.

As noted in Chapter 1 of this EIA Report, 12 Solar Photovoltaic (PV) power generation facilities and associated Electrical Grid Infrastructure (EGI) are being proposed north-east of the town of De Aar, in the Renosterberg Local Municipality and Pixley Ka Seme District Municipality, in the Northern Cape Province. The Solar PV Facilities are referred to as Projects 1 to 12, and the related EGI projects are referred to as Projects 13 to 26. Separate EIA Reports have been compiled for each Solar Facility. This EIA Report only addresses **Project 4** (i.e. Kudu Solar Facility 4 and associated infrastructure) (hereafter referred to as the "Kudu Solar Facility" or "proposed project").

In terms of the EGI projects (i.e. Projects 13 to 26), these address the proposed grid connection from the proposed Kudu Solar Facilities to the nearby Eskom Hydra-Perseus 400 kV Overhead Power Line; and separate Basic Assessment (BA) Processes and/or adoption of the EGI Standard (Government Gazette 47095; Government Notice (GN) 2313, dated 27 July 2022) will be followed for these projects.

2.1 Definition of Project Study Area

The **study area or preferred site** for all the proposed Kudu Solar Facilities is the **full extent** of the **eight affected farm properties** on which the proposed PV Facilities are planned to be constructed. These farm properties[1] are listed in Table 2.1. The full extent of these properties has been assessed by the specialists to identify environmental sensitivities and no-go areas. The preferred site or **total study area** for all the Kudu Solar Facilities is approximately **8 150 hectares (ha)**. The preferred site serves as the study area for this Scoping and EIA Process. Therefore, the terms "site" and "study area" are used synonymously in this report.

Table 2.1: Farm Properties forming the study area.

FARM PORTION	SG CODE
Remaining Extent of the Farm Bas Berg No. 88	C05700000000008800000
Remaining Extent of Portion 3 of the Farm Bas Berg No. 88	C05700000000008800003
Portion 4 (Portion of Portion 3) of the Farm Bas Berg No. 88	C05700000000008800004
Remaining Extent of Portion 2 (Middel Plaats) (a Portion of Portion 1) of the Farm Grasspan No. 40	C05700000000004000002
Remaining Extent of the Farm Annex Wolve Kuil No. 41	C05700000000004100000
Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41	C05700000000004100001
Portion 2 of the Farm Wolve Kuil No. 43	C05700000000004300002
Remaining Extent of the Farm Wolve Kuilen No. 42	C05700000000004200000

[1] The farm property details are based on the information captured in the Title Deeds. All references made to these properties in this report should be considered as such.

At the commencement of this Scoping and EIA Process, the **Original Scoping Buildable Areas** which fall within the study area / preferred site, were identified by the Project Applicant following the completion of high-level environmental screening based on the Screening Tool. The Scoping Buildable Areas serve as the “development footprints” for the 12 proposed PV facilities and fall within the preferred site / study area.

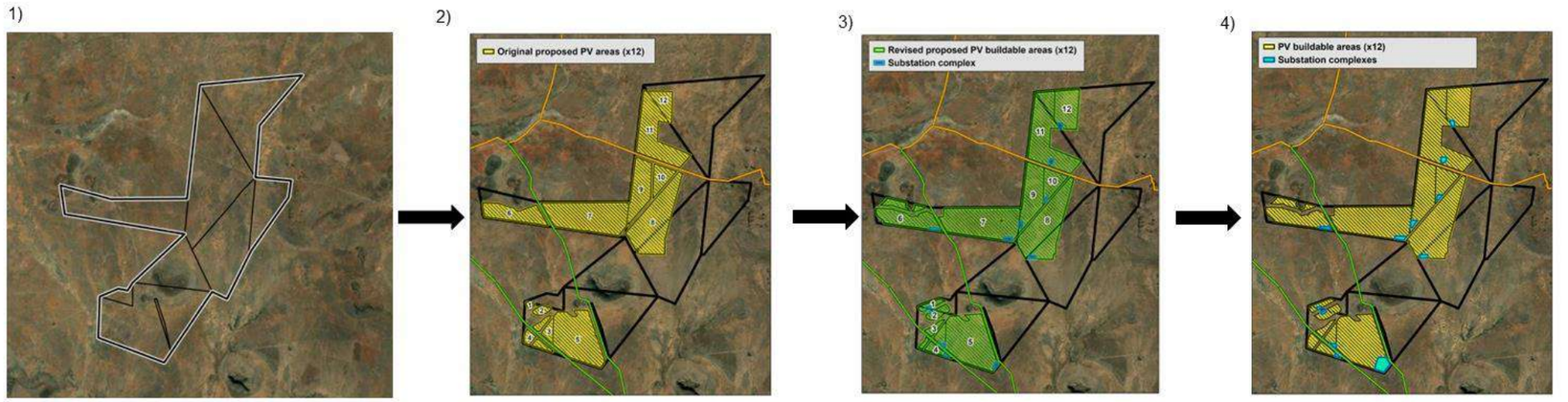
As part of the Scoping Phase, the specialists assessed and considered the entire study area / preferred site, which included the Original Scoping Buildable Areas.

Following the identification of sensitivities by the specialists and relevant specialist fieldwork during the Scoping Phase, the Project Developer took such sensitivities, and other considerations, into account and formulated the Revised Scoping Buildable Areas or development footprints for the proposed 12 x PV areas. The Revised Scoping Buildable Areas have been used to inform the design of the layout and have been further assessed during this EIA Phase in order to identify the preferred development footprint of the proposed project on the approved site as contemplated in the accepted Scoping Report. The development footprint is where the actual development will be located, i.e. the footprint containing the PV solar arrays and associated infrastructure. The buildable areas are the full extent to be approved for development, and the development footprint detailed in the layouts is based on the current proposal.

In summary, the full extent of the study area has been assessed by the specialists and mapped accordingly in the Specialist Assessments to identify environmental sensitivities and no-go areas. This approach uses environmental and social constraints to avoid sensitive features, thus applying mitigation hierarchy thinking, and it leads to the selection of the least sensitive development footprint.

Changes to the detailed layouts are deemed acceptable if the changes remain within the approved buildable areas / development footprints and area assessed during the Scoping and EIA Process with no-go sensitive areas avoided.

Figure 2.1 provides an indication of the Scoping Buildable Areas, development footprints, as well as the study area, and its evolution.



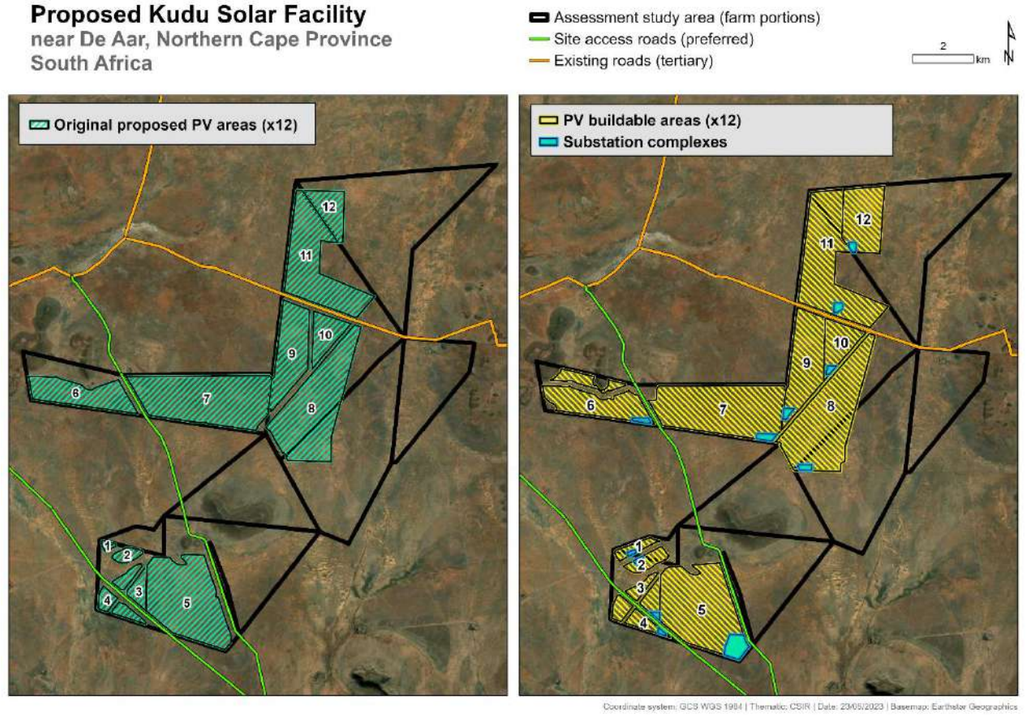
Assessment study area / preferred site
=
Total extent of the land portions identified for the development. This entire extent was assessed by the specialists.

Original proposed PV areas / development footprint
=
Preliminary PV areas (buildable areas) identified and proposed by the project proponent.

Revised proposed PV areas / development footprint
=
Revised PV areas (buildable areas) that avoids sensitive environmental features identified during specialist site visit.

Final proposed PV areas / development footprint
=
Final PV areas (buildable areas) that avoids sensitive environmental features. This was detailed during the EIA Phase.

A



B

Figure 2.1: A) Evolution of the Study Area / Preferred Site into the Scoping Buildable Areas / development footprints; B) Detailed view of the Project Study Area / Preferred Site, Original Scoping Buildable Areas and finalised Buildable Areas (development footprints).

2.2 Project Locality and Co-ordinates

Refer to Chapter 1 for a locality map of the proposed Kudu Solar Facilities and associated infrastructure. Refer to Appendix C of this EIA Report for additional maps.

The proposed project and associated infrastructure will occur on the farm portions listed in Table 2.2 below, which also specifies the corresponding 21-digit Surveyor General code for each affected farm portion. The properties to be affected by the development of the proposed project will be leased from the property owners by the Project Applicant for the life span of the proposed project.

Table 2.2: Affected Farm Properties for the proposed project.

Farm Portion	21-digit Surveyor General code
Remaining Extent of Portion 3 of the Farm Bas Berg No. 88	C05700000000008800003

Figure 2.2 provides an indication of the affected farm portions and the adjacent farm portions for the entire study area.

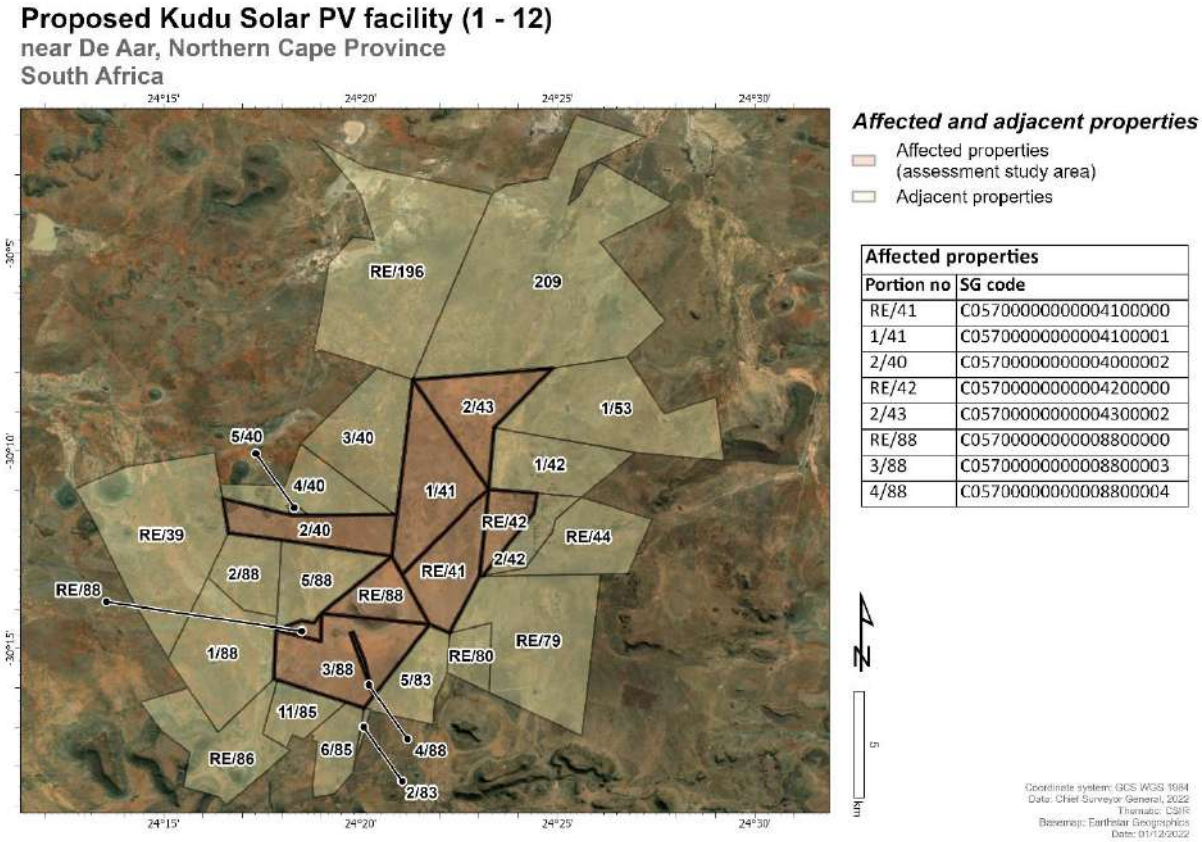


Figure 2.2: Affected and Adjacent Farm Portions for the study area.

The co-ordinates of the corner points of the proposed project are detailed in Table 2.3.

Table 2.3: Co-ordinates of the proposed project.

Point Number	Decimal Degrees		Degrees, Minutes, Seconds	
	Latitude (Y)	Longitude (X)	Latitude (S)	Longitude (E)
1	-30.26819065	24.31436161	30° 16' 05.48633160" S	24° 18' 51.70180668" E
2	-30.26386022	24.30089671	30° 15' 49.89677493" S	24° 18' 03.22813909" E
3	-30.25961444	24.30412547	30° 15' 34.61199878" S	24° 18' 14.85169900" E
4	-30.26353853	24.29989669	30° 15' 48.73871408" S	24° 17' 59.62807400" E
5	-30.26255499	24.29720486	30° 15' 45.19794780" S	24° 17' 49.93749799" E
6	-30.25942921	24.29733633	30° 15' 33.94515614" S	24° 17' 50.41079444" E
7	-30.25582692	24.29878348	30° 15' 20.97690302" S	24° 17' 55.62052197" E
8	-30.25555787	24.29928927	30° 15' 20.00832370" S	24° 17' 57.44137634" E
9	-30.25897098	24.3033702	30° 15' 32.29552852" S	24° 18' 12.13270427" E

Co-ordinates of the proposed new access road from the closest existing main road to the fence line of the PV facility are shown in Table 2.4 below. Co-ordinates are not provided for the proposed internal roads within the PV facility as these will occur within the fenced off area, for which co-ordinates are provided in Table 2.3.

Table 2.4: Co-ordinates of the road to the fence line of the PV Facility.

Point Number	Decimal Degrees		Degrees, Minutes, Seconds	
	Latitude (Y)	Longitude (X)	Latitude (S)	Longitude (E)
1	-30.26572856	24.31140485	30° 15' 56.62280080" S	24° 18' 41.05745090" E
2	-30.26494015	24.31191122	30° 15' 53.78454941" S	24° 18' 42.88038410" E
3	-30.25523716	24.30035801	30° 15' 18.85377591" S	24° 18' 01.28884729" E
4	-30.25579089	24.29956586	30° 15' 20.84720174" S	24° 17' 58.43709801" E

2.3 Key components of the proposed project

The proposed project will consist of the key components listed below in Table 2.5. A summary of the key components of the proposed project and technical information is described in this section.

Table 2.5: Description of the components of the proposed project.

Component	Description
Solar Field	
Type of Technology	Solar Photovoltaic (PV) Technology
Generation Capacity (Maximum Installed)	▪ Up to 50 MWac
Total developable area that includes all associated infrastructure within the fenced off area of the PV facility	▪ Approximately 70 ha
PV Panel Structure (with the following possible tracking and mounting systems):	▪ Height: Approximately 3.5 m (maximum)

Component	Description
▪ Single Axis Tracking structures (aligned north-south); ▪ Dual Axis Tracking (aligned east-west and north-south); ▪ Fixed Tilt Mounting Structure; ▪ Mono-facial Solar Modules; or ▪ Bifacial Solar Modules.	
Building Infrastructure	
Auxiliary Buildings	▪ Type: These include, but are not limited to, Operation and Maintenance (O&M) building / centre, site office, workshop, staff lockers, bathrooms/ablutions, warehouses, guard houses, etc. ▪ Cumulative Footprint: Approximately up to 5000 m^2 ▪ Height: Up to 10 m
Inverter/Transformer Stations	▪ Preliminary average number of stations: 27 ▪ Height: Approximately 3 m ▪ Footprint: Approximately 220 m^2 each
On-site Substation Complex	▪ Components of the on-site substation complex: o On-site Independent Power Producer (IPP) or Facility Substation (~1 ha)[2]. o Solid State Lithium Ion or Redox Flow Battery Energy Storage System. Refer to the details below. o Switching Station and Collector Station (~2 ha). This forms part of Projects 13 – 24 and will be assessed as part of separate processes. It is important to mention here for contextualisation (it does not appear in the Application for EA or relevant listed activities). ▪ Footprint of the on-site substation complex: Up to approximately 8 ha ▪ Height of the on-site substation complex: Up to 10 m ▪ Capacity of the on-site substation complex: This varies according to the detailed design and requirements from potential clients, however a capacity stepping up from 22 kV or 33 kV to 132 kV is estimated.

[2] As confirmed with the DFFE, the on-site substation complex can be included within the current Application for EA.

Component	Description
Associated Infrastructure	
Battery Energy Storage System (BESS)	▪ Technology: Solid State Lithium-Ion BESS or Redox Flow BESS (both options have been considered in the Scoping and EIA Process) ▪ Footprint: Approximately 1 ha ▪ Height: Up to 10 m ▪ Capacity: Up to 500 MW / 500 MWh
On-site medium voltage internal cables	▪ Placement: Underground or above ground in certain sections ▪ Capacity: 22 or 33 kV ▪ Depth: Maximum depth of 1.5 m
Underground low voltage cables or cable trays	▪ Depth: Maximum depth of 1.5 m
Access roads (including upgrading and widening of existing roads, where relevant)	▪ Details: Existing roads will be used as far as practically achievable to access the site. The Traffic Specialist has noted that the main roads leading to the proposed project site are of a sufficient width. However, upgrading of the main access point from the R48 will be required. This is specifically at the intersection of the TR38/01 (i.e. R48) and DR3093, which will require an existing island of approximately 60 m^2 to be removed and surfaced to accommodate the turning movements of vehicles.
Internal roads	▪ Details: New internal service roads will need to be established (i.e. new roads within the fenced off area of the PV Facility, and new roads between the closest existing road and the PV Facility to gain access). These would either comprise farm roads (compacted dirt/gravel) or paved roads. ▪ Width: o Within the PV Facility: Up to 5 m o Between the existing road and PV Facility: Up to 8 m
Fencing around the PV Facility Perimeter	▪ Type: Could be palisade, mesh or fully electrified. A single perimeter fence is proposed around the PV Facility. ▪ Height: Up to 3 m
Storm water channels	▪ Details to be confirmed once the Engineering, Procurement and Construction (EPC) contractor has been selected and the design is finalised. Where necessary, a detailed storm water management plan would need to be developed.
Panel cleaning and maintenance area	▪ The type of panels to be used (and panel cleaning) will be confirmed during detailed design/engineering phase.

Component	Description
	The panel cleaning and maintenance area will form part of the O&M Auxiliary Buildings (located at the on-site substation complex).
Work area during the construction phase (i.e. laydown area)	▪ Temporary Laydown: Up to 7 ha. ▪ The need for a permanent laydown area will be confirmed during the detailed design/engineering phase.
Water Requirements	▪ Approximately 9 000 m^3 of water is estimated to be required per year for the construction phase. ▪ Approximately 1 000 m^3 of water is estimated to be required per year for the operational phase. ▪ Water requirements during the decommissioning phase are unknown at this stage, however they are expected to be similar to the construction phase. ▪ Potential sources: Local municipality, third-party water supplier, existing boreholes or drilled boreholes on site.
Construction Period	▪ 12 – 18 months
Operational Period	▪ Once the commercial operation date is achieved, the proposed facility will generate electricity for a minimum period of 20 years.

Figure 2.3 provides a **schematic** overview (not to scale) of the proposed Kudu Solar Facilities cluster. The EGI projects that consist of the following will be subjected to separate BA processes and/or application of the EGI Standard, as noted above:

- Switching Stations and Collector Stations at each On-Site Substation Complex;
- 132 kV Overhead Power Line from each Kudu Solar Facility to the proposed Collector Station(s) or up to the proposed independent Main Transmission Substation (MTS);
- Independent 132 kV/400 kV MTS and associated infrastructure; and
- 400 kV Loop-In-Loop-Out (LILO) from the existing Hydra-Perseus 400 kV Overhead Power Line to the proposed MTS.

A description of the key components of the proposed project is described below.

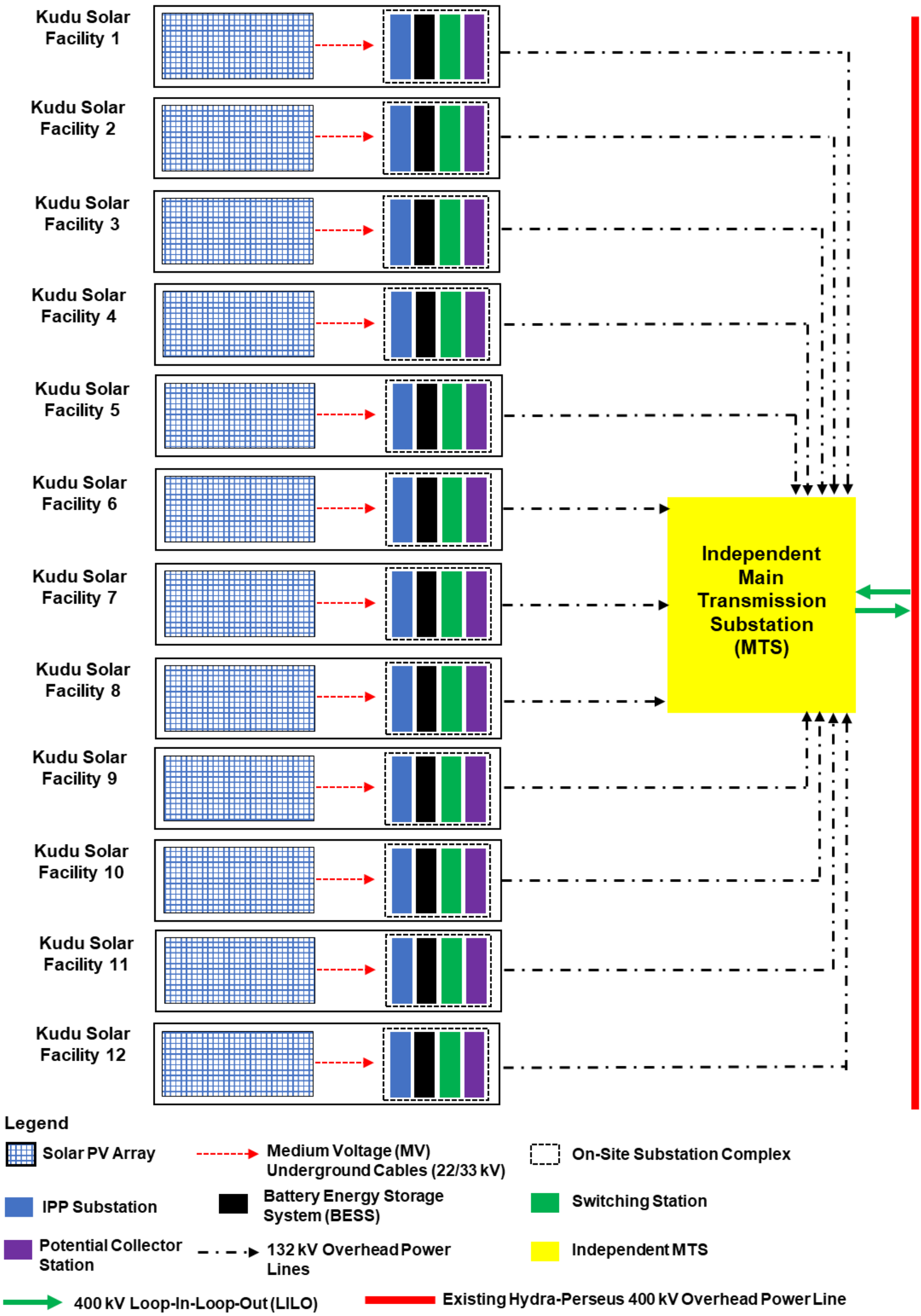


Figure 2.3. Schematic overview of the Kudu Solar Facilities and EGI Connection.

2.3.1 Solar PV Facilities – Solar Field

The Solar Field will consist of the solar arrays (panels) and building infrastructure.

The total developable area that includes all associated infrastructure within the fenced off area of the PV facility i.e. including the solar field, foundations, buildings and associated infrastructure but excluding access roads leading to the fenced off area, for the proposed project is **70 ha**.

The smallest unit of a PV installation is a cell. A number of cells form a module, and several modules cumulatively form the arrays (Figure 2.4). An example of a Solar PV Facility is provided in Figure 2.5.

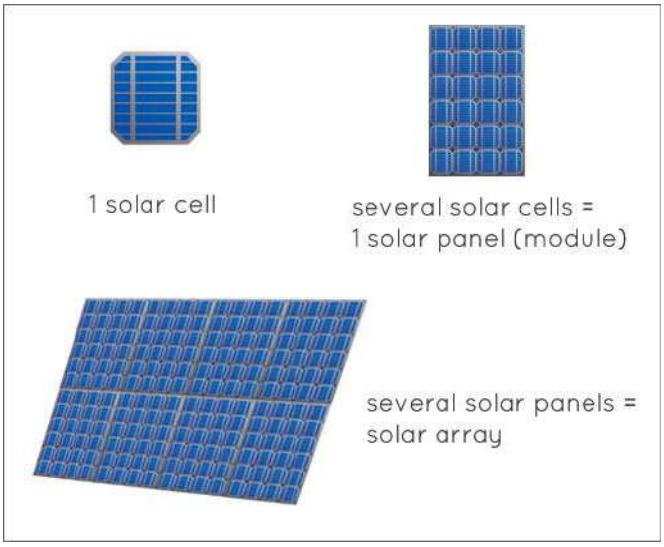


Figure 2.4. Components of the Proposed PV Installation.

Modules are arranged into strings that form the solar field, and are installed on racks which are made of aluminium or galvanised steel. Foundations will likely be drilled and concreted into the ground. The entire structure will have a maximum height of approximately 3.5 m (measured from the ground). This system may be fixed, or may track the movement of the sun, either by adopting Single Axis Tracking (aligned north-south), Dual Axis Tracking (aligned east-west and north-south), Fixed Tilt Mounting Structures, Mono-facial Solar Modules, or Bifacial Solar Modules. Bifacial panels can be up to 20 - 40 % more effective since it also utilises solar radiation reflected from the surfaces onto the rear side of the panels. The tracker design will be confirmed during the detailed engineering phase. All tracker design options have been considered in this Scoping and EIA Process.



Figure 2.5. Example of PV Technology (Department of Environment, Forestry and Fisheries (DEFF), 2019[3]).

2.3.2 Infrastructure within the PV Facility

2.3.2.1 Inverters, Low Voltage Cables, and Medium Voltage Cables

The solar arrays are typically connected to each other in strings, which are in turn connected to inverters that convert DC to AC. Each inverter station is expected to extend approximately 3 m in height, with a footprint of approximately 0.02 ha. It is estimated that there will be an average of 27 inverter stations at the PV Facility.

The strings will be connected to the inverter stations by low voltage underground (internal) DC cables (to a maximum depth of 1.5 m) or cable trays. Power from the inverter stations will be collected in medium voltage transformers through underground (internal) AC cables or cable trays.

The inverter stations will in turn be connected to the proposed on-site substation complexes, via medium voltage (22 or 33 kV) internal underground cables. It is highly unlikely that above ground 22 or 33 kV power lines will be utilised due to the shading created to the PV facility from the overhead lines. It is more likely that the 22 or 33 kV internal cables will be underground to a maximum depth of 1.5 m. However, in the isolated event of crossing a feature hindering underground cabling (e.g. a road, topographical or environmental constraint), the reticulation lines may better be suited to be above ground in certain sections. Therefore, both below and above ground routings need to be covered in this Application for EA. This does not trigger Activity 11 of Listing Notice 1, as the internal reticulation will not have “a capacity of more than 33 kV”.

[3] Department of Environment Forestry and Fisheries, 2019. Phase 2 Strategic Environmental Assessment for wind and solar PV energy in South Africa. CSIR Report Number: CSIR/SPLA/SECO/ER/2019/0085 Stellenbosch, Western Cape.

2.3.2.2 On-site Substation Complex

The proposed project will also include an on-site substation complex. The on-site substation complex will cover an approximate area of 8 ha, with a height of up to 10 m, and stepping up from 22 kV or 33 kV to 132 kV. The on-site substation complex is planned to include the following:

- On-site Independent Power Producer (IPP) or facility substation;
- Battery Energy Storage System (BESS); and
- Switching Station and Collector Station (see note below regarding this - It is important to mention here for contextualisation (it does not appear in the Application for EA or relevant listed activities)).

The on-site IPP or facility substation will cover an area of approximately 1 ha within the on-site substation complex, and with a maximum height of 10 m. This will include the relevant section that will be maintained by the IPP, focusing on the high voltage infrastructure leading up to the Point of Connection (the Project Applicant's section of the proposed on-site substation complex). As noted above, this will be included in the current Application for EA (i.e. for the Solar PV Facility and associated infrastructure), as confirmed with the DFFE.

The BESS is described in the section below.

The Switching Station and Collector Station forms part of the separate EGI projects (i.e. Projects 13 – 24). The electrical connection from the on-site substation complex to the proposed independent MTS and national grid will be discussed in a separate authorisation and/or registration process (i.e. for Projects 13 to 26).

2.3.2.3 Battery Energy Storage System

The BESS will extend up to 1 ha at the on-site substation complex, with a height of up to 10 m, and a capacity of up to 500 MW / 500 MWh.

Battery storage offers a wide range of advantages to South Africa including electricity supply reliability and quality improvement. The main purpose of the BESS is to mitigate intermittency of solar PV energy by storing and dispatching of electricity when needed i.e. to contribute to the grid 24 hours/day, during peak demand at night or during power outages. In essence, this technology allows renewable energy to enter the completely independent power generation market.

The BESS technology type will either be Solid State Lithium-Ion or Redox Flow. Both these technologies have been assessed during the Scoping and EIA Phase. It was originally planned to motivate for both technology types to be potentially authorised. However, as part of the acceptance of the Final Scoping Report, the Department of Forestry, Fisheries and the Environment (DFFE) noted that only one technology type can be authorised (should such authorisation be granted). **Refer to more information in Chapter 5 and Chapter 20 of this EIA Report for additional information on the preferred BESS technology type**. Additional information on the BESS technologies that have been considered is provided below.

- **Solid State Lithium-Ion Batteries**

Solid State Lithium-Ion batteries are solid state, sealed systems i.e. pre-assembled off site and then delivered to site for placement as per specifications of the supplier. This BESS system consists of multiple battery cells that are assembled together to form modules. A module may consist of several cells working in conjunction. Each cell contains a positive electrode, a negative electrode and an electrolyte. The negative electrode for a lithium-ion cell is typically carbon. The positive electrode can be lithium iron phosphate or a lithium metal oxide. The electrolyte is usually a lithium salt dissolved in an organic solvent (CSIR, 2015[4]).

It is proposed that the Lithium-Ion BESS would be housed in containers, with associated operational, safety and control infrastructure. The BESS will be a sealed unit and will remain sealed during operations. Based on various discussions with the DFFE on previous occasions, it has been confirmed that Lithium-Ion BESS is not classified as containers or structures for the development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good. Hence, listed activities pertaining to this aspect in the 2014 NEMA EIA Regulations (as amended) do not apply. Figure 2.6 is an illustration of a 25 MW / 50 MWh Lithium-Ion battery located at the 60 MW Gannawarra Solar Farm in Australia.



Figure 2.6. Example of PV Technology with Lithium Ion BESS (ARENAWIRE, 2018[5]).

- **Redox Flow Batteries (RFB)**

Flow batteries generally comprise of three major components; a cell stack, auxiliary parts and electrolyte storage. The active chemical species in a flow battery are stored mostly externally in above-ground storage tanks, which contain the positive and negative electrolytes separately. The energy is stored in two chemical components, which are dissolved in a liquid to form electrolytes

[4] CSIR, 2015. Final Environmental Impact Assessment Report for the proposed construction of Gemsbok Solar PV2 75 MW Solar PV facility on the Remaining Extent of Portion 3 of the Farm Gemsbok Bult 120, Kenhardt, Northern Cape. CSIR Report Number: CSIR/CAS/EMS/ER/2014/0010/B.

[5] Arenawire (2018). Solar battery storage in Victoria charging up for summer. https://arena.gov.au/blog/solar-battery-storage-in-victoria-charging-up-for-summer/ [online]. Accessed November 2021.

during operation. The energy density of a RFB is thus dependent on the size of the storage tanks (Parsons, 2017[6]).

A schematic representation of a typical RFB is provided in Figure 2.7.

There are two types of RFB's i.e. a 'true' RFB and a hybrid RFB. In a 'true' RFB the electro-active materials used to store energy remain dissolved in solution. Therefore, the energy is determined by the volumes of electrolyte available. Examples of a 'true' RFB is a Vanadium RFB and iron-chromium systems. Hybrid RFBs deposit at least one chemical species as a solid during the charge cycle, therefore preventing the complete separation of power and energy characteristics (Parsons, 2017[4]).

Examples of electrolytes for RFBs include Hydrochloric Acid and Sulphuric Acid, which are considered as dangerous goods in terms of the 2014 NEMA EIA Regulations (as amended).

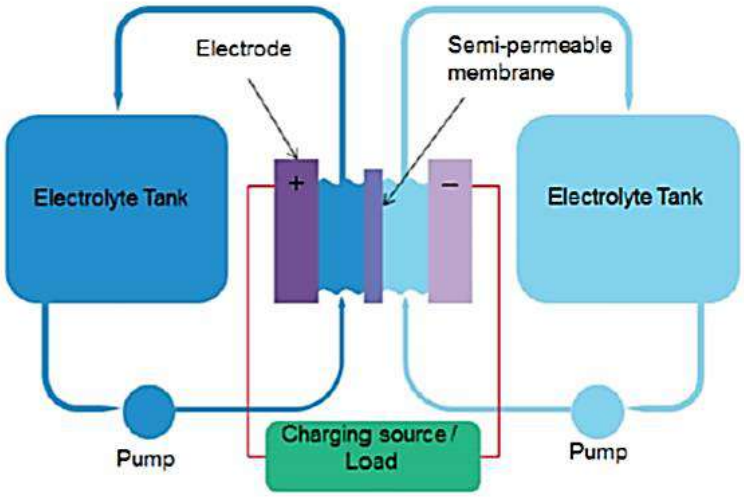


Figure 2.7: Schematic diagram of a typical Redox Flow Battery (Source: Parsons, 2017[4]).

Refer to Chapter 15 of this EIA Report for a BESS High-Level Safety, Health and Environment Risk Assessment. The report provides high level information on the safety, health and environmental risks of the BESS technologies considered during this EIA Process.

2.3.2.4 Internal Roads

New internal roads will also be constructed within the footprint of the PV facility; and between the closest existing road and the PV facility to gain access. These roads will comprise farm roads (compacted gravel/dirt) or paved roads and will extend up to 8 m wide. A perimeter road will also be constructed along the boundary of the proposed PV Facility, which will extend up to 5 m wide.

[6] Parsons, 2017. US Trade and Development Agency. South Africa Energy Storage Technology and Market Assessment. Order Number: TDA-IE201511210. USTDA Activity Number: 2015-11032A. Parsons Job Number: 640368

2.3.2.5 Panel Maintenance and Cleaning Area

During the operational phase, the accumulation of dust on solar panels generally negatively influences the productivity of solar facilities. As such the panels require regular cleaning. It is proposed that panel cleaning will take place as part of a maintenance schedule, twice per year; however, this may be revised should the site and weather conditions warrant more frequent cleaning. Cleaning may also be required after events that generate significant dust, but not daily. A dedicated panel maintenance and cleaning area will be required on site during the operational phase. The panel cleaning and maintenance area will form part of the O&M Auxiliary Buildings (located at the on-site substation complex). As indicated above, the type of panels to be used (and panel cleaning) will be confirmed during detailed design/engineering phase. Water that emanates from the cleaning process will be free from harmful detergents or will comprise of approved biodegradable substances.

2.3.2.6 Storm water

It is proposed that the area where the solar panels will be installed will not be fully cleared of vegetation. It is planned for the vegetation to be trimmed and the panels will be installed on steel supporting structures above the height of the vegetation. The solar panels will not replace the vegetated area and thus storm water runoff is not expected to increase specifically due to the proposed PV panel placement.

Stormwater infrastructure, such as channels, will be constructed on site to ensure that stormwater run-off from site is appropriately managed. Water from these channels is not likely to contain any chemicals or hazardous substances and will be released into the surrounding environment based on the natural drainage contours.

Details of storm water management are to be confirmed once the Engineering, Procurement and Construction (EPC) contractor has been selected and the design is finalised. Where necessary, a detailed Storm Water Management Plan would need to be developed during the detailed design phase (post EA, should such an authorisation be granted) and to be implemented during all phases of the project. The plan must ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion. The plan should also include the installation of appropriate design measures that allow surface and subsurface movement of water along drainage lines so as not to impede natural surface and subsurface flows. Drainage measures promotes the dissipation of storm water run-off. Recommendations for the management of storm water are discussed in the Environmental Management Programme (EMPr).

2.3.2.7 Auxiliary Building Infrastructure

The solar field will require the following auxiliary building infrastructure:

- Warehouse / workshop for storage of equipment;
- Offices;
- Operational and maintenance (O&M) building / control centre;
- Guard Houses / security enclosures;
- Ablution facilities;
- Staff lockers;
- Inverter stations; and
- On-site substation buildings.

The auxiliary buildings will have an estimated cumulative footprint of approximately 5000 m^2, and a height up to 10 m.

A temporary laydown area with a maximum footprint of 7 ha will also be constructed. The need for a permanent laydown area will be confirmed during the detailed design/engineering phase.

2.3.2.8 Additional Infrastructure

The Project Applicant may establish a concrete batch plant on site (within the laydown area) for purposes of the construction phase. Only a limited amount of water (within the overall water usage estimates described in this chapter) will be utilised during construction for the batching of concrete. Details of the concrete batching plant will be confirmed during detailed design as the development progresses.

For various reasons such as security, public protection and lawful requirements, the proposed built infrastructure on site and the entire PV facility will be secured via the installation of appropriate fencing. The PV facility fencing type could be palisade or mesh or fully electrified, with an estimated height of up to 3 m.

Existing livestock fencing on the affected farm portions may be upgraded in places, where deemed insufficiently secure, whereas permanent fencing will be required around the O&M area and on-site substation complex. Access points will be managed and monitored by an appointed security service provider. The type and height of fencing to be installed will be confirmed during detailed design as the development progresses.

2.3.3 External Access Roads

A Traffic Impact Assessment was commissioned for the proposed Kudu Solar Facilities and is included Chapter 14 of this EIA Report. The following information is based on the Traffic Impact Assessment (Sturgeon Consulting, 2023[7]).

The proposed project study area / preferred site can be accessed via various existing main roads and unnamed farm gravel roads. The potential access routes are discussed below and illustrated in Figure 2.8. Note that these access routes are not alternatives for comparison in terms of the EIA Process, however they are options as part of due diligence by the Project Developer and investigated from a technical viability perspective by the Traffic Specialist.

- **Access Route Option 1 (Figure 2.9):**
  - Route A: Along TR38/01, DR3093, and DR3096;
  - Route B: Along TR38/01, DR3093 and DR3084;
- **Access Route Option 2 (Figure 2.10):**
  - Route A: Along MR790, DR3093 and DR3084;
  - Route B: Along MR790 and DR3093;
  - Route C: Along MR790, DR3093 and DR3096;
- **Access Route Option 3 (Figure 2.11):**
  - Route A: Along TR38/01, TR3802, and DR3096;

[7] Sturgeon Consulting (2023). Traffic Impact Assessment for the proposed Kudu Solar Facilities and associated infrastructure. Prepared for the Scoping and Environmental Impact Assessment (EIA) for the Kudu Solar Facilities and associated infrastructure.

- Route B: Along TR38/01, TR3802, DR3096 and DR3093; and
- Route C: Along TR38/01, TR3802, DR3096, DR3093 and DR3084.

Access route Option 1 is the preferred main access route for the proposed project. Refer to the Traffic Impact Assessment (Chapter 14 of this EIA Report) for further information on the above roads, as well as the applicability per project.



Figure 2.8: Proposed Access Routes to the study area (Sturgeon Consulting, 2023).



Figure 2.9: Potential Access Route Option 1: Divisional Road 3093 (Photograph taken from the R48) (Sturgeon, 2023).



Figure 2.10: Potential Access Route Option 2: Main Road 790 (Photograph taken from the R48) (Sturgeon, 2023).



Figure 2.11: Potential Access Route Option 3: Divisional Road 3096 (Photograph taken from the R48) (Sturgeon, 2023).

The Traffic Specialist has also noted that, based on preliminary vehicle tracking investigations undertaken during the EIA Phase, the roads leading to the study area are of a sufficient width to accommodate truck movement, however widening by more than 4 m or more than 6 m may be required at localised positions (i.e. intersections) for Access Route Option 2 and Access Route Option 3, as required. For Access Route Option 1, no widening of the intersection at TR38/01 and DR3093 will be required, however, the existing island will need to be removed (approximately 60 m^2) and surfaced (i.e. upgraded) to accommodate turning movements. Refer to the Traffic Impact Assessment (Chapter 14 of this EIA Report) for additional specific information in this regard. Refer to Chapter 4 of this EIA Report for additional information on related legislative requirements.

All components fabricated in foreign countries will need to be imported into South Africa via one of the ports. The closest port to the proposed development is the Port of Ngqura, which would result in a route from the port via the N2, then turning north onto the N10 to De Aar.

Another option will be the route from the Port of Cape Town, which follows the N1 from the port and then turns north at Three Sisters onto the N12 to Britstown and then turns east towards De Aar.

The last option will be the route from the Port of Saldanha, which follows the N7 from the port and then turns east past Calvinia and Britstown to De Aar.

In all the above potential route options, from De Aar, the R48 can be taken east up to the proposed site access.

2.3.4 Service Provision

The Project Developer has attempted to consult with the Renosterberg Local Municipality in order to confirm the supply of services (in terms of water usage, sewage removal, solid waste removal, and electricity requirements) for the proposed project. The municipality was also consulted with as part of the 30-day public review period of the Draft Scoping Report, and as part of the 30-day public review period of the Draft EIA Report, to seek comment on the general proposed project. No feedback was obtained from the municipality. Proof of follow up consultation is included in Appendix H.4 of this EIA Report.

Should the local municipality not have adequate capacity available for the handling of waste, provision of water and sewage handling provisions; then the Project Applicant will make use of private contractors to ensure that these services are provided. An outline of the services that will be required are discussed below.

2.3.4.1 Water Usage

During the construction phase, approximately 9 000 m^3 of water will be required per year per facility. Water will be required for human consumption and construction activities. This is also classified as potable water and should be from a reputable source and conform to South African National Standards (SANS) quality standards. The decommissioning phase is also expected to result in similar water usage requirements; however, the exact specifications will be confirmed at the time and is not expected to significantly exceed the volume requirements of the construction phase.

During the operational phase, it is estimated that the panel washing process, and human consumption as well as other operational phase activities will require approximately 1 000 m^3 of water per year for an approximate 20-year operational lifespan, per facility. This equates to approximately 83 m^3 of water per month during the operational phase. The water for panel washing does not need to meet the same quality standards as that required for potable water, however the water should be tested to ensure that it does not negatively impact on the mechanical equipment. Refer to the Geohydrology Assessment (Chapter 16 of this EIA Report) for additional information.

The EMPr has provided recommendations for water conservation techniques during the construction, operational and decommissioning phases. The staff would also be encouraged to use water sparingly during all phases.
Water required for the construction, operational and decommissioning phases will either be sourced from the following sources (in order of priority and likelihood):

- The Renosterberg Local Municipality - specific arrangements will be agreed with the local municipality in a Service Level Agreement (SLA). The water will be trucked in, or made available for collection at the Local Municipal Water Treatment Plant via a metered standpipe. Should the water be trucked in, such impacts have been considered in the Traffic Impact Assessment (Chapter 14 of the EIA Report).

- Investigation into a third-party water supplier which may include private services companies. This would be trucked in, and such impacts have been considered in the Traffic Impact Assessment.

- Existing boreholes on site to source groundwater (if available and if suitable). A Geohydrology Assessment was commissioned as part of this Scoping and EIA Process. The study included an analysis of the hydrocensus chemistry results in terms of the SANS 241-1: 2015 and the Department of Water Affairs and Forestry (DWAF) (1998) Standards. Based on this, the groundwater quality in the study area is generally of good quality in terms of pH, total dissolved solids (TDS) and electrical conductivity (EC). It is possible that the groundwater can be used for potable and domestic purposes with only minor treatment however a full laboratory analysis will be required. With regards to the cleaning of panels, salts could be removed from the groundwater by thermal distillation (i.e. boiling since salt has a much higher boiling point than water) or by membrane separation (commonly reverse osmosis). Both of these techniques are possible but financial viability would have to be determined before commissioning as both techniques are costly on a large scale. Water pipelines may need to be constructed to transfer groundwater from existing boreholes or they may be transported by trucks from the boreholes to the site. Pipelines will fall below the relevant capacity and diameter noted in the Listing Notices of the EIA Regulations. Groundwater may also need to be stored on site in suitable containers or reservoir tanks during the construction and operational phases. Refer to Chapter 4 of this EIA Report for feedback on the authorisations required for this aspect in terms of the National Water Act (Act 36 of 1998, as amended).

- New boreholes that may be drilled on site to source groundwater (if available and if suitable), which will be subject to complete geohydrological testing and an assessment, as well as a Water Use Licence Application process. This will be undertaken as a separate process, once more detailed information becomes available, outside of the current Application for EA for the Solar PV Facility and associated infrastructure. Refer to Chapter 4 of this EIA Report for feedback on the authorisations required for this aspect in terms of the National Water Act (Act 36 of 1998, as amended).

2.3.4.2 Sewage or Liquid Effluent

The proposed project will require sewage services during the construction, operational and decommissioning phases. Low volumes of sewage or liquid effluent are estimated. Liquid effluent will be limited to the ablution facilities during the construction and operational phases. Portable sanitation facilities (i.e. chemical toilets) will be used during the construction phase, which will be

regularly serviced and emptied by a suitable and registered contractor. Permanent ablution facilities may be installed during the operational phase, as indicated above. The effluent may be stored on site in watertight structures (conservancy tanks) and thereafter transported to and disposed of at the Local Municipal sewerage treatment works or similar facility by a registered service provider.

2.3.4.3 Solid Waste Generation

The quantity of waste generated will depend on the construction phase, which is estimated to extend 12 to 18 months. However, it is estimated that approximately 50 m^3 of waste will be generated every month during the construction phase. The following waste materials are expected:

- Packaging material, such as the cardboard, plastic and wooden packaging and off-cuts;
- Hazardous waste from empty tins, oils, soil containing oil and diesel (in the event of spills), and chemicals;
- Building rubble, discarded bricks, wood and concrete;
- Domestic waste generated by personnel; and
- Vegetation waste generated from the clearing of vegetation.

Solid waste will be managed via the EMPr during all project phases. The EMPr (Appendix I and Appendix J of this EMPr) incorporates waste management principles. During the construction phase, general solid waste will be collected and temporarily stockpiled in skips in a designated area on site and thereafter removed, emptied into trucks, and disposed at a registered waste disposal facility on a regular or monthly basis by an approved waste disposal Contractor (i.e. a suitable Contractor) or the municipality. In addition, a skip will be placed on site and any damaged or broken PV panels (i.e. those not returned to the supplier) will be stored in this skip. A specialist waste management company will be commissioned to manage and dispose of this waste.

Any hazardous waste (such as contaminated soil as a result of spillages) will be temporarily stockpiled in a designated area on site (i.e. placed in leak-proof storage skips), and thereafter removed off site by a suitable service provider for safe disposal at a registered hazardous waste disposal facility.

Waste disposal slips and waybills will be obtained for the collection and disposal of the general and hazardous waste. These disposal slips (i.e. safe disposal certificates) will be kept on file for auditing purposes as proof of disposal. The waste disposal facility selected will be suitable and able to receive the specified waste stream (i.e. hazardous waste will only be disposed of at a registered/licenced waste disposal facility). The details of the disposal facility will be finalised during the contracting process, prior to the commencement of construction. Where possible, recycling and re-use of material will be encouraged.

During the operational phase after construction, the facility will produce minor amounts of general waste (as a result of the offices or maintenance). It is estimated that approximately 1.92 m^3 of waste will be generated every month during the operational phase.

2.3.4.4 Electricity Requirements

In terms of electricity supply, the developer may make use of generators on site during construction, and the operational electrical requirements would be nominal and would likely be supplied by the proposed facility.

2.4 Socio-Economic

It should be noted that the employment opportunity specifications provided in this report are estimates and is dependent on the final engineering design and the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) Request for Proposal provisions, or similar programme requirements, at that point in time.

2.4.1 Employment during Construction

During the construction phase, skilled, low skilled and semi-skilled temporary employment opportunities will be created. It is difficult to specify the actual number of employment opportunities that will be created at this stage; however, approximately 150 employment opportunities are expected to be created during the construction phase. The skill breakdown of employment opportunities is estimated as 60 % low skilled, 25 % semi-skilled and 15 % skilled.

Employees will most likely be housed in local nearby towns and villages. Typically, the EPC contractor will be responsible for the provision of transport of construction personnel to and from site.

2.4.2 Employment during Operations

Approximately 8 full time employment opportunities will be created during the operational phase. The employment breakdown is estimated as 70 % low skilled, 25 % semi-skilled and 5 % skilled. The low and semi-skilled jobs will be linked to services such as panel cleaning, maintenance and security. The percentage of temporary workers that may be offered permanent employment once the construction phase is completed will be dependent on the investor requirements, however will meet the requirements of the REIPPPP (or similar process) at the time as well.

2.4.3 Socio-Economic Investment and Development

The Applicant will ultimately own the project, if successful, and will compile an Economic Development Plan which will be compliant with REIPPPP requirements (or similar process) and will inter alia set out to achieve the following:

- Create a local community trust or similar (as required by REIPPPP) which has an equity share in the project life to benefit historically disadvantaged communities;
- Initiate a skills development and training strategy to facilitate future employment from the local community;
- Give preference to local suppliers for the construction of the facility; and
- Support local community upliftment projects and entrepreneurship through socio-economic and enterprise development initiatives.

2.5 Overview of the Project Development Cycle

This section provides an outline of the main activities that are proposed during each phase of the proposed project, i.e. extending from the Planning and Design phase through to the Decommissioning phase. The operational life of the PV Facility is expected to be approximately 20 years, which could be extended through regular maintenance and/or upgrades in technology.
The project can be divided into the following main phases:

- Detailed Planning and Design Phase;
- Construction Phase;
- Operational Phase; and
- Decommissioning Phase.

Each activity undertaken as part of the above phases may have environmental impacts, which have been assessed as part the EIA Phase.

2.5.1 Planning and Design Phase

The detailed project layout, including the exact placement of building infrastructure and the internal road network has been identified during the EIA Phase. The project layout has been informed by the findings of the specialist assessments. The specialists have reviewed the detailed project layout. The panel mounting system will only be confirmed during the detailed design. The detailed layout is included in Figure 2.12 of this chapter, and also included in Appendix C of this EIA Report. Comments made by the DFFE during the Scoping Phase and upon acceptance of the Final Scoping Report, and during the review of the Draft EIA Report have been taken into consideration in the project layout, as best as possible. All efforts have been made by ABO Wind to provide as much detail as possible for the layout maps during the EIA Phase. Other layout features will be identified during the detailed design/engineering phase. Any changes to the layout post EA (should such be granted), will be undertaken via a relevant EA Amendment process. However, as noted above, any changes to the layout are regarded acceptable if they fall within the assessed study area and buildable areas, and they avoid no-go sensitivities identified by the specialists.

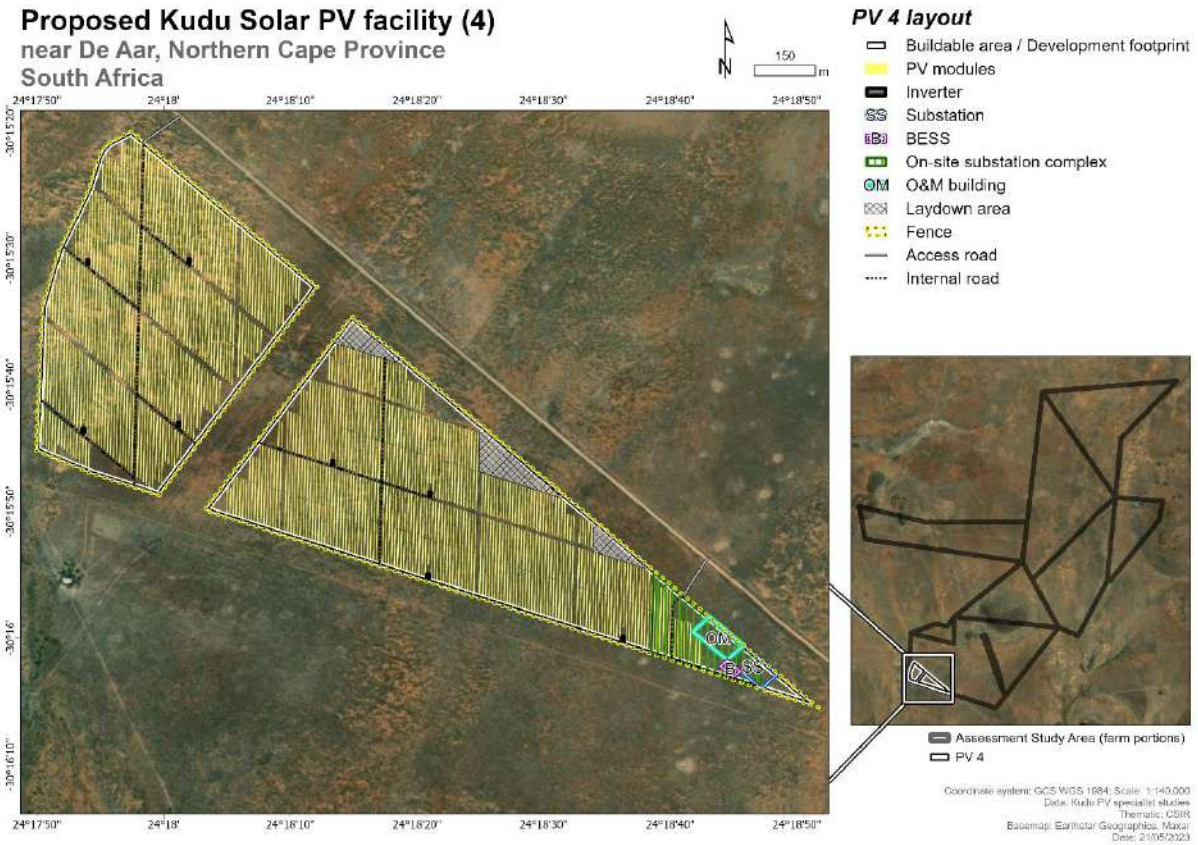


Figure 2.12: Detailed Layout for Kudu Solar Facility 4.

2.5.2 Construction Phase

The construction phase will take place subsequent to the issuing of the EA (should such authorisation be granted) and if a successful bid in terms of the REIPPPP or a similar tender process is issued, and once a power purchase agreement (PPA) is signed with a suitable energy off-taker (either national government or private). As indicated above, the construction phase is expected to extend 12 to 18 months. The main activities that will form part of the construction phase are:

- Removal of vegetation for the proposed infrastructure, where necessary, within the approved development footprint to facilitate the construction and/or establishment of infrastructure. Note that vegetation is planned to be trimmed within the PV array area (and not removed completely);
- Excavations for infrastructure and associated infrastructure;
- Establishment of a laydown area for equipment;
- Stockpiling of topsoil and cleared vegetation, where necessary (except for the PV array);
- Creation of employment opportunities;
- Transportation of material and equipment to site, and personnel to and from site; and
- Construction of the solar field, and additional infrastructure.

All efforts will be made to ensure that construction work will be undertaken in compliance with local, provincial and national legislation, local and international best practice, as well as the EMPr. An independent Environmental Control Officer (ECO) will be appointed during the construction phase and will monitor compliance with the recommendations and conditions of the EMPr and EA, respectively.

2.5.3 Operational Phase

The following activities will occur during the operational phase:

- The generation of electricity from the proposed solar facility; and
- Maintenance of the solar field and associated infrastructure.

The operational lifespan of the proposed solar PV facility is expected to be approximately 20 years. During the life span of the proposed project, on-going maintenance will be required on a scheduled basis to ensure the continued optimal functioning of the infrastructure. In general, maintenance on the structures will involve visual inspection, and only equipment that fails will be replaced in manner similar to that of construction activities. The EMPr includes the requirement for method statements to be compiled prior to the operational phase to describe the manner in which maintenance will be undertaken to ensure environmental impacts are minimised.

2.5.4 Decommissioning Phase

At the end of the operational phase, the PV facility may be decommissioned, or may be repowered i.e. redesigned and refitted so as to operate for a longer period. The main aim of decommissioning is to return the land to its original, pre-construction condition. Should the unlikely need for decommissioning arise i.e. if the facility becomes outdated or the land needs to be used for other purposes, the decommissioning procedures will be undertaken in line with an approved EMPr and relevant legislation at the time, and the site will be rehabilitated and returned to its pre-construction state.



CHAPTER 3:

Description of the Affected Environment



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3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

This chapter of the Environmental Impact Assessment (EIA) Report provides a broad overview of the affected environment for the proposed Kudu Solar Facility 4 and associated infrastructure (hereafter referred to as the "Kudu Solar Facility" or "proposed project") and the surrounding area.

The receiving environment is understood to include biophysical, socio-economic, and heritage aspects, which could be affected by the proposed project or which in turn might impact on the proposed project.

This information is provided to inform the identification of the potential issues and impacts of the proposed project on the environment and vice versa. The information presented within this chapter has been sourced from *inter alia*:

- Inputs from the specialists that form part of the project team;
- Feedback from the National Department of Forestry, Fisheries and the Environment (DFFE) National Web-based Environmental Screening Tool (hereafter referred to as the Screening Tool), where applicable;
- Review of *inter alia* information sources available on the South African National Biodiversity Institute (SANBI) Biodiversity Geographical Information System (BGIS), Agricultural Geo-Referenced Information System (AGIS), Endangered Wildlife Trust (EWT) Threatened Species No-Go Map;
- Northern Cape Province Provincial Growth and Development Strategy;
- Northern Cape Provincial Spatial Development Framework (SDF);
- Pixley ka Seme District Municipality (PKSDM) Integrated Development Plan (IDP);
- PKSDM SDF;
- Renosterberg Local Municipality (RLM) IDP; and
- Emthanjeni Local Municipality IDP.

It is important to note that this chapter intends to provide a broad overview of the affected environment and does not represent a detailed environmental study. Detailed descriptions of the study area, buildable area, and development footprint are provided in the relevant specialist assessments, which are included in Chapter 6 to 19 of this EIA Report.

3.1 Background, Study Area, and Buildable Areas

As indicated in Chapter 1 of this EIA Report, the proposed project forms part of a cluster of 12 Solar Photovoltaic (PV) facilities and associated infrastructure located approximately 50 km north-east of De Aar in the Northern Cape Province. The study area for all proposed Kudu Solar Facilities 1 to 12 is the full extent of the eight affected farm portions (approximately 8 150 hectares (ha)). Refer to Chapter 1 of this EIA Report for a list of the affected farm properties with associated SG codes, as well as Chapter 2 for feedback on the applicable properties per project.

Refer to Chapter 2 of this EIA Report for additional information on how the study area (8 150 hectares, consisting of eight affected farm properties) evolved into the buildable areas and preferred development footprint.

As previously noted, the proposed project is located within the Renosterberg Local Municipality, which falls within the Pixley ka Seme District Municipality (PKSDM). Figure 3-1 below provides a locality map of the study area and the Kudu Solar Facilities.

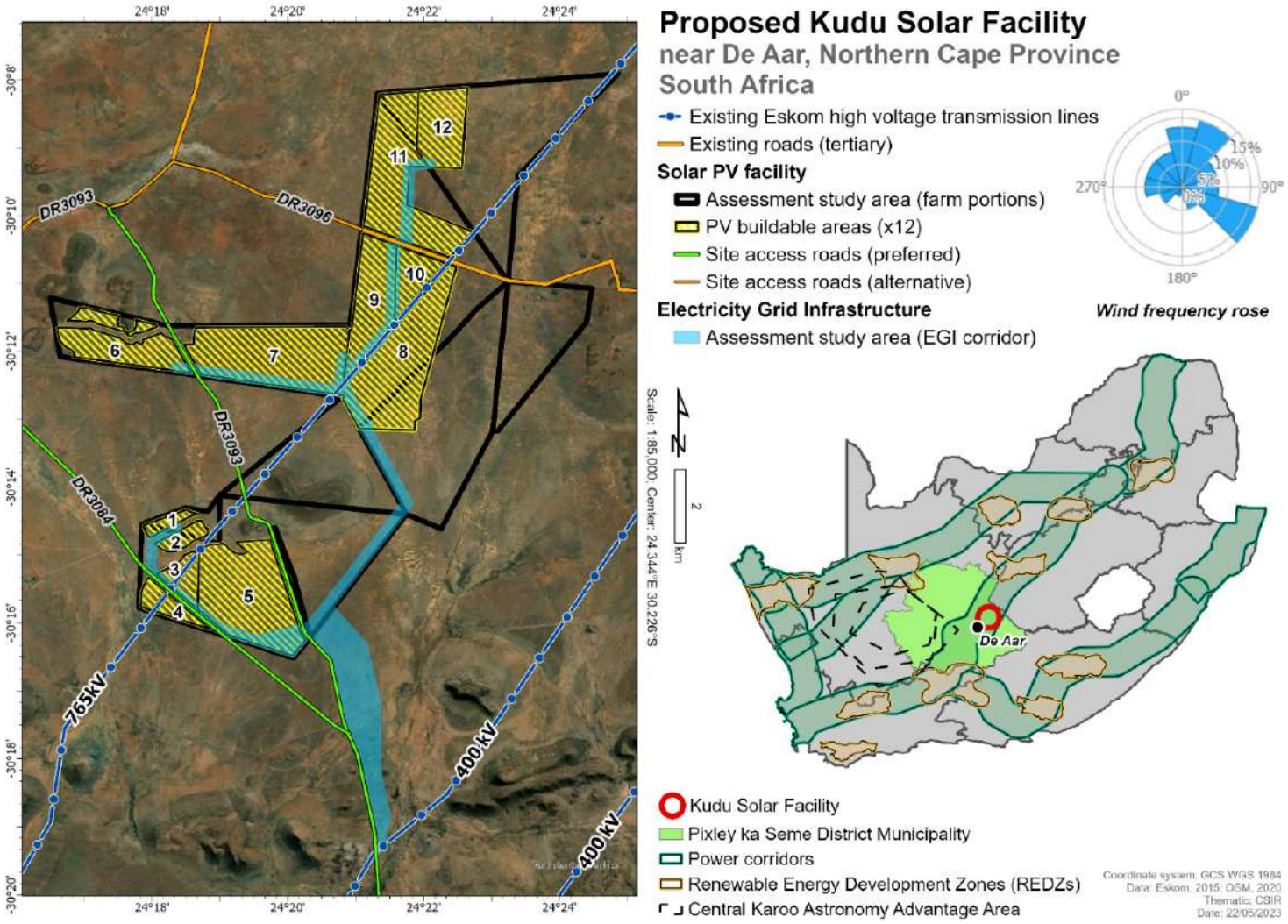


Figure 3-1: Locality map for the proposed projects situated north-east of De Aar the Northern Cape

3.2 Biophysical Environment

3.2.1 Climate and Climate Change

3.2.1.1 General Context

The study area lies near the eastern edge of the Nama Karoo Biome, which is situated on the central plateau of the western half of South Africa extending into south-eastern Namibia, and the Grassland Biome. The study area is located in three vegetation types, namely the Northern Upper Karoo (NKu3), the Eastern Upper Karoo (NKu4) and the Besemkaree Koppies Shrubland (Gh4) (Mucina and Rutherford, 2006, updated[1]).

More specifically, according to the Köppen-Geiger climate classification method the majority of the study area is classified “BSk”, which is indicative of a cold semi-arid climate (Figure 3-2). The region is characterised with a mean annual rainfall of 287 mm and average temperatures varying from 5ºC in July to 31ºC in January. The highest average temperatures occur from December to February (Figure 3-5).

Figure 3-3 shows the average monthly distribution of rainfall within the De Aar area, including the proposed project study area, with most of the rainfall occurring during December to March. Figure 3.4 shows the average annual rainfall within the region for the period 2010 to 2022. Figure 3-5 shows the average monthly maximum and minimum temperature within the region. The area is characteristic of gusty winds prevailing for most of the year, with the average gust falling within the 15 to 30 kmph range (Figure 3-6).

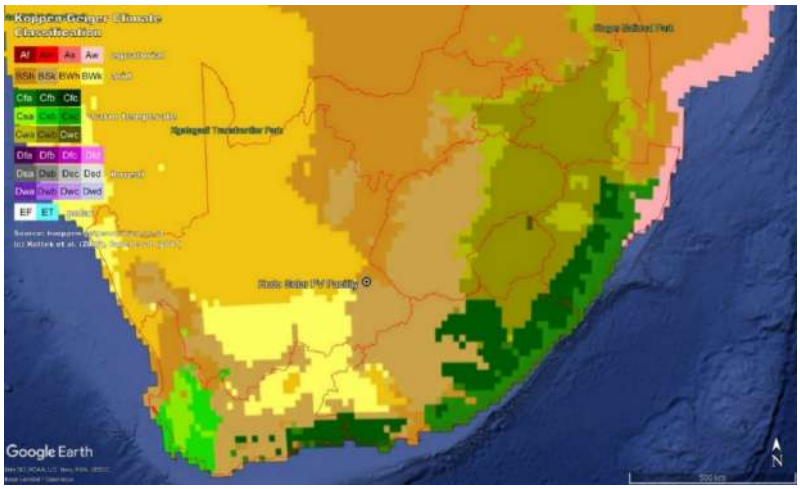


Figure 3-2: Köppen-Geiger Climate Classification of South Africa, including the study area (Source: Köppen-Geiger Climate Classification[2])

[1] Mucina, L. and Rutherford, M.C. (Eds.) 2010. The vegetation of South Africa, Lesotho and Swaziland. Strelizia 19. South African National Biodiversity Institute, Pretoria.

[2] Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006: World Map of the Köppen-Geiger climate classification updated. Meteorol. Z., 15, 259-263. DOI: 10.1127/0941-2948/2006/0130. Available at: http://koeppen-geiger.vu-wien.ac.at/present.htm [online]. Accessed: November 2022.

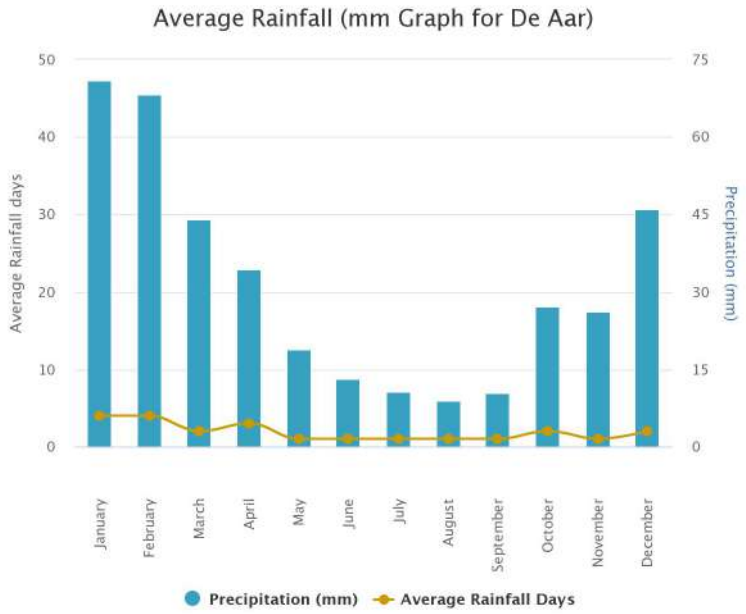


Figure 3-3: The average monthly distribution of rainfall within the De Aar area, including the study area (Source: World Weather Online, 2022[3])

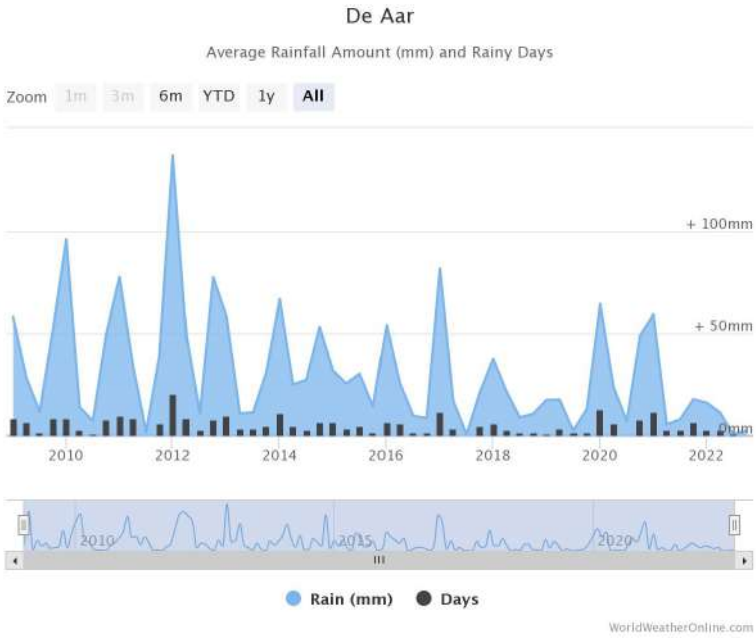


Figure 3-4: The average annual rainfall within the De Aar area, including the study area for the period 2010 – 2022 (Source: World Weather Online, 2022[4])

[3] World Weather Online. 2022. De Aar Annual Weather Averages. Available at: https://www.worldweatheronline.com/de-aar-weather-averages/north-western-province/za.aspx [online]. Accessed: 25 November 2022.

[4] World Weather Online. 2022. De Aar Annual Weather Averages. Available at: https://www.worldweatheronline.com/de-aar-weather-averages/north-western-province/za.aspx [online]. Accessed: 25 November 2022.

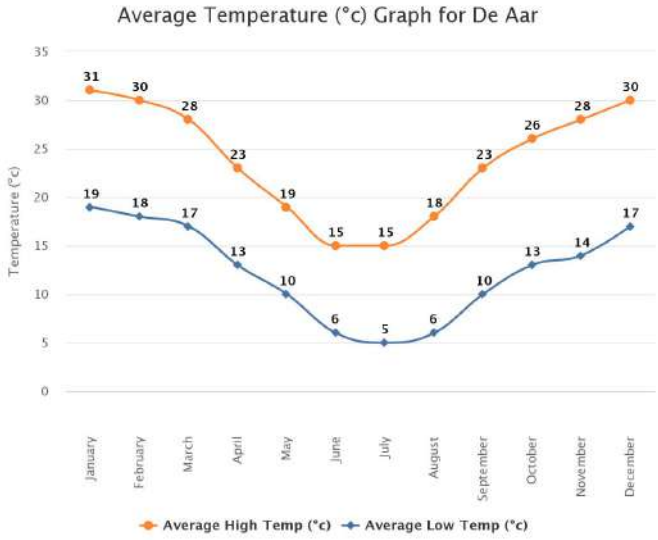


Figure 3-5: The average monthly maximum and minimum temperature for the De Aar area, including the study area (Source: World Weather Online, 2022[5])

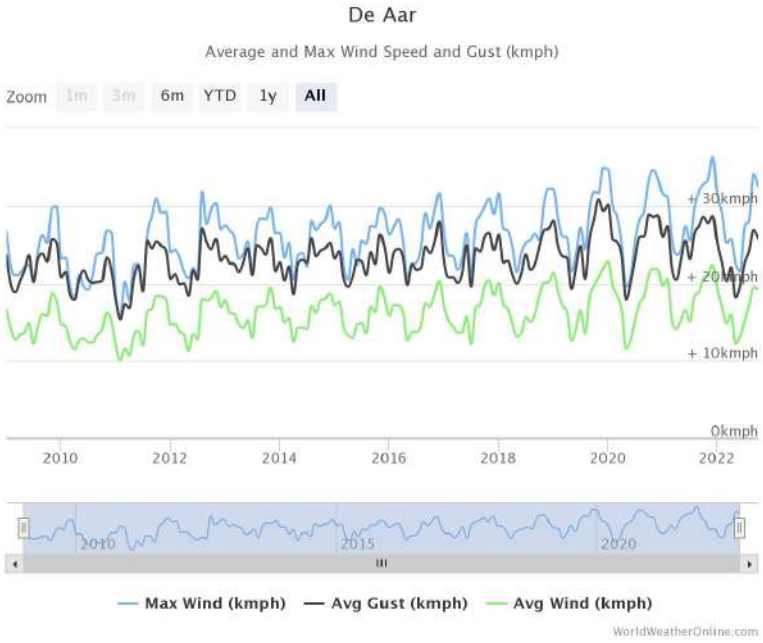


Figure 3-6: The average and maximum annual wind speeds and gusts for the De Aar area, including the study area for the period 2010 – 2022 (Source: World Weather Online, 2022[6])

[5] World Weather Online. 2022. De Aar Annual Weather Averages. Available at: https://www.worldweatheronline.com/de-aar-weather-averages/north-western-province/za.aspx [online]. Accessed: 25 November 2022.

[6] World Weather Online. 2022. De Aar Annual Weather Averages. Available at: https://www.worldweatheronline.com/de-aar-weather-averages/north-western-province/za.aspx [online]. Accessed: 25 November 2022.

3.2.1.2 Climate Change

Projected climate change data indicates that by 2025 the Northern Cape Province will be affected by higher annual average temperatures[7]. Regional predictions suggest a drying trend from west to east, a shift to more irregular rainfall of possibly greater intensity, and rising temperatures everywhere (Pixley ka Seme District, 2014)[8].

The higher temperatures will be associated with an increase in evaporation rates and an increase in the intensity of droughts. This will likely cause agricultural outputs to reduce, thereby adversely affecting food security. The drought periods coupled with increased evaporation and temperatures, will negatively impact the water supply, which is currently restricted. Furthermore, the increase in temperatures anticipated with climate change may result in increased fire frequencies. Invasive alien plants are often highly flammable and with their large volumes, are likely to fuel more frequent fires. The combination of more frequent and intense fires will have a devastating impact on the region. Consequently, climate change is one of the biggest risks facing the Northern Cape Province (Pixley ka Seme District, 2014[8]).

The Green Book provides detailed projections for future climate change in South Africa. The information captured below has been summarised from the Green Book (Engelbrecht et al., 2019[9]). The projections used in the Green Book are for the following two climate change mitigation scenarios: Representative Concentration Pathways (RCP) 8.5 – where low mitigation is implemented; and RCP 4.5 – where high mitigation is implemented.

- **Fire Likelihood** - The likelihood of wildfires occurring in the interface between developed land and fire-prone vegetation in the region of the RLM is regarded as low in terms of current hydro-meteorological trends. In terms of the projected number of fire danger days under an RCP 8.5 low mitigation (worst case) scenario, the study area varies from about 30 to 60. De Aar and Petrusville are at medium risk of increases in wildfires by the year 2050.

- **Flood Hazard** – The region of the RLM mainly includes a medium flooding hazard currently. There is largely a slight increase and moderate increase in extreme rainfall days projected for the year 2050. De Aar is at a low risk of increase in urban flooding under an RCP 8.5 low mitigation (worst case) scenario, whereas some areas within the study area and close to Petrusville area at a high and extreme risk (projected change for 2050).

- **Drought** – In terms of the projected change in drought tendencies for the period of 1995 to 2024, there is an increase in drought tendencies per 10 years within the region (ranging from 0 to -0.2) (more frequent than the observed baseline). De Aar and Petrusville are at medium and low risk of increases in drought tendencies, respectively, by the year 2050.

[7] https://letsrespondtoolkit.org/municipalities/northern-cape/

[8] Pixley Ka Seme District (2014). Pixley Ka Seme District Spatial Development Framework / Land Development Plan (SDF), 2013-2018. https://www.pksdm.gov.za/sdfs/PixleySDFMayFinal.pdf [online], Accessed November 2022.

[9] Engelbrecht, F., Le Roux, A., Arnold, K. & Malherbe, J. 2019. *Green Book. Detailed projections of future climate change over South Africa*. Pretoria: CSIR. Available at: https://pta-gis-2-web1.csir.co.za/portal/apps/GBCascade/index.html?appid=b161b2f892194ed5938374fe2192e537. Accessed November 2022.

3.2.2 Topography and Landscape

The information described below is based on inputs provided by the Visual, Palaeontology and Socio-economic Specialists, which are included in Chapters 10, 12, and 13, respectively, of this EIA Report.

The study area lies within an expansive flattish landscape, composed of Ecca Group shales, interspersed with dolerite-capped koppies (*e.g.,* Swartkoppies / Tierberg / Perdekop) and includes the small isolated *koppie* Basberg (1466 m amsl). These main scenic features in the area provide topographic relief in the expansive flattish landscape. The elevation ranges from 1000 to 1500 m in the region. The topography of Pixley Ka Seme region is one of its main assets with vast open spaces and unspoilt panoramic visual vistas stretching over great distances (Pixley ka Seme District, 2014[8]).

3.2.3 Geology

A detailed description of the geology of the study area is provided by the Terrestrial Biodiversity, Palaeontology, Geohydrology and Geotechnical Specialists, which are included in Chapters 7, 12, 16, and 17 of this EIA Report, respectively.

The main geology of the study area is listed in Table 3-1. The main geological units mapped within the wider study region include:

- Tierberg Formation (Ecca Group, Karoo Supergroup) – Pt Note that the upper part of this succession is now referred to the Waterford Formation.
- Adelaide Subgroup – Pa. Note that this is outside the study area.
- Karoo Dolerite Suite – Jd.
- Quaternary calcrete hardpans – Qc.
- Late Caenozoic alluvium
- Unmapped Late Caenozoic superficial sediments include colluvium, eluvial surface gravels and soils (including possible relict aeolian sands of the Gordonia Formation, Kalahari Group).

Table 3-1: Geological formations within the study area listed in order of relative age

Symbol	Formation	Group	Lithology
~	Quaternary Deposit		Alluvium / Terrace Gravel
Qc			Calcrete
Jd	Jurassic Intrusion		Dolerite
Pa	Adelaide Formation	Beaufort Group	Blue-grey silty mudstone, subordinate brownish-red mudstone; sandstone
Pt	Tierberg Formation	Ecca Group	Blue-grey to black shale with carbonate-rich concretions; subordinate siltstone and sandstone in upper part

The majority of the study area is underlain at depth by non-marine basinal mudrocks of the Tierberg Formation (Ecca Group, Karoo Supergroup) of Early to Middle Permian age (designated on hillslopes on the farm Swart Koppies 86, just south of the study area).The Tierberg Formation is a recessive-weathering, mudrock-dominated succession consisting predominantly of dark, well-laminated, carbonaceous shales with subordinate thin, fine-grained sandstones. These Ecca sedimentary bedrocks are currently only mapped at surface on the slopes of Basberg, as well as the koppies just east of Wolwekuil farmstead on Farm 42/RE where they crop out intermittently as low cliffs of metasediments which have been thermally metamorphosed by dolerite intrusion. Well-developed sills and dykes of the Early Jurassic Karoo Dolerite Suite build and / or cap all the koppies within and on the margins of the study area (including Basberg) and also underlie some lower-lying areas.

Soils are variable from shallow to deep, red-yellow, apedal, freely drained soils to very shallow Glenrosa and Mispah forms.

3.2.4 Agriculture and Land Capability

The information described below is based on the Agriculture Compliance Statement included in Chapter 6 of this EIA Report.

3.2.4.1 General Context

Agricultural sensitivity, as used in the Screening Tool, is a direct function of the capability of the land for agricultural production. The general assessment of agricultural sensitivity that is employed in the Screening Tool, identifies all arable land that can support viable crop production, as high (or very high) sensitivity. This is because there is a scarcity of arable production land in South Africa and its conservation for agricultural use is therefore a priority. Land which cannot support viable crop production is much less of a priority to conserve for agricultural use and is rated as medium or low agricultural sensitivity.

The Screening Tool classifies agricultural sensitivity according to two independent criteria – the land capability rating and whether the land is used for cropland or not. All cropland is classified as at least high sensitivity, based on the logic that if it is under crop production, it is indeed suitable for it, irrespective of its land capability rating.

Land capability is defined as the combination of soil, climate, and terrain suitability factors for supporting rain fed agricultural production. It is an indication of what level and type of agricultural production can sustainably be achieved on any land, based on its soil, climate and terrain. The higher land capability classes (≥8 to 15) are likely to be suitable as arable land for the production of cultivated crops, while the lower classes are only likely to be suitable as non-arable grazing land.

3.2.4.2 Screening Tool Descriptions and Site Sensitivity Verification

A map of the study area and Buildable Areas in relation to the Agricultural Sensitivity provided by the Screening Tool is shown in Figure 3-7. Since none of the land within the study area is classified as cropland, the agricultural sensitivity is therefore purely a function of land capability. The land capability of the study area, as depicted by the Screening Tool, is predominantly 5 and 6, but varies from 3 to 7. The small-scale differences in the modelled land capability across the study area are

not very accurate or significant at this scale and are more a function of how the data is generated by modelling, than actual meaningful differences in agricultural potential on the ground. Values of 3 to 5 translate to a low agricultural sensitivity and values of 6 to 7 translate to a medium agricultural sensitivity, although there is little real difference between low and medium agricultural sensitivity on the ground. There is no scarcity of such agricultural land in South Africa and its conservation for agricultural production is not therefore a priority.

The agricultural sensitivity, as identified by the Screening Tool, is confirmed by the Agriculture Compliance Statement (Chapter 6 of the EIA Report). The motivation for confirming the sensitivity is predominantly that the climate data (low rainfall of approximately 280 to 305 mm per annum and high evaporation of approximately 1 470 to 1 540 mm per annum) proves the area to be arid, and therefore of limited land capability. The land capability value is in keeping with the climate limitations that make the site totally unsuitable for dryland crop production.

The Site Sensitivity Verification (SSV) verified that the entire study area is of less than high agricultural sensitivity with a land capability value of 5 to 6. The required level of agricultural assessment is therefore confirmed as an Agricultural Compliance Statement. Based on the above and various factors, the impact of the proposed project on the agricultural production capability of the site is assessed as being acceptable. Therefore, from an agricultural impact point of view, it has been recommended that the proposed project be approved.

Therefore, there are no areas that specifically need to be avoided by the proposed project from an agricultural perspective. Furthermore, the Agriculture specialist has confirmed that the exact nature and layout of the different infrastructure within the proposed Kudu Solar Facility has no bearing on the significance of agricultural impacts because it is the total footprint size (and its agricultural production potential) that determines the impact significance. Any alternative layout within the footprint is considered acceptable. Furthermore, in this agricultural environment with uniformly low production potential, the location of the proposed project within the properties will also make absolutely no material difference to the significance of the agricultural impacts.

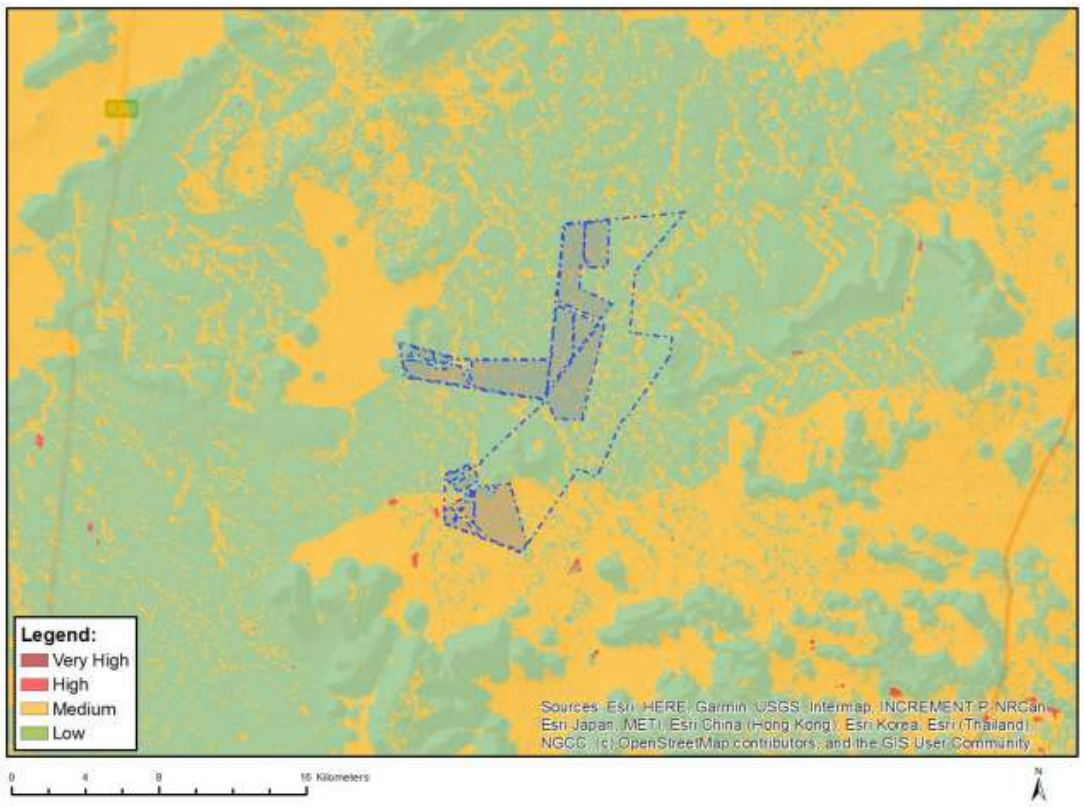


Figure 3-7: Agricultural sensitivity of the study area and buildable areas based on the Screening Tool. (Source: DFFE Screening Tool, 2023)

3.2.5 Geohydrology

The information described below is based on inputs provided by the Geohydrology Specialist, which are included in Chapter 16 of this EIA Report.

3.2.5.1 Regional and Site-Specific Information

- **Regional Hydrogeology:**

The regional aquifer directly underlying the study area is classified by the Department of Water Affairs and Forestry (DWAF) as a fractured aquifer with an average yield potential of less than 2 litres a second. A fractured aquifer describes an aquifer where groundwater only occurs in narrow fractures within the bedrock. However, based on the geological map and the site-specific information it is known that the Quaternary Deposits of alluvium and calcrete form an intergranular aquifer on top of the fractured bedrock. An intergranular aquifer is a primary aquifer and is described as an aquifer in which groundwater is stored within the flows through open pore spaces in the unconsolidated Quaternary deposits.

Based on the DWAF (2005) mapping of the regional groundwater quality, the groundwater underlying the study area and the surrounding area is in the range of 70 – 300 milli-Siemens per metre (mS/m). This is considered to be “good to marginal” quality for water with respect to drinking water standards.

- **Aquifer Vulnerability**

The proposed project study area has a Low to Medium groundwater vulnerability. The intergranular aquifer is aquifer is considered to be of medium groundwater vulnerability, as it lies on top of the fractured aquifer and has no means of protection. Therefore, any contamination that is introduced on the surface of the intergranular aquifer will infiltrate into the subsurface and can cause contamination of the intergranular aquifer.

- **Site Specific and Existing Groundwater Information**

    - **National Groundwater Archive (NGA) Database**

The NGA database provides data on borehole positions, groundwater chemistry and yield, where available. The NGA indicated there is one borehole surrounding the study area. The borehole has a yield of 0.18 L/s, depth of 73.46 m and a lithology of shale followed by sandstone.

    - **Hydrocensus**

A representative hydrocensus was conducted by the Geohydrology Specialist in March 2022 on the farm portions that form the study area, and the surrounding farm portions. During the hydrocensus, borehole depth, water level (WL), pH, total dissolved solids (TDS) and electrical conductivity (EC) were measured. A total of 51 boreholes were identified, however, some of them could not be accessed due to poor weather conditions on site; and data could not be obtained from some of them due to a base plate that covered the whole borehole, or the information was unavailable.

From the information obtained during the hydrocensus it is clear that the boreholes are shallow in the area as all of them were wind pumps, and all of the boreholes were only drilled into the alluvium (as confirmed by the farmers). The water is mainly used for domestic use and livestock watering. The boreholes had a pH that ranged from 6.8 to 9.6 (Figure 3-8), an EC that ranged from 57 mS/m to 126 mS/m (Figure 3-9), a TDS that ranged from 270 mg/L to 1260 mg/L (Figure 3-10), and a WL that ranged from 6.4 metres below ground level (mgbl) to 17.75 mgb/l (Figure 3-11).

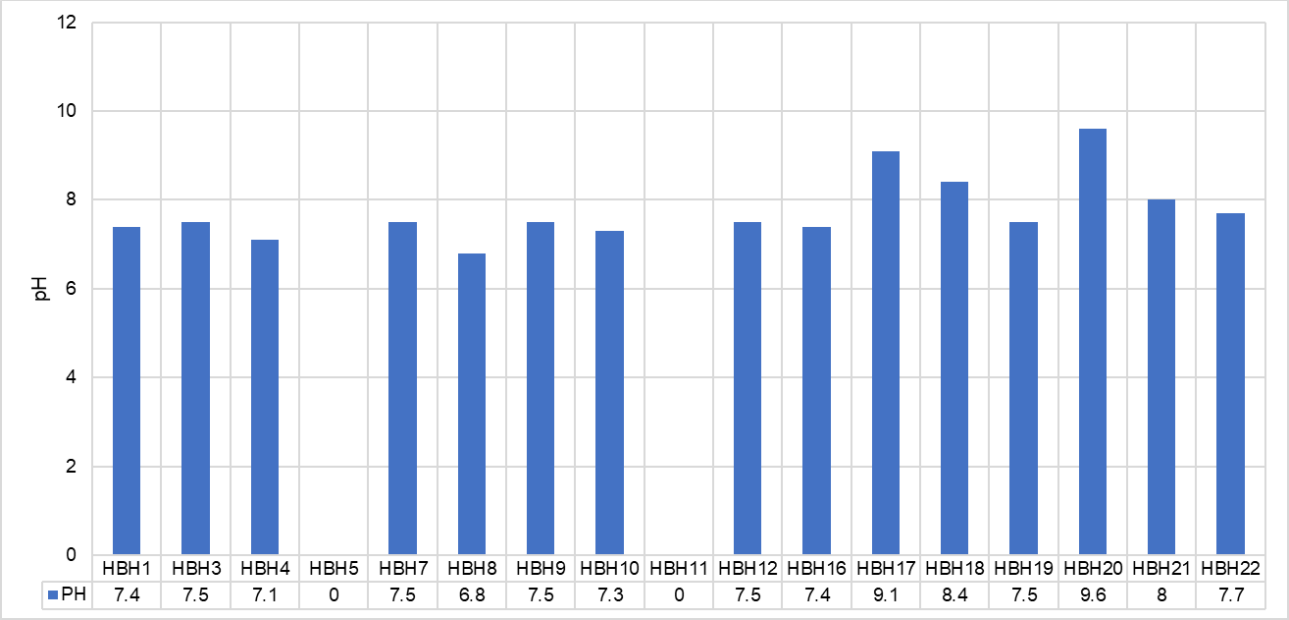


Figure 3-8: pH measured at the Hydrocensus boreholes (Derived from: GEOSS, 2023[10]).

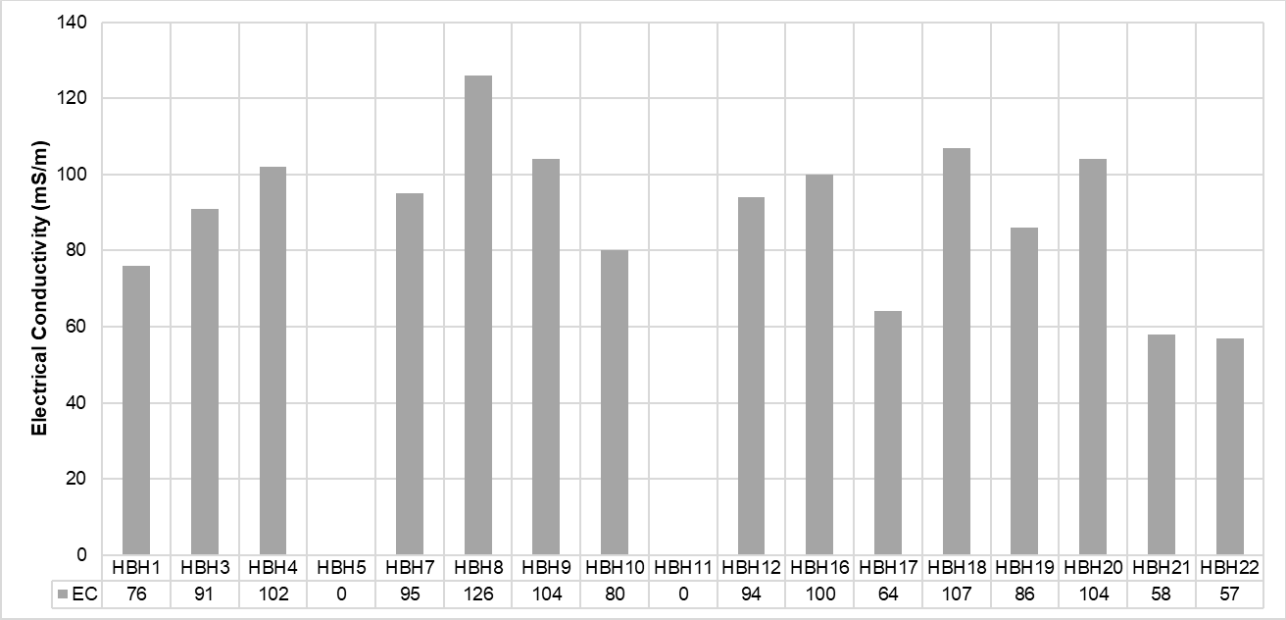


Figure 3-9: EC measured at the Hydrocensus boreholes (Derived from: GEOSS, 2022a).

[10] GEOSS (2023). Geohydrology Assessment for the proposed Kudu Solar Facilities and associated infrastructure, i.e., Chapter 16 of this EIA Report. Prepared for the Scoping and EIA for the Kudu Solar Facilities and associated infrastructure.

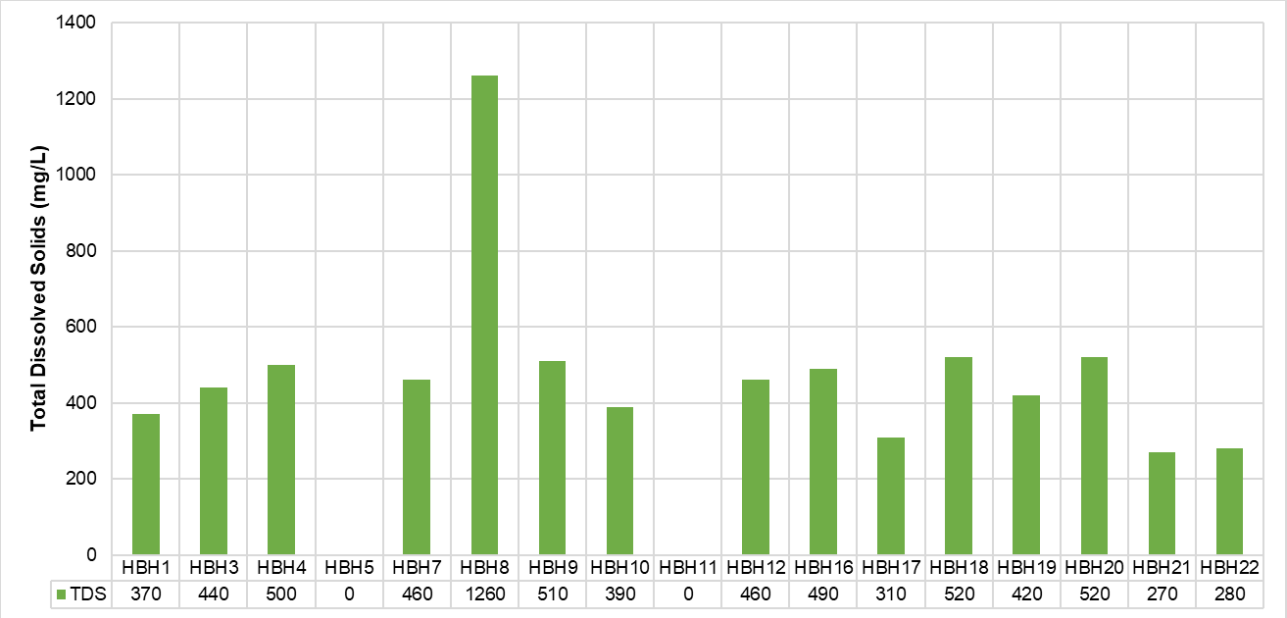


Figure 3-10: TDS measured at the Hydrocensus boreholes (Derived from: GEOSS, 2022a).

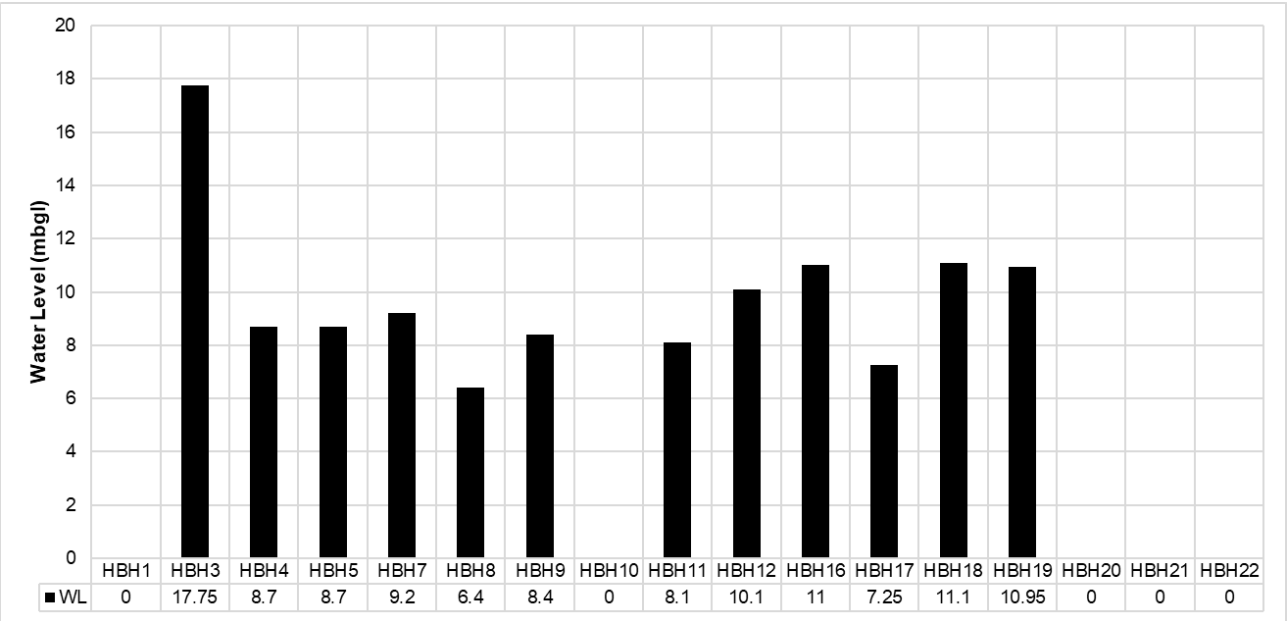


Figure 3-11: Water Level measured at the Hydrocensus boreholes (Derived from: GEOSS, 2022a).

The groundwater quality data obtained during the hydrocensus was assessed by the specialist to establish if the groundwater is suitable for the following uses: potable water; domestic use which will include housekeeping and ablutions; washing of panels; and general construction and concrete batching.

Refer to Chapter 4 of this EIA Report, as well as Chapter 16 for the legal implications of usage of the existing boreholes, as well as the findings of the hydrocensus and analysis in terms of the relevant drinking water standards.

Based on discussions with the landowners, the following water points might be closed or removed collectively for the entire development:

- **HBH 22 pipeline dam located on Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41**: This consists of a dam and water trough, and it is only fed via a pipeline from Borehole HBH 22 that is located to the south-south-east. Refer to Figure 3-12 for additional information.
- **HBH 22 dam located on Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41**: This consists of a dam that is only fed via a pipeline from a borehole to the north-east. Refer to Figure 3-13 for additional information.
- **HBH 20 pipeline dam located on Portion 2 of Farm Grass Pan 40**: This consists of a JoJo tank, pipeline dam and water trough. Refer to Figure 3-14 for additional information.
- **HBH 25 located on Remaining Extent of Portion 3 of the Farm Bas Berg No. 88**: This consists of a borehole and dam. Refer to Figure 3-15 for additional information.
- **Water point located on Remaining Extent of Portion 3 of the Farm Bas Berg No. 88**: This consists of a wind pump. Refer to Figure 3-16 for additional information.



A



B

Figure 3-12: A) HBH22 pipeline dam, picture taken in an east-south-easterly direction. B) HBH22 pipeline dam and water trough, picture taken in a south-south-westerly direction. Photos: ABO Wind.



A



B

Figure 3-13: A) HBH22, picture taken in a south-south-easterly direction. B) HBH22 dam, picture taken in an easterly direction. Photos: ABO Wind.



A



B

Figure 3-14: A) HBH20 pipeline dam and JoJo tank, picture taken in the easterly direction. B) HBH20 pipeline dam water trough, picture taken at the same location as Figure 3.16 (A) in the westerly direction. Photos: ABO Wind.



A



B

Figure 3-15: A) HBH25 borehole and dam, picture taken in a southerly direction. B) HBH25 borehole and dam, picture taken in a south easterly direction. Photos: ABO Wind.



Figure 3-16: Wind pump near Kudu Solar Facility 4. Picture taken in a south-easterly direction. Photo: L. Kellerman.

The relevant specialists have noted that closure or removal of the water points listed above are not a concern. After removal or closure, the pipelines would be left on site and the PV panels would be installed over them. In the event of future relocation, this will be dealt with as a separate process in line with the relevant regulations and legislative requirements at the time.

3.2.5.2 Screening Tool Descriptions and Site Sensitivity Verification

There are no dedicated Geohydrology or Groundwater themes on the Screening Tool as of November 2022 and May 2023, therefore the environmental sensitivity of the proposed project area as identified by the Screening Tool is not applicable. Furthermore, there is no dedicated assessment protocol prescribed for Geohydrology or Groundwater. Therefore, the specialist assessment has been undertaken in compliance with Appendix 6 of the 2014 National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations (as amended), as stipulated in Part A of the Assessment Protocols published in Government Notice (GN) 320 in March 2022.

3.2.6 Strategic Water Source Areas

Strategic Water Source Areas (SWSAs) are defined as “areas of land that either: (a) supply a disproportionate (i.e., relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important; or (b) have high groundwater recharge and where the groundwater forms a nationally important resource; or (c) areas that meet both criteria (a) and (b)” (Le Maitre *et al.*, 2018:1 in Department of Environment, Forestry and Fisheries (DEFF) [now operating as the DFFE], 2019: Page 60[11]).

[11] Department of Environment, Forestry and Fisheries (DEFF), 2019. Strategic Environmental Assessment for the Development of a Phased Gas Pipeline Network in South Africa. CSIR Report Number: CSIR/SPLA/EMS/ER/2019/0077/B. ISBN Number: ISBN 978-0-7988-5649-2. Stellenbosch and Durban.

Thirty-seven groundwater SWSAs have been identified in South Africa and are considered to be strategically important at a national level for water and economic security. The total area for groundwater SWSAs extends approximately 104 000 km^2 and covers approximately 9% of the land surface of South Africa (Le Maitre *et al.,* 2018, in DEFF, 2019: Page 61). They also include transboundary Water Source Areas that extend into Lesotho and Swaziland.

The proposed project study area is located about 28 km to the north-east of the De Aar Region Groundwater SWSA, however the proposed project will not impact this area.

3.2.7 Aquatic Biodiversity

Various resources, such as, but not limited to, Google Earth satellite imagery, the Northern Cape Biodiversity Sector Plan (NCBSP), and the National Fresh Water Priority Areas (NFEPA), have been used to define the regional vegetation, water resources, fauna and anticipated ecological sensitivity of the study area. A literature review of existing reports, scientific studies, databases, reference works, guidelines, and legislation relevant to the study area was conducted to establish the baseline ecological and vegetative condition of the site and associated environment. Details pertaining to the aquatic environment is provided in the Aquatic Biodiversity and Species Impact Assessment that is included in Chapter 8 of this EIA Report.

3.2.7.1 General Context

The majority of the study area is located in the Upper Orange Water Management Area (WMA), whilst less than 10% thereof falls within the Lower Orange WMA. The Catchment Area is comprised of unnamed ephemeral tributaries of the middle reach of the Orange River and the study area is located within the D33B (Upper Orange) and D62F (Lower Orange) Quaternary Drainage Regions (QDRs). The majority of the landscape consists of flat to slightly undulating plains with shallow valleys and small hilltops that are drained by non-perennial (ephemeral), northward-flowing tributaries of the Orange River. General drainage within the study area is from south to north. The elevation of the study area ranges from approximately 1250 to 1350 m.a.s.l.

The aquatic features within the study area comprise ephemeral unnamed tributaries of the Orange River. The larger watercourses flow along the eastern and western extents of the study area, flowing in a northerly direction to join the Orange River downstream of Van der Kloof Dam. Associated with these larger watercourses are wide floodplains. The larger watercourse channels tend to be shallow and wide. Smaller watercourses and drainage features drain into the larger river corridors.

The rivers can all be characterised as foothill and lowland rivers within the Nama Karoo Ecoregion. A dominant feature of the larger rivers is the alluvial floodplains that are characterised by multiple channels that are interchangeably used during higher flow events. These sandy floodplains tend to have mostly bare beds, with vegetation occurring in clumps along the bed and more densely along the banks. The ephemeral watercourses are highly dependent on groundwater discharge. The substrate comprises a mix of gravel and alluvium. Wetland areas tend to comprise depressions on the valley floor that occur as a perched feature on calcrete layers.

Due to the climatic conditions of the area, the watercourses and the wetland areas that occur in the area are ephemeral (non-perennial), only containing water for short periods, immediately following local rainfall events.

The vegetation for the larger watercourses usually comprises indigenous grasses (*Eragrostis* and *Stipagrostis* species and *Themeda triandra*) with a distinct riparian vegetation comprising larger shrubs such as *Searsia pyroides* and *Melianthus comosus*. These smaller ephemeral streams and drainage features within the study area do not have a distinct channel or vegetation. Wetland areas contain *Phragmites australis* in the larger features, while the smaller features contain some wetland indicator species such as *Schoenoplectus* spp.

The ephemeral streams and floodplains provide aquatic habitat to a diverse array of faunal species that are adapted to the brief periods of inundation to carry out much of their life phases. Amphibians such as the Poynton's River Frog (*Amietia poyntoni),* Tandy's sand frog (*Tomopterna tandyi*), African bullfrog, (*Pyxicephalus adspersus*), Pygmy Toad (*Poyntonophrynus vertebralis*) and Karoo Toad, *Vandijkophrynus gariepensis* use the inundated pools for breeding. Other biota that use the temporary wet habitats comprise migratory birds and many invertebrates such as water fleas (*Daphnia* spp.) and tadpole shrimps (*Triops* spp.*)*. Connectivity between aquatic ecosystems and the surrounding terrestrial landscape is essential for supporting the fauna of these ecosystems.

The watercourses and associated wetlands and floodplains are in a largely natural to moderate condition due to the low level of impact in the area. It is recommended that the larger watercourses, floodplains and wetlands within the site are not allowed to degrade further from their current ecological condition of largely natural to moderately modified.

Impacts to the watercourses in the study area are associated with agricultural encroachment, livestock grazing and infrastructure (road and powerline) construction and maintenance. The ephemeral aquatic ecosystems are particularly vulnerable to changes in hydrology as they are specifically adapted to the sporadic flow conditions that naturally occur. Contaminants and sediment are not regularly flushed from these streams.

The catchments of the tributaries of the Orange River within the study area do not fall within any National Freshwater Ecosystem Priority Area (FEPA) river sub-catchments. FEPAs are priority areas for conserving freshwater ecosystems and supporting sustainable use of water resources and upstream management areas. FEPAs were identified based on the representation of ecosystem types and flagship free-flowing rivers, maintenance of water supply areas in areas with high yields of water, identification of connected ecosystems and preferential identification of FEPAs that overlapped with any free-flowing river and priority estuaries identified in the 2011 National Biodiversity Assessment.

The only FEPA Wetland within the study area is a largely artificial wetland associated with a farm dam or erosion control structure and is thus not considered of high aquatic biodiversity conservation significance. There is also a natural depression wetland that is within the valley floor of the river system to the west of the study area that is mapped as a FEPA Wetland. Both wetlands are located outside of the study area and are unlikely to be impacted by the proposed project. The artificial wetland is more than 100 m from the study area, while the natural wetland is more than 3 km away.

3.2.7.2 Screening Tool Descriptions and Site Sensitivity Verification

Figure 3-17 below presents the information from the Screening Tool for the Aquatic Biodiversity Combined Sensitivity as it relates to the study area and the Revised Scoping Buildable Areas. Evident from this data is that the area under consideration is generally considered to be of low Aquatic Biodiversity Combined Sensitivity. The very high sensitivity mapped within the study area is linked to the mapped wetlands in the National Wetland Map Version 5 (NWM5) (the wider river floodplains associated with the unnamed tributaries of the Orange River located in the eastern and western portions of the wider study area).

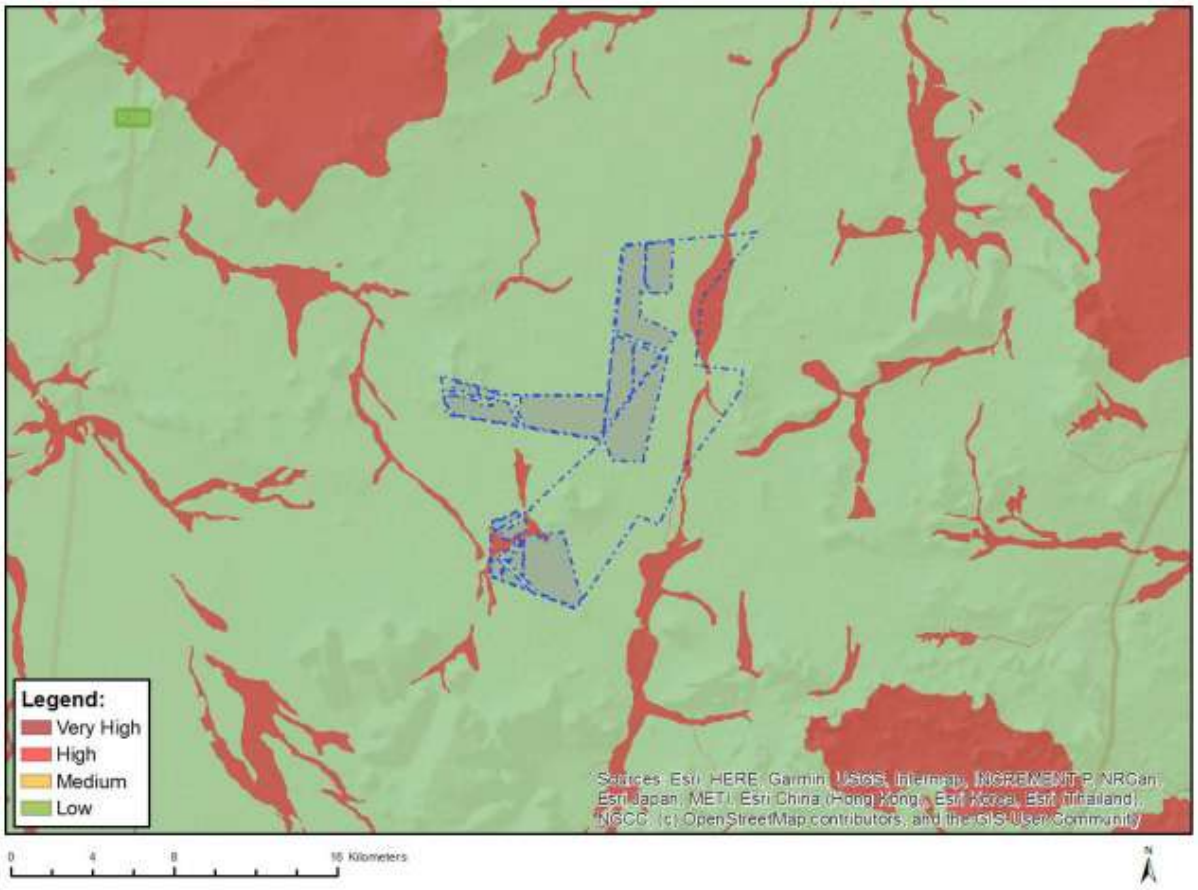


Figure 3-17: Aquatic Biodiversity Combined Sensitivity of the study area and Buildable Areas based on the Screening Tool. (Source: DFFE Screening Tool, 2022)

However, following the SSV, the aquatic constraints of the wider study area have been mapped in detail and their aquatic ecosystem sensitivities are shown below in Figure 3-18. The larger watercourses and associated floodplains, as well as wetland areas within the study area, are deemed to be of **medium aquatic ecological sensitivity**. The smaller watercourses and drainage lines that should not pose an aquatic ecosystem constraint to the proposed project are considered to be of **low aquatic ecological sensitivity**.

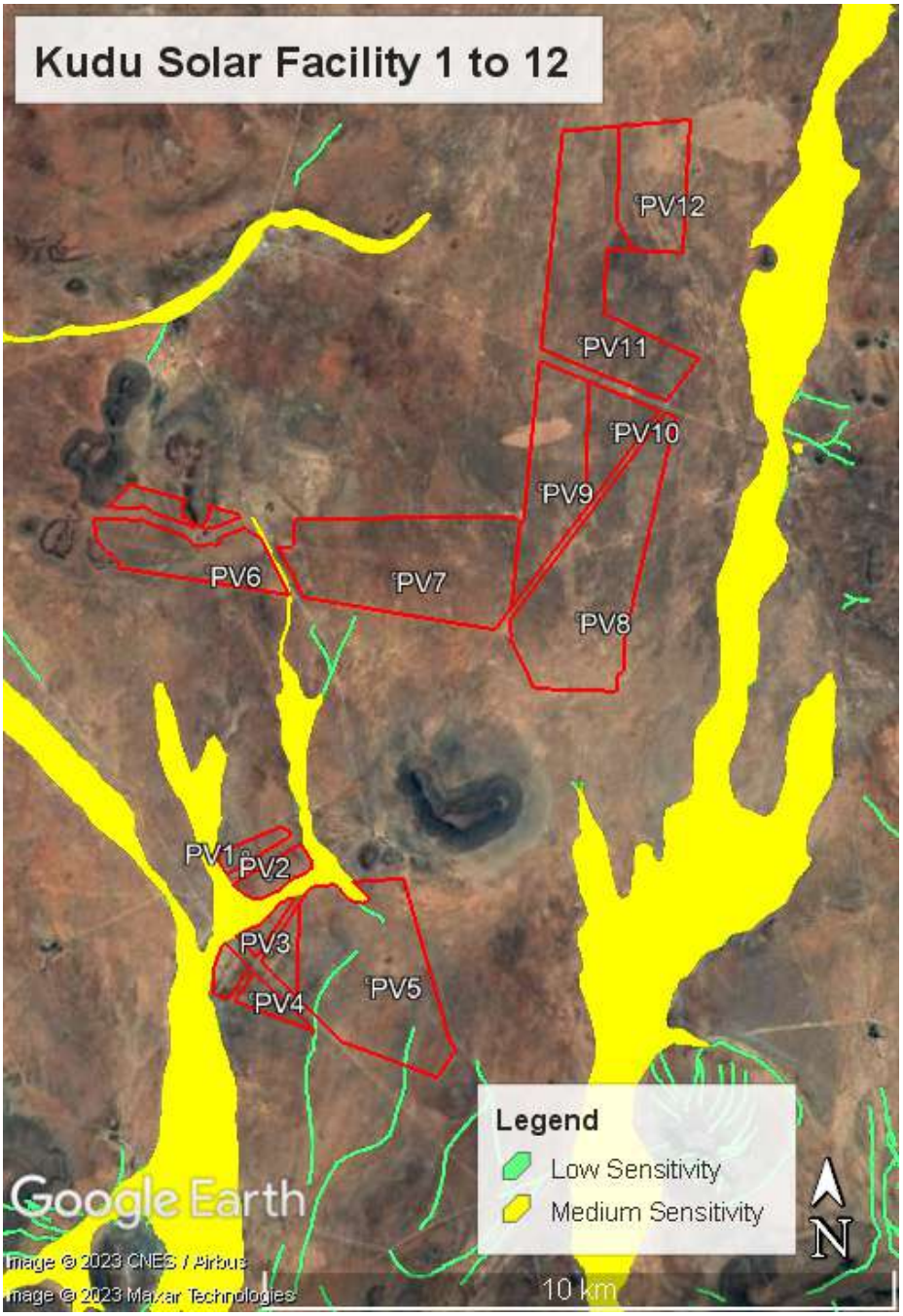


Figure 3-18: Mapped Aquatic Biodiversity Sensitivities within the study area following the SSV and detailed mapping. Yellow indicates medium sensitivity (i.e. unnamed tributaries of the Orange River, larger watercourses and their floodplains, and wetlands) and green indicates low sensitivity (i.e. smaller feeder streams, drainage lines and their floodplains) (Source: Belcher, 202312)

[12] Belcher, A. (2023). Aquatic Biodiversity and Species Scoping Level Assessment for the proposed Kudu Solar Facilities and associated infrastructure. Prepared for the Scoping and Environmental Impact Assessment (EIA) for the Kudu Solar Facilities and associated infrastructure. Chapter 8 of the EIA Report

3.2.8 Terrestrial Biodiversity

Various resources, such as, but not limited to, South African National Protected Areas Database (SAPAD), National Biodiversity Assessment (NBA), and the National Vegetation Map (VEGMAP) have been used to define the regional vegetation, water resources, fauna and anticipated ecological sensitivity of the study area. Details pertaining to the terrestrial environment is provided in the Terrestrial Biodiversity and Species Impact Assessment that is included in Chapter 7 of this EIA Report.

A site visit was undertaken in February 2022 and March 2022 (wet season) where the Terrestrial Biodiversity and sensitive flora aspects of the survey area were evaluated. During the field surveys performed, the habitats were evaluated, and a series of georeferenced photographs were taken of the habitat attributes. The field surveys focused on identifying dominant flora species, main habitat types as well as the actual and potential presence of SCC (either classified as Threatened by the International Union for Conservation of Nature (IUCN) (2022), protected by the National Environmental Management: Biodiversity Act (NEMBA) (2007, as amended) or other legislation applicable provincially or nationally).

3.2.8.1 Regional Vegetation

As noted above, the study area falls within the Nama Karoo and Grassland Biomes, covering three vegetation types, namely the Northern Upper Karoo (NKu3), the Eastern Upper Karoo (NKu4) and the Besemkaree Koppies Shrubland (Gh4) (Figure 3-19). The Northern Upper Karoo vegetation unit occupies the Northern regions of the Upper Karoo plateau from Prieska, Vosburg and Carnarvon in the west to Philipstown, Petrusville and Petrusburg in the east. Bordered in the north by Niekerkshoop, Douglas and Petrusburg and in the south by Carnarvon, Pampoenpoort and De Aar. A few patches occur in Griqualand West. The Eastern Upper Karoo vegetation type is one of the largest vegetation types in the country and is found in the Northern, Western and Eastern Cape, between Carnarvon and Loxton in the west, De Aar, Petrusville and Venterstad in the north and Burgersdorp and Cradock in the east, and the Great Escarpment in the south. Besemkaree Koppies Shrubland occurs in the Northern Cape, Free State and Eastern Cape provinces on the plains of the Eastern Upper Karoo, between Richmond and Middelburg in the south and the Orange River in the north.

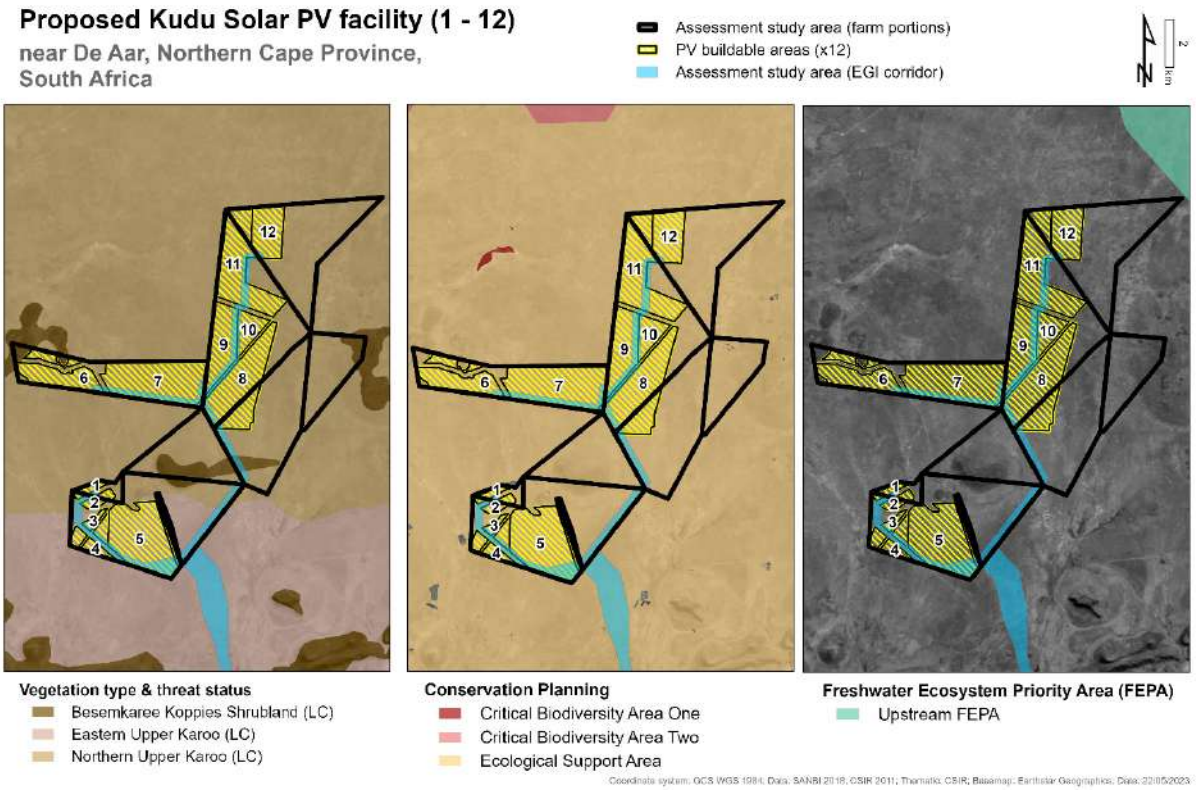


Figure 3-19: The study area and Buildable Areas in relation to Vegetation Types, Conservation Planning and Freshwater Ecosystem Priority Areas (FEPAs).

3.2.8.2 Biodiversity Conservation Planning

Critically Endangered and Threatened Ecosystems

Based on specialist input no Critically Endangered, Threatened and/or Vulnerable Ecosystems appear to be present within the proposed project site.

Critical Biodiversity Areas and Ecological Support Areas

Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) are indicated in terms of the Northern Cape Critical Biodiversity Area Map, which was published in 2016 to update, revise and replace all older systematic biodiversity plans and associated products for the province. This was developed by the Northern Cape Department of Environment and Nature Conservation (currently operating as the Northern Cape Department of Agriculture, Environmental Affairs, Rural Development and Land Reform (DAEARDLR)) by using a Systematic Conservation Planning approach. The Northern Cape DAEARDLR confirmed that the Northern Cape 2016 CBA Map serves as “CBAs identified in systematic biodiversity plans adopted by the competent authority”, as per the relevant listed activities in Listing Notice 3 of the 2014 NEMA EIA Regulations (as amended). Refer to Appendix F Part 3 for a copy of this correspondence from the Northern Cape DAEARDLR.

CBAs and ESAs together with Protected Areas are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole (Holness and Oosthuysen, 2016 in Enviro-Insight, 2023[13]).

CBAs are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services. The primary purpose of CBAs is to inform land-use planning in order to promote sustainable development and protection of important natural habitat and landscapes. Biodiversity priority areas are described as follows:

- CBAs are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses. For CBAs the impact on biodiversity of a change in land-use that results in a change from the desired ecological state is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g., loss of populations or habitat). All FEPA prioritized wetlands and rivers have a minimum category of CBA1, while all FEPA prioritised wetland clusters have a minimum category of CBA2.
- ESAs are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of CBAs and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for CBAs. For ESAs a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway (e.g. removing a corridor results in a population going extinct elsewhere or a new plantation locally results in a reduction in stream flow at the exit to the catchment which affects downstream biodiversity). All natural non-FEPA wetlands and larger rivers have a minimum category of ESA.

Identified ESAs (2016 Northern Cape CBA Map) extend over a wide area in this specific region of the Northern Cape. The entire study area, and thus all identified buildable areas are located in an ESA (Figure 3-19). The ESA is due to the study area being located in the Platberg-Karoo Conservancy, the vegetation units and important wetland and river features. From a Terrestrial Biodiversity perspective, the Platberg-Karoo Conservancy and the vegetation units are important systems for grasslands and grassland associated animals, as well as important areas for the conservation of avifauna. This section of the Karoo has the highest rainfall and provides an ecotone between the Nama Karoo and Grassland biomes. More information on the Platberg-Karoo Conservancy is provided below.

[13] Holness, S., & Oosthuysen, E. (2016). Critical Biodiversity Areas of the Northern Cape: Technical Report. In Enviro-Insight (2023). Terrestrial Biodiversity and Species Scoping Level Assessment for the proposed Kudu Solar Facilities and associated infrastructure. Prepared for the Scoping and Environmental Impact Assessment (EIA) for the Kudu Solar Facilities and associated infrastructure. Chapter 7 of the EIA Report.

Protected Areas

According to the South African Protected Areas Database (SAPAD), Quarter 2 (2022), the study area does not include any formally Protected Areas (Figure 3-20), as defined by the National Environmental Management: Protected Areas Act (Act 57 of 2003) (NEM: PAA). This has also been confirmed by the DFFE Directorate: Protected Areas Planning and Management Effectiveness (Appendix F Part 3 of the EIA Report). The closest formally Protected Area is the Rolfontein Provincial Nature Reserve, which is located more than 30 km to the north-east of the study area. The Rolfontein Provincial Nature Reserve was declared in 1994, based on the information provided on SAPAD. The Tuinhoek Reserve and Grasberg Reserve lie directly adjacent to the Rolfontein Provincial Nature Reserve, and fall within the Free State, more than 40 km from the study area, towards the north-east. The Doornkloof Provincial Nature Reserve lies more than 50 km away from the study area, towards the south-east, in the Free State. In addition, the De Aar Nature Reserve lies more than 50 km away from the study area, towards the south-west, in the Northern Cape.

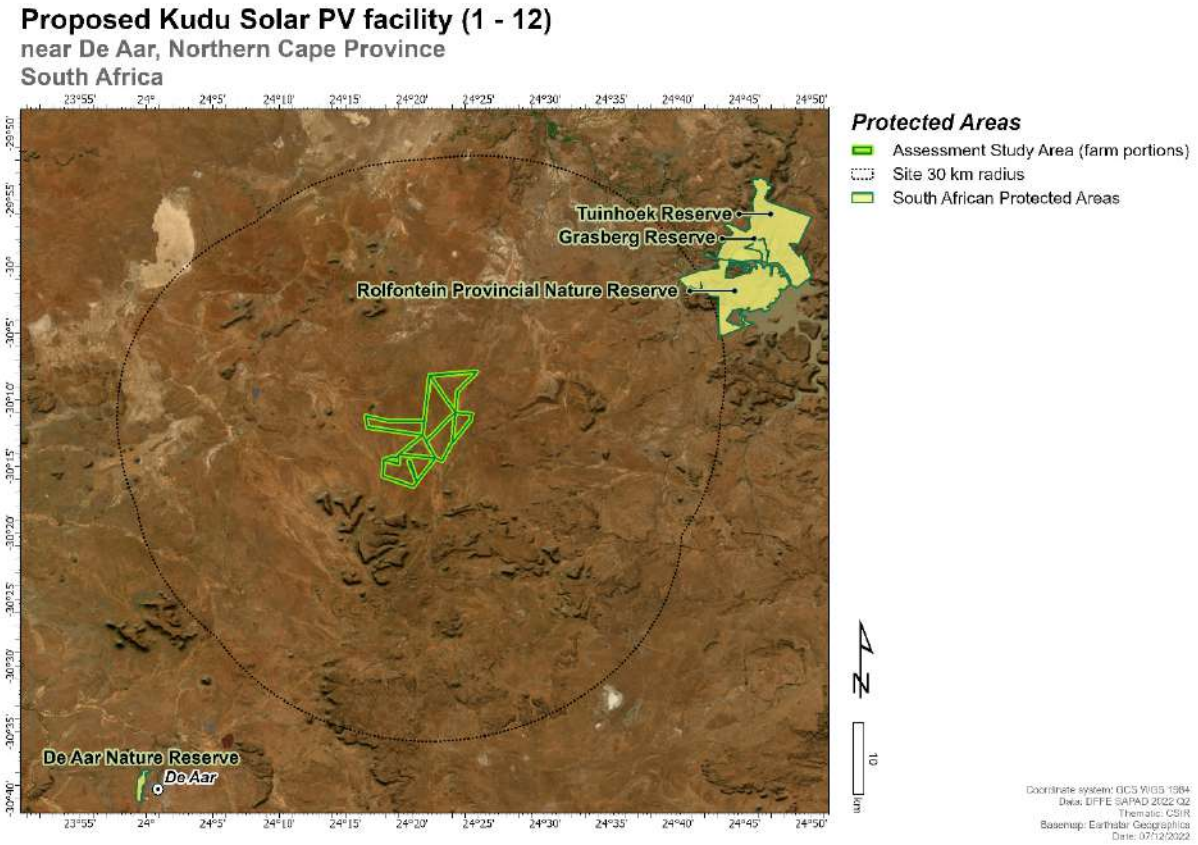


Figure 3-20: Protected Areas in relation to the Study Area

Conservation Areas

According to the South African Conservation Areas Database (SACAD), Quarter 2 (2022), the study area does not include any Conservation Areas.

National Protected Area Expansion Strategy (NPAES) Focus Areas

The NPAES focus areas for land-based protected area expansion are large, intact and unfragmented areas of high importance for biodiversity representation and ecological persistence, suitable for the creation or expansion of large, Protected Areas. Representative of opportunities for meeting the ecosystem-specific protected area targets set in the NPAES and were designed with strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems. There are no National Protected Area Expansion Strategy (NPAES) focus areas within the study area.

Important Bird and Biodiversity Areas

The study area is located in the Platberg-Karoo Conservancy[14], which is regarded as an Important Bird and Biodiversity Areas (IBA).

The Platberg–Karoo Conservancy was established in July 1990. In collaboration with MD Anderson of DENC, various research and environmental awareness projects were initiated, including the Karoo Large Terrestrial Bird Survey, the Blue Crane Awareness Project and 11 years of colour-ringing Blue Crane chicks. The major threat of power-line collisions was initially investigated by the Eskom/EWT partnership and MD Anderson. This covered the impact of power lines on populations of large terrestrial bird species and evaluated the effectiveness of earth-wire marking devices.

The Platberg–Karoo Conservancy IBA covers the entire districts of De Aar, Philipstown and Hanover, including suburban towns. This IBA is in the Nama Karoo and Grassland Biomes. The land is used primarily for grazing and agriculture. Commercial livestock farming is mostly extensive wool and mutton production, with some cattle and game farming. Less than 5% of this IBA is cultivated under dry-land or irrigated conditions.

This IBA contributes significantly to the conservation of large terrestrial birds and raptors. These include Blue Crane *Anthropoides paradiseus*, Ludwig's Bustard *Neotis ludwigii*, Kori Bustard *Ardeotis kori*, Blue Korhaan *Eupodotis caerulescens*, Black Stork *Ciconia nigra*, Secretarybird *Sagittarius serpentarius*, Martial Eagle *Polemaetus bellicosus*, Verreauxs' Eagle *Aquila verreauxii,* and Tawny Eagle *Aquila rapax*.

Refer to the Avifauna Assessment (Chapter 9 of this EIA Report) which provides detailed information on the proposed project and resultant potential impacts on birds.

[14] A conservancy is a vehicle and platform for community-based conservation. It is a voluntary association of environmentally conscious land-owners and land-users who choose to cooperatively manage their natural resources in an environmentally sustainable manner without necessarily changing the land-use of their properties.

3.2.8.3 Fauna

A Compliance Statement was undertaken for the Terrestrial Animal Species (excluding Avifauna). Refer to Chapter 9 of the EIA Report for additional information. The Compliance Statement notes that the study area is in a natural or semi-natural state (due to presence of alien invasive species), and accordingly it is of a medium to low sensitivity for terrestrial animal species.

Leopard tortoise, Cape Ground Squirrel, Steenbok, Porcupine, Small-spotted genet, Springbok, Scrub hare, Common warthog, Bat eared fox, Puff Adder, Striped polecat, Cape cobra were recorded on site, and one animal SCC was recorded, namely Sable Antelope, however, since this is an introduced species, and it is believed that the species are from the adjacent property a full animal assessment is not required. The species could still be included as part of the construction and operational management plan, as the species moves between the two properties.

Almost all fauna species recorded within the study area are provincially protected, including species under Schedule 1 and 2 of the Northern Cape Nature Conservation Act (No. 9 of 2009). Should it be necessary to capture and relocate any of these animals prior to or during construction, or during the operational phase of the project, a permit application with the provincial authority is required.

3.2.8.4 Habitats and Terrestrial Plant Species

Four main habitats were identified within the study area based on species composition and structure following the desktop review and field-based assessments done by the specialists. These are listed below.

- Shrubby Grassland;
- White Grassland;
- Koppies; and
- Watercourse.

In addition, transformed areas were included which makes up existing roads, homesteads and bare soil.

The Terrestrial Biodiversity specialist has noted that many species found within the study area are widespread and not of any conservation concern but protected due to the fact that the Northern Cape Nature Conservation Act (2009) protects entire families of flowering plants irrespective of whether some members are rare or common. Refer to Chapter 7 for a list of plant SCC observed within the study area. The provincially protected species must either be relocated prior to construction or alternative measures made (depending on comments received from the provincial authority). A permit application is required for submission to the relevant provincial department where the proposed development will impact on these species.

The protected tree *Boscia albitrunca* occurs in the Shrubby Grassland at the base of a Koppie (in the vicinity of Kudu Solar Facility 6), and where individuals are impacted on by the approved layout, a permit application for destruction must be submitted to the Northern Cape DFFE. Currently the only known individual is excluded from development.

3.2.8.5 Screening Tool Descriptions and Site Sensitivity Verification

Figure 3-21, Figure 3-22 and Figure 3-23 below indicate the results of the Screening Tool in terms of terrestrial plant species, terrestrial animal species, and the terrestrial biodiversity combined sensitivity, respectively, for the proposed project.

The Screening Tool shows Low and Medium sensitivity for the Plant species theme due to suitable habitat for one SCC, namely *Tridentea virescens* (Figure 3-21). This species has an extensive, but very sporadic distribution from the south-eastern corner of Namibia to De Aar, Hopetown and Beaufort West in South Africa. Specimens are usually found in stony ground or hard loam in floodplains and they are often associated with shrubs of *Lycium* or *Rhigozum trichotomum*. No individuals were recorded during the survey within the study area. Even though *Lycium* and *Rhigozum* spp. are present throughout the study area, it does not always indicate suitable habitat for the species as the species tends to be sporadic. The species has a moderate likelihood of occurring on the study area, especially towards the northern boundary.

The Screening Tool shows that faunal populations for the study area are considered to be of medium sensitivity due to the presence of sensitive avifauna species (Refer to Section 3.2.9 of this chapter for additional information), while the remaining taxa groups are considered to be low sensitivity (Figure 3-22). Accordingly, only a compliance statement is required (refer to Chapter 7 for more details).

In terms of the terrestrial biodiversity combined sensitivity layer on the Screening Tool, the study area is shown to have a very high sensitivity due to the ESA designation (Figure 3-23).

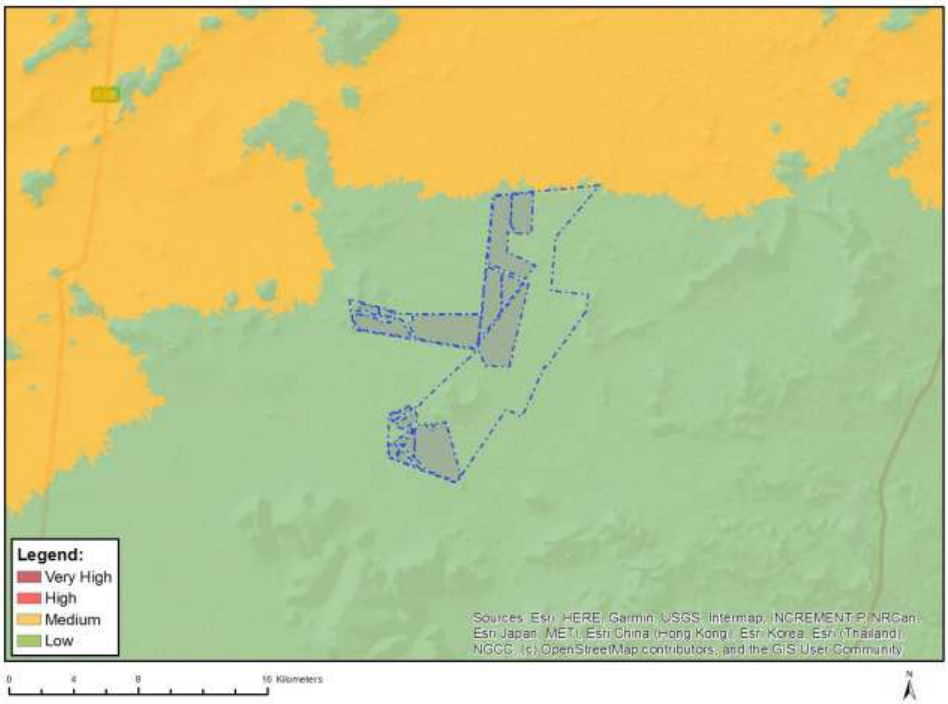


Figure 3-21: Terrestrial Plant Species sensitivity of the study area and Buildable Areas based on the Screening Tool. (Source: DFFE Screening Tool, 2023)



Figure 3-22: Terrestrial Animal Species sensitivity of the study area and Buildable Areas based on the Screening Tool. (Source: DFFE Screening Tool, 2023)

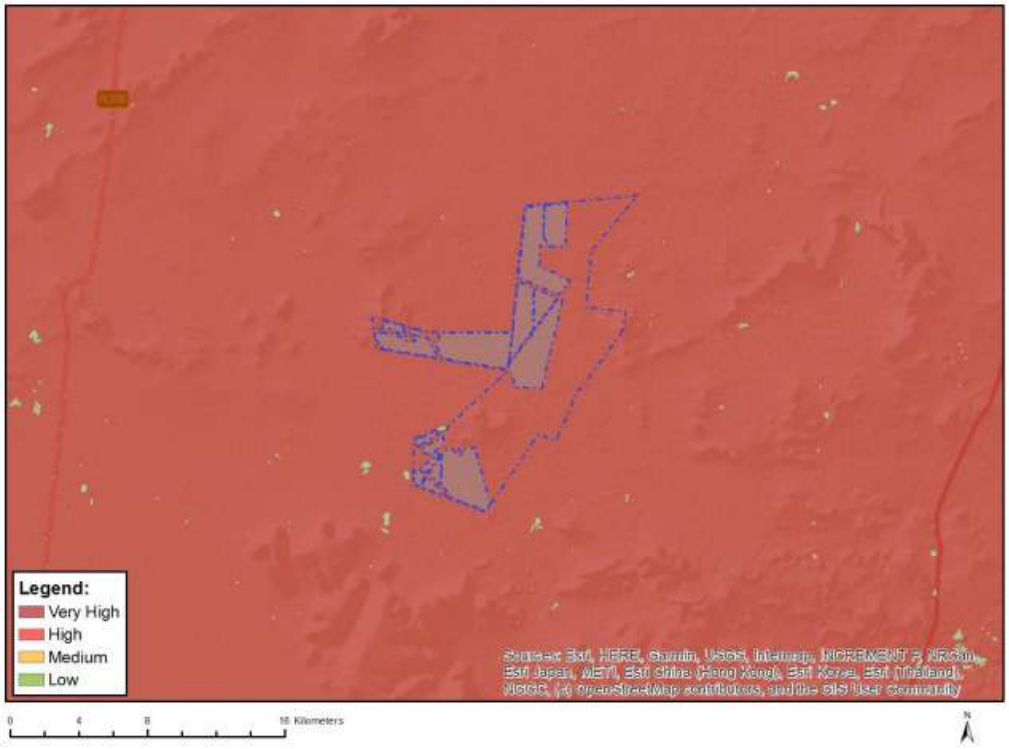


Figure 3-23: Terrestrial Biodiversity Combined Sensitivity of the study area and Buildable Areas based on the Screening Tool. (Source: DFFE Screening Tool, 2023)

The Terrestrial Biodiversity Combined Sensitivity Theme is indicated as Very High on the Screening Tool due to the ESA. Terrestrial Biodiversity theme The ESA is due to the site being in the Platberg-Karoo Conservancy (not formally protected), the vegetation units and important wetland and river features. The Terrestrial Biodiversity theme therefore includes information on avifauna and aquatic features – the relevant specialist assessments with regards to these specific taxa and features must be read in combination with the Terrestrial Biodiversity and Species Report (Chapter 7 of the EIA Report) to report to obtain a holistic view of the environment and in order to determine and assess relevant impacts from the proposed project on these features and taxa. The vegetation itself is not considered sensitive but does provide important feeding and breeding habitat for fauna. The relevant buffers indicated in the Avifauna Assessment must be incorporated into the layout design, and where necessary these areas must be avoided from development. Important river and wetland features occur in the landscape, which are vital for ecosystem services, maintaining connectivity in the landscape, and act as important habitats for many fauna species. Accordingly, the overall sensitivity of the study area in terms of Terrestrial Biodiversity is considered medium, with some landscape features, including the Koppies, as High sensitivity. These features need to be excluded from development as identified by the relevant specialists (refer to aquatic and avifauna assessments).

For the Plant Species theme, the identified suitable habitat for *Tridentea virescens* had to be further assessed, and accordingly the medium sensitivity rating was upgraded to comply with a Terrestrial Plant Species Specialist Assessment. *Tridentea virescens* has been recorded previously near to De Aar and could possibly occur within the study area.

3.2.9 Avifauna

The information described below is based on inputs provided by the Avifauna Specialist, which are included in Chapter 9 of this EIA Report.

An integrated pre-construction monitoring programme has been implemented at the study area. The pre-construction avifaunal monitoring programme is following an adapted Regime 2 protocol as defined in the Birds and Solar Energy best practice guidelines (Jenkins et al. 2017 in Chris van Rooyen Consulting, 2023[15]) which require a minimum of two surveys over a six-month period. Both surveys have been conducted.

A total of 85 species could potentially occur within the Broader Area where the project is located. Of these, 21 are classified as priority species for solar developments. Of the 21 priority species, 17 were recorded during the monitoring so far, and 15 priority species have a medium to high probability of occurring regularly in the study area. Five Red Data species were recorded during the site surveys, namely Blue Crane, Martial Eagle, Verreaux's Eagle, Cape Vultures and White-backed Vulture. Refer to Chapter 9 of this EIA Report for a list of priority species potentially occurring in the study area and potential impacts on them by the proposed project.

[15] Jenkins, A.R., Ralston-Patton, Smit- Robinson, A.H. 2017. Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa. BirdLife South Africa. In Chris van Rooyen Consulting (202). Avifauna Scoping Level Assessment for the proposed Kudu Solar Facilities and associated infrastructure. Prepared for the Scoping and Environmental Impact Assessment (EIA) for the Kudu Solar Facilities and associated infrastructure. Chapter 9 of the EIA Report.

3.2.9.1 Screening Tool Descriptions and Site Sensitivity Verification

In terms of the Screening Tool, the study area and immediate environment is classified as medium and low sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme (Figure 3-22). The Buildable Areas specifically are classified as medium sensitivity. In a Screening Tool Report that was generated in February 2022, the medium classification was linked to the potential occurrence of Ludwig's Bustard (Globally and Regionally Endangered) and Verreaux's Eagle (Regionally Vulnerable). However, in a Screening Tool Report that was generated in May 2023 for the study area, the medium classification was linked to the potential occurrence of Ludwig's Bustard (Globally and Regionally Endangered) and Tawny Eagle (Regionally Endangered). The study area contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020). The occurrence of SCC was confirmed during the surveys so far i.e. Martial Eagle (Globally and Regionally Endangered), Verreaux's Eagle (Regionally Vulnerable), Blue Crane (Globally Vulnerable and Regionally Near-threatened), Cape Vulture (Globally Vulnerable and Regionally Endangered) and White-backed Vulture (Globally and Regionally Endangered) was recorded in the Study Area, as well as habitat for Secretarybird (Globally and Regionally Endangered) and Ludwig's Bustard.

Based on the SSV conducted on 28 March 2022 to 1 April 2022, the specialists concluded that the study area is of high sensitivity for avifauna from a solar perspective as the presence of SCC in the study area was confirmed during the surveys so far. Therefore, the medium and low sensitivity on the Screening Tool for avifauna is disputed and a high sensitivity finding is confirmed and more appropriate.

3.2.10 Visual Aspects and Sensitive Receptors

The information described below is based on inputs provided by the Visual Specialist, which are included in Chapter 10 of this EIA Report.

The visual assessment provides information on landscape, terrain, and vegetation, as well as other aspects such as land use and sensitive receptors. As described in Section 3.2.2 of this chapter, the study area lies within an expansive flattish landscape interspersed with dolerite-capped koppies and the small isolated *koppie* Basberg, which provide topographic relief.

The approach and methodology for the visual specialist study is based on the "Guideline for Involving Visual and Aesthetic Specialists in EIA Processes" (Oberholzer, 2005), as well as a site visit undertaken by the specialists in March 2022, and the use of a 3D digital terrain model of the study area to determine the viewshed of the proposed project, as well as establishing a photographic record with the emphasis on views from potential sensitive receptors of the proposed project at varying distances, and panoramic photographs, which include GPS positions, to create the post-mitigation photomontages.

The assessment concluded that the viewshed, or zone of visual influence, potentially extends for some 5 km. Various potential scenic resources and sensitive receptors, such as farmsteads, as well as landscape features were identified within the study area and have been categorised into

no-go (very high), high, medium and low visual sensitivity zones, as well as buffers, for the proposed project. Refer to the Visual Impact Assessment for the visual sensitivity mapping categories and sensitivity findings.

3.2.10.1 Screening Tool Descriptions and Site Sensitivity Verification

The Screening Tool "Landscape" Combined Sensitivity Map as it relates to solar energy developments in the region is considered to be Very High in the northern and southern parts of the study area, where the very high sensitivities are mainly linked to slopes of more than 1:4., i.e. mountain tops and high ridges (Figure 3-24). These findings were partly disputed based on more detailed project-scale mapping of landscape features. A more accurate map of landscape features, along with recommended visual sensitivity buffers, has been prepared at the local project scale by the specialists and is included in Chapter 10 of the EIA Report.

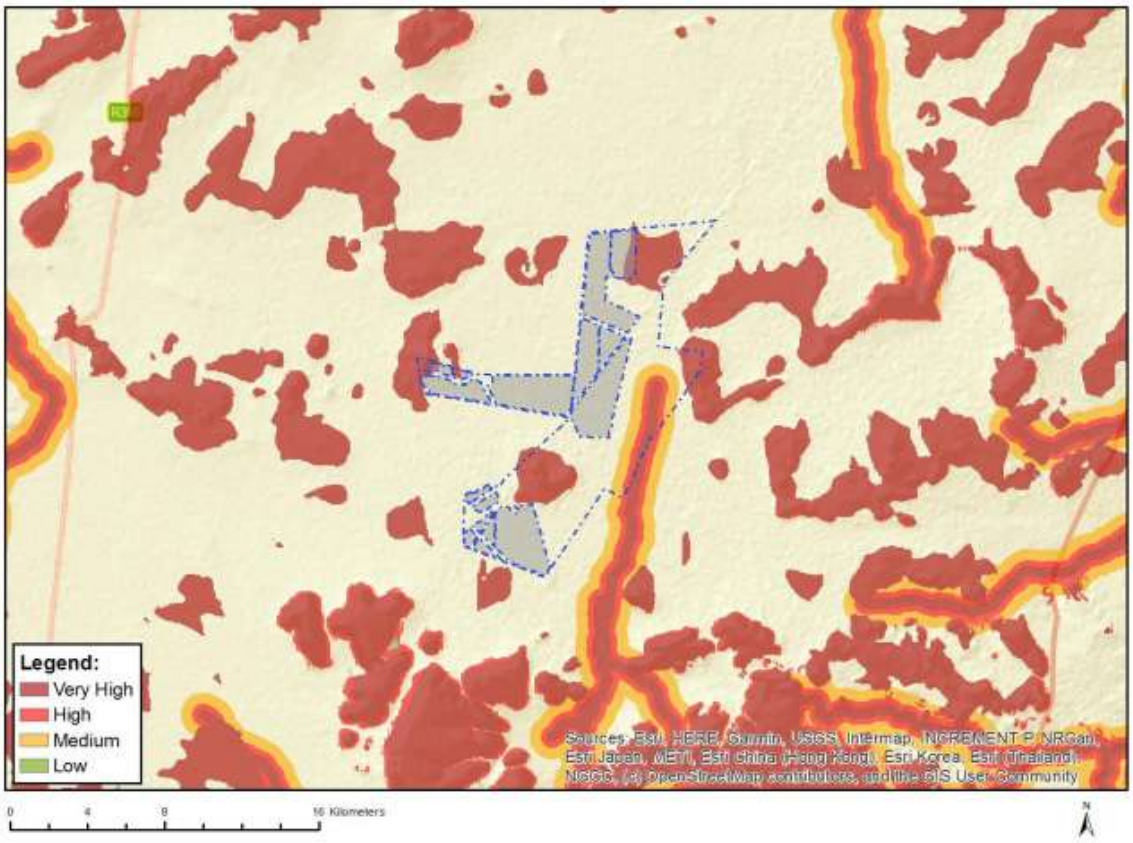


Figure 3-24: Potential Landscape (Solar) Combined Sensitivity of the study area and Buildable Areas based on the Screening Tool. (Source: DFFE Screening Tool, 2023)

3.2.11 Heritage: Archaeology and Cultural Landscape

A detailed description of the archaeological features and cultural landscape within the study area and proposed project site is provided in the Heritage Impact Assessment that is included in Chapter 11 of this EIA Report.

Initial work was carried out using satellite aerial photography in combination with the specialist's accumulated knowledge of the wider Karoo landscape. This was used to determine areas most likely to be sensitive and that needed to be targeted during the survey. The subsequent fieldwork undertaken in April 2022 served to ground truth the study area, including areas identified as potentially sensitive. Desktop research was also used to inform on the heritage context of the area.

Heritage resources that have been allocated high and very high sensitivities by the survey, including but not limited to a graveyard, historical engravings, and a farmstead, were identified within the study area. Refer to Chapter 11 for an extensive list of heritage resources recorded during the survey.

3.2.11.1 Screening Tool Descriptions and Site Sensitivity Verification

Figure 3-25 indicates the archaeological and heritage sensitivity as assigned by the Screening Tool for the study area, as well as the Buildable Areas. The overall heritage sensitivity of the study area is considered to be low based on the Screening Tool. The site visit by the specialist showed that much of the study area is indeed of low sensitivity, but several pockets of higher sensitivity were found to occur. These are places where archaeological and other heritage resources were found and tended to be near farmsteads or dolerite outcrops. These areas are considered to be of variably medium to very high sensitivity. The heritage specialist thus disputes the Screening Tool findings in that a uniform low sensitivity is not applicable to the entire study area. Refer to Chapter 11 of the Heritage Assessment for a spatial distribution of these higher sensitivity areas. Details of the SSV are included in Chapter 11 of this EIA Report.

In all cases the Very High, High and Medium sensitivity areas are located outside of the development footprints (i.e. Buildable Areas). Most resources located within the study areas are cultural landscape components and are of low cultural significance and hence sensitivity. The only exceptions are an engraving consisting of a few small scratches and a pair of stone-lined farm reservoirs, both near Kudu Solar Facility 6 and both also of low sensitivity. It is preferred, however, that the reservoirs be retained because of their relationship with the adjoining ruined farmstead and for this reason they have been included in the medium sensitivity polygon around the farmstead. There are no other areas in any of the Buildable Areas that require avoidance on heritage grounds.

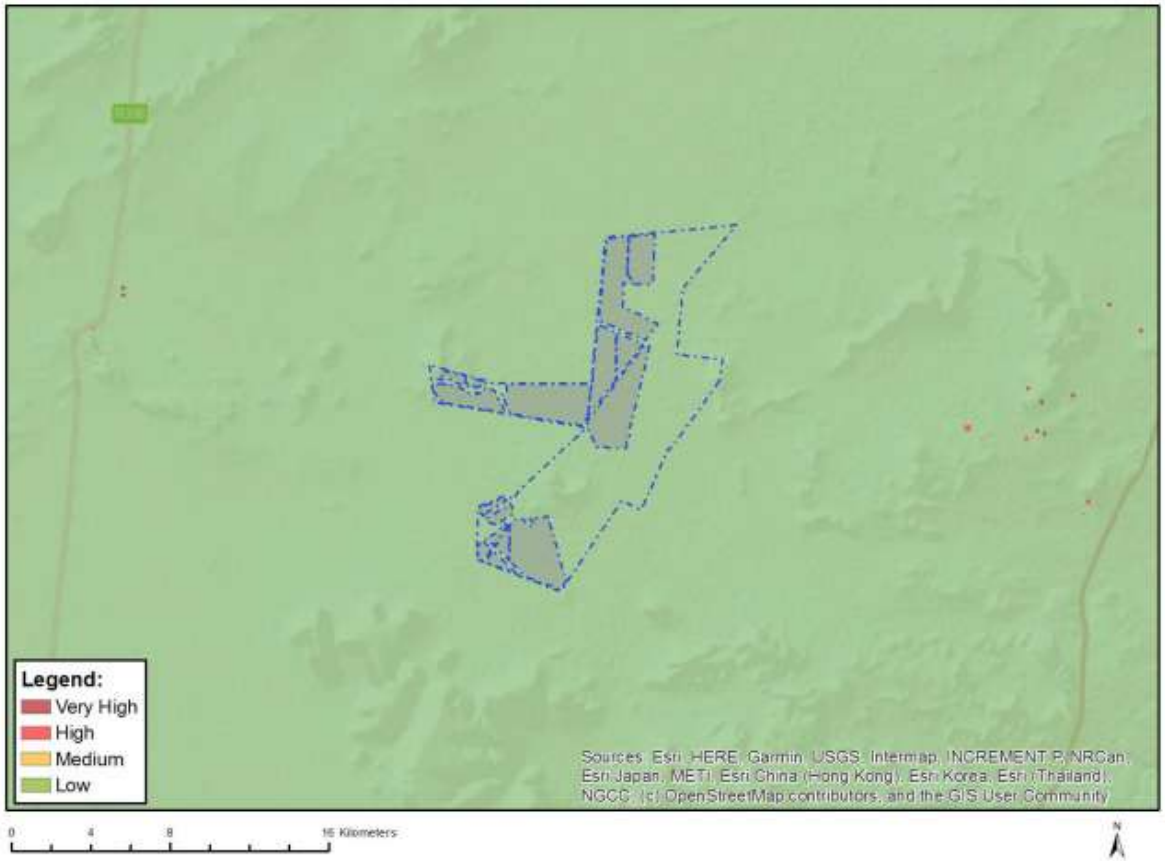


Figure 3-25: Archaeology and Cultural Heritage Combined Sensitivity of the study area and Buildable Areas based on the Screening Tool. (Source: DFFE Screening Tool, 2023)

3.2.12 Palaeontology

The information described below is based on the SSV provided by the Palaeontologist, which is included in Chapter 12 of this EIA Report.

The study area largely comprises low-relief terrain mantled with thick Late Caenozioic calcrete hardpans, alluvial deposits, surface gravels and soils that are generally of low palaeo-sensitivity. Natural bedrock exposure here is very limited and mainly involves unfossiliferous dolerite as well as baked Ecca Group metasediments (probable Waterford Formation) building *kranzes* on upper hillslopes that will not be directly impacted by the proposed project. Early to Middle Permian basinal mudrocks of the Tierberg Formation (Ecca Group, Karoo Supergroup) underlie the majority of the study area but are rarely exposed and, where seen, are generally weathered, friable and extensively disrupted by near-surface calcrete veins. The offshore mudrocks of the Tierberg Formation are not known elsewhere to have a rich fossil record. In the study area, the potential for well-preserved fossils is further reduced by near-surface weathering, calcrete veining as well as baking of sedimentary bedrocks by intensive regional dolerite intrusion in Early Jurassic times. The only fossils recorded from the Ecca Group sediments during the 2-day palaeontological site visit comprise sparse, low diversity trace fossil assemblages of low scientific or conservation interest. Thick sandy to gravelly alluvial deposits associated with long-established drainage lines are extensively calcretised. No fossil remains were recorded within them.

3.2.12.1 Screening Tool Descriptions and Site Sensitivity Verification

According to the Screening Tool, the study area ranges from Medium to High palaeontological sensitivity (Figure 3-26). Based on several previous desktop and field-based Palaeontology Impact Assessment (PIA) studies undertaken in the broader De Aar - Kimberley region, as well as the 2-day palaeontological site visit, the Screening Tool sensitivity allocations have been contested by the specialist. It is concluded that the study area is in fact of Low to Very Low palaeo-sensitivity overall, thus disputing the Medium to High sensitivity of the Screening Tool (Figure 3-26). However, the potential for rare, largely unpredictable fossil sites of High palaeo-sensitivity associated with older alluvial and pan deposits in the subsurface cannot be entirely discounted. Most such fossil sites would probably be protected during construction by environmental buffer zones along drainage lines. If any fossiliferous deposits are exposed by surface clearance or excavations during the construction phase of the development, the Chance Fossils Finds Protocol (included in Chapter 12 of the EIA Report) should be fully implemented. These recommendations are also included in the Environmental Management Programmes (EMPrs) for the proposed project (Appendix I and Appendix J of this EIA Report).

Therefore, the project area for all the solar PV facilities, on-site substations, grid connection corridors and associated infrastructure are of low to very low palaeo-sensitivity.

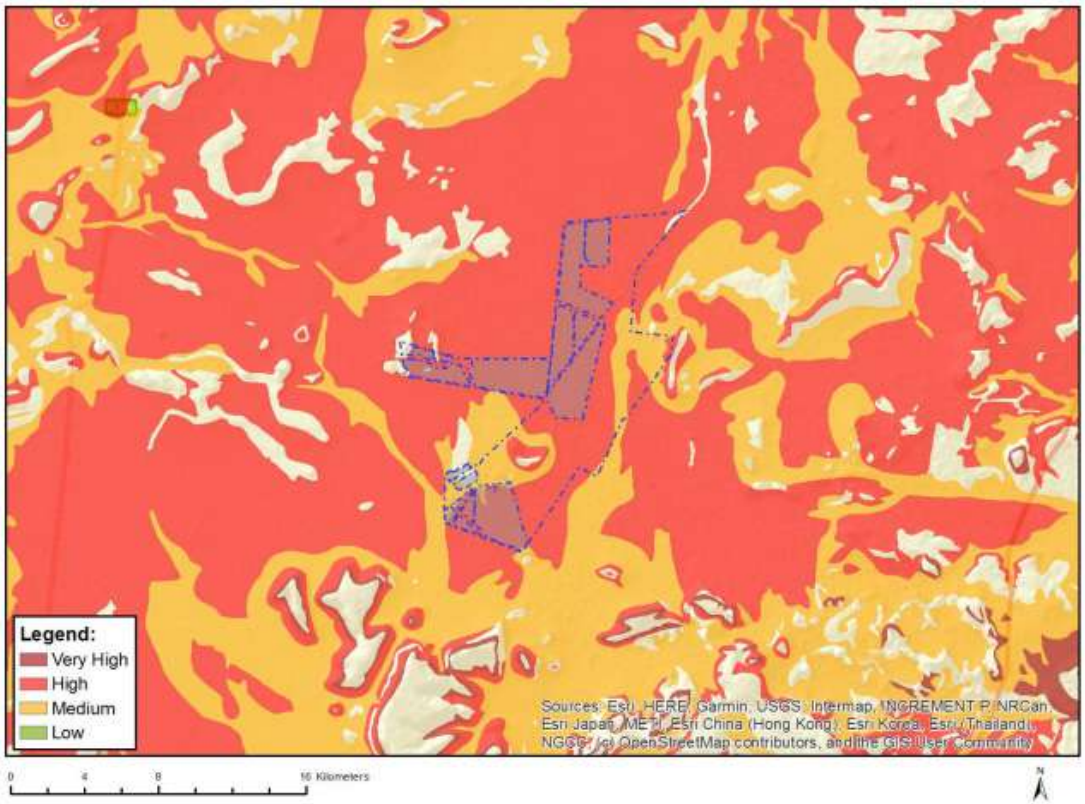


Figure 3-26: Palaeontology sensitivity of the study areaand Buildable Areas based on the Screening Tool. (Source: DFFE Screening Tool, 2023)

3.3 Socio-Economic Environment

The available data used to compile the socio-economic baseline for the RLM, PKSDM, and De Aar area, although not exhaustive, is interpreted in terms of professional opinion and is indicative of generally accepted trends within the Northern Cape Province and the broader South Africa.

The information described below is based on inputs provided by the Socio-Economic Specialist, which are included in Chapter 13 of this EIA Report, as well as a review of various planning documents such as IDPs and SDFs.

3.3.1 Regional Context – Pixley ka Seme District Municipality

As noted above, the study area is located within the RLM, which falls within the PKSDM in the Northern Cape Province. The PKSDM covers an area of 103 222 km^2 and is made up of eight Category B local municipalities which include Emthanjeni, Kareeberg, Thembelihle, Renosterberg, Siyathemba, Ubuntu, Siyancuma and Umsobomvu municipalities. De Aar is the administrative seat of the PKSDM.

3.3.1.1 Demographics and Economic Profile

According to the Statistics South Africa (StatsSA) Community Survey of 2016 (StatsSA, 2016)[16], the PKSDM had a population of 211 108 in 2016 (Table 3-2), which subsequently increased to 220 830 in 2019 (PKSDM District Development Model (DDM), 2020[17]). Of this, the largest (64 900) age category was the young working age (25-44), whilst at 16 200 the smallest category was 65 and over (StatsSA, 2016[28]). Per the national census of 2011, in terms of race groups, Coloureds made up 59.6% of the population in the PKSDM, followed by Black Africans (30.9%), Whites (8.8%), and Asians (0.66%) (StatsSA, 2012[18]). The main language spoken in 2011 was Afrikaans (78%), followed by Xhosa (17%) and Setswana (2%) (StatsSA, 2012[30]).

With a Gross Domestic Product (GDP) of R 12.5 billion in 2019 (up from R 6.67 billion in 2009), the PKSDM contributed 12.21% to the Northern Cape Province GDP in 2019 (PKSDM DDM, 2020[29]). The Community Services sector was the largest economic sector in 2019 within the PKSDM, at R 3.31 billion of the total Gross Value Added (GVA) (PKSDM DDM, 2020[29]). The transport sector (tertiary) was the second largest economic sector in the PKSDM, accounting for 13.6% of the GVA in 2019, followed by followed by the agriculture sector (primary) with 13.4% (PKSDM DDM, 2020[29]).

[16] Statistics South Africa (2016). Community Survey 2016, Statistical release P0301 / Statistics South Africa. Pretoria: Statistics South Africa, 2016. Available at: http://cs2016.statssa.gov.za/wp-content/uploads/2016/07/NT-30-06-2016-RELEASE-for-CS-2016-_Statistical-releas_1-July-2016.pdf [online]. Accessed November 2022.

[17] Pixley Ka Seme District Municipality District Development Model. 2019. Available at: https://www.cogta.gov.za/ddm/wp-content/uploads/2020/07/Pixley_Ka_Seme_District_Profile_.pdf [online]. Accessed: November 2022.

[18] Statistics South Africa (2012). Census 2011 Municipal report – Northern Cape/ Statistics South Africa. Pretoria: Statistics South Africa, 2012. Available at: http://www.statssa.gov.za/census/census_2011/census_products/NC_Municipal_Report.pdf [online]. Accessed November 2022.

Table 3-2: Total population of the PKSDM, RLM, Northern Cape, and National for the period 2006 – 2016 (Sources: StatsSA 2016[28] and the Comparative Analysis for PKSDM, (Northern Cape Provincial Treasury, 2019[19])

Region → / Year ↓	PKSDM	RLM	Northern Cape	National Total	RLM as a % of the DM	RLM as a % of the province	RLM as a % of national
2006	177 559	10 081	1 094 500	47 800 000	5.6%	0.92%	0.021%
2016	211 108	12 458	1 193 780	55 908 900	6.09%	1.04%	0.024%

3.3.1.2 Social Characteristics

Unemployment and inequality remain a challenge within the PKSDM (PKSDM IDP, 2022[20]). The district had an unemployment rate of 28.3% in 2011, which is lower than South Africa's national unemployment rate of 33.9% (PKSDM IDP, 2022[32]). However, the district has a higher (35.4%) youth unemployment rate (ages 15 to 34) than the national average. The Coloured population recorded the highest unemployment rate when comparing the race groups in the district, where females in general had a higher unemployment rate than males (PKSDM IDP, 2022[32]).

Based on the 2011 Census data, approximately 11% of households in the PKSDM had no income, whereas 3.4% of households earned up to R4800 per annum (StatsSA, 2012[30]). The majority of households (61%) had a monthly income of less than R3500, whilst 24.8% earned less than R15 0000 per month. This means that 90% of households in the PKSDM had a monthly income that is lower than that of the average South African household (R11 514) (StatsSA, 2012[30]). The COVID-19 pandemic likely impacted income levels and increased the number of households in the PKSDM that live close to or below the poverty line.

In the PKSDM, 82.3% of households lived in formal housing in 2017 and only 0.32% of households resided in traditional dwellings (Northern Cape Provincial Treasury, 2019[31]). Approximately 10.8% of households resided in informal dwellings.

3.3.2 Local Context – Renosterberg Local Municipality

The RLM is the smallest of eight municipalities in the district, making up only 5% or 5 529 km^2 of its geographical area. The RLM derives its name from Afrikaans meaning "rhinoceros mountain". The municipality is named after the mountain range found in the area. It was formed through the amalgamation of three towns, that is, Petrusville, Vanderkloof and Phillipstown. The administrative

[19] Northern Cape Provincial Treasury (2019). Comparative Analysis for Pixley ka Seme District Municipality. Available at: http://www.ncpt.gov.za/Portals/0/Pixley%20ka%20Seme%20Comparative%20Analysis%202019_compressed%20(1).pdf?ver=GwVZk3xUoqrh7HGZaFtZ8Q%3d%3d [online]. Accessed: November 2022. ISBN: 978-0-621-47166-3

[20] Pixley Ka Seme District Final Integrated Development Plan (IDP) 2022 – 2027. 2022. Available: https://www.pksdm.gov.za/idps/PKSDM%20Final%20Integrated%20Development%20Plan%20(IDP)%202022-2027.pdf. [online] Accessed: November 2022

seat of the RLM is Petrusville. Table 3-3 provides an overview of various key statistics for the RLM.

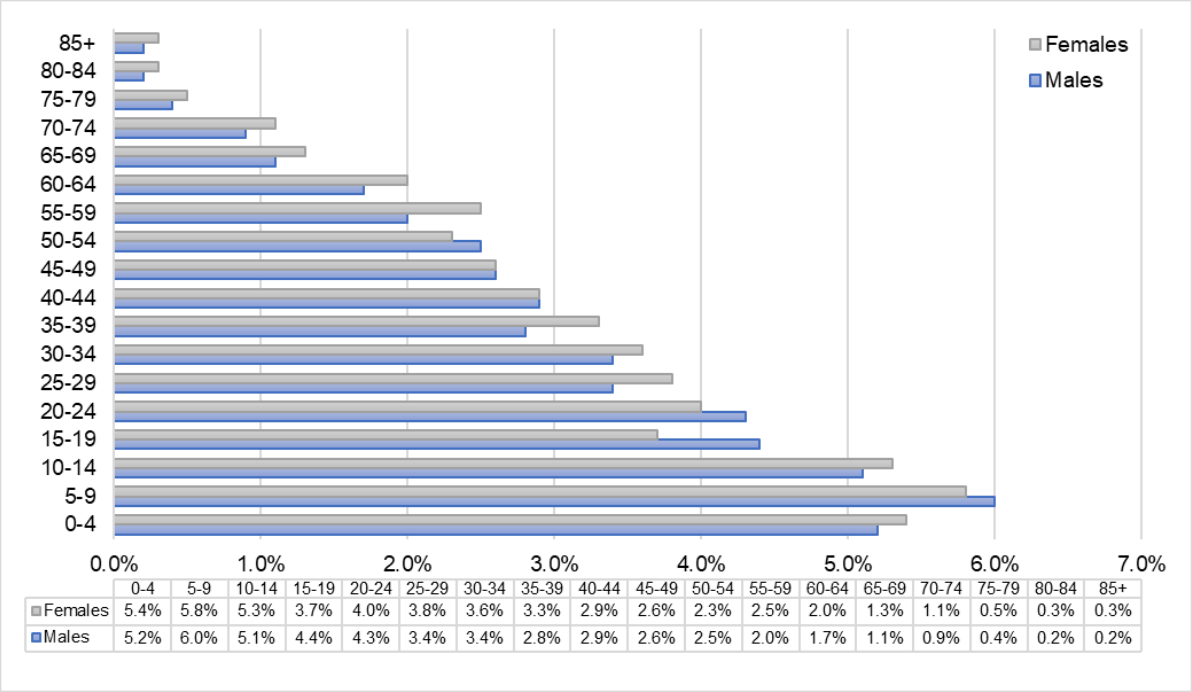
Table 3-3: Key statistics for the RLM for 2016, 2011, and 2001 (StatsSA, 2011[21] and 2016[28])

	YEAR		
KEY STATISTICS	**2016**	**2011**	**2001**
Total population	11 818	10 976	9 070
Young (0-14)	27.4%	32.8%	32.9%
Working Age (15-64)	66.5%	61%	61%
Elderly (65+)	6.1%	6.2%	6.5%
Dependency ratio	No data	64%	65.1%
Gender ratio	No data	95,8	94.7
Growth rate	1.7%	1.91%	-0.78%
Population density	No data	2 persons/km^2	No data
Unemployment rate	No data	26.8%	48.9%
Youth unemployment rate	No data	29.8%	55.8%
No schooling aged 20+	11.4%	16%	26.1%
Higher education aged 20+	5%	6.6%	6.1%
Matric aged 20+	32.7	21,8%	12.4%
Number of households	3 563	2 995	2 448
Number of Agricultural households	No data	616	No data
Average household size	3.3	3.4	3.7
Female headed households	No data	34.8%	30.3%
Formal dwellings	85.1%	94.7%	91.1%
Housing owned/paying off	No data	52.3%	67.9%
Flush toilet connected to sewerage	77.4%	71.7%	37.7%
Weekly refuse removal	54.9%	74.4%	72.9%
Piped water inside dwelling	43.3	53.4%	43.8%
Electricity for lighting	86.3%	88.1%	72.1%

3.3.2.1 Demographics and Economic Profile

The population of the RLM in 2016 was 11 818, thereby accounting for the smallest share (6%) in the district (StatsSA 2016[28]). Approximately 40.9 % of the population was under the age of 20, approximately 52.60% were between 20 and 64, and about 6.3% were 65 and older in 2011 (StatsSA, 2011[33]) (Figure 3-27). The RLM therefore has a relatively large young population. This creates challenges in terms of creating employment opportunities.

[21] StatsSA, 2011, Renosterberg. Available: https://www.statssa.gov.za/?page_id=993&id=renosterberg-municipality [online]. Accessed November 2022.



	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
Females	5.4%	5.8%	5.3%	3.7%	4.0%	3.8%	3.6%	3.3%	2.9%	2.6%	2.3%	2.5%	2.0%	1.3%	1.1%	0.5%	0.3%	0.3%
Males	5.2%	6.0%	5.1%	4.4%	4.3%	3.4%	3.4%	2.8%	2.9%	2.6%	2.5%	2.0%	1.7%	1.1%	0.9%	0.4%	0.2%	0.2%

Figure 3-27: Gender and age distributions within the RLM (Redrawn based on StatsSA, 2011[33]).

In terms of race groups, Coloureds made up about 57.4% of the population, followed by Black Africans (32.9%) and Whites (8.6%) in 2011 (Figure 3-28). In 2011, the main first language spoken in the RLM was Afrikaans (71%), followed by IsiXhosa (23.9%) and Sesotho (1.2%).

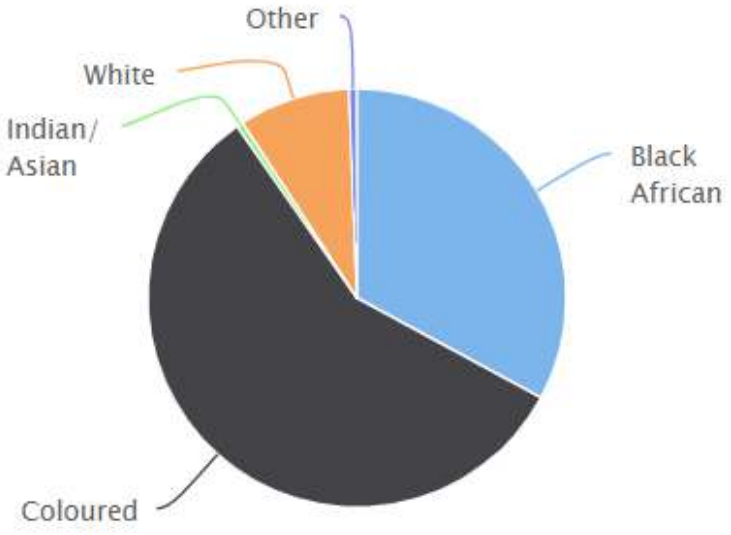


Figure 3-28: Population groups within the RLM (StatsSA, 2011[33]).

The RLM contributed 4.7% to the PKSDM GDP in 2017 (Northern Cape Provincial Treasury, 2019[31]). This is the lowest GDP contribution per LM to PKSDM when compared to the remaining seven regions within the district. Additionally, the RLM had the third lowest annual economic growth at 4.44% in 2017 when compared to the remaining regions within the district (Northern Cape Provincial Treasury, 2019[31]). In terms of contributions by LMs to the economic industry totals for the PKSDM, the RLM made the largest contribution to electricity at 31.6% in 2007.

3.3.2.2 Education

In terms of the highest education level for all ages in 2011, approximately 3.1 % had no schooling, 51.2% had some Primary education, 7.2 % completed Primary School, 26.7 % had some Secondary education, 10.6 % completed Secondary education, and 0.8 % had Higher education (StatsSA, 2011[33]). The relatively poor education levels in the RLM pose a potential challenge for economic development.

3.3.2.3 Employment and Income

The RLM has the largest percentage of unemployment in the district at 31% (Pixley ka Seme District, 2014[8]). The figures of the 2011 Census also indicate that the majority of the population are not economically active, namely 41.8% (Figure 3-29). These figures are substantially higher than the official unemployment rate for the Northern Cape Province (14.5%) and PKSDM (14.8%). This reflects the limited employment opportunities in the area, which in turn are reflected in the low income and high poverty levels. However, the COVID-19 pandemic is likely to have resulted in an increase in unemployment rates in the RLM. Recent figures released by Stats SA also indicate that South Africa's unemployment rate is in the region of 36%. The youth unemployment rates are closer to 50%.

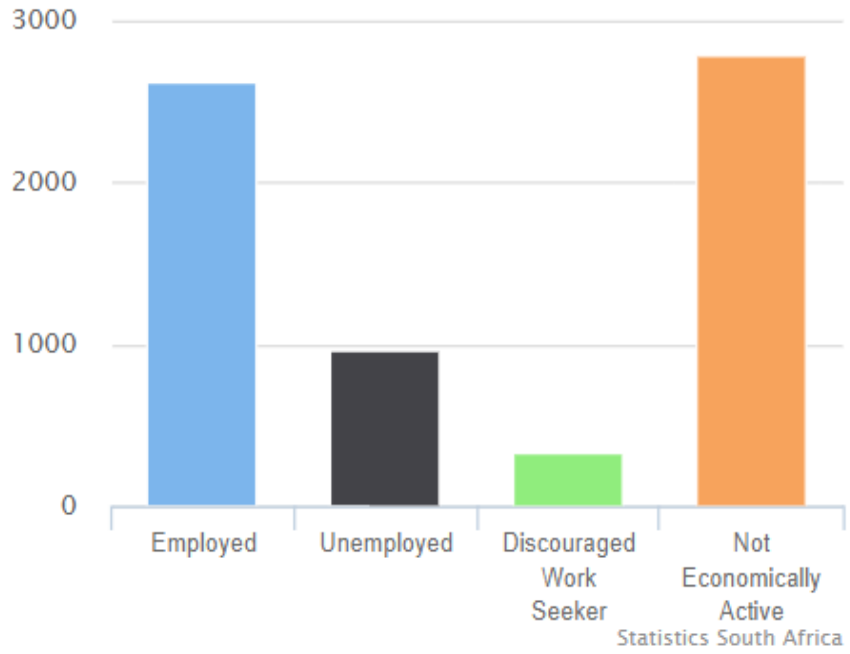


Figure 3-29: Employment status (ages 15 – 64) within the RLM (StatsSA, 2011[33]).

Based on the data from the 2011 Census, 11.2% of the population of the RLM had no formal income, 4% earned less than R4 800, 6.4% earned between R4 801 and R9 600 per annum, 23.1% between R9601 and R19 600 per annum, and 23.4% between R19 601 and R38 200 per annum (StatsSA, 2011[33]) (Figure 3-30). Based on the poverty gap indicator produced by the World Bank Development Research Group, in the region of 70% of the households in the RLM live close to or below the poverty line. This figure is higher than the provincial level of 62.9%. The low-income levels reflect the limited employment opportunities in the area and dependence on the agricultural sector. This is also reflected in the high unemployment rates.

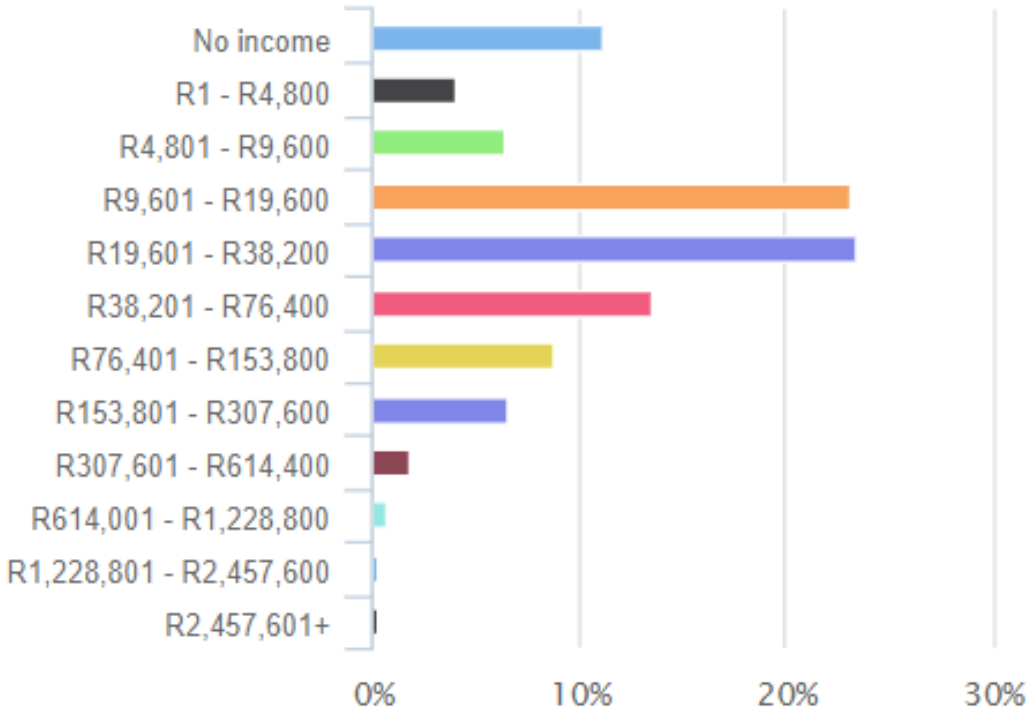


Figure 3-30: Average household income within the RLM (StatsSA, 2011[33]).

Household income levels are likely to have been impacted by the COVID-19 pandemic. The number of households in the RLM and PKSDM that live close to or below the poverty line is likely to have increased over the last 18 months. This, coupled with the high dependency ratio, is a major cause of concern for the area. The low-income levels are a major concern given that an increasing number of individuals and households are likely to be dependent on social grants. The low-income levels also result in reduced spending in the local economy and less tax and rates revenue for the RLM. This in turn impacts on the ability of the RLM to maintain and provide services.

The dependency ratio is the ratio of non-economically active dependents (usually people younger than 15 or older than 64) to the working age population group (15 - 64). The dependency ratios for the RLM, Northern Cape, and national in 2011 was 64%, 55.7%, and 52.7% (StatsSA, 2011[33]). The higher dependency ratio of the RLM reflects the limited employment opportunities in the area and represent a significant risk to the district and local municipality. The high dependency ratio also highlights the importance to maximising local employment opportunities and the key role played by training and skills development programmes.

3.3.2.4 Health and Community Services

The PKSDM is served by 3 District Hospitals, 8 Community Health Centres, 28 Primary Health Care Clinics, 4 satellite clinics and 1 mobile clinic, distributed over the district. The RLM has 1 District Hospital and 6 Primary Health Care clinics. There are no community health centres within RLM that provide a 24-hour service. A new hospital was built in De Aar and was opened in 2017. The Central Karoo Hospital serves as the referral hospital for the district.

In terms of education the RLM has 16 schools of which 13 are no-fee schools. The RLM also has libraries.

3.3.2.5 Municipal Services

Access to services is generally high across the RLM in 2011. The majority of households have access to electricity for lighting (88.1%), municipal water supply (79.9%), flush toilets connected to sewerage (71.7%), and refuse removal (74.4%) (Figure 3-31).

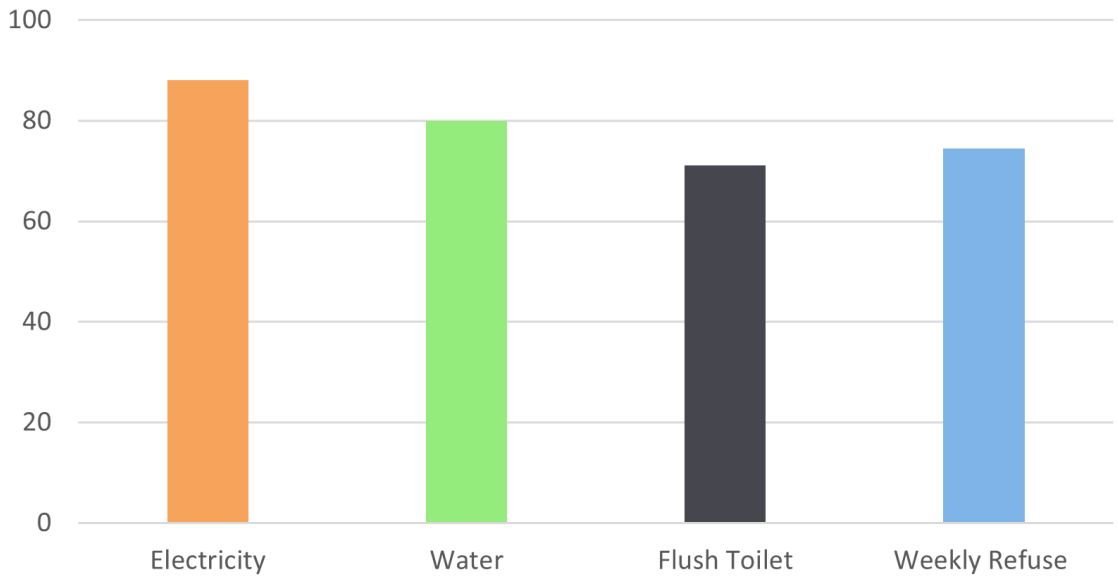


Figure 3-31: Percentage of households with access to basic services within the RLM (StatsSA, 2011[33]).

3.3.3 Study Area Context

The proposed project is located approximately 60 km north of De Aar. De Aar, which means “the artery”, was founded in 1904, and is the second most important railway junction in the country. Rail lines linking Gauteng, Cape Town, Gqeberha (formerly Port Elizabeth) and Namibia all pass through the town. The decline of the railway sector over the last 20 years has impacted negatively on the towns economy. De Aar also has the largest abattoir in the Southern Hemisphere and supplies all the major centres throughout the entire country with the famous “Karoo” lamb and mutton. Apart from meat production, the sheep farms around De Aar are also major suppliers of wool. The town is total dependant on boreholes for its water supply.

The smaller settlements of Philipstown and Petrusville are located approximately 24 km and 22 km to the south-east and east of the study area respectively. Orania and Hopetown are located approximately 35 km and 64 km to the north and north-west of the study area respectively.

The Gariep (Orange) River and Vanderkloof Dam are located approximately 35 km to the north-east of the site. The landscape associated with the study area is a typical Karoo landscape consisting of dolerite koppies and ridges separated by valley bottoms. The land uses are linked to livestock farming, specifically sheep farming.

3.4 Eco-Tourism Activities

The information described below is based on inputs provided by the Socio-economic Specialists, which is included in Chapter 13 of this EIA Report.

The RLM consists of three towns, namely Petrusville (administrative centre), Philipstown, and Vanderkloof. It is located along the Orange River and adjoining the Vanderkloof Dam. The locality of the area along the Orange River provides a sustainable water resource that offers various development opportunities in terms of tourism and agriculture. The nearest nature reserves are in the vicinity of Vanderkloof, which is located more than 30 km to north-east of the study area. The main focus of Vanderkloof is for residential and recreational purposes and the town is a well-established holiday resort town. The tourism potential of the town and the surrounding area are linked to the water sports activities in the Vanderkloof Dam (boating, swimming, fishing etc.), and the Vanderkloof and Rolfontein Nature Reserves. In contrast, Philipstown's tourism potential is linked to farm stays and hunting. There are also a number of San Rock Art sites in the area.

At a local level, there are a limited number of tourism facilities located in the study area. None of the affected or adjacent farm properties offer safari or game watching facilities, farm stay accommodation, or other tourism is associated with the study area. However, several properties offer annual (winter) hunting opportunities, where Jakkalskuil is the only operation primarily focused on international hunters.

3.5 Civil Aviation

The Screening Tool has indicated that the study area is of low sensitivity as it relates to Civil Aviation (Figure 3-32). The low sensitivity was verified during a site visit undertaken in August 2022, whereby no civil aviation features or installations were found within the study area. Therefore, as required by GN 320, a Civil Aviation SSV was compiled and is included in Chapter 18 of this EIA Report. Additionally, in line with GN 320, no further requirements are applicable i.e., a Civil Aviation Compliance Statement is not required.



Figure 3-32: Civil Aviation sensitivity of the study area based on the Screening Tool. The Revised Scoping Buildable Areas are shown in grey (Source: Screening Tool, 2022)

3.6 Defence

The Screening Tool has indicated that the study area is of low sensitivity as it relates to Defence (Figure 3-33). The low sensitivity was verified during a site visit undertaken in August 2022, whereby no defence features or installations were found within the study area. Therefore, as required by GN 320, a Defence SSV was compiled and is included in Chapter 19 of this EIA Report. Additionally, in line with GN R320, no further requirements are applicable i.e., a Defence Compliance Statement is not required.

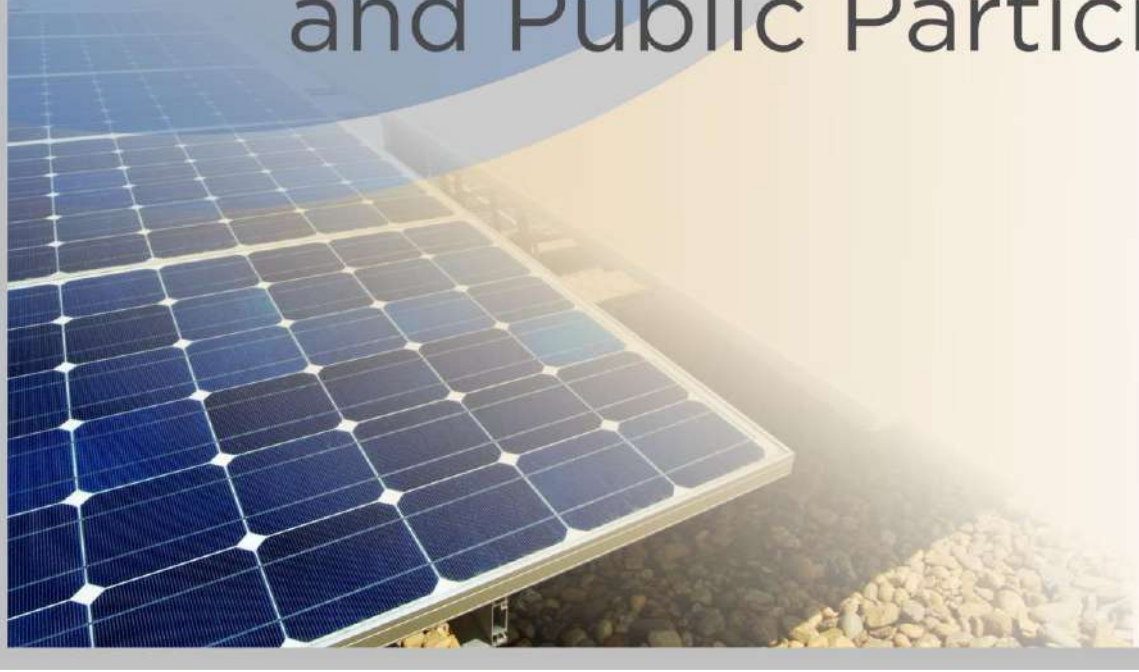


Figure 3-33: Defence sensitivity of the study area and Buildable Area based on the Screening Tool (Source: DFFE Screening Tool, 2023)



CHAPTER 4:

Approach to EIA Process and Public Participation



CSIR
Touching lives through innovation



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4. APPROACH TO THE EIA PROCESS AND PUBLIC PARTICIPATION

This chapter presents the approach followed for the impact assessment phase of the Environmental Impact Assessment (EIA) Process, for the Kudu Solar Facility 4 (hereafter referred to as the "Kudu Solar Facility" or "proposed project"[1]), and gives particular attention to the legal context and guidelines that apply to this EIA, the steps in the Public Participation component of the EIA, in accordance with Regulations 41, 42, 43 and 44 of Government Notice (GN) R326 of the 2014 National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations (as amended), and the schedule for the EIA Process. The EIA Phase is shaped by the findings of the Scoping Process. For information from the Scoping Phase, including the approach to stakeholder engagement, identification of issues, overview of relevant legislation, and key principles and guidelines that provide the context for this EIA Process, refer to the Final Scoping Report (FSR) (CSIR, 2023[2]).

4.1 Purpose of EIA and Requirements of the EIA Regulations

As captured in Section 2 of Appendix 3 of the 2014 NEMA EIA Regulations (as amended), which specifies the content requirements for EIA Reports, "the purpose of the EIA Phase is to, through a consultative process:

- Determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
- Describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the development footprint on the approved site as contemplated in the accepted scoping report;
- Identify the location of the development footprint within the approved site as contemplated in the accepted scoping report based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;
- Determine the:
    - nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
        - degree to which these impacts: (aa) can be reversed; (bb) may cause irreplaceable loss of resources, and (cc) can be avoided, managed or mitigated;
- Identify the most ideal location for the activity within the development footprint of the approved site as contemplated in the accepted scoping report based on the lowest level of environmental sensitivity identified during the assessment;

[1] Note that an integrated PPP is being undertaken for all the Kudu Solar Facilities and EGI Projects, hence in some cases this is referred to as "proposed projects".

[2] CSIR, 2023. Scoping and Environmental Impact Assessment (EIA) Process for the proposed development of a Solar Photovoltaic (PV) Facility (Kudu Solar Facility 4) and associated infrastructure, near De Aar in the Northern Cape Province. Final Scoping Report. CSIR Report Number: CSIR/SPLA/SECO/ER/2022/0054/B.

- Identify, assess and rank the potential impacts that the activity will impose on the development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity;
- Identify suitable measures to avoid, manage or mitigate identified impacts; and
- Identify residual risks that need to be managed and monitored."

The EIA Phase consists of three parallel and overlapping processes:

- Central assessment process through which inputs are integrated and presented in an EIA Report that is submitted for approval to the National Department of Forestry, Fisheries and the Environment (DFFE) and other commenting authorities;
- Undertaking of a Public Participation Process (PPP) whereby findings of the EIA Phase are communicated and discussed with Interested and Affected Parties (I&APs) and responses are documented; and
- Undertaking of specialist assessments that provide additional information or assessments required to address the issues raised in the Scoping Phase.

The EIA process is a planning, design and decision-making tool used to demonstrate to the responsible authority, the DFFE, and the Project Applicant, what the consequences of their choices will be in biophysical, social, and economic terms. As such it identifies potential impacts (negative and positive) that the project may have on the environment. The EIA makes recommendations to mitigate negative impacts and enhance positive impacts associated with the proposed project.

4.2 Legislation, Policies and Guidelines Pertinent to this EIA

The scope and content of this EIA Report has been informed by the main legislation, policies, guidelines and information series documents described in this section. Additional information on applicable legislation is provided in the Specialist Assessments included in Chapters 6 to 17 of this EIA Report.

4.2.1 National Legislation

4.2.1.1 The Constitution of the Republic of South Africa (Act 108 of 1996)

The Constitution, which is the supreme law of the Republic of South Africa, provides the legal framework for legislation regulating environmental management in general, against the backdrop of the fundamental human rights. Section 24 of the Constitution states that:

- "*Everyone has the right:*
  - *to an environment that is not harmful to their health or well-being; and*
  - *to have the environment protected, for the benefit of present and future generations through reasonable legislative and other measures that –*
    - *prevent pollution and ecological degradation;*
    - *promote conservation; and*
    - *secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development*."

Section 24 of the Bill of Rights therefore guarantees the people of South Africa the right to an environment that is not detrimental to human health or well-being, and specifically imposes a duty on the State to promulgate legislation and take other steps that ensure that the right is upheld and that, among other things, ecological degradation and pollution are prevented.

In support of the above rights, the environmental management objectives of the proposed project are to protect ecologically sensitive areas and support sustainable development and the use of natural resources, whilst promoting justifiable socio-economic development in the towns nearest to the study area[3].

4.2.1.2 NEMA and EIA Regulations

Chapter 1, Section 2 of the NEMA sets out several principles to give guidance to developers, private landowners, members of the public and authorities. The proclamation of the NEMA gives expression to an overarching environmental law. Various mechanisms, such as cooperative environmental governance, compliance and non-compliance, enforcement, and regulating government and business impacts on the environment, underpin NEMA. NEMA, as the primary environmental legislation, is complemented by many sectoral laws governing marine living resources, mining, forestry, biodiversity, protected areas, pollution, air quality, waste and integrated coastal management. Principle number 3 determines that a development must be socially, environmentally and economically sustainable. Principle Number 4(a) states that all relevant factors must be considered, *inter alia* i) that the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied; ii) that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied; vi) that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; and viii) that negative impacts on the environment and on peoples' environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.

Section 24 (1) of the NEMA, as amended states that "*In order to give effect to the general objectives of integrated environmental management laid down in this Chapter, the potential impact on the environment of listed activities must be considered, investigated, assessed and reported to the Competent Authority charged by this Act with granting the relevant EA*". The reference to "listed activities" in Section 24 (1) of NEMA relates to the regulations promulgated in GN R982, R983, R984 and R985 in Government Gazette (GG) 38282, dated 4 December 2014, which came into effect on 8 December 2014. These were amended in GN R326, R327, R325 and R324 in GG 40772, dated 7 April 2017. GN R326 contains the regulations for the Environmental Assessment Process. GN R327 and GN R324 includes listed activities that trigger the need for a Basic Assessment (BA) Process, whereas GN R325 includes listed activities that trigger the need for a full Scoping and EIA Process.

[3] The preferred site for the proposed Kudu Solar Facility comprises the full extent of the affected farm portions which cover a combined footprint of 8 150 ha, which serves as the study area for this Scoping and EIA Process. Therefore, the terms "site" and "study area" are used synonymously in the report. The Buildable Areas and "development footprint" fall within the preferred site (or study area).

The 2014 NEMA EIA Regulations (as amended) were further amended as follows:

- GG 41766, GN 706 on 13 July 2018;
- GG 43358, GN 599 on 29 May 2020;
- GG 44701, GN 517 on 11 June 2021; and
- GG 45999, GN 1816 on 3 March 2022.

Based on the transitional arrangements, these amendments (where they have been commenced with) apply to the proposed project as the original Application for Environmental Authorisation (EA) was not submitted before the above amendments took effect (where relevant). The relevant amendments have been taken into consideration in this Scoping and EIA Process.

In terms of the NEMA and the 2014 NEMA EIA Regulations (as amended), a Scoping and EIA Process is required for the proposed development of the Kudu Solar Facility and associated infrastructure. Refer to Section 4.3 of this chapter for additional information on the 2014 NEMA EIA Regulations (as amended).

4.2.1.3 GN 960 (published 5 July 2019)

GN 960 was published on 5 July 2019 and came into effect for compulsory use of the National Web Based Environmental Screening Tool (hereafter referred to as the Screening Tool) from 4 October 2019. The notice outlines the requirement to submit a report generated by the Screening Tool, in terms of Section 24(5)(h) of the NEMA and Regulation 16(1)(b)(v) of the 2014 NEMA EIA Regulations (as amended), when submitting an Application for EA in terms of Regulations 19 and 21 of the 2014 NEMA EIA Regulations (as amended). As such, the proposed project was run through the Screening Tool, and the associated reports generated and attached to the Application for EA, which was submitted to the DFFE with the Draft Scoping Report (DSR) on 9 December 2022. A comment was received from the DFFE Chief Directorate: Integrated Environmental Authorisations during the 30-day review period on the DSR, which explained that individual Screening Tool Reports must be provided for each project, and signed, as opposed to one report with all twelve proposed projects. As such, individual Screening Tool Reports were generated showing the proposed development footprint at the Scoping Phase. However, the original Screening Tool Reports have still been included for background and context as it shows the entire study area or preferred site that has been assessed for all projects. Updated Screening Tool Reports were also run for the finalised development footprint (at the Draft EIA Report phase). The individual Screening Tool Reports have been included as an appendix to the Amended Application for EA, and in Appendix K of this EIA Report. In addition, the findings of the Screening Tool Report are discussed in the Specialist Assessments as relevant, in Chapters 6 to 19 of this EIA Report, as well as Chapter 3 and 4 of this EIA Report.

4.2.1.4 GN 320 (published 20 March 2020)

GN 320 prescribes the general requirements for undertaking site sensitivity verifications and protocols for the assessment and minimum report content requirements for identified environmental impacts for environmental themes in terms of Sections 24(5)(a) and (h) and 44 of NEMA, when applying for EA. The protocols were enforced within a period of 50 days of publication of the notice i.e., on 9 May 2020.

The Specialist Assessments undertaken as part of this Scoping and EIA Process have complied with GN 320, where applicable, specifically Agriculture, Terrestrial Biodiversity, and Aquatic Biodiversity. Some of the remaining specialist assessments comply with Appendix 6 of the 2014 NEMA EIA Regulations (as amended), and where relevant, Part A of GN 320 which contains site sensitivity verification requirements where a Specialist Assessment is required but no specific assessment protocol has been prescribed. This specifically applies to the Visual; Heritage (Archaeology and Cultural Heritage); Palaeontology; Socio-Economic; Traffic; Geohydrology; and Geotechnical Assessments. However, in some instances there are no themes on the Screening Tool that relate to some of these studies and as such sensitivities cannot be verified against the Screening Tool. More information in this regard is included in Chapters 6 to 19 of this EIA Report, which also address the aspect of Site Sensitivity Verifications, where relevant and applicable. Some of the specialist assessments comply with the Assessment Protocols published in GN R1150 on 30 October 2020, specifically Terrestrial Biodiversity and Species and Avifauna (as described below). The Battery Energy Storage System (BESS) High Level Safety, Health and Environment Risk Assessment serves as a technical report, and the aforementioned legislation will thus not be applicable.

The site sensitivity verifications for Civil Aviation and Defence also comply with GN 320. Additional detail on Civil Aviation and Defence is included in Chapters 18 and 19 of this EIA Report.

4.2.1.5 GN 1150 (published on 30 October 2020)

GN 1150 prescribes procedures and protocols in respect of specific environmental themes for the assessment of, as well as the minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the NEMA, when applying for EA. GN 1150 includes a protocol for the specialist assessment and minimum report content requirements for environmental impacts on a) terrestrial animal species and b) terrestrial plant species. The requirements of these protocols apply from the date of publication (i.e., from 30 October 2020), except where the Project Applicant provides proof to the Competent Authority that the specialist assessment affected by these protocols had been commissioned prior to the date of publication of these protocols in the GG, in which case Appendix 6 of the 2014 NEMA EIA Regulations (as amended) will apply to such applications.

The Terrestrial Biodiversity and Species Assessment undertaken as part of this Scoping and EIA Process was commissioned following the publication date of the Species Protocols. Therefore, the Terrestrial Animal and Plant Species components have been undertaken in compliance with GN 1150. As communicated during the Scoping Phase, one combined report has been compiled for Terrestrial Biodiversity, Terrestrial Animal Species and Terrestrial Plant Species. The Terrestrial Biodiversity, Terrestrial Plant Species and Terrestrial Animal Species Assessment is included in Chapter 7 of this EIA Report. The Avifauna Assessment also complies with GN 1150, as relevant.

4.2.1.6 National Environmental Management: Biodiversity Act (Act 10 of 2004)

The National Environmental Management: Biodiversity Act (Act 10 of 2004, as amended) (NEMBA) provides for “the management and conservation of South Africa’s biodiversity within the framework of the NEMA, the protection of species and ecosystems that warrant national protection, and the use of indigenous biological resources in a sustainable manner, amongst other provisions”. The Act states that the state is the custodian of South Africa’s biological diversity and is committed to respect, protect, promote and fulfil the constitutional rights of its citizens.

Overall, the NEMBA focuses on the protection of national biodiversity through the regulation of activities that may affect biodiversity including habitat disturbance, culture of and trade in organisms, both exotic and indigenous. Lists of threatened ecosystems (Sections 52 (1) (a)), threatened and protected species (Sections 56 (1)), and alien invasive organisms (Section 97 (1)) have been published and maintained in terms of NEMBA.

Chapter 1 sets out the objectives of the Act, and they are aligned with the objectives of the Convention on Biological Diversity, which are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits of the use of genetic resources. The Act also gives effect to CITES, the Ramsar Convention, and the Bonn Convention on Migratory Species of Wild Animals. The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

This Act therefore serves to control the disturbance and land utilisation within certain habitats, as well as the planting and control of certain exotic species. Effective disturbance and removal of threatened or protected species encountered on or around the sites, will require specific permission from the applicable authorities.

Furthermore, NEMBA states that the loss of biodiversity through habitat loss, degradation or fragmentation must be avoided, minimised or remedied. The loss of biodiversity includes *inter alia* the loss of endangered, threatened or protected plant and animal species.

4.2.1.6.1 Threatened Ecosystems

GG 34809, GN 1002, published on 9 December 2011 in terms of Section 52 (1) (a) of the NEMBA, provides a list of threatened terrestrial ecosystems categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) and Protected.

However, a revised national list of ecosystems that are threatened and in need of protection was published in GG 47526, GN 2747 on 18 November 2022 in terms of Section 52 (1) (a) of NEMBA. The revised list includes threatened terrestrial ecosystem types that are classed as CR, EN and VU.

The list of threatened ecosystems includes threatened ecosystems based on vegetation types present within these ecosystems. Should a project fall within a listed vegetation type or ecosystem that is listed, actions in terms of NEMBA are triggered. In addition, Listing Notice 3 (GN R324) of the 2014 NEMA EIA Regulations (as amended) includes Listed Activity 12, for the clearance of an area of 300 m^2 or more of indigenous vegetation in the Northern Cape, specifically within any CR or EN ecosystem listed in terms of Section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as CR in the National Spatial Biodiversity Assessment 2004.

As explained in the Terrestrial Biodiversity and Species Assessment (Chapter 7 of this EIA Report), the vegetation within the study area falls within the Northern Upper Karoo (NKu3), Eastern Upper Karoo (NKu4), and Besemkaree Koppies Shrubland (Gh4) (Mucina and Rutherford 2006). These vegetation types are classified as **Least Threatened**, and therefore the above GN and Listed Activity does not apply.

4.2.1.6.2 Threatened and Protected Species

The 2007 Threatened or Protected Species Regulations of the NEMBA declares species of high conservation value, national importance or that are considered threatened and in need of protection. Furthermore, the regulations provide for the prohibition of specific restricted activities involving specific listed threatened or protected species.

The list of CR, EN, VU or Protected species was published in GG 29657, GN R151 on 23 February 2007 in terms of Section 56 (1) of the NEMBA. The list was further amended in GG 30568, GN R1187 on 14 December 2007, as well as in GG 43386, GN R627 of 3 June 2020. Should a project include threatened and protected species that are listed, actions in terms of NEMBA are triggered.

Based on the site sensitivity verification undertaken by the Terrestrial Biodiversity Specialists, the following faunal species were recorded within the larger study area:

- *Hippotragus niger niger*, Sable Antelope, Vulnerable, Provincially Protected;
- *Stigmochelys pardalis*, Leopard tortoise, Least Concern, Provincially Protected;
- *Xerus inauris*, Cape Ground Squirrel, Least Concern, Provincially Protected;
- *Raphicerus campestris*, Steenbok, Least Concern, Provincially Protected;
- *Hystrix africaeaustralis*, Porcupine, Least Concern, Provincially Protected;
- *Genetta genetta*, Small-spotted genet, Least Concern, Provincially Protected;
- *Antidorcas marsupialis*, Springbok, Least Concern, Provincially Protected;
- *Lepus saxatilis*, Scrub hare, Least Concern, Provincially Protected;
- *Phacochoerus africanus*, Common warthog, Least Concern, Provincially Protected;
- *Otocyon megalotis*, Bat eared fox, Least Concern, Provincially Protected;
- *Bitis arietans*, Puff Adder, Least Concern;
- *Ictonyx striatus*, Striped polecat, Least Concern, Provincially Protected; and
- *Naja nivea*, Cape cobra, Least Concern.

4.2.1.6.3 Alien and Invasive Species

Chapter 5 of NEMBA (Sections 73 to 75) regulates activities involving invasive species, and lists duty of care as follows:

- the landowner/land user must take steps to control and eradicate the invasive species and prevent their spread, which includes targeting offspring, propagating material and regrowth, in order to prevent the production of offspring, formation of seed, regeneration or re-establishment;
- take all required steps to prevent or minimise harm to biodiversity; and
- ensure that actions taken to control/eradicate invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.

The Alien and Invasive Species Regulations, published in 2014 and amended in 2020, in terms of the NEMBA provides for the protection of biodiversity through the control and eradication of listed alien and invasive species categorised as follows:

- Category 1a Listed Invasive Species – must be combatted or eradicated;
- Category 1b Listed Invasive Species – must be controlled or 'contained' in accordance with the requirements of an Invasive Species Management Programme;
- Category 2 Listed Invasive Species – require a permit to carry out a restricted activity e.g., cultivation within an area;
- Category 3 Listed Invasive Species – species that are less-transforming invasive species, but introduction, trade or transportation should be limited. Category 3 plant species are automatically Category 1b species where located within riparian and wetland areas;
- Exempted Alien Species – species that are not regulated; and
- Prohibited Alien Species – species for which a permit for restricted activities (e.g., inter alia hunting, gathering, breeding, cultivating, trading, transporting) may not be issued.

The Alien and Invasive Species List was published in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of the NEMBA in GG 40166, GN 864 on 29 July 2016.

As noted in the Terrestrial Biodiversity and Species Scoping Level Assessment (Chapter 7 of this EIA Report), *Prosopis* spp., planted Eucalyptus, and *Opuntia* species are present. In some areas, *Opuntia* has spread into the grassland.

4.2.1.7 The National Heritage Resources Act (Act 25 of 1999)

The National Heritage Resources Act (Act 25 of 1999) (NHRA) introduces an integrated and interactive system for the management of national heritage, archaeological and palaeontological resources (which include landscapes and natural features of cultural significance).

Parts of sections 35(4), 36(3) (a) and 38(1) of the NHRA apply to the proposed project:

Archaeology, palaeontology and meteorites:
Section 35 (4) – No person may, without a permit issued by the responsible heritage resources authority:

a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
c) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

Burial grounds and graves:
Section 36 (3) (a) - No person may, without a permit issued by South African Heritage Resources Agency (SAHRA) or a provincial heritage resources authority:

a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals.

Heritage resources management:
38 (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorized as:
a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
b) the construction of a bridge or similar structure exceeding 50 m in length;
c) any development or other activity which will change the character of the site –
    (i) exceeding 5 000 m^2 in extent, or
    (ii) involving three or more erven or subdivisions thereof; or
    (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
    (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA, or a provincial resources authority;
d) the re-zoning of a site exceeding 10 000 m^2 in extent; or
e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

While landscapes with cultural significance do not have a dedicated Section in the NHRA, they are protected under the definition of the National Estate (Section 3). Section 3(2)(c) and (d) list “historical settlements and townscapes” and “landscapes and natural features of cultural significance” as part of the National Estate. Furthermore, Section 3(3) describes the reasons a place or object may have cultural heritage value. Section 38 (2a) of the NHRA states that if there is reason to believe that heritage resources will be affected then an impact assessment report must be submitted.

A Heritage Impact Assessment (Archaeology and Cultural Heritage) has been commissioned and included in Chapter 11 of this EIA Report. The assessment includes an investigation of potential impacts on archaeology and cultural heritage, as well as a site sensitivity verification. The Screening Tool indicates that the study area (i.e., preferred site) is low sensitivity in terms of the archaeological and cultural heritage theme. The site visit undertaken by the Heritage Specialist indicated that much of the study area is indeed of low sensitivity, but several pockets of higher sensitivity were found to occur. These are places where archaeological and other heritage resources were found and tended to be near farmsteads or dolerite outcrops. These areas are of variably medium to very high sensitivity. Additional detail is provided in Chapters 3 and 11 of this EIA Report.

In terms of Palaeontology, a Site Sensitivity Verification Report (in terms of Part A of GN 320) was compiled during the Scoping Phase, as included in Chapter 12 of this EIA Report. Based on a site visit and several previous field-based and desktop Palaeontology Impact Assessment studies undertaken by the specialist in the De Aar region, it is concluded that the study area is, in practice,

of Low to Very Low palaeo-sensitivity in general. Provided that the recommended Chance Fossil Finds Protocol is incorporated into the Environmental Management Programme (EMPr) and fully implemented during the construction phase of the proposed project, there are no objections on palaeontological heritage grounds to authorisation of the proposed Solar PV Facility and associated infrastructure. Pending the discovery of significant new fossil finds before or during construction, the specialist has thus confirmed that **no further specialist palaeontological studies, monitoring or mitigation are recommended for the Kudu Solar PV Facilities and Electricity Grid Infrastructure (EGI) projects**. Refer to Chapter 12 for additional information.

Ngwao-Boswa Ya Kapa Bokone (Heritage Northern Cape) and the SAHRA are required to provide comment on the proposed project. To this end and to facilitate comment from the relevant heritage authorities, the Background Information Document (BID) was loaded onto the South African Heritage Resources Information System (SAHRIS) during the Project Initiation Phase. A single case (Case Number 18899) was created for all 12 Solar PV and 14 EGI proposed projects and the necessary project information was uploaded to the SAHRIS. Comments were provided by SAHRA (dated 28 July 2022) in response to the review of the BID (as part of the Project Initiation Phase). For continuity, the Scoping Phase PPP documentation are included in Appendix F of this EIA Report.

The DSR was also uploaded onto SAHRIS for each proposed project during the 30-day review period. SAHRA provided an interim comment for each proposed project, and assigned Case Numbers (i.e., SAHRIS Case ID 20336 – 20347). Refer to copies of the comments received from SAHRA during the 30-day review of the DSR, as well as the Scoping Phase Comments and Responses Trail in Appendix F. The recommendations provided by SAHRA for the HIA and Palaeontology Site Sensitivity Report have been addressed during the EIA Phase.

The HIA and Palaeontology Site Sensitivity Verification Report, along with relevant chapters of the Draft EIA Report were uploaded to SAHRIS during the 30-day review period on the Draft EIA Report. Comments received from SAHRA during the EIA Phase are included in Appendix H.6 of this EIA Report, and such comments are captured and responded to in the Comments and Responses Trail in Appendix H.7.

The proposed project may require a permit in terms of the NHRA prior to any fossils or artefacts being removed by professional palaeontologists and archaeologists. If archaeological mitigation is needed, then the appointed archaeologist will need to contact SAHRA and/or the Heritage Northern Cape in order to confirm requirements to conduct the work. The permit application must be carried out well in advance of construction to ensure that there is enough time for the authorities to approve the mitigation work before construction commences. Should professional palaeontological mitigation be necessary during the construction phase, the palaeontologist concerned will need to apply for a Fossil Collection Permit. Palaeontological collection should comply with international best practice. All fossil material collected must be deposited, together with key collection data, in an approved depository (museum / university). Palaeontological mitigation work including the ensuing Fossil Collection reports should comply with the minimum standards specified by SAHRA (2013).

4.2.1.8 National Forests Act (Act 84 of 1998)

The National Forests Act (Act 84 of 1998, as amended) (NFA) allows for the protection of certain tree species. The Minister has the power to declare a particular tree to be a protected tree. The most recent list of protected tree species was published in 2018 in GN 536. In terms of Section 15(1) of the NFA, no person may cut, disturb, damage or destroy any protected tree; or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any product derived from a protected tree, except under a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated. The DFFE is authorised to issue licences for any removal, cutting, disturbance, damage to or destruction of any protected trees. Therefore, the removal of any protected tree species listed within the NFA will require a tree removal permit, which can be obtained from the DFFE.

As noted in the Terrestrial Biodiversity and Species Assessment (Chapter 7 of this EIA Report), *Boscia albitrunca* is a protected tree in terms of the NFA and was found within the larger study area. Where the proposed project impacts on these species, a permit for the removal of *Boscia albitrunca* from the DFFE will be required during the pre-construction phase, should EA be granted. This has also been commented on by the Northern Cape Department of Agriculture, Environmental Affairs, Rural Development and Land Reform (DAEARDLR) during the 30-day review of the DSR.

In addition, protection of natural forests through gazetted lists of Natural Forests in terms of Sections 7 (2) of the NFA must also be highlighted. In terms of section 7(1) of the NFA, no person may cut, disturb, damage or destroy any indigenous tree in, or remove or receive any such tree from a natural forest except in terms of (a) a license issued under subsection (4) or section 23 of the NFA; or (b) an exemption from the provisions of subsection (4) of the NFA published by the Minister in the Gazette.

4.2.1.9 Conservation of Agricultural Resources Act (Act 43 of 1983)

The objectives of the Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA) are to provide for the conservation of the natural agricultural resources of South Africa by the:

- maintenance of the production potential of land;
- combating and prevention of erosion and weakening or destruction of the water sources; and
- protection of the vegetation and the combating of weeds and invader plants.

The CARA states that no land user shall utilise the vegetation of wetlands (a watercourse or pans) in a manner that will cause its deterioration or damage. This includes cultivation, overgrazing, diverting water run-off and other developments that damage the water resource. The CARA includes regulations on alien invasive plants. According to the amended regulations (GN R280 of March 2001), declared weeds and invader plants are divided into three categories:

- Category 1 may not be grown and must be eradicated and controlled,
- Category 2 may only be grown in an area demarcated for commercial cultivation purposes and for which a permit has been issued, and must be controlled, and
- Category 3 plants may no longer be planted, and existing plants may remain as long as their spread is prevented, except within the flood line of watercourses and wetlands. It is the legal duty of the land user or landowner to control invasive alien plants occurring on the land under their control.

Invasive alien species likely to occur on site are listed above and in the Terrestrial Biodiversity and Species Assessment (Chapter 7 of this EIA Report). These alien plant species will be managed in line with the EMPr (Appendix I and Appendix J of this EIA Report).

As noted in the Agriculture Compliance Statement (Chapter 6 of this EIA Report), rehabilitation after disturbance to agricultural land is managed by the CARA. A consent in terms of CARA is required for the cultivation of virgin land. Cultivation is defined in CARA as "any act by means of which the topsoil is disturbed mechanically". The purpose of this consent for the cultivation of virgin land is to ensure that only land that is suitable as arable land is cultivated. Therefore, despite the above definition of cultivation, disturbance to the topsoil that results from the construction of a renewable energy facility and its associated infrastructure does not constitute cultivation as it is understood in CARA. This has been corroborated by the National Department of Agriculture, Land Reform and Rural Development (DALRRD). The construction and operation of the proposed Solar PV Facility will therefore not require consent from the DALRRD in terms of this provision of CARA.

4.2.1.10 Subdivision of Agricultural Land Act (Act 70 of 1970)

As noted in the Agriculture Compliance Statement, two approvals from the DALRRD are required if a proposed renewable energy facility is located on agriculturally zoned land.

The first approval is a No Objection Letter for the change in land use issued by the Deputy Director General (Agricultural Production, Health and Food Safety, Natural Resources and Disaster Management). This letter is one of the requirements for receiving municipal rezoning. It is advisable to apply for this as early in the process as possible. A positive EA does not assure DALRRD's approval of this. This application requires a motivation backed by good evidence that the development will not significantly compromise the future agricultural production potential of the development site, and the Agricultural Compliance Statement will suffice in this regard. Such an application will be submitted for the proposed Kudu Solar Facility by the Project Developer.

The second required approval is a consent for long-term lease in terms of the Subdivision of Agricultural Land Act (Act 70 of 1970) (SALA). If the DALRRD approval for the proposed project has already been obtained in the form of the No Objection Letter, then SALA approval should not present any difficulties. Note that SALA approval is not required if the lease is over the entire farm portion. In the case of the proposed Kudu Solar Facility, only portions of the farm portion would be leased. SALA approval can only be applied for once the Municipal Rezoning Certificate and EA is in hand. This will be dealt with by the Project Developer, post EA (should it be granted).

4.2.1.11 National Water Act (Act 36 of 1998)

One of the important objectives of the National Water Act (Act 36 of 1998) (NWA) is to ensure the protection of the aquatic ecosystems of South Africa's water resources. Section 21 of this Act identifies certain land uses, infrastructural developments, water supply/demand and waste disposal as 'water uses' that require authorisation (licensing) by the Department of Water and Sanitation (DWS). Chapter 4 (Part 1) of the NWA sets out general principles for the regulation of water use. Water use is defined broadly in the NWA, and includes taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities (activities which impact detrimentally on a water resource), altering the bed, banks, course or characteristics of a watercourse, removing water found underground for certain purposes, and recreation. In general, a water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a General Authorisation (GA), or if a responsible authority waives the need for

a licence. The Minister may limit the amount of water which a responsible authority may allocate. In making regulations the Minister may differentiate between different water resources, classes of water resources and geographical areas.

All water users who are using water for agriculture: aquaculture, agriculture: irrigation, agriculture: watering livestock, industrial, mining, power generation, recreation, urban and water supply service must register their water use. This covers the use of surface- and groundwater.

Section 21 of the NWA lists the following water uses that need to be licensed:

a) taking water from a water resource;
b) storing water;
c) impeding or diverting the flow of water in a watercourse;
d) engaging in a stream flow reduction activity contemplated in section 36;
e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) disposing of waste in a manner which may detrimentally impact on a water resource;
h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
i) altering the bed, banks, course or characteristics of a watercourse;
j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
k) using water for recreational purposes.

Any activities that take place within the outer edge of the 1 in 100 year flood line and /or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; within a watercourse; within 100 m of the edge of a watercourse; or within 500 m of a delineated wetland boundary, will require a water use authorisation in terms of Section 21 (c) and Section 21 (i) of the NWA. An application for water use authorisation for the proposed project will be required should any of the planned structures or infrastructure associated with the proposed project trigger water uses in terms of Section 21 (c) and Section 21 (i) of the NWA.

The GA for Section 21 (c) and (i) water uses as defined under the NWA were revised in 2016 (GN R509). Determining if a Water Use Licence is required for these water uses is now associated with the risk of degrading the ecological status of a watercourse. A low risk of impact could be authorised in terms of a GA.

According to the Aquatic Biodiversity Assessment (Chapter 8 of this EIA Report), the risk of the proposed project altering the ecological integrity of the adjacent aquatic ecosystems, if mitigated as recommended, is likely to be low such that the associated water use activities in terms of Section 21 (c) and (i) of the NWA would fall within the ambit of the GA. Based on the risk matrix assessment undertaken to inform the Section 21 (c) and (i) water use authorisation process for the proposed project and associated infrastructure, the associated risk to the aquatic features for the proposed project would be low.

The NWA also provides for measures to prevent, control and remedy the pollution of surface and groundwater sources. The study area is located mainly within quaternary catchment D33B with small sections within quaternary catchment D62F. Both of these quaternary catchments form part of the Lower Orange Water Management Area in the Northern Cape. The groundwater GA for both of the catchments is 45 m^3/ha/a (published on 2 September 2016, in GG 40243, GN 538 (i.e., Revision of GA for the taking and storing of water)). If groundwater will be used for the proposed project, and if more than this is required for the proposed project, or to source all the water from a single property, then an integrated Water Use Licence Application would be required. However, if the proposed project is planned appropriately with regards to groundwater use, all the water can be obtained from groundwater, with the use being Generally Authorised. Registration of the usage in terms of the GA with the DWS would be required.

Should groundwater be used as a water source for the proposed project, then water pipelines may need to be constructed to transfer groundwater from existing boreholes or they may be transported by trucks from the boreholes to the site. Such pipelines will fall below the relevant thresholds in terms of capacity and diameter as specified in the Listed Activities of the 2014 NEMA EIA Regulations (as amended). In addition, groundwater may also need to be stored on site in suitable containers or reservoir tanks during the construction and operational phases. Such storage may trigger the need for a Water Use Authorisation. According to the Revision of GA for the taking of and storing of water published in terms of the NWA, a total of 2000 m^3/a can be stored on each property in an open container under the regional GA as long as it is not in a water course. If this is exceeded, then a Water Use Licence would be needed. Therefore, for the proposed project, it is proposed that a total of 2000 m^3/a will be stored at the facility on the affected property in an open container.

In addition, the disposal of sewage from the developed site is likely to be stored in conservancy tanks for removal and treatment at the nearby wastewater treatment works of the local authority. This low volume would be within the GA for Section 21 (g) water use activities.

In terms of GAs or Water Use Licences needed for the proposed project, these will be undertaken post EA (should such authorisation be granted), as there are various factors to consider, such as confirmation of the selected water source in terms of the various options available; and the fact that the proposed projects still need to be subjected to the competitive REIPPPP. Note that precedent has been set in the sense that EAs for renewable energy projects have been granted positively and are not contingent on the application for Water Use Licence or GA. Nevertheless, the relevant applications will be made by the Applicant post EA once relevant investigations have been completed.

The DWS has provided comment on the Draft EIA Report. Such comments are included in Appendix H.6 of this EIA Report; and captured and responded to in the Comments and Responses Trail in Appendix H.7 of this EIA Report.

4.2.1.12 Water Services Act (Act 108 of 1997)

Water will be required during the construction, operational and decommissioning phases of the proposed project. Potable water is only to be utilised for human consumption purposes, whereas greywater is to be used for earthworks, dust suppression, etc. Water will be sourced from the following potential sources (in the order of likelihood): Renosterberg Local Municipality; third-party water supplier; existing boreholes or drilled boreholes on site. Should the latter be selected for

water use, the boreholes will be subjected to complete geohydrological testing and an assessment, as well as a Water Use Licence Application process. This will be undertaken as a separate process, once more detailed information becomes available, outside of these current EA Application for the proposed project. Compliance with the Water Services Act (Act 108 of 1997) will be undertaken during the relevant phase of the proposed project, in consultation with the local and district municipalities.

4.2.1.13 Hazardous Substances Act (Act 15 of 1973)

During the proposed project, fuel and diesel will be utilised to power vehicles, generators and equipment. In addition, potential spills of hazardous materials could occur during the relevant phases. Such management actions have been recommended in the EMPr, which is included in Appendix I and J of this EIA Report.

4.2.1.14 National Environmental Management: Waste Act (Act 59 of 2008, as amended) (NEM:WA)

The National Environmental Management: Waste Act (Act 59 of 2008, as amended) (NEM:WA) was published with one of the main objectives to reform the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development. Section 19 of the NEM:WA allows the Minister to publish a List of Waste Management Activities that have, or are likely to have, a detrimental effect on the environment published. Such a list specifies the waste management activities that will require a Waste Management Licence.

The List of Waste Management Activities was originally published in GN 921 on 29 November 2013, and thereafter amended in GN 332 on 2 May 2014; GN 633 on 24 July 2015; GN 1094 on 11 October 2017; and GN 1757 on 11 February 2022. The List of Waste Management Activities include Categories A, B and C. If any waste management activities listed in Category A are triggered by a development, a BA process must be undertaken in terms of the 2014 NEMA EIA Regulations (as amended), as part of the Waste Management Licence application. Waste management activities in Category B will, however, require a full Scoping and EIA Process in terms of the 2014 NEMA EIA Regulations (as amended), as part of the Waste Management Licence application. If any of the waste management activities in Category C are triggered, then the relevant Norms and Standards must be followed.

Based on a review of the project description, the proposed project (and all projects that form part of the Kudu Solar Facilities and EGI Projects) will **not** trigger the need for a Waste Management Licence. However, general and hazardous waste will be generated during the construction, operational and decommissioning phases, which will require proper management. Such management actions have been recommended in the EMPr, which is included in Appendix I and J of this EIA Report.

4.2.1.15 National Environmental Management: Air Quality Act (Act 39 of 2004)

The National Environmental Management: Air Quality Act (Act 39 of 2004, as amended) (NEM: AQA) was published in 2004 and came into full effect on 31 March 2010, when the Atmospheric Pollution Prevention Act (Act 45 of 1965) (APPA) was repealed. The NEM: AQA was published with the overall objective to:

- "*reform the law regulating air quality in order to protect the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development while promoting justifiable economic and social development;*
- *provide for national norms and standards regulating air quality monitoring, management and control by all spheres of government; for specific air quality measures; and for matters incidental thereto*".

The list of activities which result in atmospheric emissions which have or may have a significant detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage was published under GN 248, GG 33064 dated 31 March 2010 and thereafter amended in GN 893, GG 37054 dated 22 November 2013. The list of activities was further amended in GN 551, GG 38863 dated 12 June 2015; GN 1207, GG 42013 dated 31 October 2018; GN 687, GG 42472 dated 22 May 2019; and GN 421, GG 43174 dated 27 March 2020.

Section 22 of the NEM: AQA deals with the consequences of listing, and it states that "no person may without a provisional atmospheric emission licence, or an atmospheric emission licence conduct an activity (a) listed on the national list anywhere in the Republic; or (b) listed on the list applicable in a province anywhere in that province". Therefore, a Provisional Atmospheric Emissions Licence (AEL) and/or AEL is required for any plant or proposed development that triggers a listed activity.

Based on a review of the project description, the proposed project (and all projects that form part of the Kudu Solar Facilities and EGI Projects) will **not** trigger the need for an AEL. However, the proposed stockpiling activities, including earthworks, may result in the unsettling of, and temporary exposure to, dust. Appropriate dust control methods will need to be applied. Such management actions have been recommended in the EMPr, which is included in Appendix I and J of this EIA Report.

4.2.1.16 Astronomy Geographic Advantage (Act 21 of 2007)

The Astronomy Geographic Advantage (AGA) Act (Act 21 of 2007) aims to provide for the preservation and protection of areas within the Republic that are uniquely suited for optical and radio astronomy; to provide for intergovernmental co-operation and public consultation on matters concerning nationally significant astronomy advantage areas; and to provide for matters connected therewith. The purpose of the AGA Act is to preserve the geographic advantage areas that attract investment in astronomy. The AGA Act also notes that declared astronomy advantage areas are to be protected and properly maintained in terms of Radio Frequency Interference (RFI). The AGA Act is administered by the Department of Higher Education, Science and Technology (previously the Department of Science and Technology).

According to the CSIR Wind and Solar Phase 2 SEA (Department of Environment, Forestry and Fisheries (DEFF), 2019: Part 3, Page 2[4]), the majority of the mid-frequency dish array of the Square Kilometre Array (SKA) will be constructed in the core which is in located in the Northern

[4] Department of Environment, Forestry and Fisheries (DEFF), 2019. Phase 2 Strategic Environmental Assessment for wind and solar PV energy in South Africa. CSIR Report Number: CSIR/SPLA/SECO/ER/2019/0085 Stellenbosch, Western Cape.

Cape; with dish antennas being located in the spiral arms. The South African component of the SKA will consist of approximately 3 000 receptors comprising dish antennas, each with a diameter of 15 m, and radio receptors known as dense aperture-arrays. The outer stations in the spiral arms will extend beyond the borders of South Africa and at least 3 000 km from the core area. About 80% of the receptors, including a dense core and up to 5 spiral arms, will be located in the Karoo Central Astronomy Advantage Area (KCAAA) (DEFF, 2019[2]: Part 3, Page 2).

The KCAAA, which is located between Brandvlei, Van Wyksvlei, Carnarvon and Williston in the Northern Cape Province, was officially declared in 2014 by the Minister of Science and Technology in terms of the AGA Act for the purposes of protection RFI and Electromagnetic Interference (EMI). The declaration of the KCAAA ensures the long-term viability of the area to be used for astronomical installations (DEFF, 2019[2]: Part 3, Page 2).

PV installations are known to have unintentional radiated emissions from electrical and electronic equipment that have the potential to interfere with the SKA Radio Telescope project in the Northern Cape. This can result in interference to celestial observations and/or data loss. Such interference is typically referred to as RFI (DEFF, 2019[2]: Part 3, Page 2).

The proposed project study area is not located within the KCAAA, and therefore not expected to have any significant impacts on the SKA. Refer to the locality map provided in Chapter 1 of this EIA Report for additional information in this regard.

The South African Radio Astronomy Observatory (SARAO) / SKA Office have been pre-identified as a key stakeholder and therefore included on the project database of I&APs (as shown in Appendix E of this EIA Report). As such, the SKA office was provided with a copy of the BID and Letter 1 during the Project Initiation Phase; as well as a notification of the release of the DSR for a 30-day comment period (i.e., Letter 2) during the Scoping Phase; and a notification for the release of the Draft EIA Report for a 30-day comment period (i.e., Letter 5). The developer has also communicated with the SARAO. SARAO provided a letter confirming that they have undertaken a high-level impact assessment based on the information provided for the proposed projects, and it was determined that the proposed projects represent a **low risk of interference to the nearest SKA radio telescope with a compliance surplus of 279.92 dBm/Hz**. As such, the SARAO does not have any objection to the proposed development. Refer to Appendix K of the EIA Report for a copy of this correspondence from the SARAO.

4.2.1.17 Development Facilitation Act (Act 67 of 1995)

The Development Facilitation Act (Act 67 of 1995) (DFA) sets out a number of key planning principles which have a bearing on assessing proposed developments in light of the national planning requirements. The planning principles most applicable to the study area include:

- Promoting the integration of the social, economic, institutional and physical aspects of land development;
- Promoting integrated land development in rural and urban areas in support of each other;
- Promoting the availability of residential and employment opportunities in close proximity to or integrated with each other;
- Optimising the use of existing resources including such resources relating to agriculture, land, minerals, bulk infrastructure, roads, transportation and social facilities;

- Contributing to the correction of the historically distorted spatial patterns of settlement in the Republic and to the optimum use of existing infrastructure in excess of current needs;
- Promoting the establishment of viable communities; and
- Promoting sustained protection of the environment.

4.2.1.18 Other Applicable Legislation

Other applicable national legislation that may apply to the proposed project include:

- Advertising on Roads and Ribbons Act (Act 21 of 1940);
- Electricity Act (Act 41 of 1987);
- Electricity Regulations Amendments (August 2009);
- Promotion of Administrative Justice Act (Act 2 of 2000);
- Civil Aviation Act (Act 13 of 2009) and Civil Aviation Regulations (CAR) of 1997;
- Civil Aviation Authority Act (Act 40 of 1998);
- White Paper on Renewable Energy (2003);
- Integrated Resource Plan for South Africa (2019);
- Occupational Health and Safety Act (Act 85 of 1993), as amended by Occupational Health and Safety Amendment (Act 181 of 1993)[5];
- Road Safety Act (Act 93 of 1996);
- Fencing Act (Act 31 of 1963);
- National Environmental Management: Protected Areas Act (NEM:PA) (Act 57 of 2003); and
- National Road Traffic Act (Act 93 of 1996).

4.2.2 Provincial Legislation

4.2.2.1 Northern Cape Nature Conservation Act (Act 9 of 2009)

The Northern Cape Nature Conservation Act (Act 9 of 2009) (NCNCA) has reference to the proposed project. This Act aims at improving the sustainability in terms of balancing natural resource usage and protection or conservation thereof. It includes six schedules, as follows:

- Schedule 1 - Specially Protected species;
- Schedule 2 - Protected species;
- Schedule 3 - Common indigenous species;
- Schedule 4 - Damage causing animal species;
- Schedule 5 - Pet species; and
- Schedule 6 - Invasive Species.

With regards to protected flora, the NCNCA includes a list of protected flora.

Based on the Terrestrial Biodiversity and Species Assessment (Chapter 7 of this EIA Report), no SCC were recorded, and some Provincially Protected species were found. These Provincially Protected species are protected in terms of the NCNCA. Relocation permits will be required from the Northern Cape DAEARDLR under the NCNCA, should the final development footprint of the

[5] The proposed Battery Energy Storage Systems (BESS) must be designed, operated, maintained and decommissioned according to the requirements of Occupational Health and Safety Act (Act 85 of 1993).

proposed project necessitate the removal or relocation of these species. Refer to the Terrestrial Biodiversity and Species Assessment for additional information.

The Terrestrial Biodiversity and Species Scoping Level Assessment also noted that according to the Screening Tool, habitat in the study area could support *Tridentea virescens*, but no individuals were found during the site sensitivity verification survey. The species is listed as Rare as it is highly habitat specific and/or have small numbers of individuals, all of which makes it vulnerable to extinction should it lose habitat. The species is extremely small and grows underneath shrubs (especially *Rhigozum trichotomum* which is dominant on the study area), making it difficult to observe. Furthermore, the grass layer was tall and dense during the site sensitivity verification survey (which was a first for the area in over 10 years due to good rains), which made the visibility of the species more difficult. It accordingly has a moderate likelihood of occurring. Since it is not a highly threatened species (and a succulent), relocation could be considered as a viable option should it be found. The optimal time to search for it is between February to March when the species is in flower. It is therefore suggested that the species form part of the search and rescue procedure during the appropriate flowering period, and if recorded to apply for a permit application with the provincial authority for relocation.

Therefore, it has been recommended as part of the EMPr, that a detailed plant search and rescue operation be conducted before the final design process, during the appropriate flowering period where needed, and prior to the commencement of the construction phase. If any of the listed species are found, the relevant permits should be obtained by the Project Applicant prior to their relocation or destruction.

The Northern Cape DAEARDLR, serving as the provincial authority for issuing of the relevant permits, has been pre-identified as a key stakeholder and is included on the project database (as shown in Appendix E of this EIA Report). Efforts have been made to ensure that the Northern Cape DAEARDLR is aware of the progress of the Scoping and EIA Processes. The Department also provided comments on the DSR, and these comments are included in the Scoping Phase PPP (Appendix F of this report). Follow up correspondence was sent to the Northern Cape DAEARDLR during the 30-day comment period on the Draft EIA Report, in order to seek comments. Such correspondence is included in Appendix H.4 of this EIA Report. Telephonic discussions were also held with the Northern Cape DAEARDLR to seek clarification on the applicability of the listed activities in Listing Notice 3. Clarification from the Northern Cape DAEARDLR was sent via email, as included in Appendix H.6 of this EIA Report,

4.2.2.2 Northern Cape Strategic Plan 2020-2025

The vision of the Strategic Plan is a modern, growing, and successful Northern Cape. In addition, the main aim of the Plan is to govern the Northern Cape Province towards alleviating the triple challenges (e.g., unemployment, inequality, and poverty) and towards a people centred Public Service.

The Northern Cape Strategic Plan 2020 stated that the province is one of the best sites in the world to produce solar renewable energy and that this potential has attracted a large number of investors to the province. However, the Plan also stated that the province also experiences inequality, unemployment, and poverty.

The proposed project aligns itself with the aim of this Strategic Plan in that it will provide employment opportunities as well as a required source of energy to the national grid. Employment creation would mainly be temporary in nature during the construction phase with limited opportunities created during the operational phases. Refer to Chapter 2 of this EIA Report for additional information on the proposed employment opportunities.

4.2.2.3 Northern Cape Provincial Spatial Development Framework (2018)

The focus areas on the Northern Cape Provincial Spatial Development Framework (SDF) include urban and rural development; enhancing regional connectivity; promoting infrastructure investment; and protecting local resources. In addition, the SDF stresses the need to address spatial inefficiencies and inequalities, identify areas of opportunity and ensure proactive management of natural resources and ecosystems in the Northern Cape. The SDF also outlines that sustainability is central to provincial economic policies, as well as to its social development agenda. The proposed project is in line with the focus areas of the Northern Cape SDF. It will uplift the local communities through employment creation and increased investment in infrastructure. In addition, the proposed development will provide a sustainable source of energy for the national grid.

4.2.3 District and Local Planning Legislation

4.2.3.1 Environmental Management Framework

Research indicates that there is no Environmental Management Framework (EMF) for the Pixley Ka Seme District Municipality (PKSDM). The Screening Tool also notes that no intersections with EMF areas have been found.

4.2.3.2 PKSDM Integrated Development Plan (IDP)

The strategic objectives of the PKSDM Integrated Development Plan (IDP) 2022 - 2027 are (PKSDM, 2022[6], Page 99):

- “To enhance compliance with the tenets of good governance as prescribed by legislation and best practice;
- To administer finances in a sustainable manner and strive to comply with legislative requirements to achieve a clean audit outcome;
- To monitor and support local municipalities to enhance service delivery;
- To promote economic growth in the district;
- To guide local municipalities in the development of their IDP’s and in spatial development;
- To provide a professional, people-centred human resources and administrative service to citizens, staff and Council;
- To provide an independent and objective internal audit assurance and consulting service to add value and to improve the administrative operations of all the municipalities in the district through an approach that is systematic and disciplined;
- To provide disaster management services to the citizens; and
- To provide municipal health services to improve the quality of life of the citizens.”

[6] Pixley Ka Seme District Final Integrated Development Plan (IDP) 2022 – 2027. 2022. Available: https://www.pksdm.gov.za/idps/PKSDM%20Final%20Integrated%20Development%20Plan%20(IDP)%202022-2027.pdf. [online] Accessed: November 2022.

The IDP (PKSDM, 2022[4]) emphasises that there is great opportunity for renewable energy development in the PKSDM, since there is a vision of placing the PKSDM as the leading innovative region and global centre for renewable energy. Specifically, the IDP highlights that the Renosterberg Local Municipality, in which the proposed project will be located, recognises solar energy as an opportunity and aspires to harness solar energy as an alternative that can be directly sold to the community, thereby accentuating the renewable energy sector as a strategic economic sector (PKSDM, 2022[4]).

The proposed project is line with the PKSDM IDP because it will enable the PKSDM to achieve environmental sustainability and to build resilience (PKSDM, 2022[4]). Furthermore, the IDP states that the district has favourable conditions for solar energy development which is a significant positive factor for the proposed project. Furthermore, the proposed project is aligned with one of the objectives of the IDP in that it will encourage local economic growth through increased investment and employment opportunities. The proposed project will create job opportunities and economic spin offs during the construction and operational phases (if EA is granted by the DFFE).

4.2.3.3 Guidelines, Frameworks and Protocols

The following guidelines, frameworks and protocols are applicable to the proposed project:

- Guidelines published in terms of the NEMA EIA Regulations, in particular:
  - Guideline on Alternatives (DEA, 2014);
  - Guideline on Transitional Arrangements (Department of Environmental Affairs and Development Planning (DEA&DP), 2013);
  - Guideline on Alternatives (DEA&DP, 2013);
  - Guideline on Public Participation (DEA, 2012; DEA&DP, 2013; DEA, 2017);
  - National Noise Control Regulations (GN R154 of 1992) and SANS 10103:2008;
  - Guideline on Need and Desirability (DEA&DP, 2013; DEA, 2017);
- Information Document on Generic Terms of Reference for Environmental Assessment Practitioners (EAPs) and Project Schedules (March 2013);
- Integrated Environmental Management Information Series (Booklets 0 to 23) (Department of Environmental Affairs and Tourism (DEAT), 2002 – 2005);
- Guidelines for Involving Specialists in the EIA Processes Series (DEA&DP; CSIR and Tony Barbour, 2005 – 2007);
- BirdLife South Africa (BLSA) 2017 Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa;
- Species Environmental Assessment 2020 Guideline: Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for EIAs in South Africa. South African National Biodiversity Institute (SANBI);
- United Nations Framework Convention on Climate Change (1997); and
- Kyoto Protocol (which South Africa acceded to in 2002).

4.2.4 International Finance Corporation Performance Standards

In order to promote responsible environmental stewardship and socially responsible development, the proposed project will as far as practicable incorporate the environmental and social policies of the International Finance Corporation (IFC). These policies provide a frame of reference for lending institutions to review environmental and social risks of projects, particularly those undertaken in developing countries.

Through the Equator Principles, the IFC's standards are now recognised as international best practice in project finance. The IFC screening process categorises projects into A, B or C in order to indicate relative degrees of environmental and social risk. The categories are:

- *Category A* - Projects expected to have significant adverse social and/or environmental impacts that are diverse, irreversible, or unprecedented;
- *Category B* - Projects expected to have limited adverse social and/or environmental impacts that can be readily addressed through mitigation measures; and
- *Category C* - Projects expected to have minimal or no adverse impacts, including certain financial intermediary projects.

Accordingly, projects such as the proposed Kudu Solar Facility are categorised as Category B projects. The EIA Process for Category B projects examines the project's potential negative and positive environmental impacts. As required for Category B projects, a Scoping and EIA Process was commissioned.

Other Acts, standards and/or guidelines are reviewed in more detail as part of the specialist studies that have been conducted in the EIA Phase.

4.3 Legal Context for this EIA

In terms of the NEMA and the 2014 NEMA EIA Regulations (as amended), a full Scoping and EIA Process is required for the proposed project. The need for the full Scoping and EIA Process is triggered by, amongst others, the inclusion of Activity 1 listed in GN R325 (Listing Notice 2):

- ***"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more, excluding where such development of facility or infrastructure is for photovoltaic installations and occurs (a) within an urban area; or (b) on existing infrastructure".***

Note that the proposed project is not located within any of the 11 Renewable Energy Development Zones (REDZs) gazetted in GN 114 on 16 February 2018 and GN 144 on 26 February 2021. However, the proposed EGI projects (which will be subjected to separate BA and/or Standard Registration processes[7]) are located within the Central Strategic Transmission Corridor that was gazetted in GN 113 on 16 February 2018.

[7] The registration processes are based on the Standard for the Development and Expansion of Power Lines and Substations within identified Geographical Areas and the Exclusion of this Infrastructure from the Requirement to obtain an Environmental Authorisation, published in Government Gazette 47095, GN 2313, published on 27 July 2022.

Therefore, a full Scoping and EIA Process is being undertaken for the proposed Kudu Solar Facility, subjected to a 107-day decision-making timeframe.

All the listed activities forming part of this proposed development and therefore requiring EA were included in the Application Form for EA that was prepared and submitted to the DFFE with the DSR. However, during the 30-day review period on the DSR, various comments were raised by the DFFE Chief Directorate: Integrated Environmental Authorisations on the applicability of certain listed activities, and specifications of the project description and how they relate to the applicable listed activities. Based on these comments, the applicability of certain listed activities was updated and as such an Amended Application Form for EA was submitted with the FSR. A summary is provided below describing the main updates made at the end of the Scoping Phase:

- **Activity 11 of Listing Notice 1**: The Independent Power Producer (IPP) Substation is required to facilitate the connection of the proposed Kudu Solar Facility to the national grid. The applicability of this listed activity was to be confirmed with the DFFE i.e. to clarify if the IPP Substation can be included in this EIA or whether a separate process is required under the EGI Standard (similar to Projects 13 to 26). Based on the feedback received (as captured in Appendix F.10 and F.11 of this EIA Report), this listed activity will be retained in the current application for the proposed project (i.e., the PV and associated infrastructure application). Therefore, the IPP Substation will not be subjected to a separate registration process in terms of the EGI Standard.
- **Activity 14 of Listing Notice 1**: More clarity was provided around the proposed Redox Flow BESS. This listed activity is not applicable to the Lithium-Ion BESS.
- **Listing Notice 3 Listed Activities:** The DFFE requested that written confirmation must be obtained from the relevant authority (i.e., Northern Cape DAEARDLR) to confirm if there is an adopted bioregional plan or systematic biodiversity plan in relation to Critical Biodiversity Areas (CBAs). **As noted in Appendix F.10 of this EIA Report, the Northern Cape DAEARDLR confirmed that the Northern Cape CBA Map is adopted by the Department as a systematic biodiversity plan, and that the Northern Cape does not have any bioregional plans**.
- **Overall certainty needed on the applicability of the listed activities:** The applicability of the listed activities has been updated, where possible, to ensure that it is more specific and to describe how the listed activities applied for are linked to the project description.

However, at the Scoping Phase there were some project aspects that still needed to be confirmed during the EIA Phase, and it was necessary to follow the maximum development scenario or precautionary approach at the time. In this regard, concerted efforts have been made to confirm the applicability of the listed activities during the EIA Phase, and an Amended Application for EA was submitted accordingly with the Draft EIA Report. As part of the acceptance of the FSR (Appendix G of this EIA Report), the DFFE did request for clarification on certain listed activities, as well as more succinct information presented in the applicability discussion. The following must be taken into consideration:

- **Road Widening and Lengthening Listed Activities**: As noted in the Traffic Impact Assessment, various Access Route Options are available for the proposed project. The existing main roads, divisional roads and unnamed farm gravel roads may need to be upgraded for access to the proposed Kudu Solar cluster, depending on which route is used. The roads leading to the study area are of a sufficient width to accommodate truck movement, however

widening by more than 4 m or more than 6 m may be required at localised positions (i.e. intersections) as required. However, exact specifications of the intersection widening, upgrading and lengthening will require further engineering analysis. Therefore, these listed activities (i.e. Activity 56 of Listing Notice 1; and Activity 18 (g) (ii) (ee) (ii) of Listing Notice 3) have been removed from the current Application for EA, and will be considered through a separate process once more details become available. It is possible to align such with the separate EGI Projects 13 to 26. Information regarding the access routes have been detailed in this EIA Report for background purposes.

- **Listed Activities for the BESS**: The DFFE confirmed that both Solid State Lithium-Ion and Redox Flow BESS cannot be authorised in the EA, should such be granted, and that a preferred technology type must be selected. Refer to Chapter 15 of this EIA Report for a High-Level BESS Risk Assessment, and Chapter 20 of this EIA Report which documents the motivation for the preferred technology for authorisation (i.e. Solid State Lithium-Ion BESS). Therefore, the listed activities have been updated to remove reference to Redox Flow BESS. Note that both technologies are suitable, as discussed in the specialist assessments. Should the need to change the technology arise in future, it is understood that an EA amendment process can be followed as both technologies have been assessed as part of the EIA Phase.

As part of the comments made by the DFFE during the 30-day review of the Draft EIA Report, the DFFE requested for clarification on certain listed activities particularly included in Listing Notice 3. The following must be taken into consideration:

- **Listing Notice 3 Listed Activities**: Activity 4 (g) (ii) (ee) relates to "(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans". Activity 14 (ii) (a) and (c); (g), (ii) (ff) relates to "(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans". Activity 23 (ii) (a) (g) (ii) (ee) relates to "(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans". However, the entire study area (i.e., preferred site), which contains the Buildable Area and development footprint, falls within an Ecological Support Area (ESA) according to the Northern Cape Critical Biodiversity Area (CBA) Map (2016). DFFE stated in their comment on the Draft EIA Report that the aforementioned listed activities only apply to CBAs and not ESAs, and therefore the applicability of these listed activities must be clarified. This was discussed with the Northern Cape DAEARDLR and they have confirmed that ESAs are not listed under Listing Notice 3 for the Northern Cape (unlike other provinces such as Gauteng), and ESAs have been separately mapped in the 2016 Northern Cape CBA map (which consist of CBA 1, CBA 2, ESAs and Other Natural Areas). Based on this, as well as the comment from the DFFE, the aforementioned listed activities are no longer applicable to the proposed project as it only relates to CBAs. Therefore, these listed activities have been removed from the Application for EA; and an updated amended Application for EA has been submitted to the DFFE with the Final EIA Report. Refer to Appendix H.6 of this EIA Report for the correspondence from the Northern Cape DAEARDLR. It would have been preferred to still include such listed activities in the Application for EA from a precautionary perspective, however based on the comments received from the DFFE thus far regarding the need for certainty, these have been removed. However, the impact on the ESA has still been considered in this EIA Process.

- **Activity 15 of Listing Notice 2**: The DFFE has requested that the indigenous vegetation types be specified in the applicability of the listed activities. This has been included, and an updated amended Application for EA has been submitted to the DFFE with the Final EIA Report.

The updated listed activities triggered by the proposed project are indicated in Table 4.1. All updates have been carried through to the Amended Application for EA which was submitted to the DFFE with the Final EIA Report.

Table 4.1: Listed Activities in GN R327, GN R325, and GN R324 that will be potentially triggered by the proposed project.

Listed Activity Number	Listed Activity Description	Description of the portion of the proposed project to which the applicable listed activity relates
Listing Notice 1, GN R327		
Activity 11 (i)	The development 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; excluding the development of bypass infrastructure for the transmission and distribution of electricity where such bypass infrastructure is — (a) temporarily required to allow for maintenance of existing infrastructure; (b) 2 kilometres or shorter in length; (c) within an existing transmission line servitude; and (d) will be removed within 18 months of the commencement of development.	The proposed project will entail the construction of an on-site substation complex at the Solar PV Facility. The on-site substation complex will include various infrastructure, as well as an On-site Independent Power Producer (IPP) or Facility Substation. This will include the relevant section that will be maintained by the IPP (i.e., the high voltage infrastructure leading up to the Point of Connection (the Project Applicant's section of the proposed on-site substation complex)). This constitutes facilities for the distribution and transmission of electricity. The on-site substation complex will be up to 8 ha in area and will have a height of up to 10 m, with a capacity stepping up to 132 kV. The proposed project will take place outside of an urban area. It will be constructed on various affected farm portions, north-east of the town of De Aar, in the Renosterberg Local Municipality and Pixley Ka Seme District Municipality, in the Northern Cape Province.
Activity 12 (ii) [(a) and (c)]	The development of: (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs: (a) within a watercourse;	The proposed project will entail the construction of various infrastructure and structures (such as the solar field, on-site substation complex, Battery Energy Storage System (BESS), laydown area, internal roads (i.e. new roads within the fenced off area of the PV Facility, and new roads between the closest existing road and the PV Facility to gain access), and various ancillary infrastructure such as Operation and Maintenance (O&M) building / centre, site office, workshop, staff lockers, bathrooms/ablutions, warehouse, guard house, etc.).

Listed Activity Number	Listed Activity Description	Description of the portion of the proposed project to which the applicable listed activity relates
	(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; excluding: (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; (ee) where such development occurs within existing roads, road reserves or railway line reserves; or (ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of commencement of the development and where indigenous vegetation will not be cleared.	These infrastructure and structures will exceed a footprint of 100 m^2 and some occur within small drainage features, floodplain areas, and 32 m of the watercourses, as indicated in the sensitivity mapping identified by the aquatic specialist. The proposed project will take place outside of an urban area. It will be constructed on various affected farm portions, north-east of the town of De Aar, in the Renosterberg Local Municipality and Pixley Ka Seme District Municipality, in the Northern Cape Province.
Activity 14	The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres.	The construction and operational phases of the proposed Solar PV Facility will require dangerous goods such as chemicals, fuels, oils, lubricants and solvents. Therefore, infrastructure for the storage and handling of dangerous goods of more than 80 m^3 but not exceeding 500 m^3 are proposed at the Solar PV Facility. Dangerous goods will be stored on site within designated areas such as laydown areas, workshops etc.
Activity 19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil,	The proposed project will entail the excavation, removal and moving of more than 10 m^3 of soil, sand, pebbles or rock from nearby watercourses and floodplains. The proposed project will also entail

Listed Activity Number	Listed Activity Description	Description of the portion of the proposed project to which the applicable listed activity relates
	sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving- a) will occur behind a development setback; b) is for maintenance purposes undertaken in accordance with a maintenance management plan; c) falls within the ambit of activity 21 in this Notice, in which case that activity applies; d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or e) where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.	the infilling of more than 10 m^3 of material into the nearby watercourses and wide floodplains. Specifically, the associated infrastructure traversing watercourses (such as access roads) will result in the accumulated infilling or depositing of more than 10m^3 of material into watercourse and wide flood plains.
Activity 28 (ii)	Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture, game farming, equestrian purposes or afforestation on or after 01 April 1998 and where such development: (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare; excluding where such land has already been developed for residential, mixed, retail, commercial, industrial or institutional purposes.	The proposed project will take place outside of an urban area. It will be constructed on various affected farm portions, north-east of the town of De Aar, in the Renosterberg Local Municipality and Pixley Ka Seme District Municipality, in the Northern Cape Province. The land within the study area is currently being used for livestock grazing, with some game animals such as springbok. Therefore, the land earmarked for the development of the proposed Kudu Solar Facility is currently used for agricultural purposes (mainly low intensive livestock farming). The proposed solar PV facility, which is considered a commercial/industrial development, will have a footprint in excess of 1 ha (minimum footprint of about 34 ha). The proposed project will also entail the construction of various infrastructure and structures

Listed Activity Number	Listed Activity Description	Description of the portion of the proposed project to which the applicable listed activity relates
		(such as the solar field, on-site substation complex, BESS, laydown area, internal roads (i.e. new roads within the fenced off area of the PV Facility, and new roads between the closest existing road and the PV Facility to gain access), and various ancillary infrastructure such as O&M building / centre, site office, workshop, staff lockers, bathrooms/ablutions, warehouse, guard house, etc.). This will constitute infrastructure with a physical footprint of more than 1 ha.
Listing Notice 2, GN R325		
Activity 1	The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more, excluding where such development of facilities or infrastructure is for photovoltaic installations and occurs — (a) within an urban area; or (b) on existing infrastructure.	The proposed project is a Solar PV Facility (i.e., facility for the generation of electricity from a renewable resource) with a capacity of up to 50 MWac (more than 20 MWac). The proposed project will take place outside of an urban area. It will be constructed on various affected farm portions, north-east of the town of De Aar, in the Renosterberg Local Municipality and Pixley Ka Seme District Municipality, in the Northern Cape Province.
Activity 15	The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for: (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	The proposed Solar PV Facility will have a footprint in excess of 20 ha (minimum footprint of about 34 ha). As a result, more than 20 ha of indigenous vegetation will be removed for the construction of the proposed Solar PV Facility. According to Mucina & Rutherford (2006, as amended), the proposed project falls within the Eastern Upper Karoo vegetation type.

4.4 Screening Tool

As noted above, GN 960 (dated 5 July 2019) stipulates the compulsory requirement (as from 4 October 2019) to submit a report generated by the Screening Tool, when submitting an Application for EA. The proposed project has accordingly been run through the Screening Tool, and the associated report generated and attached to the Application for EA that was submitted at the Scoping Phase. Additional Screening Tool Reports, showing only the development footprint for each project have been run and added to the Amended Application for EA (that was submitted with the Draft EIA Report) and Appendix K of this EIA Report.

Based on the selected classification, the Screening Tool provides a list of specialist assessments that should be undertaken as part of the Scoping and EIA Process, as well as identifies the sensitivities on site that need to be verified by either the EAP or the specialists, where relevant, as noted in the Assessment Protocols of 20 March 2020 (GN 320) and 30 October 2020 (GN 1150). The classification that applies to the proposed project is **Utilities Infrastructure; Electricity; Generation; Renewable; Solar; PV**.

The following list of Specialist Assessments have been identified by the Screening Tool for inclusion in the Scoping and EIA Processes (Table 4.2). **The Screening Tool Report notes that it is the responsibility of the EAP to confirm this list and to motivate in the EIA Report, the reason for not including any of the identified specialist assessments, where relevant**.

As discussed at the Pre-Application Meeting held on 26 April 2022, the DFFE noted that the Screening Tool must be used as a guidance in terms of what studies are required and not required, and that the EAP must confirm this. Hence, the EAP is recommending that certain studies are not required. Refer to the discussion below.

Table 4.2: List of Specialist Assessments identified by the Screening Tool for the proposed project.

Specialist Assessment Required by the Screening Tool		Assessment undertaken in Scoping and EIA Process	Type of Assessment undertaken in Scoping and EIA Process or Motivation/Feedback for not undertaking the recommended study	Chapter of EIA Report
1	Agricultural Impact Assessment	Yes	Protocol GN 320: Part B: Agriculture (Protocol for the Specialist Assessment and Minimum Report Content Requirements of Environmental Impacts on Agricultural Resources by Onshore Wind and/or **Solar PV** Energy Generation Facilities where the Electricity Output is 20 MW or more): **Compliance Statement**	Chapter 6
2	Landscape/Visual Impact Assessment	Yes	Protocol GN 320: Part A: Site Sensitivity Verification; and Appendix 6 of the 2014 NEMA EIA Regulations (as amended): **Impact Assessment**	Chapter 10
3	Archaeological and Cultural Heritage Impact Assessment	Yes	Protocol GN 320: Part A: Site Sensitivity Verification; and Appendix 6 of the 2014 NEMA EIA Regulations (as amended) and NHRA: **Impact Assessment**	Chapter 11
4	Palaeontology Impact Assessment	Yes (Site Sensitivity Verification)	Protocol GN 320: Part A: Site Sensitivity Verification; and Appendix 6 of the 2014 NEMA EIA Regulations	Chapter 12

Specialist Assessment Required by the Screening Tool		Assessment undertaken in Scoping and EIA Process	Type of Assessment undertaken in Scoping and EIA Process or Motivation/Feedback for not undertaking the recommended study	Chapter of EIA Report
			(as amended): **Motivation for no further requirements and no Impact Assessment**	
5	Terrestrial Biodiversity Impact Assessment	Yes	Protocol GN 320: Part B: Biodiversity (Protocol for the Specialist Assessment and Minimum Report Content Requirements of Environmental Impacts on Terrestrial Biodiversity): **Impact Assessment** Note that the reporting for Terrestrial Biodiversity, Terrestrial Plant Species and Terrestrial Animal Species are combined in one report.	Chapter 7
6	Aquatic Biodiversity Impact Assessment	Yes	Protocol GN 320: Part B: Biodiversity (Protocol for the Specialist Assessment and Minimum Report Content Requirements of Environmental Impacts on Aquatic Biodiversity): **Impact Assessment** Note there is currently no Species Protocol applicable to Aquatic Plants and Animals.	Chapter 8
7	Civil Aviation Assessment	Yes (Site Sensitivity Verification)	Protocol GN 320: Part B: Civil Aviation (Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Civil Aviation Installations): **Site Sensitivity Verification or Compliance Statement** The Screening Tool indicates that the proposed project area is of “low” sensitivity. This has been verified and confirmed on site. As per the protocols, a Site Sensitivity Verification is only required. The South African Civil Aviation Authority (SACAA) and Air Traffic Navigation Services (ATNS) are included on the Interested and Affected Party (I&AP) database, and were provided with access to the DSR in order to seek comment during the 30-day review period. Proof of correspondence during the Scoping Phase is included in Appendix F of this report. The Draft EIA Report was also provided to the SACAA and ATNS for the 30-day review period. Comment has been received from the SACAA, as included in Appendix H.6 of this EIA Report, and responded to in the Comments and Responses Report in Appendix H.7.	Chapter 18
8	Defence Assessment	Yes (Site Sensitivity Verification)	Protocol GN 320: Part B: Defence (Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Defence Installations): **Site Sensitivity Verification or Compliance Statement** The Screening Tool indicates that the proposed project area is of “low” sensitivity. This has been verified and confirmed on site. As per the protocols, a Site Sensitivity Verification is only required.	Chapter 19

Specialist Assessment Required by the Screening Tool		Assessment undertaken in Scoping and EIA Process	Type of Assessment undertaken in Scoping and EIA Process or Motivation/Feedback for not undertaking the recommended study	Chapter of EIA Report
			The Department of Defence was provided with access to the DSR in order to seek comment during the 30-day review period. Proof of correspondence during the Scoping Phase is included in Appendix F of this report. The Draft EIA Report was also provided to the Department of Defence for the 30-day review period. Feedback has been received from the Department of Defence, as included in Appendix H.6 of this EIA Report, and responded to in the Comments and Responses Report in Appendix H.7..	
9	Radio Frequency Interference (RFI) Assessment	No	Protocol GN 320: Part A: Site Sensitivity Verification; and Appendix 6 of the 2014 NEMA EIA Regulations (as amended): **Impact Assessment** The Screening Tool indicates that the proposed project area is of medium and low sensitivity in terms of RFI. The medium sensitivity is based on the study area being located between 30 and 60 km from a Weather Radar installation and within the radar's line of sight. The Developer has communicated with the South African Weather Service (SAWS). SAWS provided a letter that notes that tests conducted by the SAWS indicated that the proposed projects will not have any direct impact on the SAWS radar station located in De Aar. Therefore, SAWS supports the development of the Kudu Solar Facilities at the proposed location. Therefore, this is not a concern from an RFI perspective. Refer to Appendix K of this EIA Report for a copy of this correspondence. Furthermore, the SARAO also confirmed that proposed projects represent a low risk of interference to the nearest SKA radio telescope with a compliance surplus of 279.92 dBm/Hz; and as such, the SARAO does not have any objection to the proposed development. Refer to Appendix K of this EIA Report for a copy of this correspondence. Further to the above, the proposed project is located outside of the KCAAA and thus not expected to impact significantly on the SKA. Therefore, an RFI Assessment was not undertaken during the EIA Phase. Refer to additional information in Section 4.3.2 below.	Not applicable
10	Geotechnical Assessment	Yes	Appendix 6 of the 2014 NEMA EIA Regulations (as amended): **Impact Assessment** There are no themes on the Screening Tool that currently relate to Geotechnical features that could be verified on site. Hence Part A of GN 320 (Site	Chapter 17

Specialist Assessment Required by the Screening Tool		Assessment undertaken in Scoping and EIA Process	Type of Assessment undertaken in Scoping and EIA Process or Motivation/Feedback for not undertaking the recommended study	Chapter of EIA Report
			Sensitivity Verification) is not applicable in this regard.	
11	Socio-Economic Assessment	Yes	Appendix 6 of the 2014 NEMA EIA Regulations (as amended): **Impact Assessment** There are no themes on the Screening Tool that currently relate to Socio-Economic features that could be verified on site. Hence Part A of GN 320 (Site Sensitivity Verification) is not applicable in this regard.	Chapter 13
12	Plant Species Assessment	Yes	Protocol GN 1150: Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Plant Species: **Impact Assessment** Note that the reporting for Terrestrial Biodiversity, Terrestrial Plant Species and Terrestrial Animal Species are combined in one report.	Chapter 7
13	Animal Species Assessment	Yes	Protocol GN 1150: Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species: **Compliance Statement** Note that the reporting for Terrestrial Biodiversity, Terrestrial Plant Species and Terrestrial Animal Species are combined in one report.	Chapter 7

4.4.1 Additional Specialist Assessments

It must be noted that the Screening Tool did not identify the need for the following specialist assessments, however these studies have been commissioned as part of the Scoping and EIA Process to ensure that all potential impacts resulting from the proposed project are considered as best as possible:

- **Avifauna Impact Assessment**: The Specialist Assessment is included in Chapter 9 of this EIA Report. The Avifauna Impact Assessment has been undertaken in compliance with GN 1150 (Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species: Impact Assessment), as well as relevant guidelines.
- **Traffic Impact Assessment**: The Specialist Assessment is included in Chapter 14 of this EIA Report. The Traffic Impact Assessment has been undertaken in compliance with Appendix 6 of the 2014 NEMA EIA Regulations (as amended).
- **BESS High Level Safety, Health and Environment Risk Assessment:** The detailed study is included in Chapter 15 of this EIA Report. This is a technical report and does not need to fulfil the requirements of the 2014 NEMA EIA Regulations (as amended).

- **Geohydrology Impact Assessment**: The Specialist Assessment is included in Chapter 16 of this EIA Report. The Geohydrology Impact Assessment has been undertaken in compliance with Appendix 6 of the 2014 NEMA EIA Regulations (as amended).

4.4.2 RFI Assessment

The Screening Tool identified the need for an RFI Assessment. However, an RFI Assessment has not been undertaken as part of the Scoping and EIA Process because the proposed project does not fall within the KCAAA region, and thus not expected to have a significant impact on the SKA. Refer to the locality map provided in Chapter 1 of this EIA Report for additional information.

The SARAO confirmed that the proposed projects represent a low risk of interference to the nearest SKA radio telescope and that the SARAO does not have any objection to the proposed development. Refer to Appendix K of this EIA Report for a copy of this correspondence.

The RFI Theme on the Screening Tool indicates medium and low sensitivity due to the proposed project being located between 30 and 60 km from a Weather Radar installation and within the radar's line of sight. Research indicates that this is the De Aar Weather Office. The CSIR Wind and Solar Phase 2 SEA (DEFF, 2019[2]: Part 3.13, Page 2) notes that solar PV development generally does not have an impact on weather surveillance radar, however wind turbines are known to influence such systems. The SEA Report notes that there are no specific assessment requirements for impacts on weather radar systems, and that the South African Weather Services (SAWS) should be consulted for comment where a proposed development is in an area which may impact weather radars. In addition, the SEA explains that in medium sensitivity areas there is a low potential for negative impacts, there is a high likelihood of mitigation in the event of impacts, and further assessment of the potential impacts may not be required. The SAWS did provide comment on the proposed projects and confirmed that tests conducted by the SAWS indicated that the proposed projects will not have any direct impact on the SAWS radar station located in De Aar; and that the SAWS supports the development of the Kudu Solar Facilities at the proposed location.

In addition, photographs of the site are included in the Civil Aviation and Defence Site Sensitivity Verifications (Chapters 18 and 19 of this EIA Report, respectively). These can be referred to for a general overview of the site.

Based on this, the EAP is of the opinion that an RFI Assessment is not warranted.

This motivation for exclusion was acknowledged by the DFFE during the pre-application meeting, with the recommendation for such motivation to be included in the Scoping and EIA Reports. No objections to this approach were raised by the DFFE during the Scoping Phase. All correspondence relating to the pre-application meeting is addressed in Appendix D of this EIA Report.

4.5 Overview of Approach to Preparing the EIA Report and EMPr

Separate EIA Reports have been complied for each of the 12 Kudu Solar Facilities. The EIA Report was released for a 30-day I&AP and authority comment period extending from 2 June 2023 to 3 July 2023. I&APs registered on the project database were notified in writing of the release of the EIA Report for comment.

Comments raised, through written correspondence (emails and letters) have been captured in a Comments and Responses Report that is included in Appendix H.7 of this Final EIA Report that has been submitted to the DFFE for decision-making.

The EIA Report includes an EMPr that has been prepared in compliance with the relevant regulations. The content of an EMPr must either contain the information set out in Appendix 4 of the 2014 NEMA EIA Regulations (as amended) or must be a Generic EMPr relevant to an application as identified and gazetted by the Minister in a GN. As part of the 2016 EGI Strategic SEA, a Generic EMPr was compiled for the development and expansion of (a) overhead electricity transmission and distribution infrastructure; and (b) substation infrastructure for the transmission and distribution of electricity. On 2 March 2018, these two Generic EMPrs were gazetted in Government Gazette (GG) 41473, GN 162 and GN 163, for public comment for a period of 45 days. On 22 March 2019, these two Generic EMPrs were gazetted for implementation, in GG 42323, GN 435.

The EMPrs compiled for this proposed project are included in Appendix I and Appendix J of this EIA Report, and therefore separately comply with Appendix 4 of the 2014 NEMA EIA Regulations (as amended) for the proposed Solar PV facility and associated infrastructure, as well as the requirements of the gazetted EMPr for substation infrastructure (Gazette 42323, GN 435), for the Independent Power Producer (IPP) Substation (as Activity 11 of Listing Notice 1 is included in this application).

The Generic EMPr for power lines only applies to aboveground power lines and those that have a capacity of more than 33 kV (i.e. triggering Listed Activity 11 of GN 327 or Listed Activity 9 of GN 325). Therefore, it is understood that the Generic EMPr for the development and expansion of overhead electricity transmission and distribution infrastructure does not apply to any of the proposed projects, as the medium-voltage power lines within the footprint of the Solar PV Facility are planned to have a capacity of 22 or 33 kV (i.e. below the capacity threshold of the relevant listed activity).

The EMPrs are based broadly on the environmental management philosophy presented in the ISO 14001 standard, which embodies an approach of continual improvement. Actions in the EMPr have been drawn primarily from the impact management actions in the specialist assessments for the construction and operational phases of the project. If the project components are decommissioned or re-developed this will need to be done in accordance with the relevant environmental standards and clean-up/remediation requirements applicable at the time. However, general management actions for the decommissioning phase have been provided.

4.6 Public Participation Process

4.6.1 Introduction to the PPP

This section provides an overview of the tasks that have been undertaken in the EIA Phase, with a particular emphasis on providing a clear record of the PPP that has been followed. An integrated PPP was undertaken for the 12 Kudu Solar Facilities (Projects 1 to 12) and for the EGI (Projects 13 to 26), as confirmed with the DFFE during the Pre-Application Meeting[8].

The integrated PPP for the proposed projects ensured that all public participation documents (such as newspaper advertisements, site notices, notification letters, emails etc.) served to notify I&APs, Stakeholders and Organs of State of the joint availability of reports for the abovementioned projects and provided I&APs with an opportunity to comment on the reports. This approach was undertaken due to the proximity of the sites (i.e., the proposed projects will take place within the same geographical area) and that proposed projects entail the same activity (i.e., generation of energy using a renewable source (i.e., Solar PV), and distribution of electricity via power lines (which are subjected to separate BA and/or EGI Standard Registration Processes)).

Guideline 4 on "*Public Participation in support of the EIA Regulations*" published by the former DEAT in May 2006, states that public participation is one of the most important aspects of the Environmental Assessment Process. This stems from the requirement that people have a right to be informed about potential decisions that may affect them and that they must be afforded an opportunity to influence those decisions. Effective public participation also improves the ability of the Competent Authority to make informed decisions and results in improved decision-making as the view of all parties are considered.

An effective PPP could therefore result in stakeholders working together to produce better decisions than if they had worked independently. The DEAT guideline states the following in terms of PPP:

- "*Provides an opportunity for I&APs, EAPs and the Competent Authority to obtain clear, accurate and understandable information about the environmental impacts of the proposed activity or implications of a decision;*
    - *Provides I&APs with an opportunity to voice their support, concern and question regarding the project, application or decision;*
    - *Enables an applicant to incorporate the needs, preferences and values of affected parties into its application;*
    - *Provides opportunities for clearing up misunderstanding about technical issues, resolving disputes and reconciling conflicting interests;*
    - *Is an important aspect of securing transparency and accountability in decision-making; and*
    - *Contributes toward maintaining a health, vibrant democracy*."

[8] At the pre-application phase, a total of 15 PV Projects and 17 EGI Projects were proposed, however following the sensitivity mapping, discussions with landowners and capacities of Bid Window 6, the number of projects have been reduced to 12 PV projects and 14 EGI Projects.

To the above, one can add the following universally recognised principles for public participation:

- Inclusive consultation that enables all sectors of society to participate in the consultation and assessment processes;
- Provision of accurate and easily accessible information in a language that is clear and sufficiently non-technical for I&APs to understand, and that is sufficient to enable meaningful participation;
- Active empowerment of grassroots people to understand concepts and information with a view to active and meaningful participation;
- Use of a variety of methods for information dissemination in order to improve accessibility, for example, by way of discussion, documents, meetings, workshops, focus group discussions, and the printed and broadcast media;
- Affording I&APs sufficient time to study material, to exchange information, and to make contributions at various stages during the assessment process;
- Provision of opportunities for I&APs to provide their inputs via a range of methods, for example, via briefing sessions, public meetings, written submissions or direct contact with members of the EIA team; and
- Public participation is a process and vehicle to provide sufficient and accessible information to I&APs in an objective manner to assist I&APs to identify issues of concern, to identify alternatives, to suggest opportunities to reduce potentially negative or enhance potentially positive impacts, and to verify that issues and/or inputs have been captured and addressed during the assessment process.

At the outset it is important to highlight two key aspects of public participation:

- There are practical and financial limitations to the involvement of all individuals within a PPP. Hence, the PPP aims to generate issues that are representative of societal sectors, not each individual and has been designed to be inclusive of a broad range of sectors relevant to the proposed project; and
- The PPP will aim to raise a diversity of perspectives and will not be designed to force consensus amongst I&APs. Indeed, diversity of opinion rather than consensus building is likely to enrich ultimate decision-making. Therefore, where possible, the PPP aims to obtain an indication of trade-offs that all stakeholders (i.e., I&APs, technical specialists, the authorities and the development proponent) are willing to accept with regard to the ecological sustainability, social equity and economic growth associated with the project.

The Department of Environmental Affairs (2017), Public Participation guideline in terms of the NEMA EIA Regulations was also considered throughout this Scoping and EIA Process.

The key steps in the PPP for this Scoping and EIA Process are described below and also illustrated in Figure 4.1. This approach is structured in line with the requirements of Chapter 6 (PPP) of the 2014 NEMA EIA Regulations (as amended, i.e., GN R326), as described below. Various mechanisms have been undertaken to provide notice to all potential and registered I&APs of the proposed project, as described below.

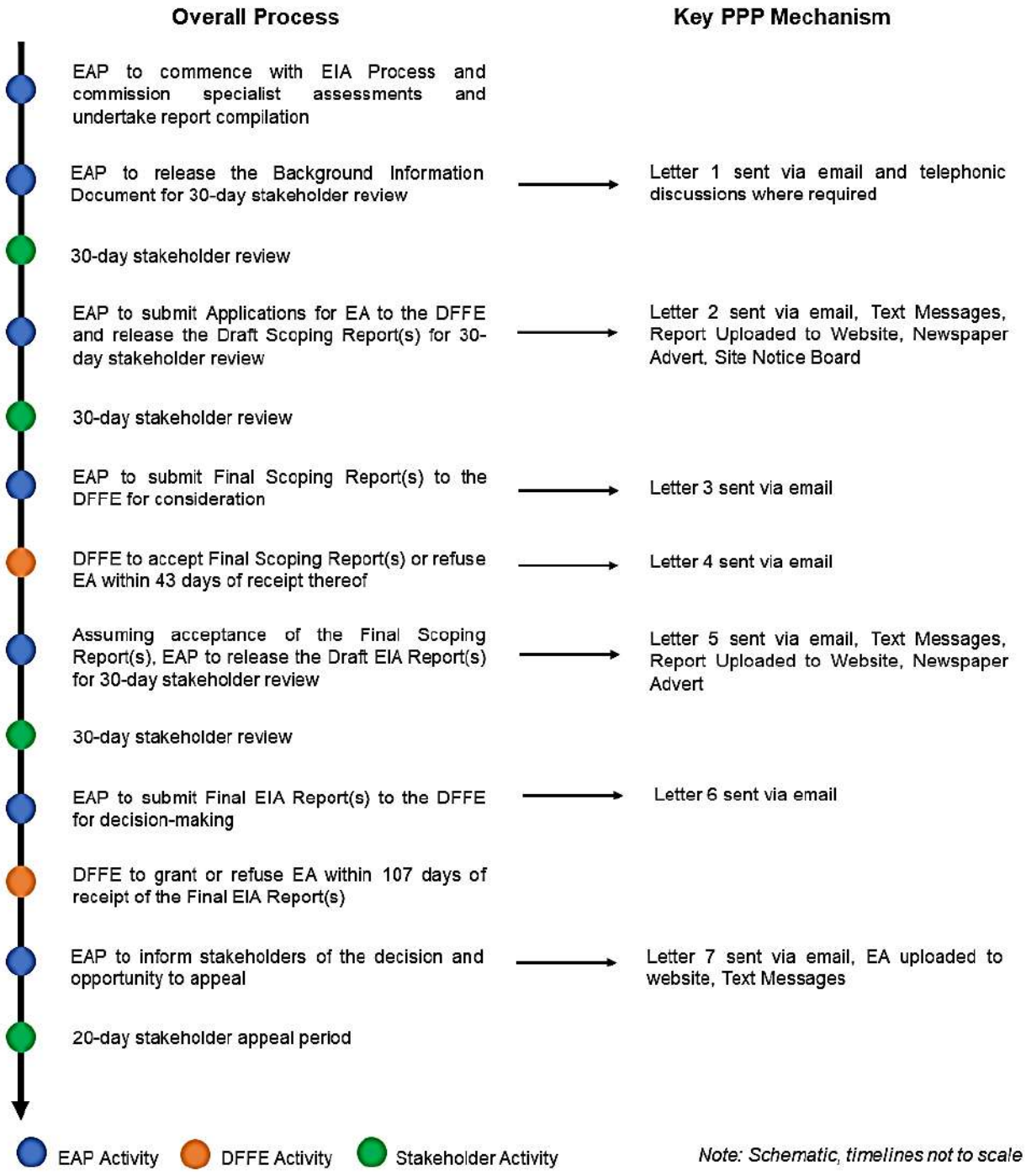


Figure 4.1. Overview of the Scoping and EIA Process and PPP.

4.6.2 Requirement for a Public Participation Plan

The proposed Public Participation Plan was discussed at the Pre-Application Meeting on 26 April 2022, and the plan was submitted via email to the assigned DFFE Case Officers on 6 May 2022. However, the DFFE confirmed via email on 16 May 2022 that Public Participation Plans are no longer required for Applications for EA. Refer to Appendix F.1 of this EIA Report for a copy of this email correspondence, confirming that no Public Participation Plan is required for the proposed project.

4.6.3 Pre-Application Consultation with the DFFE

A request for a Pre-Application Meeting was submitted to the DFFE on 5 April 2022 after which the EAP received a response from the DFFE on 6 April 2022 (Reference Number: 2022-04-0005). The DFFE later confirmed via email that a Pre-Application Meeting was scheduled for 26 April 2022. The Pre-Application Meeting was undertaken in order to discuss and agree on various aspects prior to the commencement of the process. Refer to Appendix D of this EIA Report for the pre-application correspondence with the DFFE.

4.6.4 Landowner Written Consent

Regulation 39 (1) of the 2014 NEMA EIA Regulations (as amended) states that "*if the proponent is not the owner or person in control of the land on which the activity is to be undertaken, the proponent must, before applying for an environmental authorisation in respect of such activity, obtain the written consent of the landowner or person in control of the land to undertake such activity on that land*".

Regulation 39 (2) of the 2014 NEMA EIA Regulations (as amended) further states that "*sub-regulation (1) does not apply in respect of: (a) linear activities; (b) activities constituting, or activities directly related to prospecting or exploration of a mineral and petroleum resource or extraction and primary processing of a mineral or petroleum resource; and (c) strategic integrated projects as contemplated in the Infrastructure Development Act, 2014*".

There has been no changes to the legislation regarding the above at the time of submitting the Application for EA, therefore, written consent has been obtained from the respective landowners of the affected farm portions on which the non-linear infrastructure is proposed to be located. The written consent was included as an appendix to the Application for EA, which was submitted to the DFFE.

4.6.5 Site Notices

One specific mechanism of informing I&APs of the proposed projects includes the placement of site notice boards. As per the requirements of Regulation 41 (2) (a) of the 2014 NEMA EIA Regulations (as amended), notice boards in the Afrikaans and English languages were placed at the commencement of the Scoping and EIA Process, at the key affected farm portions on which the proposed projects will be constructed, as well as at other strategic locations, such as well-known retail, public and/or government facilities in the wider region, as indicated in Table 4.3.

Table 4.3: Site Notice Board Placement for the Proposed Projects.

Number	Locality / Description	Co-ordinates
1	At the entrance of the Petrusville Community Library on the R48, Petrusville	30°4'55.35"S; 24°39'27.74"E
2	At the entrance of the Frans Jooste Library on the R48, Philipstown	30°26'10.27"S; 24°28'15.51"E
3	At the entrance of the Hennie Liebenberg Junior Library on Voortrekker Street, De Aar	30°39'0.44"S; 24°0'42.46"E
4	At the entrance of the Renosterberg Local Municipality Office on the R48, Philipstown	30°26'8.62"S; 24°28'23.11"E
5	At the entrance of the Renosterberg Local Municipality Office on Skool Street, Petrusville	30° 4'48.58"S; 24°39'24.21"E
6	At the entrance of the Pixley ka Seme District Municipality on Culvert Road, De Aar	30°38'14.31"S; 24°1'21.04"E
7	At the Saamstaan Shopping Centre on Saffier Street, Orania	29°48'47.54"S; 24°24'33.98"E
8	Centrally located between the proposed Kudu Solar Facility 1 and Kudu Solar Facility 2 at an entrance gate to Remaining Extent of the Farm Bas Berg No. 88	30°14'39.15"S; 24°18'15.59"E
9	Centrally located between the proposed Kudu Solar Facility 3 and Kudu Solar Facility 4 along the fence of Remaining Extent of Portion 3 of the Farm Bas Berg No. 88	30°15'43.45"S; 24°18'30.54"E
10	Centrally located at the main access road at the road split, southeast of the proposed Kudu Solar Facility developments	30°17'26.22"S; 24°20'48.07"E
11	Along the fence of Remaining Extent of Portion 3 of the Farm Bas Berg No. 88 on the eastern border of the proposed Kudu Solar Facility 5	30°15'24.33"S; 24°20'0.47"E
12	At an entrance gate of Remaining Extent of Portion 2 (Middel Plaats) (a portion of Portion 1) of the Farm Grasspan No. 40 on the north-eastern border of the proposed Kudu Solar Facility 6	30°11'37.87"S; 24°18'14.99"E
13	Along the fence of Remaining Extent of Portion 2 (Middel Plaats) (a portion of Portion 1) of the Farm Grasspan No. 40 on the southwestern border of the proposed Kudu Solar Facility 7	30°12'16.62"S; 24°18'37.41"E
14	At an entrance gate of Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41 on the southwestern border of the proposed Kudu Solar Facility 11	30°10'12.20"S; 24°21'5.70"E
15	Along the fence of Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41 on the northern border of the proposed Kudu Solar Facility 10	30°10'32.53"S; 24°22'2.50"E

Refer to Appendix F.6 of this EIA Report for a copy of the content and proof of placement of the site notice boards.

4.6.6 Key Steps of the PPP for the EIA Phase

The section below outlines the PPP for the EIA Phase of this assessment in order to provide potential I&APs, Stakeholders and Organs of State access to information on the project and the opportunity to comment.

4.6.6.1 Task 1 – I&AP Review of the Draft EIA Report and EMPr

The first stage in the process entailed the release of the EIA Report for a 30-day I&AP and stakeholder comment period, which extended from 2 June 2023 to 3 July 2023 (excluding public holidays). Relevant stakeholders, Organs of State and I&APs were informed of the review period in the following manner:

- **Database Maintenance:** In line with Regulation 42 of GN R326, an initial database of potential I&APs (including key stakeholders and Organs of State) was developed for the Scoping and EIA processes and has been updated throughout the process. Appendix E of this EIA Report includes a copy of the latest I&AP database, which indicates interaction with I&APs, key stakeholders and all I&APs that have been added to the electronic project database thus far, including those that have submitted comments, to date. While I&APs have been encouraged

to register their interest in the project from the start of the process, following the public announcements, the identification and registration of I&APs was ongoing for the duration of the study. As a result, I&AP details were captured and automatically updated as and when information was distributed to or received from I&APs. This ongoing record of communication is an important component of the PPP. While not required by the regulations, those I&APs proactively identified at the outset of the Scoping and EIA Process remain on the project database throughout the process and have been kept informed of all opportunities to comment and will only be removed from the database by request. The updated database was used to provide written notification of the release of the EIA Report for comment.

- **Protection of Personal Information:** In accordance with the Protection of Personal Information Act (Act 4 of 2013), the CSIR aimed to conduct itself responsibly when collecting, processing, storing and sharing any personal information collected for the purposes of PPP in terms of the 2014 NEMA EIA Regulations (as amended). By registering as an I&AP and/or submitting information and comments, the stakeholder essentially consents to the collection, collation, processing, and storing of such information and the use and disclosure of such information for the aforementioned purpose[9]. This was explained on all correspondence sent throughout the EIA Process. The stakeholders were also given an opportunity to send an email to the EAP if they wished to opt out of communications on the proposed project.

- **Advertisements to Register Interest:** In line with Regulation 41 (2) (c) of the 2014 NEMA EIA Regulations (as amended), in order to notify and inform the public of the proposed projects, to invite I&APs to register on the project database, as well as to inform I&APs of the release of the DSRs for comment, the Scoping and EIA Processes was advertised in the following three local newspapers at the commencement of the 30-day comment period for the DSR: a) Echo/Midland News; b) Noordkaap Bulletin; and c) Bloemnuus. Refer to Appendix F.7 of this EIA Report for a copy of the newspaper advertisements placed during Scoping.

  Adverts were also placed in the same newspapers for the 30-day comment period on the EIA Report. Refer to Appendix H.3 of this EIA Report for a copy of the content of, and proof of placement of, the newspaper advertisements. The content of the newspaper advertisement complied with Regulation 41 (3) of the 2014 NEMA EIA Regulations (as amended) and also included the details of the project website, where information available on the proposed project can be downloaded from.

  There were no official Gazettes published specifically for the purpose of providing public notice of applications or other submissions made in terms of the 2014 NEMA EIA Regulations (as amended).

- **Letter 4[10] to I&APs (Outcome of the consideration of the FSR and commencement of the EIA Phase for Kudu Solar Facility 1 to 12**): Written notification of the outcome of the consideration of the FSR and the commencement of the EIA Phase (i.e. Letter 4) was sent to all I&APs and Organs of State included on the updated project database via email, where email addresses are available. Letter 4 was sent in May 2023 and included a notification of the commencement of the EIA Phase for the proposed projects, and was written in English. Copies of Letter 4 and the emails sent are included in Appendix F.14 of this EIA Report.

[9] CSIR Privacy Notice. Website: https://www.csir.co.za/csir-privacy-notice
[10] Note that Letters 1, 2, and 3 are addressed in Chapter 4 of the FSR (CSIR, 2023) and apply to the Scoping Phase.

- **Submission of the Amended Application for EA and Draft EIA Report to the DFFE and DFFE Acknowledgement of Receipt**: The Amended Application Form for EA and Draft EIA Report were submitted to the DFFE via the DFFE Novell S-Filer System on 2 June 2023 and proof of upload was emailed to the DFFE. Proof of submission of the EIA Report for comment and Amended Application for EA to the DFFE, and proof of upload to the DFFE Novell S-Filer System are included in Appendix H.5 of this EIA Report. The DFFE sent an email on 6 June 2023 acknowledging receipt of the Amended Applications for EA and EIA Reports for comment on 2 June 2023 (as included in Appendix H.5).

- **Letter 5 to I&APs (Availability of the EIA Reports for Kudu Solar Facility 1 to 12 for public comment):** Written notification of the availability of the EIA Reports (i.e. Letter 5) was sent to all I&APs, Stakeholders and Organs of State included on the updated project database via email, where email addresses are available. This letter was sent at the commencement of the 30-day review period on the EIA Report (i.e. on 2 June 2023), and included information on the proposed projects and notification of the release and availability of the reports. Letter 5 was written in English. Proof of email, as well as copies of the Letter 5, are included in Appendix H.4 of these Final EIA Reports that have been submitted to the DFFE for decision-making.

- **Text Messaging:** SMS texts were sent to all I&APs on the updated project database, where cell phone numbers are available, to inform them of the proposed projects and how to access the EIA Reports available for comment. These text messages were sent on 3 June 2023 for the release, and 21 June 2023 as a reminder of the comment period closure. Refer to Appendix H.4 of this Final EIA Report for proof of text message consultation.

- **Local Networks**: Where possible, communication was made, via telephonic calls and text messages, with the a Municipal Ward Councillor to provide information on the EIA Reports that were available for comment, and to request that they inform stakeholders, including the municipal officials, about the proposed project, with the overall aim to send notifications of the proposed projects, and report availability via their local networks (such as WhatsApp groups, Neighbourhood Watch groups, Farmers Unions, other social media mechanisms etc.). However, since the Renosterberg Local Municipality is under administration, communication with Councillors was difficult. Nonetheless, communication via telephone call, SMS, and email was made, and proof of such is included in Appendix H.4 of this EIA Report.

- **30-day Comment Period:** As noted above, potential I&APs, including authorities and Organs of State, were notified via Letter 5, of the 30-day comment and registration period within which to submit comments on the EIA Reports and/or to register on the I&AP database.

- **Executive Summaries**: Links to the Executive summaries of the EIA Reports were emailed to I&APs on the database, where email addresses are available, together with Letter 5, and these were also uploaded to the project website and alternative web-platforms.

- **Availability of Information:** The EIA Reports were made available for a 30-day comment period and was distributed electronically to ensure access to information. The EIA Reports were uploaded to the project website (i.e. https://www.csir.co.za/environmental-impact-assessment) for I&APs to access it. As a supplementary mechanism, the EIA Reports were also uploaded to another alternative web-platform (i.e., Google Drive: https://bit.ly/KUDU_SOLAR_PV). As noted in the EIA Report, if an I&AP could not access the

reports via the project website or Google Drive, and if additional information was required (other than what was provided in the Executive Summaries), then the I&AP could contact the EAP, to then make an electronic copy available (where feasibly possible). However, no such requests were received during the 30-day comment period on the Draft EIA Reports.

- **Reminder / Follow Up Emails of the Comment Period Closure**: A number of reminder / follow up emails informing stakeholders of the comment period closure and to seek comments were sent to I&APs, stakeholders and Organs of State included on the project database, where email addresses are available. Reminder emails were sent on 8 June 2023, 21 June 2023, 30 June 2023 and 3 July 2023. In addition, personalised reminder emails were sent on 22 June 2023 and thereafter. Refer to Appendix H.4 of this EIA Report for proof of such correspondence.

- **Telephonic calls**: During the 30-day comment period, key stakeholders were called telephonically, followed by a confirmation of discussion email or text message. Refer to Appendix H.4 of this EIA Report for proof of such correspondence.

- **Comments Received:** A key component of the Scoping and EIA Process is documenting and responding to the comments received from I&APs and the authorities. Copies of all comments received during the 30-day review of the EIA Report are included in Appendix H.6 of this EIA Report, as well as in the Comments and Responses Trail in Appendix H.7. Comments/feedback were received from the following stakeholders during the 30-day review of the EIA Report:
    - DFFE Chief Directorate: Integrated Environmental Authorisations (Competent Authority);
    - DFFE: Biodiversity Conservation / CBO: Biodiversity Mainstreaming and EIA Directorate;
    - DFFE: Protected Areas Planning and Management Effectiveness Directorate;
    - Department of Water and Sanitation;
    - Department of Defence;
    - Department of Agriculture, Land Reform and Rural Development (DALRRD): Directorate Land and Soil Management;
    - Eskom;
    - SAHRA;
    - Northern Cape Heritage Resources Authority;
    - BirdLife South Africa;
    - South African Civil Aviation Authority; and
    - Various private individuals / I&APs.

Note that the correspondence received from stakeholders (i.e. the DALRRD, Telkom and I&APs) between the submission of the FSRs and release of the EIA Reports for the 30-day comment period are included in Appendix H.1 of this EIA Report; and are also responded to in Appendix H.7. Also note that correspondence with a specific stakeholder regarding the visual impacts of the Kudu Solar Facilities on their Farm Portion and Farmstead (Correspondence between the submission of the FSR for Decision-Making and the release of the Draft EIA Report) is included in Appendix H.2 of this EIA Report.

4.6.6.2 Task 2 – Comments and Responses Report

A key component of the EIA process is documenting and responding to the comments received from I&APs and the authorities. Copies of all written comments received during the review of the EIA Reports have been compiled into a Comments and Responses Report included in Appendix H.7 of these Final EIA Reports that have been submitted to the DFFE for decision-making. The Comments and Responses Report indicate the nature of the comment, as well as when and who raised the comment. The comments received have been considered by the EIA team and appropriate responses provided by the EIA team, the Project Developer and/or specialists. The response provided indicates how the comment received has been dealt with in the EIA Process and considered in the Final EIA Reports, the project design or EMPrs. If the comment received falls beyond the scope of this EIA, clear reasoning has been provided.

4.6.6.3 Task 3 – Compilation of the Final EIA Reports and Submission to DFFE (Current Stage)

Following the 30-day commenting period on the EIA Reports and incorporation of the comments received into the reports, the Final EIA Reports are submitted to the DFFE for decision-making in line with Regulation 23 (1) (a) of the 2014 NEMA EIA Regulations (as amended). The reports have been submitted electronically to the DFFE via the Novell S-Filer system, as recommended by the DFFE since June 2020.

In line with best practice, I&APs on the project database will be notified via **Letter 6** via email (where email addresses are available) of the submission of the Final EIA Reports to the DFFE for decision-making. To ensure ongoing access to information, copies of the Final EIA Reports that have been submitted for decision-making and the Comments and Response Reports (detailing comments received during the EIA Phase and responses thereto) will be placed on the project website (i.e. https://www.csir.co.za/environmental-impact-assessment). As a supplementary mechanism, the Final EIA Reports will also be uploaded to other alternative web-platforms such as Dropbox or Google Drive.

The Final EIA Reports, submitted to the DFFE for decision-making, includes proof of the PPP that was undertaken to inform Organs of State, Stakeholders and I&APs of the availability of the EIA Reports for the 30-day comment period (as explained above).

The DFFE will have 107 days (from receipt of the Final EIA Reports) to either grant or refuse EA (in line with Regulation 24 (1) of the 2014 NEMA EIA Regulations, as amended).

4.6.6.4 Task 4 – Environmental Authorisation (EA) and Appeal Process

Subsequent to the decision-making phase, if EAs are granted by the DFFE for the proposed projects, all registered I&APs, Organs of State and Stakeholders on the project database will receive notification of the issuing of the EAs and the associated appeal period. The 2014 NEMA EIA Regulations (as amended) (i.e. Regulation 4 (1)) states that after the Competent Authority has reached a decision, it must inform the Project Applicant of the decision, in writing, within 5 days of such decision. Regulation 4 (2) of the 2014 NEMA EIA Regulations (as amended) stipulates that I&APs need to be informed of the EA and associated appeal period within 14 days of the date of the decision.

The distribution of the EAs (should such authorisations be granted by the DFFE), as well as the notification of the appeal period, will include a letter (i.e. **Letter 7** (Release of EAs and Notification of Opportunity to Appeal)) to be sent via email to all registered I&APs, Stakeholders and Organs of State on the project database, where email addresses are available. The letter will include information on the appeal period, as well as details regarding where to obtain a copy of the EAs. The EAs will be uploaded to the project website (i.e. https://www.csir.co.za/environmental-impact-assessment). SMS texts will also be sent to all I&APs on the database, where cell phone numbers are available, to inform them of the EAs (should they be granted).

4.7 Authority Consultation during the EIA Phase

Authority consultation is integrated into the PPP, with meetings or discussions held on online platforms with the lead authorities, where necessary. The Competent Authority (DFFE) as well as other lead authorities were consulted at various stages during the EIA Process. The following key authorities have been identified for the purpose of this EIA Process:

- Air Traffic Navigation Services (ATNS)
- AgriSA;
- Birdlife South Africa;
- Department of Transport;
- Department of Water and Sanitation;
- DALRRD;
- DFFE Integrated Environmental Authorisations Directorate;
- DFFE Biodiversity and Conservation Directorate;
- DFFE Protected Areas Directorate;
- Endangered Wildlife Trust;
- Eskom SOC Ltd;
- National Energy Regulator of South Africa (NERSA);
- Ngwao Boswa Kapa Bokoni (Heritage Northern Cape);
- Northern Cape DAEARDLR;
- Pixley Ka Seme District Municipality;
- Renosterberg Local Municipality;
- South African Civil Aviation Authority (CAA);
- SAHRA;
- South African Local Government Association (SALGA) (Northern Cape)
- South African National Parks (SANParks);
- South African National Roads Authority (SANRAL);
- South African Radio Astronomy Observatory (SARAO);
- South African Weather Services;
- VulPro;
- Wildlife and Environmental Society of South Africa (WESSA); and
- World Wildlife Fund (WWF).

The authority consultation process for the EIA Phase is outlined in Table 4.4 below.

Table 4.4: Authority Communication Schedule.

STAGE IN EIA PHASE	FORM OF CONSULTATION
During the EIA Process (most likely on submission of the EIA Report for decision-making)	Site visit with authorities (including DFFE), if required.
During preparation of EIA Report	Communication (via email or online platforms (i.e. Microsoft Teams) with the DFFE as required.
On submission of EIA Report for comment	Online meetings with dedicated departments, if requested by the DFFE, with jurisdiction over particular aspects of the project (e.g. Local Authority). This was not requested during the EIA Process.

4.8 Schedule for the Scoping and EIA Processes

The proposed schedule for the Scoping and EIA Processes based on the legislated EIA timeframes, is presented in Table 4.5.

As noted above, the BA and/or EGI Standard Registration Processes will be undertaken separately for the EGI Projects 13 to 26. However, where possible the processes will be aligned with the Scoping and EIA Processes as best as possible, including PPP mechanisms, where relevant.

Table 4.5: Schedule for the proposed Kudu Solar Facilities 1 to 12 (Projects 1 to 12).

Key Milestones	Proposed Timeframe
Appointment of CSIR by the Developer (i.e. ABO Wind)	December 2021
Appointment of Specialists	January 2022 to early March 2022
Specialist Site Visits	February 2022 to May 2022
Project Initiation and Pre-Application Consultation with the Department of Forestry, Fisheries and the Environment (DFFE)	April 2022
Approval of Notes of the Pre-Application Meeting	16 May 2022
Submission of Combination Request	26 May 2022
DFFE Decision on the Combination Request	21 June 2022
Release Background Information Document (BID) for 30-day comment period for the Kudu Solar Facilities Environmental Impact Assessment (EIA) Projects and the Electricity Grid Infrastructure (EGI) Basic Assessment (BA) Projects	6 June 2022 to 7 July 2022 (excluding Public Holidays)
Specialist Inputs to the Draft Scoping Reports (DSRs) for the Kudu Solar Facilities EIA Projects (Projects 1 to 12)	May 2022 to December 2022
Prepare DSRs and Plan of Study for EIA including specialist inputs for the Kudu Solar Facilities EIA Projects (Projects 1 to 12)	May 2022 to December 2022

Key Milestones	Proposed Timeframe
Release DSRs for the Kudu Solar Facilities EIA Projects (Projects 1 to 12) for 30-day comment period	9 December 2022 to 30 January 2023 (excluding mandatory regulated shutdown period)
Submit Final Scoping Reports (FSRs) for the Kudu Solar Facilities EIA Projects (Projects 1 to 12) to the DFFE for Consideration	13 February 2023
DFFE to Accept FSRs for the Kudu Solar Facilities EIA Projects (Projects 1 to 12) or Refuse EAs	24 to 29 March 2023
Specialist Assessments for the Kudu Solar Facilities EIA Projects (Projects 1 to 12)	December 2022 to mid-April 2023
Prepare Draft EIA Reports for the Kudu Solar Facilities EIA Projects (Projects 1 to 12)	December 2022 to end May 2023
Release Draft EIA Reports for the Kudu Solar Facilities EIA Projects (Projects 1 to 12) for 30-day comment period	2 June 2023 to 3 July 2023 (excluding public holidays)
Submit Final EIA Reports for the Kudu Solar Facilities EIA Projects (Projects 1 to 12) to the DFFE for Decision-Making	Mid-July 2023
DFFE Decision-Making on the Final EIA Reports and issue of Decisions (i.e., grant or refuse EA): 107 days	End-October 2023
EAP to Notify I&APs of Decisions (14 days)	Mid-November 2023

4.9 Approach to the Impact Assessment Methodology and Specialist Assessments

This section outlines the assessment methodology for the specialist assessments, as recommended by the then Department of Environmental Affairs (DEA) 2006 Guideline on Assessment of Impacts.

4.9.1 Impact Assessment Methodology

The Impact Assessment Methodology has been aligned with the requirements for EIA Reports as stipulated in Appendix 3 (3) (1) (j) of the 2014 NEMA EIA Regulations (as amended) which states the following:

"An *environmental impact assessment report must contain the information that is necessary for the Competent Authority to consider and come to a decision on the application, and must include an assessment of each identified potentially significant impact and risk, including-*

(i) cumulative impacts;
(ii) the nature, significance and consequences of the impact and risk;
(iii) the extent and duration of the impact and risk;
(iv) the probability of the impact and risk occurring;
(v) the degree to which the impact and risk can be reversed;
(vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and
(vii) *the degree to which the impact and risk can be mitigated*".

The identification of potential impacts includes impacts that may occur during the construction, operational and decommissioning phases of the development. The assessment of impacts includes direct, indirect as well as cumulative impacts. In order to identify potential impacts (both positive and negative) it is important that the nature of the proposed project is well understood so that the impacts associated with the project can be assessed. The process of identification and assessment of impacts includes:

- Determining the current environmental conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured;
- Determining future changes to the environment that will occur if the activity does not proceed;
- Develop an understanding of the activity in sufficient detail to understand its consequences; and
- The identification of significant impacts, which are likely to occur if the activity is undertaken.

The following principles underpin the application of this methodology:

- Transparent and repeatable process - specialists are to describe the thresholds and limits they apply in their assessment, wherever possible.
- Adapt parameters to context (where justified) – the methodology proposes some thresholds (e.g. for spatial extent, in Step 3 below), however, if the nature of the impact requires a different definition of the categories of spatial extent, then this can be provided and described by the specialist.
- Combination of a quantitative and qualitative assessment – where possible, specialists are to provide quantitative assessments (e.g. areas of habitat affected, number of jobs), however, it is recognised that not all impacts can be quantified, and then qualitative assessments are to be provided.

As per the then DEAT Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of direct, indirect and cumulative impacts:

- **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

- **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.

- **Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

In addition to the above, the Impact Assessment Methodology includes the following aspects:

- **Step 1: Nature of impact/risk** - this reviews the type of effect that a proposed activity will have on the environment and includes "what will be affected and how?" The term environment has a broad interpretation that includes both the natural (biophysical) environment and the socio-economic environment. The term socio-ecological system is also used to describe the natural and socio-economic environment and the interactions amongst these components.

- **Step 2: Status** - Whether the impact/risk on the overall environment (social, biophysical and economic) will be:

    - Positive - environment overall will benefit from the impact/risk;
    - Negative - environment overall will be adversely affected by the impact/risk; or
    - Neutral - environment overall will not be affected.
    - Note: The significance of a negative impact may be called a risk, and the significance of a positive impact may be called an opportunity.

- **Step 3**: Qualitative determination of the consequence of the impact/risk by identifying the a) spatial extent; b) duration; c) reversibility; and d) irreplaceability.

    - **A) Spatial extent** – The size of the area that will be affected by the impact/risk:
        - Site specific;
        - Local (<10 km from site);
        - Regional (<100 km of site / within the district municipality);
        - National; or
        - International (e.g. Greenhouse Gas emissions or migrant birds).

    - **B) Duration** – The timeframe during which the impact/risk will be experienced:
        - Very short term (instantaneous);
        - Short term (less than 1 year);
        - Medium term (1 to 10 years);
        - Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration)); or
        - Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).

    - **C) Reversibility** of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):
        - High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);
        - Moderate reversibility of impacts;
        - Low reversibility of impacts; or
        - Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).

- **D) Irreplaceability** of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):
  - High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);
  - Moderate irreplaceability of resources;
  - Low irreplaceability of resources; or
  - Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).

These criteria are then combined in a qualitative manner to determine the **consequence**. The consequence terms ranging from slight to extreme (as described below) are calibrated per Specialist Study, where required, so that there is transparency and consistency in the way a risk/impact is measured.

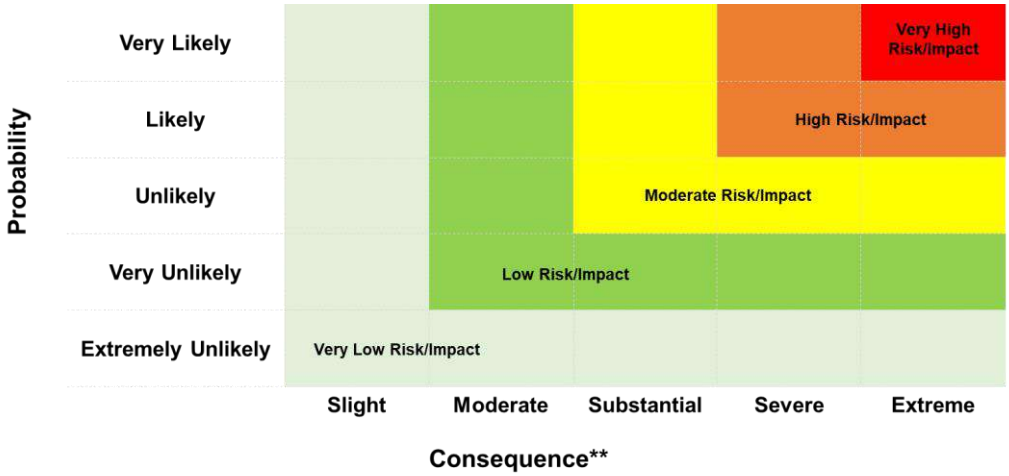
- **Consequence** – The anticipated consequence of the risk/impact is generally defined as follows:
  - Extreme (extreme alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they permanently cease);
  - Severe (severe alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease);
  - Substantial (substantial alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease;
  - Moderate (notable alteration of natural or socio-economic systems, patterns or processes, i.e. where the natural or socio-economic environment continues to function but in a modified manner; or
  - Slight (negligible and transient alteration of natural or socio-economic systems, patterns or processes, i.e. where natural systems/environmental or socio-economic functions, patterns, or processes are not affected in a measurable manner, or if affected, that effect is transient and the system recovers).

- **Step 4**: The **probability** of the impact/risk must be rated using the criteria below:

  - **Probability** – The probability of the impact/risk occurring:
    - Extremely unlikely (little to no chance of occurring);
    - Very unlikely (<30% chance of occurring);
    - Unlikely (30-50% chance of occurring)
    - Likely (51 – 90% chance of occurring); or
    - Very Likely (>90% chance of occurring regardless of prevention measures).

- **Step 5**: Determination of the **significance** of the identified impact/risk using both the **consequence** and **probability** (qualitatively as shown in Figure 4.2). The approach incorporates internationally recognised methods from the Intergovernmental Panel on Climate

Change (IPCC) (2014) assessment of the effects of climate change and is based on an interpretation of existing information in relation to the proposed activity, to generate an integrated picture of the risks related to a specified activity in a given location, with and without mitigation. Risk is assessed for each significant stressor (e.g. physical disturbance), on each different type of receiving entity (e.g. the municipal capacity, a sensitive wetland), qualitatively (very low, low, moderate, high, very high) against a predefined set of criteria. Significance definitions and rankings are provided below:



[Qualitatively determined based on Spatial Extent, Duration, Reversibility and Irreplaceability]

Figure 4.2. Guide to assessing risk/impact significance as a result of consequence and probability.

- **Significance** – Will the impact cause a notable alteration of the environment?
  - Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
  - Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
  - Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);
  - High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and
  - Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- Very low = 5;
- Low = 4;
- Moderate = 3;
- High = 2; and
- Very high = 1.

- **Step 6**: Determine the **Confidence Level** – The degree of confidence in predictions based on available information and specialist knowledge:
    - Low;
    - Medium; or
    - High.

Other aspects taken into consideration in the assessment of impact significance are:

- Impacts are to be evaluated for the construction, operational and decommissioning phases of the development. The assessment of impacts for the decommissioning phase is brief, as there is limited understanding at this stage of what this might entail. The relevant rehabilitation guidelines and legal requirements applicable at the time will need to be applied;
- Impacts are evaluated with and without mitigation in order to determine the effectiveness of mitigation measures on reducing the significance of a particular impact;
- The impact evaluation takes into consideration, where possible, the cumulative effects associated with this and other Wind and Solar PV, and EGI, projects which are either developed or in the process of being developed in the local area (i.e. within 30 km from the proposed Kudu Solar Facilities). Refer to Section 4.9.2 for a description of the cumulative impact assessment methodology; and
- The impact assessment attempts to quantify the magnitude of potential impacts (direct, indirect and cumulative effects) and outline the rationale used. Where appropriate, national standards are to be used as a measure of the level of impact.

Impacts are then collated into the EMPr, which include the following:

- Quantifiable standards for measuring and monitoring mitigatory measures and enhancements are set. This includes a programme for monitoring and reviewing the recommendations to ensure their ongoing effectiveness;
- Identifying negative impacts and prescribing mitigation measures to avoid or reduce negative impacts. Where no mitigatory measures are possible this is stated; and
- Positive impacts and augmentation measures are identified to potentially enhance positive impacts where possible.

Table 4.6 below has been used by the specialists for the rating of impacts, and repeated for the Construction, Operational and Decommissioning Phases.

Table 4.6: Example of Table for Assessment of Impacts/Risks.

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Habitat and species loss as a result of clearance of vegetation for the PV Facility	***Status***	*Negative*	*Moderate (3)*	*Plant search and rescue (EMPr)*	*Low (4)*	*Medium*
	Spatial Extent	*Site Specific*				
	Duration	*Long-term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Moderate*				

4.9.2 Cumulative Impact Assessment Methodology

The cumulative impact assessment includes the impact of the Kudu Solar Facilities and other renewable energy projects (i.e. Wind and Solar PV) and EGI projects within a 30 km radius of the proposed projects that are in different stages of planning and/or development. At the time of submission of the FSR to the DFFE for consideration, the various renewable energy projects that were to be considered in the cumulative impact assessment had either received an EA, the Environmental Assessment was in progress, or the project had been constructed. Under some instances, usually only authorised projects are considered in the cumulative assessment. However, for this project various project statuses were considered based on the comments received during the pre-application meeting with the DFFE. In addition, other existing and planned Eskom power lines have also been taken into consideration. It must be re-iterated that some of the projects considered in the cumulative impact assessment are only in the Environmental Assessment phase, and such projects are most likely going to be subjected to a competitive tender process, therefore its development is not guaranteed.

The information has been sourced from the National DFFE Renewable Energy EIA Application (REEA) database; as well as from the SAHRIS and the Eskom Generation Connection Capacity Assessment (GCCA) (2022). Table 4.7 provides more details, whilst Figure 4.3 provides an illustration of the projects that have been considered in the cumulative impact assessment. All withdrawn or lapsed projects have not been considered. Each project has been allocated a specific number indicated in the table below, which correlates to the display on the map below, for ease of reference.

Refer to each specialist assessment in Chapters 6 to 17 of this EIA Report for a description on how cumulative impacts have been identified.

A summary of the general process flow followed in the cumulative impact assessment is provided below:

- A list of Renewable Energy and EGI projects within a 30 km radius was identified based on research, SAHRIS, REEA and the Eskom 2022 GCCA.

- The cumulative impacts were then clearly defined, and **where possible** the size of the identified impact was quantified and indicated. In most cases the actual development footprint of the nearby Renewable Energy developments could not be easily quantified or accessed spatially. For example, the REEA database contains land parcels, and not the footprints. Hence the land parcels were considered, which took into account the worst case. This typically allowed the determination of the following aspects (or similar aspects) in the relevant specialist assessments:
    - The total affected land parcel area taken up by the other renewable energy projects and EGI within the 30 km radius.
    - The total affected land parcel area of the 12 Kudu Solar Facilities.
    - Combined land parcel area affected by the renewable energy developments within the 30 km radius.
    - The total area within the 30 km radius around the proposed projects of similar habitat.
    - The total combined size of the land parcels affected by renewable energy and EGI projects as a percentage of the available habitat in the 30 km radius.
- Therefore, the assessment of cumulative impacts was based on the specialist and EAP's knowledge of similar approved Renewable Energy and EGI projects in the 30 km radius. In some cases, the specialists involved in this Scoping and EIA Process were also involved in other Renewable Energy Projects within the larger region, thus being well aware of the type of impacts and mitigation measures recommended. The specialists assessed such impacts based on their expertise and knowledge of similar projects and management actions. However, the following points are important to note in terms of the cumulative impact assessment:
    - Some of projects in the 30 km radius employ wind turbines, which present fundamentally different impacts and externalities that may affect the broader ecology of the region. Furthermore, the majority of the mitigation measures adopted for wind energy facilities do not necessarily apply to Solar PV, such as those relating to avifaunal collisions, noise from turbines, and visual screening.
    - The assessment of cumulative impacts is not necessarily solely focused on an assessment of impacts linked to previously authorised similar developments and consideration of their mitigation measures, but also about the sensitivities of the land on which the projects take place.
    - From a heritage perspective, these impacts are difficult to quantify because of the variable survey conditions that are likely to have pertained during the assessments of the various projects. Nonetheless, it is noted that archaeological finds in the areas typically considered for development in the grasslands tend to be minimal, while finds on hills tend to be avoided in the construction of wind energy facilities.

Refer to the relevant specialist studies for additional information.

Table 4.7: Renewable energy and EGI projects, located within 30 km of the proposed Kudu Solar Facilities, that are considered in the Cumulative Impact Assessment (Source: DFFE REEA, Quarter 4, 2022; and SAHRIS).

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
1	• 12/12/20/2258 • 12/12/20/2258/1	Solar PV	75	Approved and Preferred Bidder (Operational)	• The Proposed Establishment of Photovoltaic (Solar Power) Farms in the Northern Cape Province - Kalkbult	2010	Scoping and EIA	Scatec Solar SA Pty Ltd	Sustainable Development Projects cc
2	• 12/12/20/2463/1 • 12/12/20/2463/1/2 • 12/12/20/2463/1/A2 • 12/12/20/2463/1/AM3 • 12/12/20/2463/1/AM4 • 12/12/20/2463/1/AM5	Onshore Wind	140	Approved and Preferred Bidder (Operational)	• Longyuan Mulilo De Aar 2 North Wind Energy Facility • Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility • The Wind Energy Facility (North and South) situated on the Plateau Near De Aar, Northern Cape Province	2010 and 2014	Scoping and EIA and Amendment	Longyuan Mulilo De Aar 2 South (Pty)	Aurecon South Africa (Pty) Ltd and Holland and Associates Environmental Consultants
3	• 12/12/20/2463/2 • 12/12/20/2463/2/AM2	Onshore Wind	100	Approved and Preferred Bidder (Operational)	• Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility • The Wind Energy Facility (North and South) Situated On The Plateau Near De Aar, Northern Cape Province	2010 and 2014	Scoping and EIA and Amendment	Mulilo Renewable Energy (Pty) Ltd	Aurecon South Africa (Pty) Ltd
4	• 14/12/16/3/3/1/1166 14/12/16/3/3/1/1166/AM3 14/12/16/3/3/1/1166/AM4	Transmission line	132	Approved	• Basic Assessment for the proposed construction of a 132 kV transmission line corridor adjacent to the existing Eskom transmission line from Longyuan Mulilo De Aar 2 North Wind Energy Facility (WEF) to the Hydra Substation in De Aar, Northern Cape	2010 and 2014	Basic Assessment	Longyuan Mulilo De Aar 2 North (Pty) Ltd	Aurecon South Africa (Pty) Ltd
5	• 14/12/16/3/3/1/785	Transmission line	132	Approved	• Proposed construction of two 132kV transmission lines from the South & North Wind Energy Facilities on the Eastern Plateau (De Aar 2) near De Aar, Northern Cape.	2010	Basic Assessment	Mulilo Renewable Energy (Pty) Ltd	Aurecon South Africa (Pty) Ltd
6	• 14/12/16/3/3/2/278 • 14/12/16/3/3/2/278/1 • 14/12/16/3/3/2/278/2	Onshore Wind	118	Approved	• Proposed Castle Wind Energy Facility Project, located near De Aar, Northern Cape	2010 and 2014	Scoping and EIA	Castle Wind Farm (Pty) Ltd	Aurecon South Africa (Pty) Ltd; and Savannah Environmental Consultants (Pty) Ltd
7	• 14/12/16/3/3/2/564 • 14/12/16/3/3/2/564/AM1 • 14/12/16/3/3/2/564/AM2	Solar PV	75	To be confirmed	• Proposed Swartwater 75MW solar PV power facility in Petrusville within Renosterburg Local Municipality, Northern Cape	2010 and 2014	Scoping and EIA and Amendment	AE-AMD Renewable Energy (Pty) Ltd	USK Environmental and Waste Engineering (Pty) Ltd
8	• 14/12/16/3/3/2/740	Solar PV	300	Approved	• Proposed 300MW Solar Power Plant in Phillipstown area in Renosterberg Local Municipality	2010	Scoping and EIA	To be confirmed	Tshikovha Environmental and Communication Consultants
9	• 14/12/16/3/3/2/744	Solar PV	Unknown	Approved	• Proposed PV facility on farm Jakhalsfontein near De Aar	2010	Scoping and EIA	Solar Capital (Pty) Ltd	Eco Compliance (Pty) Ltd
10	• 14/12/16/3/3/2/739	Solar PV	70 - 100	To be confirmed	• Proposed 70 - 100 MW Solar Power Plant in Petrusville	2010	Scoping and EIA	To be confirmed	Tshikovha Environmental and Communication Consultants
11	• Not issued yet (it is understood that the project is still within the pre-application stage)	Solar PV	800 (Maximum)	Pre-Application	• The Proposed Keren Energy Odyssey Solar PV Facilities (Odyssey Solar 1, Odyssey Solar 2, Odyssey Solar 3, Odyssey Solar 4, Odyssey Solar 5, Odyssey Solar 6, Odyssey Solar 7 And Odyssey Solar 8)	2014	Scoping and EIA	Keren Energy Group Holdings	EnviroAfrica cc
12[11]	• Tafelkop Solar PV: 14/12/16/3/3/2/2272 • Koppy Allen Solar PV: 14/12/16/3/3/2/2273 • Vrede Solar PV: 14/12/16/3/3/2/2274 • Zionsheuvel Solar PV: 14/12/16/3/3/2/2277	Solar PV	3050	EIA Phase	• The Proposed Development of the Crossroads (formally referred to as the Hydra B) Green Energy Cluster of Renewable Energy Facilities and Grid Connection Infrastructure, Pixley Ka Seme District Municipality, Northern Cape Province. The Cluster entails the development of up to 21 solar energy facilities, with the Scoping and EIA Processes consisting of three phases. Phases 1, 2 and 3 consist of 9, 6 and 6 solar facilities, respectively. The Phase 1 Scoping and EIA Processes were launched in	2014	Scoping and EIA	Akuo Energy Afrique	Savannah Environmental Consultants (Pty) Ltd

[11] At the time of finalization of this EIA Report for the proposed Kudu Solar Facility, the mapping files for the proposed Cross Roads Green Energy Cluster were provided for Phase 1 of the development only. Hence Phase 2 and Phase 3 are not spatially shown on Figure 4.3.

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
	• Amper Daar Solar PV: 14/12/16/3/3/2/2278 • Wag-'n-Bietjie Solar PV: 14/12/16/3/3/2/2279 • Ruspoort 1 Solar PV: 14/12/16/3/3/2/2280 • Ruspoort 2 Solar PV: 14/12/16/3/3/2/2281 • Middelplaas Solar PV: 14/12/16/3/3/2/2282				January 2023. Phase 1 of this development is only considered in this cumulative impact assessment.				
Study area shown on map	• Kudu Solar Facility 1: 14/12/16/3/3/2/2244 • Kudu Solar Facility 2: 14/12/16/3/3/2/2245 • Kudu Solar Facility 3: 14/12/16/3/3/2/2246 • Kudu Solar Facility 4: 14/12/16/3/3/2/2247 • Kudu Solar Facility 5: 14/12/16/3/3/2/2248 • Kudu Solar Facility 6: 14/12/16/3/3/2/2249 • Kudu Solar Facility 7: 14/12/16/3/3/2/2250 • Kudu Solar Facility 8: 14/12/16/3/3/2/2251 • Kudu Solar Facility 9: 14/12/16/3/3/2/2252 • Kudu Solar Facility 10: 14/12/16/3/3/2/2253 • Kudu Solar Facility 11: 14/12/16/3/3/2/2254 • Kudu Solar Facility 12: 14/12/16/3/3/2/2255	Solar PV	2180	Scoping and EIA Process underway (Final EIA Report submitted in July 2023)	• Proposed Development of 12 Solar Photovoltaic (PV) Facilities (Kudu Solar Facility 1 to 12) and associated infrastructure, near De Aar, Northern Cape Province	2014	Scoping and EIA	Kudu Solar Facility 1 (Pty) Ltd to Kudu Solar Facility 12 (Pty) Ltd	CSIR
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• HYDRA ROODEKUIL 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• HYDRA ROODEKUIL 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	765	Existing Power Line	• BETA HYDRA 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• HYDRA PERSEUS 3	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• VAN DER KLOOF ROODEKUIL 2	-	-	-	-

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• VAN DER KLOOF ROODEKUIL 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• BETA HYDRA 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• HYDRA PERSEUS 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• KALKBULT/KAREEBOSCHPAN 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• ROODEKUIL/ORANIA 1	-	-	-	-
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Perseus to Gamma 2nd 765 kV line • Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line	-	-	-	-
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Relocate Beta-Hydra 765kV line to form Perseus-Hydra 1st 765kV line • Cape Corridor Phase 2: Zeus - Hydra 765kV Integration	-	-	-	-
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Perseus to Gamma 2nd 765 kV line • Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line	-	-	-	-

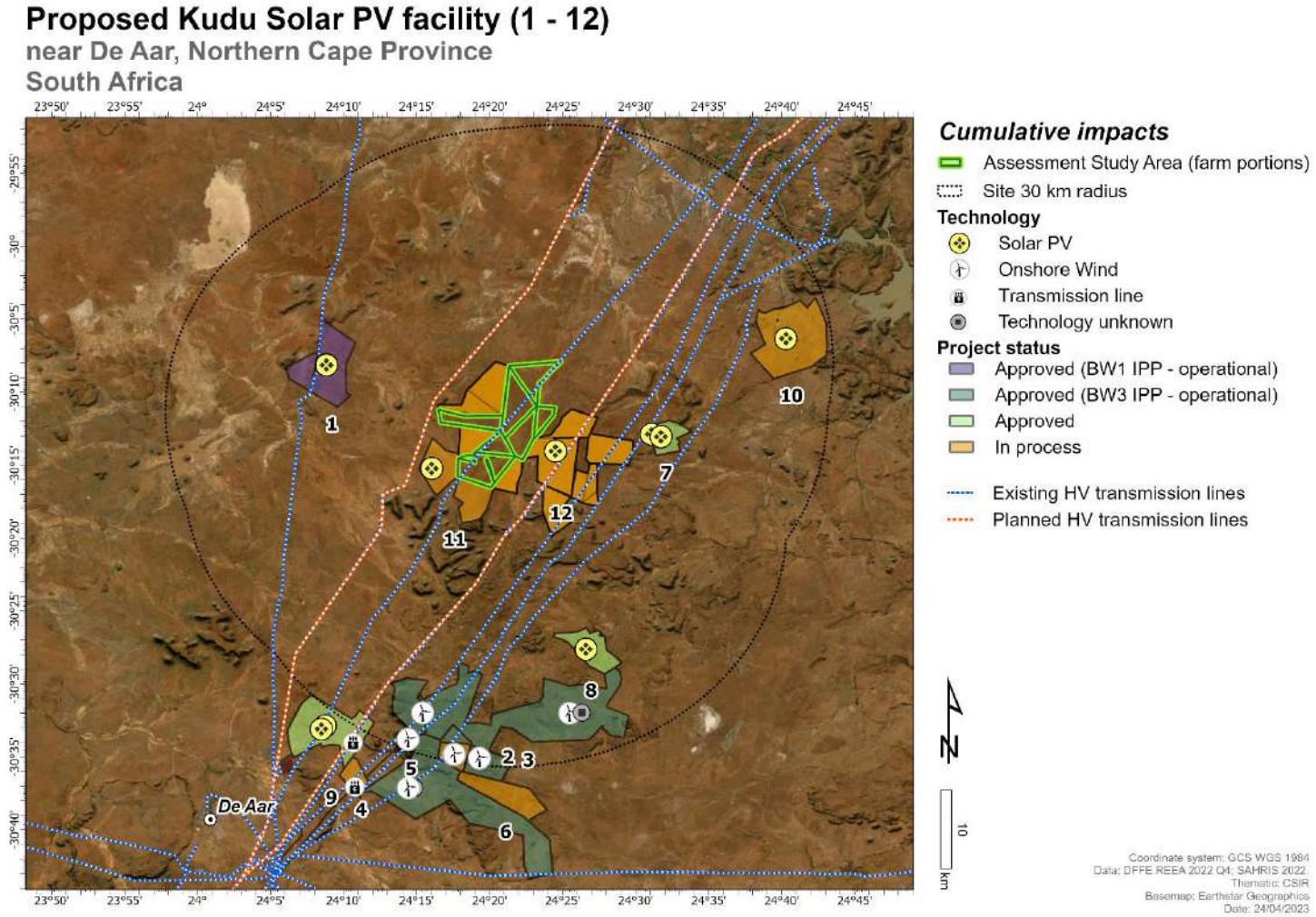


Figure 4.3. Renewable Energy projects within the 30 km radius considered for the Cumulative Impact Assessment (Source: DFFE REEA Quarter 4, 2022; and SAHRIS).

4.10 Terms of Reference for the Specialist Assessments

The specialist studies have been undertaken based on compliance with relevant legislation and based on the Terms of Reference indicated in the Plan of Study for the EIA, i.e. Chapter 7 of the FSR[12], which was accepted in March 2023. The Terms of Reference did not require any update following the 30-day commenting period of the DSR.

The Terms of Reference has also been included in the relevant specialist assessment chapters, i.e., Chapters 6 to 17 of this EIA Report. The results of the specialist assessments and other relevant project information and research undertaken for this proposed project have been integrated into this EIA Report.

The Terms of Reference for the Specialist Assessments essentially consist of the generic assessment requirements and the specific issues identified for each discipline, as captured in the Plan of Study for EIA.

[12] CSIR, 2023. Scoping and Environmental Impact Assessment (EIA) Process for the proposed development of a Solar Photovoltaic (PV) Facility (Kudu Solar Facility 4) and associated infrastructure, near De Aar in the Northern Cape Province. Final Scoping Report. CSIR Report Number: CSIR/SPLA/SECO/ER/2022/0054/B.



CHAPTER 5:
Project Alternatives



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Touching lives through innovation



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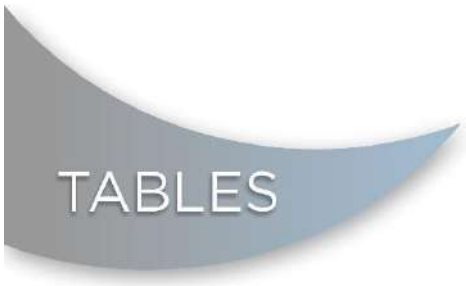


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5. APPROACH TO THE ASSESSMENT OF ALTERNATIVES

This chapter discusses the alternatives that have been considered as part of the Environmental Impact Assessment (EIA) Phase. Sections 24(4) (b) (i) and 24(4A) of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) require an Environmental Assessment to include investigation and assessment of impacts associated with alternatives to the proposed project. In addition, Section 24O (1)(b)(iv) also requires that the Competent Authority, when considering an application for EA, takes into account "*where appropriate, any feasible and reasonable alternatives to the activity which is the subject of the application and any feasible and reasonable modifications or changes to the activity that may minimise harm to the environment*".

Therefore, the assessment of alternatives should, as a minimum, include the following:

- The consideration of the no-go alternative as a baseline scenario;
- A comparison of the reasonable and feasible alternatives; and
- Providing a methodology for the elimination of an alternative.

The 2014 NEMA EIA Regulations (as amended) define "alternatives", in relation to a proposed activity, "as different means of meeting the general purpose and requirements of the activity, which may include alternatives to the:

- property on which or location where the activity is proposed to be undertaken;
- type of activity to be undertaken;
- design or layout of the activity;
- technology to be used in the activity;
- operational aspects of the activity; and
- includes the option of not implementing the activity".

Appendix 3 of the 2014 NEMA EIA Regulations (as amended) provides the following objectives, *inter alia*, of the EIA Process in relation to alternatives:

- To identify the location of the development footprint within the approved site as contemplated in the accepted scoping report based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment; and
- To identify the most ideal location for the activity within the development footprint of the approved site as contemplated in the accepted scoping report based on the lowest level of environmental sensitivity identified during the assessment.

The EIA Report is therefore required to provide a full description of the process followed to reach the proposed preferred activity, technology, site and location of the development footprint within the site, including details of all the alternatives considered and the outcome of the site selection matrix. The details presented in this chapter applies to the Kudu Solar Facility 4 (hereafter referred to as the "Kudu Solar Facility" or "proposed project").

5.1 Assessment of Alternatives

5.1.1 No-go Alternative

The no-go alternative assumes that the proposed project will not go ahead i.e. it is the option of not developing the proposed solar photovoltaic (PV) facility and associated infrastructure. This alternative would result in no environmental impacts on the site or surrounding local area as a result of the proposed project. It provides the baseline against which other alternatives are compared. The following implications will occur if the “no-go” alternative is implemented (i.e. the proposed project does not proceed):

- No benefits will be derived from the implementation of an additional land-use;
- No additional power will be generated or supplied through means of renewable energy resources by the proposed project at this location;
- The “no go” alternative will not contribute to and assist the government in achieving its renewable energy target of 26 630 MW total installed capacity by 2030 (for Wind, Solar PV and Concentrated Solar Power (CSP)) (Integrated Resource Plan (IRP), 2019);
- Electricity generation will remain constant (i.e. no renewable energy generation will occur on the site for the proposed project) and as a result, the local economy in terms of surrounding communities and towns within the local municipality will not be diversified, while existing electricity generation sources nationally will age and degrade over time, with maintenance requirements potentially leading to outages;
- There will be lost opportunity for skills transfer and education/training of local communities;
- The positive socio-economic impacts likely to result from the project such as increased local spending and the creation of local employment opportunities will not be realised;
- There will be no opportunity for additional employment in an area, where job creation is identified as a key priority;
- The local economic benefits associated with the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) will not be realised, and socio-economic contribution payments into the local community trust will not be realised;
- The development of solar PV facilities instead of coal fired power stations can directly contribute to South Africa’s response to climate mitigation; and
- Wind and solar energy are the cheapest source of electricity in South Africa, as seen in the REIPPPP Bidding Window 5 Preferred Bidder announcement on 28 October 2021. The development of the proposed Solar PV Facilities can contribute to the competitive nature of the REIPPPP to drive prices down even further to ensure that South Africans have access to affordable yet clean electricity.

Converse to the above, the following benefits could occur if the “no-go” alternative is implemented:

- Only the agricultural land use (livestock farming) will remain;
- No vegetation or protected species (flora) will be removed or disturbed during the development of the proposed project;
- No aquatic resources will be impacted upon during the construction and operation of the proposed project;
- No destruction of habitat will occur;

- No change to the current landscape will occur (i.e. the visual character of the area will remain unchanged);
- No heritage features will be impacted on;
- No noise impacts associated with construction activities will occur;
- No avifaunal impacts will occur due to the establishment of the project;
- No additional traffic will be generated; and
- No additional water use will be required.

The no-go alternative has been considered further by the specialists in the EIA Phase. Refer to the Specialist Assessments captured in Chapters 6 to 17 of this EIA Report for feedback on the no-go alternative. It is important to note that none of the Specialist Assessments have identified any environmental fatal flaws, and no unacceptable residual impacts have been identified.

The no-go alternative means no addition of renewable energy, which means further reliance on fossil fuels that will continue to have a negative environmental impact. While the no-go alternative i.e. not developing the proposed project will not result in any negative environmental impacts in the area, it will also not have any positive community development or socio-economic benefits. In addition, it will not assist government in addressing climate change, reaching its set targets for renewable energy, nor will it assist in supplying the increasing electricity demand within the country. **Hence, the no-go alternative is not the preferred alternative, nor is it a reasonable and feasible alternative to be considered in this EIA Process**.

5.1.2 Land-Use Alternatives

According to the Agricultural Compliance Statement, included in Chapter 6 of the EIA Report, the arid climate is the limiting factor for land capability, regardless of the soil capability and terrain. Moisture availability is insufficient for crop production without irrigation and the potential agricultural land use of the study area is therefore limited to grazing. The farm portions forming part of the study area are used for grazing sheep and game. Grazing capacity of the study area is fairly low at 20 hectares (ha) per large stock unit.

The Agricultural Site Sensitivity Verification verifies that the entire study area is classified as low and medium agricultural sensitivity with a land capability value of 5 to 6, which is in line with the climate limitations that make the site totally unsuitable for dryland crop production. There is no scarcity of such agricultural land in South Africa and its conservation for agricultural production is not therefore a priority. The proposed project offers positive impact on agriculture by way of improved financial security for farming operations, as well as security benefits against stock theft and other crime.

Hence, the agricultural land use is not a preferred alternative, and is not deemed as feasible for consideration in the EIA Phase, based on the motivation provided above.

5.1.3 Renewable Energy Alternatives

In terms of the type of activity, this relates to the generation of electricity from a renewable energy source, and in this particular case, from **solar** resources. As indicated in Chapter 1 of this EIA Report, the South African subsidiary of ABO Wind[1] focuses on solar, wind and biogas technologies and works with landowners, technology providers, regulators and investors to source and develop renewable energy projects. Therefore, the **generation of electricity from a renewable energy source** was the only activity considered by the Project Applicant, and thus considered in this Scoping and EIA Process. **No other activity types were considered or deemed appropriate based on the expertise of the Project Applicant, as motivated below**.

Where the "activity" is the generation of electricity from a renewable energy source, possible alternatives that could potentially be considered include Biomass, Hydro Energy, Wind Energy and Solar Energy. However, based on the preliminary investigations undertaken by the Project Applicant, **Solar PV development is the preferred technology alternative** and no other renewable energy technologies are deemed to be feasible for the study area. The unsuitability of other renewable energy technologies in the study area, and impacts of each, are discussed below.

5.1.3.1 Biomass Energy

The proposed project study area does not contain an abundant or sustainable supply of biomass. As indicated in Figure 5.1, the proposed project area has less than 5 000 t/a annual forestry residue, which is the lowest for this category. Therefore, the study area does not have any biomass energy potential.

Therefore, the implementation of a Biomass Energy Facility within the study area is not considered to be a reasonable and feasible alternative for assessment as part of this Scoping and EIA Process.

5.1.3.2 Hydro Energy

The proposed project study area does not contain any large inland water bodies, which excludes the possibility of renewable energy from small- or large-scale hydro energy generation. In terms of macroscale hydropower potential (Figure 5.1), the study area falls within an area classified as "Not Suitable" (i.e. less than 1 000 kWh/year).

Therefore, the implementation of a Hydro Energy Facility within the study area is not considered to be a reasonable and feasible alternative for assessment as part of this Scoping and EIA Process.

[1] ABO Wind renewable energies (Pty) Ltd (hereafter "ABO Wind") is involved in the development proposal stage, however the responsibility for the actual implementation of the project (should EA and relevant approvals be granted) lies with the Project Developer / Project Applicant (i.e. Kudu Solar Facility 4 (Pty) Ltd).

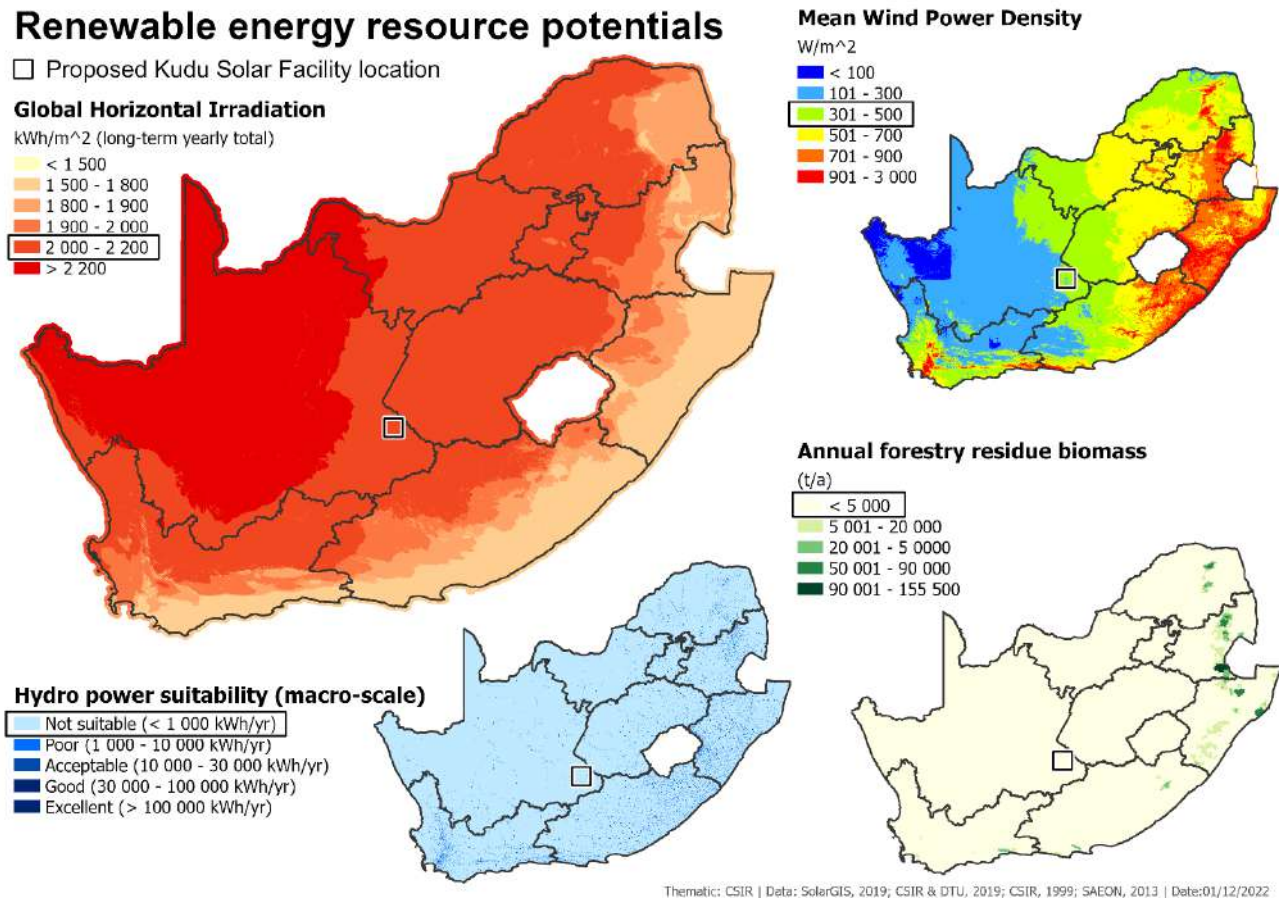


Figure 5.1: Solar Resource Availability / Global Horizontal Irradiation (kWh/m^2); Annual Mean Wind Power Density (W/m^2); Hydropower Potential (kWh/year); and Biomass Potential in terms of Annual Forestry Residue (t/a) for South Africa. The proposed project location is indicated by the black square.

5.1.3.3 Wind and Solar Energy

5.1.3.3.1 National Planning: IRP 2019

The 2019 IRP was published in Government Gazette (GG) 42784, Government Notice (GN) 1360 on 18 October 2019 for the period 2019 to 2030. As indicated in Figure 5.2 for the projection to 2030, coal makes up approximately 43 % of the total installed capacity, whereas Wind and Solar PV respectively make up 23 % and 10 % (Table 5, Page 42 of the IRP 2019 published in GG 42784).

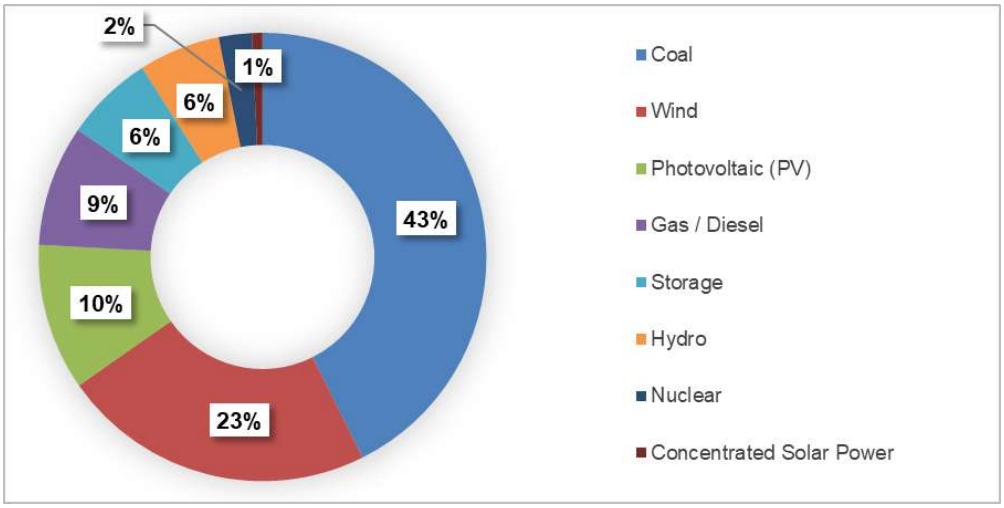


Figure 5.2: Total Installed Capacity for 2030 (% of MW) in the IRP of 2019.

The 2019 IRP proposes to secure 26 630 MW of renewable energy capacity by 2030 (for Wind, Solar PV and CSP). This amount excludes Hydropower and Storage. Of this total, 1 474 MW of Solar PV, 1 980 MW of Wind and 300 MW of CSP is already installed capacity. In addition, of the 26 630 MW, approximately 814 MW of Solar PV, 1 362 of Wind and 300 MW of CSP is committed or already contracted capacity. Furthermore, of the 26 630 MW total, 6 000 MW is allocated to Solar PV, and 14 400 MW is allocated to wind as new additional capacity. Refer to Figure 5.3 for additional information.

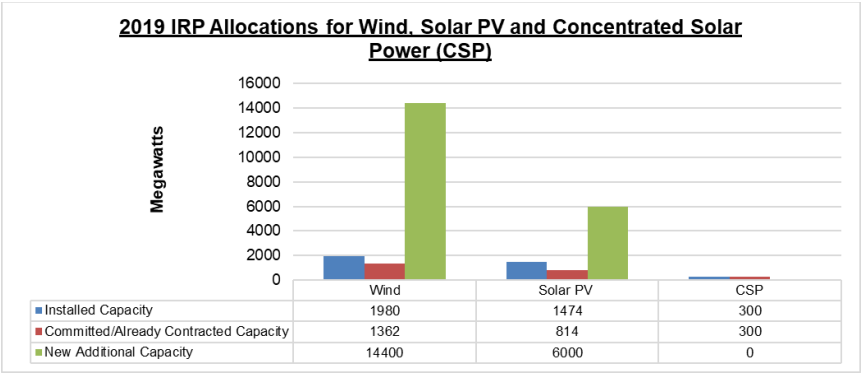


Figure 5.3: 2019 IRP Allocations for Wind, Solar and CSP in MW.

As part of the rollout of renewable energy in the country, the Department of Mineral Resources and Energy (DMRE) developed a bidding process for the procurement of a set amount (MW) of renewable energy in accordance with the IRP from Independent Power Producers (IPPs). The REIPPPP was launched in 2011 to implement the vision of the IRP and it included several bidding rounds (called "Bidding Windows"). To date, Bidding Windows 1, 2, 3, 3.5, 4, 5 and 6 have been announced. It is understood that Bid Window 7 will be open in 2023 to potentially procure 5000 MW (DMRE, 2023[2]).

On 18 August 2015, an additional procurement target of 6 300 MW to be generated from renewable energy sources was added to the REIPPPP for the years 2021 - 2025, as published in GN 733, GG 39111. Of this, the additional target allocated for solar PV was 2 200 MW.

On 28 October 2021, the Minister of Mineral Resources and Energy (DMRE, 2021a[3]) announced the Preferred Bidders of Bid Window 5 of the REIPPPP, which was released in April 2021. The aim was to procure a total of 2 600 MW (consisting of 1 600 MW from onshore wind and 1 000 MW from Solar PV). Approximately 102 Bids were submitted in August 2021. Twenty-five (25) Preferred Bidder Projects, totalling 2 583 MW, were selected (DMRE, 2021a[1]). Of the 2 583 MW, approximately 1 608 MW and 975 MW will be respectively procured from 12 wind projects and 13 Solar PV projects (DMRE, 2022a[4]). In Bid Window 5, the Preferred Bidders provided an average tariff of 50 c/kWh for wind and of 43 c/kWh for solar PV. This is a considerable reduction in tariff from Bid Window 4 in November 2015 where the tariff provided for wind and solar PV were both 78 c/kWh. This confirms the crucial role that renewable energy is playing in being the lowest cost energy alternative in South Africa, while supporting the decarbonisation of the power system and ensuring that electricity is cost-effective and sustainable.

According to the IPP Office, in a presentation made at the Bid Window 6 Bidders' Conference on 7 July 2022 (IPP Office, 2022b[5]), as of March 2022 (excluding Bid Window 5 statistics), the DMRE had selected 92 Preferred Bidders, with a total combined electricity capacity of 6 323 MW procured, of which 5 826 MW is already operational from 87 IPPs.

Bid Window 6 was announced in April 2022 and closed on 3 October 2022, and will aim to procure 4200 MW (i.e. 3 200 MW from wind and 1 000 MW from Solar PV). Six preferred bidders for Solar PV projects have been announced for Bid Window 6.

On 7 July 2020, in GG 43509, GN R753, the Minister of Mineral Resources and Energy, in consultation with the National Energy Regulator of South Africa (NERSA), determined that new generation capacity needs to be procured to contribute towards energy security. Specifically, the gazette noted that 2000 MW needs to be procured from a range of energy source technologies in

2 DMRE (2023). Minister Gwede Mantashe: Mineral Resources and Energy Dept Budget Vote 2023/24 NCOP. https://www.gov.za/speeches/minister-gwede-mantashe-national-council-provinces-mineral-resources-and-energy-dept-budget [online]. Accessed May 2023.

3 DMRE (2021a). Announcement by the Minister of Mineral Resources and Energy, the Honourable Gwede Mantashe 28 October 2021 Renewable Energy IPP Procurement Programme (REIPPPP) Bid Window 5 Announcement of Preferred Bidders. https://ipp-projects.co.za/PressCentre [online]. Accessed November 2021.

4 DMRE (2022a). Media Statement by the DMRE: Signing of an additional three project agreements under the 5th Bid Window of the Renewable Energy Independent Power Producer Programme (REIPPPP BID WINDOW 5), dated 10 November 2022. https://ipp-projects.co.za/PressCentre [online]. Accessed November 2022.

5 IPP Office (2022b). Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) Bid Window 6 Bidders' Conference dated 7 July 2022. https://ipp-projects.co.za/PressCentre [online]. Accessed August 2022.

accordance with the short-term risk mitigation capacity allocated for the years 2019 to 2022 (under "other" in the allocation table contained in 2019 IRP). In line with this, the Risk Mitigation IPP Procurement Programme (RMIPPPP) was designed and launched in August 2020 by the DMRE in order to fulfil the GN R753 Ministerial Determination. Bids were submitted by various IPPs on 22 December 2020, and on 18 March 2021, the Minister of Mineral Resources and Energy, announced eight Preferred Bidders selected under the RMIPPPP, totalling 1 845 MW (DMRE, 2021b[6]). Three additional Preferred Bidder projects were also announced on 1 June 2021 under the RMIPPPP with a combined capacity of 150 MW, resulting in a total of approximately 1 995 MW to be procured under the RMIPPPP (DMRE, 2021c[7]).

As indicated in Chapter 2 of this EIA Report, the proposed project forms part of a cluster of 12 Solar PV Facilities, which will each have a generation capacity that ranges from 50 MWac to 350 MWac. **It is intended for these projects to be bid under the future rounds of the REIPPPP or similar bidding processes, following the issuing of Environmental Authorisations (EAs), should such be granted**.

5.1.3.3.2 Wind Energy

In order to ensure that a Wind Energy Facility is successful, a reliable wind resource is required. Wind resource is defined in terms of average wind speed and includes Weibull distribution (used to describe wind speed distributions); turbulence, wind direction, and pattern of wind direction (as depicted by a wind rose). These factors are all key considerations used in determining whether a site is suitable for the development of a Wind Energy Facility. A mean wind power density map has been created (CSIR, 2018), which is not related to any specific turbine type and demonstrates the wind resource of the country. The mean wind power density map shows that the project study area falls within an area of approximately 301 – 500 W/m^2 (Figure 5.1).

Overall, wind energy development can occur within this area but other localities in South Africa may be more favourable for such development. Site specific requirements for **Wind Energy Facilities** however make this proposed project study area a **less feasible alternative** when compared to solar PV.

The Avifauna Specialist Assessment (Chapter 9 of the EIA Report) notes that a suspected Verreaux's Eagle nest is present on the Hydra - Perseus 1 765 kV high voltage line within the study area for the proposed project. The Avifauna Specialist has recommended a 1 km all infrastructure exclusion zone around this nest to prevent the displacement of the breeding pair during the construction phase due to disturbance. In addition, the buffer area will reduce the risk of injury to the juvenile bird due to collision with the solar panels, when it starts flying and practicing its hunting technique around the nest. This buffer is in relation to the development of a solar PV project. For a proposed wind development, the buffer around this nest would be greater. According to the Avifauna Specialist, the wind energy buffers for Verreaux's Eagle are generally 3.7 km for a turbine exclusion zone, and 5.2 km buffer for medium sensitivity, wherein mitigation is required.

[6] DMRE (2021b). Media Statement: To Announce Preferred Bidders for the Risk Mitigation IPP Procurement Programme (RMIPPPP). https://www.dmr.gov.za/news-room/post/1894/media-statement-to-announce-preferred-bidders-for-the-risk-mitigation-ipp-procurement-programme-rmipppp [online]. Accessed November 2021.

[7] DMRE (2021c). Media Statement: Department of Mineral Resources and Energy Announces Three Additional Preferred Bidders Appointed under the Risk Mitigation Independent Power Producer Procurement Programme (RMIPPPP). https://www.ipp-rm.co.za/ [online]. Accessed November 2021.

Alternatively, a Verreaux's Eagle Risk Assessment (VERA) would be required for the wind energy development in order to inform the layout, and the results could be more restrictive.

Therefore, it is understood that the development of wind energy within the study area would most likely result in impacts that are more difficult to manage and that there would be limited space available based on Very High sensitivities relating to avifauna. Furthermore, one of the aims is to try and receive EA (should it be granted) as promptly as possible in order to ensure the project is bid in the next bidding windows of the REIPPPP or similar tender processes; and development of Wind Energy Facilities would need at least 12 months of pre-construction monitoring for birds and bats. In addition, for wind energy developments, collecting on-site wind data is necessary to confirm both the presence of the wind resource on site and the bankable viability of the proposed project. The provision of at least 12 months on-site wind monitoring data is also a requirement of the REIPPPP. The timelines for these monitoring programmes are not favourable to the overall current project schedule.

Therefore, the implementation of a Wind Energy Facility within the proposed project study area is not considered to be a feasible alternative for assessment as part of this current Application for EA. However, it is possible for ABO Wind to pursue this technology in the future and undertake detailed environmental screening to determine if it is feasible.

5.1.3.3.3 Solar Energy

In terms of the suitability of solar energy development at this location, the proposed project study area falls within the **second highest** Global Horizontal Irradiation[8] (GHI) category, relevant to PV installations (Figure 5.1). As indicated in Figure 5.1, the study area has a GHI of 2 000 kWh/m^2 to 2 200 kWh/m^2 in terms of the long-term yearly total.

Therefore, this area is deemed as one of the most suitable for the construction and operation of solar energy facilities as opposed to other areas and provinces within South Africa. For example, coastal regions within the Eastern Cape and Western Cape mainly have a lower GHI (shown in the lighter orange shades in Figure 5.1), which is not completely feasible for the proposed project. It is important to note that there are three operational PV facilities, that received Preferred Bidder status, located within 30 km of the proposed project study area; and there are several other approved PV projects within the 30 km radius as indicated in Chapter 4 of this EIA Report. Furthermore, as indicated in the earlier discussion on the outcomes of Bid Window 5 in October 2021, solar PV is currently the least cost energy generation option for South Africa. These factors substantiate that use of solar resources in the area is extremely viable and support the development of Solar PV within the proposed project study area.

Therefore, the implementation of a solar energy facility within the study area is more favourable and feasible than wind energy, biomass and hydropower development, especially from a project economic and energy generation viability and location compatibility perspective. Therefore, the proposed Solar PV Facility is the most feasible and preferred Renewable Energy Alternative.

[8] Global Horizontal Irradiance is the total amount of shortwave radiation received from above by a surface horizontal to the ground.

Finally, since the alternative renewable energy generation activities considered were deemed to be unreasonable and unfeasible for the study area, no other Renewable Energy alternatives were further assessed as part of the Scoping and EIA Process.

5.1.3.3.4 Summary of the Renewable Energy Alternatives

Table 5.1 presents a summary and an evaluation matrix for the possible renewable energy alternatives with regards to resource suitability and availability, and potential risks and impacts.

Table 5.1: Summary of Evaluation of Potential Risks and Impacts for Renewable Energy Alternatives.

Type of Renewable Energy Alternative	Are suitable resources available at the proposed project site?	Main Potential Impacts and Risks	Is this the preferred Alternative?
Biomass Energy	▪ No – not suitable i.e. less than 5 000 t/a annual forestry residue.	▪ Significant Waste Generation with the potential need for a Waste Management Licence; and ▪ Air Emissions with the potential need for an Atmospheric Emissions Licence.	▪ No
Hydro Energy	▪ No – "Not Suitable" (i.e. less than 1 000 kWh/year)	▪ Significant impacts on aquatic biodiversity and hydrology of the affected river system; ▪ Water Use Licence would be required for the establishment of an in-stream hydropower development; and ▪ Long lead times would be required for the various permits needed for such development.	▪ No
Wind Energy	▪ Yes, but other sites might have better wind resources - 301 – 500 W/m^2	▪ Visual impacts as a result of construction activities and turbines during operation; ▪ Noise generation as a result of construction activities and turbines during operation; ▪ Bird and bat collisions during the operational phase; ▪ More restrictive buffers due to Verreaux's Eagle, Cape Vulture, and White-backed Vulture (which were recorded during the site monitoring); ▪ Impacts on aquatic ecology and terrestrial ecology; ▪ Impact on archaeology and palaeontology; and ▪ Impact on Civil Aviation due to nearby aerodromes.	▪ No
Solar Energy	▪ Yes – 2 000 - 2 200 kWh/m^2	▪ Visual impacts as a result of construction activities and the PV panels during operation; ▪ Noise generation as a result of construction activities; ▪ Loss of agricultural land (i.e. grazing); ▪ Impacts on heritage resources (i.e. archaeology and palaeontology); ▪ Impacts on the water balance as a result of water required for panel cleaning; ▪ Impacts on avifauna, aquatic ecology and terrestrial ecology.	▪ Yes

5.1.4 Site Alternatives

The 2014 NEMA EIA Regulations (as amended) requires a site selection matrix to be provided to show how the preferred site was determined through a site selection process. Within this context, the "site" is the farms or land portions earmarked for the development of the proposed project. This is essentially the proposed project study area, which consists of farm portions indicated in Table 5.2. The total study area for all the Kudu Solar Facilities is approximately 8 150 ha.

Table 5.2: Farm portions forming the study area of the Kudu Solar Facilities.

FARM PORTION	SG CODE
Remaining Extent of the Farm Bas Berg No. 88	C05700000000008800000
Remaining Extent of Portion 3 of the Farm Bas Berg No. 88	C05700000000008800003
Portion 4 (Portion of Portion 3) of the Farm Bas Berg No. 88	C05700000000008800004
Remaining Extent of Portion 2 (Middel Plaats) (a Portion of Portion 1) of the Farm Grasspan No. 40	C05700000000004000002
Remaining Extent of the Farm Annex Wolve Kuil No. 41	C05700000000004100000
Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41	C05700000000004100001
Portion 2 of the Farm Wolve Kuil No. 43	C05700000000004300002
Remaining Extent of the Farm Wolve Kuilen No. 42	C05700000000004200000

The preferred site (i.e. study area) was strategically selected by the Project Developer based on various factors and detailed research, as noted below:

- As an initial step, the Project Developer undertook internal research, exploration work, and a desktop feasibility analysis (based on the grid connection options, solar resource and land availability) in order to identify the preferred site.
- The Project Developer then consulted the National Department of Forestry, Fisheries and the Environment (DFFE) Screening Tool and other available datasets, such as the Northern Cape Critical Biodiversity Area (CBA) map, and the South African National Biodiversity Institute (SANBI) Biodiversity GIS (BGIS) system, as well as the Endangered Wildlife Trust (EWT) No-Go Screening Tool, in order to identify desktop environmental sensitivities and to determine if there are any fatal flaws and concerns. The findings indicated that the study area is generally developable.
- The Project Developer then consulted with the owners of the farm portions forming the study area to obtain consent to develop the proposed project, and to also identify any areas where development must be excluded based on the requirements of the landowners. These landowner exclusion zones were then acknowledged and implemented, which influenced the site selection process.
- The Project Developer also considered adjacent farm portions and approached the landowners; however, this exercise was unsuccessful as the land had already been secured by other developers.
- The study area falls inside the Central Strategic Transmission Corridor that was gazetted in GN 113 of 16 February 2018, which allows for streamlining of the Environmental Assessment for Electricity Grid Infrastructure (EGI) development within the corridor, whereby a Basic Assessment and 57 days decision-making can be followed, instead of a full Scoping and EIA

with 107 days decision-making. In addition, the EGI Standard was published on 27 July 2022, in GG 47095; GN 2313, which allows for the exclusion from an Environmental Assessment for EGI development within the gazetted corridors in low and medium sensitivity areas. Should the EGI Standard apply, then the development for the EGI components of the project would only be subjected to a registration process with a decision-making of 30 days. This benefit was considered very significant by the Project Developer, and therefore obtaining a site within any of the gazetted Strategic Transmission Corridors was focused on.

- The Eskom Transmission Development Plan (TDP) 2022 – 2031 (Eskom, 2022[9]) notes that the Hydra B 400/132 kV Substation, a new substation, is required in the Northern Cape over the current TDP period. The Hydra B Substation is proposed to be located "approximately 50 km from the existing Hydra Substation along the Hydra-Perseus 400 kV line" (Eskom, 2022, Page 115). Eskom also confirmed that the proposed location of the Hydra B Substation falls within the EGI Corridor to be separately assessed as part of Projects 13 – 26. Refer to Chapter 1 of this EIA Report for additional feedback in this regard. Therefore, since the proposed Hydra B Substation is planned to be constructed in the same area, this makes a potential connection opportunity available. This is considered a significant benefit for the Project Developer, as grid connection is an important factor.
- It was also important for the site to be located outside of the Karoo Central Astronomy Advantage Area (KCAAA) so that there are no unacceptable impacts on the Square Kilometre Array (SKA), which could potentially be a fatal flaw or require significant investment in Radio Frequency Interference and Electromagnetic Control studies to be undertaken.

At a local level, the affected farm portions for the development of the proposed project were selected based on a combination of the factors listed above. Furthermore, from an impact and risk assessment perspective, the implementation of the proposed project at the **preferred site** will most likely result in fewer risks in comparison to its implementation at alternative sites within the Northern Cape (i.e. regions with similar solar radiation levels), based on the following points:

- There is no guarantee that the current land use of alternative sites will be flexible in terms of development potential, for example, the agricultural potential at the alternative sites might be higher and of greater significance.
- There is no guarantee of the willingness of other landowners to allow the implementation of a solar facility on their land and if the landowners strongly object, then the project will not be feasible.
- There is no guarantee that other sites will be located close to existing or proposed EGI to enable connection to the national grid. The further away a project is from the grid, the higher the potential for significant environmental and economic impacts.

[9] Eskom (2022). Eskom Transmission Development Plan: 2022 – 2031. Available online: https://www.eskom.co.za/wp-content/uploads/2022/03/TDP2022-2031Rev1.pdf. Accessed September 2022.

5.1.4.1 Site Specific Considerations

As indicated above, the preferred site for the proposed project extends over the farm portions indicated in Table 5.2.

On a site specific level, the preferred site was deemed suitable due to all the site selection factors (such as land availability, environmental sensitivities, irradiation levels, distance to the national grid, site accessibility, topography, current land use and landowner willingness) being favourable. The site selection criteria considered by ABO Wind are discussed in detail below in Table 5.3.

Table 5.3: Site selection factors and suitability of the preferred site for the development of the proposed project.

FACTOR	SUITABILITY OF THE PREFERRED SITE
Land Availability	The farm portions comprising the preferred site are of a suitable size for the proposed project. The land available for the development of all the proposed projects is approximately 8 150 ha in extent. Although this total area was assessed by the specialists during the site verifications and have been further assessed during the EIA Phase, only approximately 141 ha (on average) will be required for the permanent development footprint of the proposed project and its associated infrastructure.
Environmental Sensitivity	Although the preferred site for the proposed project does contain environmental features that need to be avoided due to very high or high environmental sensitivity, as described in the relevant chapters of this EIA Report, following these exclusions sufficient suitable land is still available to ensure the development feasibility of the project (see Section 5.1.5 below).
Irradiation Levels	The availability of the solar resource is the main driver of project viability. The project site was identified by the Project Developer through a desktop analysis based on the estimation of the solar energy resource, and other factors. This viable solar resource ensures the best value for money is gained from the project, allowing for competitive pricing and maximum generation potential, with the resulting direct and indirect benefits for the South African economy. The study area has a GHI of 2 000 to 2 200 kWh/m^2 in terms of the long-term yearly total.
Distance to and availability of the Grid	The proposed project is planned to connect to the existing Hydra-Perseus 400 kV overhead power line via a dedicated proposed 132 kV power line and an independent Main Transmission Substation (MTS). However, if the proposed Eskom Hydra B Substation is built by Eskom, then additional upgrades of this Eskom substation would be undertaken to ensure that the substation can accommodate the power generated by the proposed 12 Kudu Solar Facilities. Separate Basic Assessment (BA) and/or EGI Standard Registration Processes will be undertaken for the EGI Projects (Projects 13 – 26). Eskom has confirmed that the proposed Hydra B Substation is located within the EGI corridor that will be assessed and considered separately as part of Projects 13 – 26.
Site Accessibility	The proposed project site can be accessed via the following roads: ▪ Divisional Road 3084 (DR 3084); ▪ Divisional Road 3093 (DR 3093); ▪ Divisional Road 3096 (DR 3096); ▪ Trunk Road 38/1 (TR 38/01) (R48); ▪ Trunk Road 38/2 (TR 38/02) (R48); and ▪ Main Road 790 (MR 790) (R388). Refer to the Traffic Impact Assessment (Chapter 14of the EIA Report) and Chapter 2 of the EIA Report for additional information on the route options per project. Note that these route options are not alternatives for comparison in terms of the EIA Regulations; but rather

FACTOR	SUITABILITY OF THE PREFERRED SITE
	an indication that investigations of all possible options have been taken by the traffic specialist and Project Applicant. An island at the intersection of the DR 3903 and TR 38/01 will need removal and upgrading in order to accommodate the turning movement of the trucks. Details of this has been provided in Chapter 2, Chapter 4 and the Traffic Impact Assessment (Chapter 14 of the EIA Report). Internal service roads will also be constructed within the footprint of the PV facility (extending up to 5 m wide), and from the nearest existing road to the PV facility (extending up to 8 m wide).
Topography	The Visual Impact Assessment (Chapter 10 of this EIA Report) notes that the study area lies within an expansive flattish landscape, composed of Ecca Group shales, interspersed with dolerite-capped koppies, which are the main scenic features of the area and provide topographic relief. The elevation ranges from 1000 to 1500 m in the region.
Current Land Use	Agriculture (mainly low-density livestock grazing)
Landowner Willingness	All affected landowners have signed letters of consent for the use of the land for the proposed project (should an EA be granted). This is considered an important aspect of the proposed project in terms of its viability (i.e. this will limit potential appeals during the decision-making process, as the landowner is willing and supportive of the proposed project being undertaken on the affected farm portions).

Furthermore, the proposed project forms part of a large cluster of 12 Solar PV projects. The main determining points for the Project Developer was to find suitable, developable land in one contiguous block to (i) optimize design, (ii) minimize construction and operational costs, and (iii) minimize sprawling development and limit the impact footprints. In addition, the proximity to the proposed Eskom Hydra B Substation, as well as existing Eskom 400 kV power lines, was also a major determinant for identifying suitable sites for the proposed development.

In order to submit a bid in terms of the REIPPPP, the proponent is required to have obtained an EA in terms of the EIA Regulations as well as several additional authorisations or consents. It is important to note that the National Department of Environmental Affairs (DEA) in discussion with the Department of Energy (DoE) (now respectively operating as the DFFE and DMRE), was mandated by MinMec to commission a Strategic Environmental Assessment (SEA) to identify the areas in South Africa that are of strategic importance for Wind and Solar PV development. The Phase 1 Wind and Solar PV SEA[10] was completed in 2015, and was in support of the Strategic Infrastructure Plan (SIP) 8, which focuses on the promotion of green energy in South Africa. Similarly, the Phase 2 Wind and Solar SEA was commissioned in 2017 and completed in 2019. The SEA aimed to identify strategic geographical areas best suited for the roll-out of large scale wind and solar PV energy projects, referred to as Renewable Energy Development Zones (REDZs). Through the identification of the REDZs, the key objective of the SEA was to enable strategic planning for the development of large scale wind and solar PV energy facilities in a manner that avoids or minimises significant negative impact on the environment while being commercially attractive and yielding the highest possible social and economic benefit to the country – for example through strategic investment to lower the cost and reduce timeframes of grid access. Following the completion of the Phase 1 Wind and Solar SEA, eight REDZs were gazetted in

[10] More information on the SEA can be accessed at https://redzs.csir.co.za

February 2018 in GN 114 by the Minister of Environmental Affairs. In addition, following the completion of the Phase 2 Wind and Solar SEA, three REDZs were gazetted in February 2021 in GN 144 by the Minister of Forestry, Fisheries and the Environment.

The proposed project is located approximately 120 km away (at its closest point) from the Kimberley REDZ. While the proposed project is not located within the REDZ, it still indeed supports the development of a large-scale renewable energy project at the proposed location. The proposed project is linked to the national planning vision for Renewable Energy development in South Africa.

Given the site selection requirements associated with solar energy facilities and the suitability of the land available on the **preferred site**, and the fact that no initial fatal flaws are present on the site, as well as the motivating factors listed above, **no other site alternatives were considered as part of this Scoping and EIA Process. Therefore, the site is deemed feasible and selected as the preferred site.**

5.1.5 Location Alternatives – Development Footprint within the Preferred Site

The strategic process followed to reach the preferred site and to consider various development footprints (or location alternatives) within the preferred site are discussed in this section and illustrated in Figure 5.4. The approach followed is to use environmental and social constraints to avoid sensitive features, thus applying mitigation hierarchy thinking. This approach replaces the need to rank alternative sites and locations, as it leads to the selection of the least sensitive development footprint. Refer to Chapter 2 of this EIA Report for additional information in this regard, specifically the progression from the study area / preferred site to the buildable areas and development footprint.

Once the preferred site was identified, the Project Developer then determined the **Original Scoping Buildable Areas** based on the high-level environmental screening. Following this, the Environmental Assessment Practitioner (CSIR) and Specialists were appointed by ABO Wind to undertake the Scoping and EIA Processes for the Kudu Solar Facilities.

The specialists then undertook the Scoping Level Specialist Assessments, and site sensitivity verifications, where necessary. The specialists assessed the full extent of the preferred site (i.e. approximately 8 150 ha), which serves as the Study Area for this Scoping and EIA Process. The specialists also provided feedback on the Original Scoping Buildable Areas. The Scoping Level Specialist Assessments resulted in the determination and verification of environmental sensitivities present on the preferred site.

Based on the findings of the Scoping Level Specialist Assessments, the **Original Scoping Buildable Areas** were revised in order to avoid the sensitivities identified. This resulted in the identification of the **Revised Scoping Buildable Areas**. Overall, the entire site / study area, and thus all identified buildable areas were assessed by the specialists.

Based on the above, environmental feature and sensitivity maps were produced during the Scoping Phase. These maps showed the identified environmental features and sensitivities such as terrestrial biodiversity, aquatic features, avifauna, heritage, visual, and geohydrological features present within the study area and buildable areas.

At the end of Scoping, the no-go or very highly sensitive environmental features found within the preferred site were avoided by the location, layout and design of the proposed project. Following the exclusion of the required areas, sufficient developable area is still available on site which does not compromise the current ecological integrity of the site.

The layout or location of the development footprint of the proposed project has been refined / finalised during the EIA Phase. This led to identification of the development footprints within the investigated buildable areas, as well as a layout plan of the proposed project, which is shown in Chapter 2 of the EIA Report. The current layout and **Buildable Areas / development footprints** are thus a culmination of extensive technical, economic and environmental planning. Refer to Chapter 3, the specialist studies in Chapters 6 to 17, and Chapter 20 of this EIA Report for feedback on the relevant sensitivities identified.

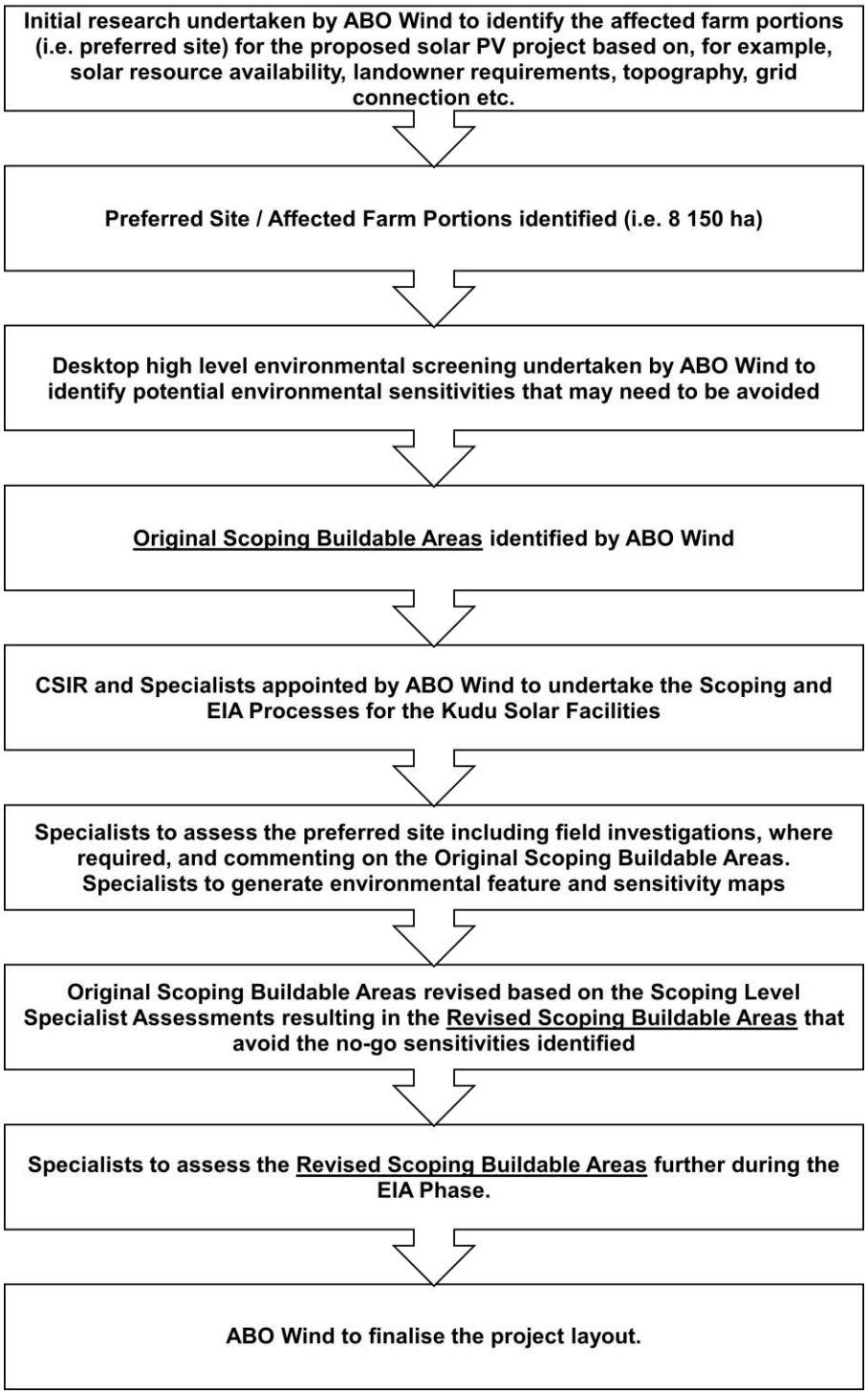


Figure 5.4: Process flow for the identification of the Preferred Site and Development Footprint.

It must be re-iterated that a strategic site, location and development footprint identification process has been followed, where the selection is informed by the environmental constraints identified through screening. This is based on the mitigation hierarchy approach of firstly trying to avoid impacts through careful siting. Therefore, it must be noted that different site, location or development footprint alternatives are not ranked, but rather a strategic process was followed (as

shown in Figure 5.4) where sensitive features are screened out, such as in Table 5.3, in order to reach the preferred location or development footprint within the preferred site.

5.1.6 Technology Alternatives

The following technology alternatives were considered as part of this Scoping and EIA Process.

5.1.6.1 Solar Panel Types

Only the PV solar panel technology type has been considered in this Scoping and EIA Process (i.e. no other technology types considered in this regard). Due to the scarcity of water in the proposed project area and the large volume of water required for CSP, this technology is not deemed feasible or sustainable and has not been considered in this Scoping and EIA Process. This is the main difference between PV and CSP technology that led to the selection of PV as the preferred solar panel technology.

Furthermore, CSP technology requires a larger development footprint to obtain the same energy output as PV technology, and it requires active solar tracking to be effective. As described above, in terms of the 2019 IRP, 300 MW capacity is already installed for CSP; and an additional 300 MW has been allocated for 2019, whilst there is no new additional capacity allocated for this technology. Solar PV is allocated an additional new capacity of 6 000 MW in terms of the 2019 IRP. This means that the need and desirability of CSP is not as evident and justified compared to PV.

5.1.6.2 PV Mounting System

Solar panels can be mounted in various ways to ensure maximum exposure of the PV panels to sunlight. The main mounting systems considered as part of the Scoping and EIA Process and design are Single Axis Tracking structures (aligned north-south); Dual Axis Tracking (aligned east-west and north-south); Fixed Tilt Mounting Structure; Mono-facial Solar Modules and Bifacial Solar Modules.

Note that the mounting options are not weighed against each other in order to identify the most preferred alternative at the end of the EIA Phase. Instead, the specialists have assessed all of the above mounting systems, and thus all are put forward for approval in the EA (should it be granted). Regardless of the mounting system, the maximum height of the PV panel structure has been assessed by the specialists and will not be exceeded.

5.1.6.3 Battery Energy Storage Systems

As indicated in Chapter 2 of this EIA Report, two alternative technologies have been considered in the Scoping and EIA Process, i.e. Solid State Battery Energy Storage Systems (BESS) (typically Lithium technology) and Redox Flow BESS (typically vanadium chemistry). The technology is advancing rapidly, and the exact chemistry will be chosen during the Engineering, Procurement and Construction (EPC) phase. Refer to Chapter 15 of this EIA Report for a High-Level Safety, Health and Environment Risk Assessment, which provides high level information on the safety, health and environmental risks of the BESS technologies being considered. Table 5.4 provides high level advantages and disadvantages of the two technologies.

Table 5.4: Advantages and disadvantages associated with the BESS technologies being considered for the proposed project (Sources: ISHECON, 2022, Parsons, 2017[11]; Zhang *et al*., 2016[12]).

BESS technologies being considered	Advantages	Disadvantages
Solid State Lithium-ion BESS	▪ Sealed systems i.e. pre-assembled off site and delivered to site for placement (i.e. carries less potential risk to the environment in terms of spillages). Hence, they are easier to install and will not likely need many permanent staff. ▪ Reduced risk of spillage as storage of large quantities of electrolyte is not required.	▪ Explosions and fires can occur as well as the possibility of generating noxious smoke under these circumstances. This can occur as result of electrolytes mixing when a breach occurs due to: - improper maintenance near operating temperature, - thermal expansion, or - freeze thaw cycles. ▪ Over the long term, these BESS may be more difficult to repurpose / dispose of and may present cumulative long term environmental impacts.
Redox Flow Batteries (RFB)	▪ RFBs are self-discharging systems therefore generally require little maintenance. However, RFBs are more difficult to install, i.e. formal brick and mortar structures, and will potentially require many permanent staff. ▪ High economic efficiency, for example, Vanadium has a high economic value and can be recycled.	▪ Risk of spillage tends to be higher for RFB as opposed to sealed solid-state BESS as the storage tanks of RFB, may be subjected to leaks or spills during the replacement or blending of the electrolyte, or during transport of the battery to and from site.

Note that the specialists have assessed both BESS technologies. The original proposed plan was, if both technologies are deemed acceptable, to motivate to the DFFE in the EIA Phase that both options be considered for approval in the EA (should it be granted). However, the DFFE requested, as part of their acceptance of the Final Scoping Report, that one preferred technology must be selected during the EIA Phase. All the specialists have confirmed and assessed that both BESS technologies are acceptable, as noted in Chapters 6 to 17 of this EIA Report. **Nevertheless, the preferred technology has been selected and confirmed in Chapter 20 of this EIA Report (Conclusions and Recommendations)**. The relevant listed activities have been addressed in the Amended Application for EA, as applicable.

[11] Parsons, 2017. US Trade and Development Agency. South Africa Energy Storage Technology and Market Assessment. Order Number: TDA-IE201511210. USTDA Activity Number: 2015-11032A. Parsons Job Number: 640368.

[12] Zhang, X., Tang, Y., Zhang, F., and Lee, C. S., (2016). A novel aluminium–graphite dual-ion battery. Advanced energy materials, 6(11), p.1502588.

5.2 Concluding Statement of Preferred Alternatives

As per Appendix 3, Section 3 (1) (h) (x) of the 2014 NEMA EIA Regulations (as amended), and based on Section 5.1 above, the following alternatives were addressed in the EIA Phase. This serves as a concluding statement indicating the location of the preferred alternative development footprint within the approved site as contemplated in the accepted scoping report:

- **No-Go Alternative:**
  - The no-go alternative assumes that the proposed project will not go ahead i.e. it is the option of not constructing the proposed Kudu Solar Facility. This alternative would result in no environmental impacts (positive and negative) on the preferred site or surrounding local area, as a result of the proposed project. The no-go alternative has been assessed in detail by all the specialists on the project team during the EIA Phase. **At this EIA Phase, the no-go alternative is not preferred**.

- **Land-Use Alternative:**
  - The current land-use is agriculture, specifically low density small stock grazing. There is no cultivation in the area. The study area has low to medium agricultural sensitivity and is **not deemed feasible for further assessment during the EIA Phase**. The proposed project offers some positive impact on agriculture by way of improved financial security for farming operations, as well as wider, societal benefits. The development of the proposed project at the preferred site is more favourable than the agricultural land-use alternative.

- **Type of Activity Alternative:**
  - This relates to the generation of electricity from a renewable energy source, and in this particular case, from solar resources. The **generation of electricity from a renewable energy source was the only activity considered** by the Applicant, and thus considered in this Scoping and EIA Process. **No other activity types were considered or deemed appropriate** based on the expertise of the Applicant.

- **Renewable Energy Alternatives:**
  - Given the above, the development of Solar PV is the preferred and only renewable energy technology to be developed on site because the site has a **very good solar resource availability** (i.e. GHI of 2 000 to 2 200 kWh/m^2 in terms of the long-term yearly total) and the **local conditions are favourable**.
  - In addition, **Hydro Power and Biomass Energy** are deemed **unsuitable**.
  - The study area does have wind resources (i.e. 301 – 500 W/m^2), however other sites might have better wind resources. In addition, based on the findings of the Avifauna Specialist Assessment, the presence of certain bird species would make wind energy development and associated impacts **more difficult to manage and there would be limited space available based on the Very High and High sensitivities**.

- **Preferred Site and Development Footprint within the site:**
  - The preferred site for all the proposed Kudu Solar Facilities comprises the following farm portions which cover a combined footprint of 8 150 ha, which serves as the study area for this Scoping and EIA Process. This is the approved site as per the accepted Final Scoping Report:
    - Remaining Extent of the Farm Bas Berg No. 88
    - Remaining Extent of Portion 3 of the Farm Bas Berg No. 88
    - Portion 4 (Portion of Portion 3) of the Farm Bas Berg No. 88
    - Remaining Extent of Portion 2 (Middel Plaats) (a Portion of Portion 1) of the Farm Grasspan No. 40
    - Remaining Extent of the Farm Annex Wolve Kuil No. 41
    - Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41
    - Portion 2 of the Farm Wolve Kuil No. 43
    - Remaining Extent of the Farm Wolve Kuilen No. 42
  - This led to the identification of the Original Scoping Buildable Areas within the preferred site. Furthermore, a screening and site verification exercise of the study area was undertaken by the specialist team during the Scoping Phase. The findings of the Scoping Level Specialist Assessments were used to determine the Revised Scoping Buildable Areas. The Revised Scoping Buildable Areas avoided the no-go sensitivities identified by the specialists.
  - The buildable areas and preferred project layout have been confirmed during this EIA Phase. A layout plan has been included in the Chapter 2 of this EIA Report.
  - The location of the preferred development footprint and buildable area for Kudu Solar Facility 4 is on the following property: Remaining Extent of Portion 3 of the Farm Bas Berg No. 88.

- **Technology Alternatives**
  - Only the PV solar panel type has been considered in this Scoping and EIA Process, along with various mounting options that will be considered in the design.
  - The following types of BESS technologies have been assessed in the EIA Phase and the preferred alternative has been selected, as detailed in Chapter 20 of this EIA Report:
    - Lithium-ion BESS; and
    - RFB.

5.3 Summary of Legislative Requirements for the Assessment of Alternatives

As noted in Chapter 1 of this EIA Report, the 2014 NEMA EIA Regulations (as amended) have certain requirements in terms of the selection of the **proposed preferred activity, site and location of the development footprint within the site**. Table 5.5 below indicates the requirements of the 2014 NEMA EIA Regulations (as amended) in terms of alternatives, and a corresponding response from the EAP showing how the requirements have been addressed in this report.

Table 5.5: Requirements for the consideration of Alternatives based on the 2014 NEMA EIA Regulations (as amended).

	Section of the EIA Regulations	Requirements for an EIA Report in terms of Appendix 3 of the 2014 NEMA EIA Regulations (as amended)	Response from EAP
1	Appendix 3 – 3 – 1 – h – (i)	3. (1) An environmental impact assessment report must contain the information that is necessary for the competent authority to consider and come to a decision on the application, and must include: (h) a full description of the process followed to reach the proposed development footprint within the approved site as contemplated in the accepted scoping report, including: (i) details of all the development footprint alternatives considered;	Refer to Sections 5.1, 5.2, and 5.3 (i.e. this section) of this chapter which provides a description of the process that led to the identification of the preferred alternatives and which alternatives were taken further into the EIA Phase for assessment.
2	Appendix 3 – 3 – 1 – h – (ii)	(ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;	Refer to Chapter 4 of this EIA Report and Appendix F and H, which details the process followed in terms of Public Participation and includes the supporting documentation.
3	Appendix 3 – 3 – 1 – h – (iii)	(iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;	Refer to Appendix F.5 of this EIA Report for the Issues and Responses Trail, which includes the issues raised by Interested and Affected Parties (I&APs) during the 30-day comment period on the Background Information Document. Furthermore, Appendix F.11 of this EIA Report includes a record of all comments received during the 30-day comment period on the Draft Scoping Report, as well as adequate responses. Comments raised during the 30-day review of the EIA Report have been captured and responded to in a Comments and Responses Trail in Appendix H.7 of the Final EIA Report. In addition, the specialist studies are included in Chapters 6 to 17 of this EIA Report, which also discusses the issues and comments raised during the Scoping Phase (and EIA Phase, as relevant).
4	Appendix 3 – 3 – 1 – h – (iv)	(iv) the environmental attributes associated with the development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Refer to Chapter 3 and Chapters 6 to 17 of this EIA Report for a description of the environmental sensitivities associated with the development footprint and study area. Section 5.1.4 of this chapter also provides information on environmental attributes that

	Section of the EIA Regulations	Requirements for an EIA Report in terms of Appendix 3 of the 2014 NEMA EIA Regulations (as amended)	Response from EAP
			were considered in the selection of the preferred site for the proposed project.
5	Appendix 3 – 3 – 1 – h – (v)	(v) the impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts: (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated;	In terms of the no-go alternative, this is not considered as the preferred alternative, as discussed in Section 5.1.1 of this chapter. The impacts and risks of both adopting and not adopting the no-go alternative have been discussed in this section. Furthermore, this has been unpacked by the relevant specialists in this EIA Phase. Feedback on the impacts and risks that informed the identification of the preferred activity (i.e. generation of energy from solar resources) is provided in Section 5.1.3 and Section 5.1.4 above. Such feedback relating to the preferred site and location of the development footprint within the site is captured in Chapters 6 to 17 of this EIA Report, which includes the specialist assessment of impacts and risks of the proposed project, and it includes a description and assessment of the nature, significance, consequence, extent, duration and probability of the identified impacts for the preferred alternatives, as well as an assessment of the reversibility and irreplaceability of the potential identified impacts, as well as the degree to which the identified impacts can be avoided, managed or mitigated (as relevant). Furthermore, two technologies for the BESS have been assessed in terms of impacts and risks in this EIA Phase. The preferred alternative has been selected, as described in Chapter 20 of this EIA Report.
6	Appendix 3 – 3 – 1 – h – (vi)	(vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks;	Refer to Chapter 4 of this EIA Report, as well as the Specialist Assessments for the impact assessment methodology that was used in the assessment of impacts.
7	Appendix 3 – 3 – 1 – h – (vii)	(vii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the	Feedback on the impacts and risks that informed the identification of the preferred activity (i.e. generation of energy from solar resources) is provided in Section 5.1.3 and

	Section of the EIA Regulations	Requirements for an EIA Report in terms of Appendix 3 of the 2014 NEMA EIA Regulations (as amended)	Response from EAP
		geographical, physical, biological, social, economic, heritage and cultural aspects;	Section 5.1.4 above. Such feedback relating to the preferred site is captured in Chapters 6 to 17 of this EIA Report. These chapters include an assessment of impacts and risks of the proposed project at the preferred site.
8	Appendix 3 – 3 – 1 – h – (viii)	(viii) the possible mitigation measures that could be applied and level of residual risk;	
10	Appendix 3 – 3 – 1 – h – (ix)	(ix) if no alternative development footprints for the activity were investigated, the motivation for not considering such; and	Where no further alternatives were considered, a motivation has been provided in this chapter, within the relevant sections.
11	Appendix 3 – 3 – 1 – h – (x)	(x) a concluding statement indicating the location of the preferred alternative development footprint within the approved site as contemplated in the accepted scoping report.	Refer to Section 5.2 of this chapter for a concluding statement.



CHAPTER 6:
Agriculture Compliance Statement

CSIR
Touching lives through innovation

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SITE SENSITIVITY VERIFICATION AND AGRICULTURAL COMPLIANCE STATEMENT FOR PROPOSED DEVELOPMENT OF A SOLAR PHOTOVOLTAIC (PV) FACILITY (KUDU SOLAR FACILITY 4) AND ASSOCIATED INFRASTRUCTURE NEAR DE AAR, IN THE NORTHERN CAPE

Report by
Johann Lanz

Version 1: 19 May 2023
Version 2: July 2023

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EXECUTIVE SUMMARY

The purpose of the agricultural component in Environmental Authorisation is to ensure that South Africa balances the need for development against the need to ensure the conservation of the natural agricultural resources, including land, required for agricultural production and national food security.

An agricultural impact is a temporary or permanent change to the future production potential of land. Whether a development should receive agricultural approval or not should be evaluated by asking the question: Does the extent of the loss of future agricultural production potential that will result from this development, justify keeping the land solely for agricultural production and therefore not approving the development?

South Africa needs agricultural production for food security. It also urgently needs renewable energy development. In order to achieve its renewable energy generation goals, agriculturally zoned land will inevitably need to be used for renewable energy generation.

The conclusion of this assessment is that the proposed development offers a valuable opportunity for renewable energy development with very little loss of future agricultural production potential.

This is substantiated by the following points:

- The proposed development will occupy land that is of very limited land capability, which is totally insufficient for crop production. There is no scarcity of such agricultural land in South Africa and its conservation for agricultural production is not therefore a priority.
- The amount of agricultural land used by the development is well within the allowable development limits prescribed by the agricultural protocol. These limits reflect the national need to conserve valuable agricultural land and therefore to steer, particularly renewable energy developments, onto land with lower agricultural production potential.
- The proposed development offers positive impact on agriculture by way of improved financial security for farming operations, as well as security benefits against stock theft and other crime.
- The proposed development poses a low risk in terms of causing soil degradation because degradation can be prevented by standard, best practice mitigation actions.
- The proposed development will also have the wider societal benefits of generating additional income and employment in the local economy.

- In addition, the proposed development will contribute to the country's need for energy generation, particularly renewable energy that has much lower environmental and agricultural impact than existing, coal powered energy generation.
- All renewable energy development in South Africa will contribute to reducing the large agricultural impact that open cast coal mining has on highly productive agricultural land throughout the coal mining areas of the country.

Because of the above factors, the impact of the proposed development on the agricultural production capability of the site is assessed as being acceptable. Therefore, from an agricultural impact point of view, it is recommended that the development be approved.

1. INTRODUCTION

Environmental authorisation is being sought for the proposed development of 12 solar photovoltaic (PV) facilities (Kudu Solar Facilities 1 to 12) and associated infrastructure, near De Aar, in the Northern Cape (see location in Figure 1). In terms of the National Environmental Management Act (Act No 107 of 1998) (NEMA), an application for environmental authorisation requires an agricultural assessment. In this case, based on the verified sensitivity of the site, the level of agricultural assessment required is an Agricultural Compliance Statement. Separate reports have been compiled for each facility. This report covers the Kudu Solar Facility 4 and associated infrastructure.

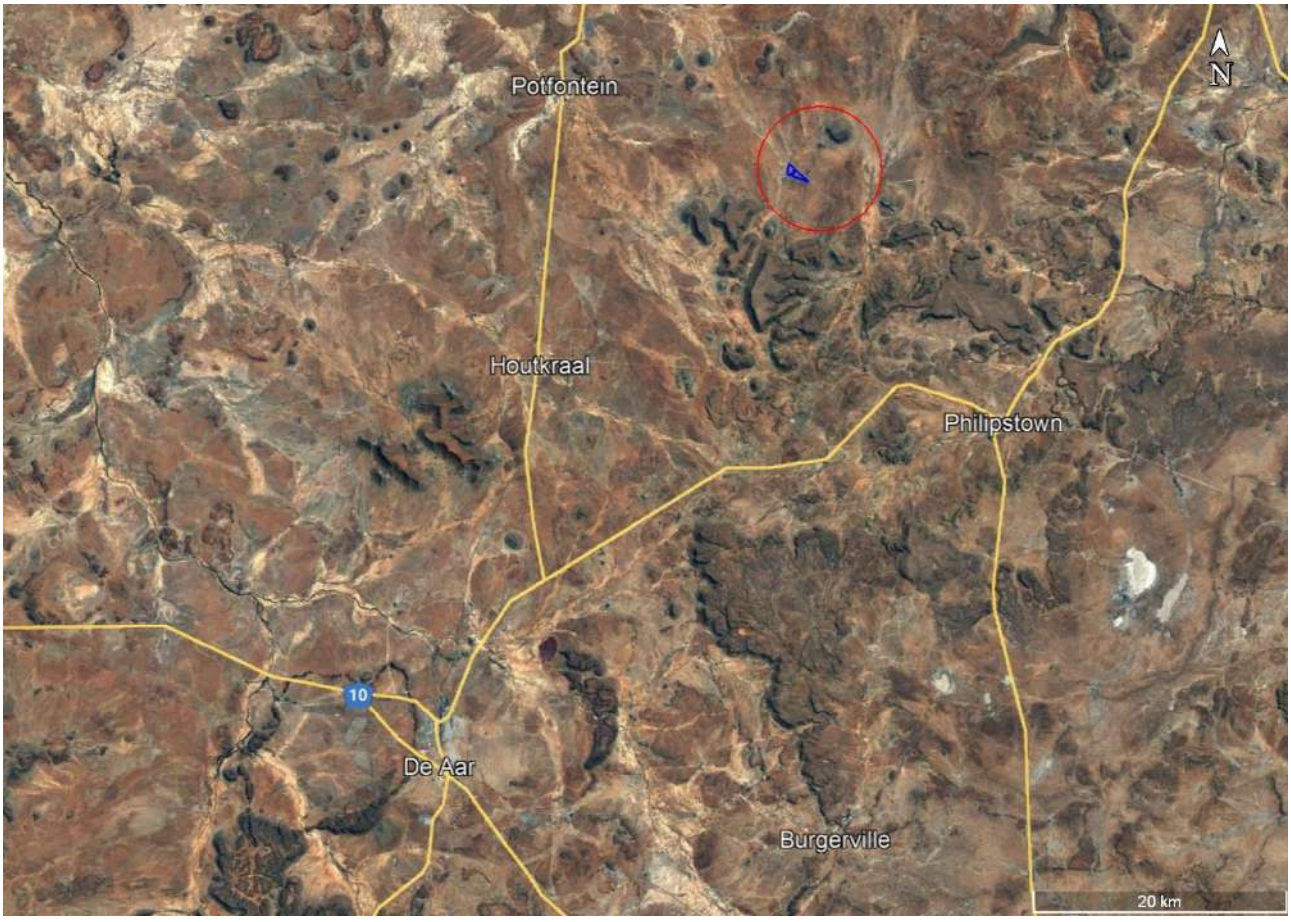


Figure 1: *Locality map of the proposed solar facility north-east of the town of De Aar.*

Johann Lanz was appointed as an independent agricultural specialist to conduct the agricultural assessment. The objective and focus of an agricultural assessment are to assess whether or not the proposed development will have an unacceptable agricultural impact, and based on this, to make a recommendation on whether or not it should be approved.

The purpose of including an agricultural component in Environmental Authorisation is to ensure that South Africa balances the need for development against the need to ensure the conservation of the natural agricultural resources, including land, required for agricultural production and national food security. The aim of the agricultural protocol of NEMA is primarily to preserve the agricultural production potential of scarce arable land by ensuring that development does not exclude agricultural production from such land or impact it to the extent that the crop production potential is reduced.

However, all land that is excluded from potential future agricultural use by this development is not suitable for crop production and therefore does not have high priority for being conserved as agricultural production land.

2. PROJECT DESCRIPTION

The proposed Kudu Solar PV cluster will entail the development of up to 12 Solar PV Facilities. Each proposed facility will consist of the standard infrastructure of a PV facility including PV array; inverters; battery storage; auxiliary buildings; access and internal roads; fencing and an on-site substation complex (including a switching station and collector station) and grid connection (which is subject to a separate assessment and EA). Each facility will have a total generating capacity ranging from 50 MWac to 350 MWac.

The exact nature and layout of the different infrastructure within a solar energy facility has absolutely no bearing on the significance of agricultural impacts. It is therefore not necessary to detail the design and layout of the facility any further in this assessment. All that is of relevance is simply the total footprint of the facility that excludes agricultural land use or impacts agricultural land, referred to as the agricultural footprint. Whether that footprint comprises a solar array, a road or a substation is irrelevant to agricultural impact.

2.1 Study Area Definition

The study area for all the proposed Kudu Solar Facilities is the full extent of the eight affected farm properties on which the proposed PV Facilities will be constructed. The full extent of these properties has been assessed in this study in order to identify environmental sensitivities and no-go areas. The total study area for all the Kudu Solar Facilities is approximately 8 150 hectares (ha).

As part of the Scoping Phase, the full study area and the Original Scoping Buildable Areas (which

fall within the entire study area) were assessed and considered in the Agricultural Compliance Statement (at Scoping).

Following the identification of sensitivities during the Scoping Phase, discussions with landowners and other considerations such as the capacities of the Bidding Window 6, the proposed projects were re-clustered and a total of up to 12 Solar PV Facilities were being proposed. The Project Developer considered such sensitivities and formulated the Revised Scoping Buildable Areas.

The revised Scoping Buildable Area for all 12 of the Kudu Solar Facilities is considered suitable from an agricultural perspective, as the sensitivities identified have been taken into consideration.

The Revised Scoping Buildable Areas have been used to inform the design of the layout and development footprints, which is now being assessed in the EIA Phase.

3. TERMS OF REFERENCE

The terms of reference for this study is to fulfill the requirements of the *Protocol for the specialist assessment and minimum report content requirements of environmental impacts on agricultural resources*, gazetted on 20 March 2020 in GN 320 (in terms of Sections 24(5)(A) and (H) and 44 of NEMA, 1998).

The level of agricultural assessment required in terms of the agricultural protocol for sites of less than high sensitivity, as this site was verified to be, is an Agricultural Compliance Statement. The protocol also requires that a Site Sensitivity Verification be done.

The terms of reference for such an assessment, as stipulated in the protocol, are listed below, and the section number of this report which fulfils each stipulation is given after it in brackets.

1. The Agricultural Compliance Statement must be prepared by a soil scientist or agricultural specialist registered with the South African Council for Natural Scientific Professions (SACNASP) **(Appendix 3)**.
2. The compliance statement must:
    1. be applicable to the preferred site and proposed development footprint;
    2. confirm that the site is of “low” or “medium” sensitivity for agriculture **(Section 7)**; and
    3. indicate whether or not the proposed development will have an unacceptable impact on the agricultural production capability of the site **(Section 9.11)**.
3. The Agricultural Compliance Statement must contain, as a minimum, the following

information:

1. details and relevant experience as well as the SACNASP registration number of the soil scientist or agricultural specialist preparing the statement including a curriculum vitae **(Appendix 1)**;
2. a signed statement of independence by the specialist **(Appendix 2)**;
3. a map showing the proposed development footprint (including supporting infrastructure) with a 50 m buffered development envelope, overlaid on the agricultural sensitivity map generated by the screening tool **(Figure 2)**;
4. calculations of the physical development footprint area for each land parcel as well as the total physical development footprint area of the proposed development including supporting infrastructure **(Section 9.9)**;
5. confirmation that the development footprint is in line with the allowable development limits contained in Table 1 of the protocol **(Section 9.9)**;
6. confirmation from the specialist that all reasonable measures have been taken through micro-siting to avoid or minimize fragmentation and disturbance of agricultural activities **(Section 9.7)**;
7. a substantiated statement from the soil scientist or agricultural specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not of the proposed development **(Section 9.11)**;
8. any conditions to which this statement is subjected **(Section 11)**;
9. in the case of a linear activity, confirmation from the agricultural specialist or soil scientist, that in their opinion, based on the mitigation and remedial measures proposed, the land can be returned to the current state within two years of completion of the construction phase **(Section 9.8)**;
10. where required, proposed impact management outcomes or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr) **(Section 10)**; and
11. a description of the assumptions made and any uncertainties or gaps in knowledge or data **(Section 5)**.

4. METHODOLOGY OF STUDY

4.1 Methodology for assessing the agro-ecosystem

As per the protocol requirement, the assessment was based on a desktop analysis of existing soil and agricultural potential data for the site. The following sources of information were used:

- Soil data was sourced from the land type data set, of the Department of Agriculture, Forestry and Fisheries (DAFF) [currently operating as the Department of Agriculture, Land Reform and Rural Development (DALRRD)]. This data set originates from the land type survey that was conducted from the 1970's until 2002. It is the most reliable and comprehensive national database of soil information in South Africa and although the data was collected some time ago, it is still entirely relevant as the soil characteristics included in the land type data do not change within time scales of hundreds of years.
- Land capability data was sourced from the 2017 National land capability evaluation raster data layer produced by the DAFF, Pretoria.
- Field crop boundaries were sourced from Crop Estimates Consortium, 2019. *Field Crop Boundary data layer, 2019*. Pretoria. Department of Agriculture, Forestry and Fisheries.
- Rainfall and evaporation data was sourced from the SA Atlas of Climatology and Agrohydrology (2009, R.E. Schulze) available on Cape Farm Mapper.
- Grazing capacity data was sourced from the 2018 DAFF long-term grazing capacity map for South Africa, available on Cape Farm Mapper.
- Satellite imagery of the site and surrounds was sourced from Google Earth.

These sources of information are considered entirely adequate and comprehensive for the purposes of this assessment.

5. ASSUMPTIONS, UNCERTAINTIES OR GAPS IN KNOWLEDGE OR DATA

There are no specific assumptions, uncertainties or gaps in knowledge or data that affect the findings of this study.

6. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

A renewable energy facility requires approval from the National Department of Agriculture, Land Reform and Rural Development (DALRRD) if the facility is on agriculturally zoned land. There are two approvals that apply. The first is a No Objection Letter for the change in land use issued by the Deputy Director General (Agricultural Production, Health and Food Safety, Natural Resources and Disaster Management). This letter is one of the requirements for receiving municipal rezoning. It is advisable to apply for this as early in the renewable development process as possible because not receiving this DALRRD approval is a fatal flaw for a project. Note that a positive EA does not assure DALRRD's approval of this. This application requires a motivation backed by good evidence that the development will not significantly compromise the future agricultural production potential of the

development site. This Agricultural Compliance Statement will suffice for that purpose.

The second required approval is a consent for long-term lease in terms of the Subdivision of Agricultural Land Act (Act 70 of 1970) (SALA). If DALRRD approval for the development has already been obtained in the form of the No Objection letter, then SALA approval should be easy and not present any difficulties. Note that SALA approval is not required if the lease is over the entire farm portion. SALA approval (if required) can only be applied for once the Municipal Rezoning Certificate and EA is in hand.

Rehabilitation after disturbance to agricultural land is managed by the Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA). A consent in terms of CARA is required for the cultivation of virgin land. Cultivation is defined in CARA as "any act by means of which the topsoil is disturbed mechanically". The purpose of this consent for the cultivation of virgin land is to ensure that only land that is suitable as arable land is cultivated. Therefore, despite the above definition of cultivation, disturbance to the topsoil that results from the construction of a renewable energy facility and its associated infrastructure does not constitute cultivation as it is understood in CARA. This has been corroborated by Anneliza Collett (Acting Scientific Manager: Natural Resources Inventories and Assessments in the Directorate: Land and Soil Management of the DALRRD). The construction and operation of the facility will therefore not require consent from the DALRRD in terms of this provision of CARA.

7. SITE SENSITIVITY VERIFICATION

In terms of the gazetted agricultural protocol, a site sensitivity verification must be submitted that:

1. confirms or disputes the current use of the land and the environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status etc.;
2. contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity.

A site investigation was not considered necessary for this assessment, including for the site sensitivity verification. This is because the land capability limitation is predominantly a function of climate, which cannot be informed by a site assessment.

Agricultural sensitivity, as used in the national web-based environmental screening tool, is a direct function of the capability of the land for agricultural production. The general assessment of

agricultural sensitivity that is employed in the national web-based environmental screening tool, identifies all arable land that can support viable crop production, as high (or very high) sensitivity. This is because there is a scarcity of arable production land in South Africa and its conservation for agricultural use is therefore a priority. Land which cannot support viable crop production is much less of a priority to conserve for agricultural use, and is rated as medium or low agricultural sensitivity.

The screening tool classifies agricultural sensitivity according to only two independent criteria – the land capability rating and whether the land is used for cropland or not. All cropland is classified as at least high sensitivity, based on the logic that if it is under crop production, it is indeed suitable for it, irrespective of its land capability rating.

The screening tool sensitivity categories in terms of land capability are based upon the Department of Agriculture's updated and refined, country-wide land capability mapping, released in 2016. The data is generated by GIS modelling. Land capability is defined as the combination of soil, climate and terrain suitability factors for supporting rain fed agricultural production. It is an indication of what level and type of agricultural production can sustainably be achieved on any land, based on its soil, climate and terrain. The higher land capability values (≥8 to 15) are likely to be suitable as arable land for crop production, while lower values are only likely to be suitable as non-arable grazing land.

A map of the proposed development area overlaid on the screening tool sensitivity is given in Figure 2. Because none of the land is classified as cropland, agricultural sensitivity is purely a function of land capability. The land capability of the site on the screening tool is predominantly 5 and 6, but varies from 3 to 7. The small scale differences in the modelled land capability across the project area are not very accurate or significant at this scale and are more a function of how the data is generated by modelling, than actual meaningful differences in agricultural potential on the ground. Values of 3 to 5 translate to a low agricultural sensitivity and values of 6 to 7 translate to a medium agricultural sensitivity, although there is little real difference between low and medium agricultural sensitivity on the ground.

The agricultural sensitivity, as identified by the screening tool, is confirmed by this assessment. The motivation for confirming the sensitivity is predominantly that the climate data (low rainfall of approximately 280 to 305 mm per annum and high evaporation of approximately 1,470 to 1,540 mm per annum) proves the area to be arid, and therefore of limited land capability.

This site sensitivity verification verifies the entire site as being of less than high agricultural

sensitivity with a land capability value of 5 to 6. The land capability value is in keeping with the climate limitations that make the site totally unsuitable for dryland crop production. The required level of agricultural assessment is therefore confirmed as an Agricultural Compliance Statement.

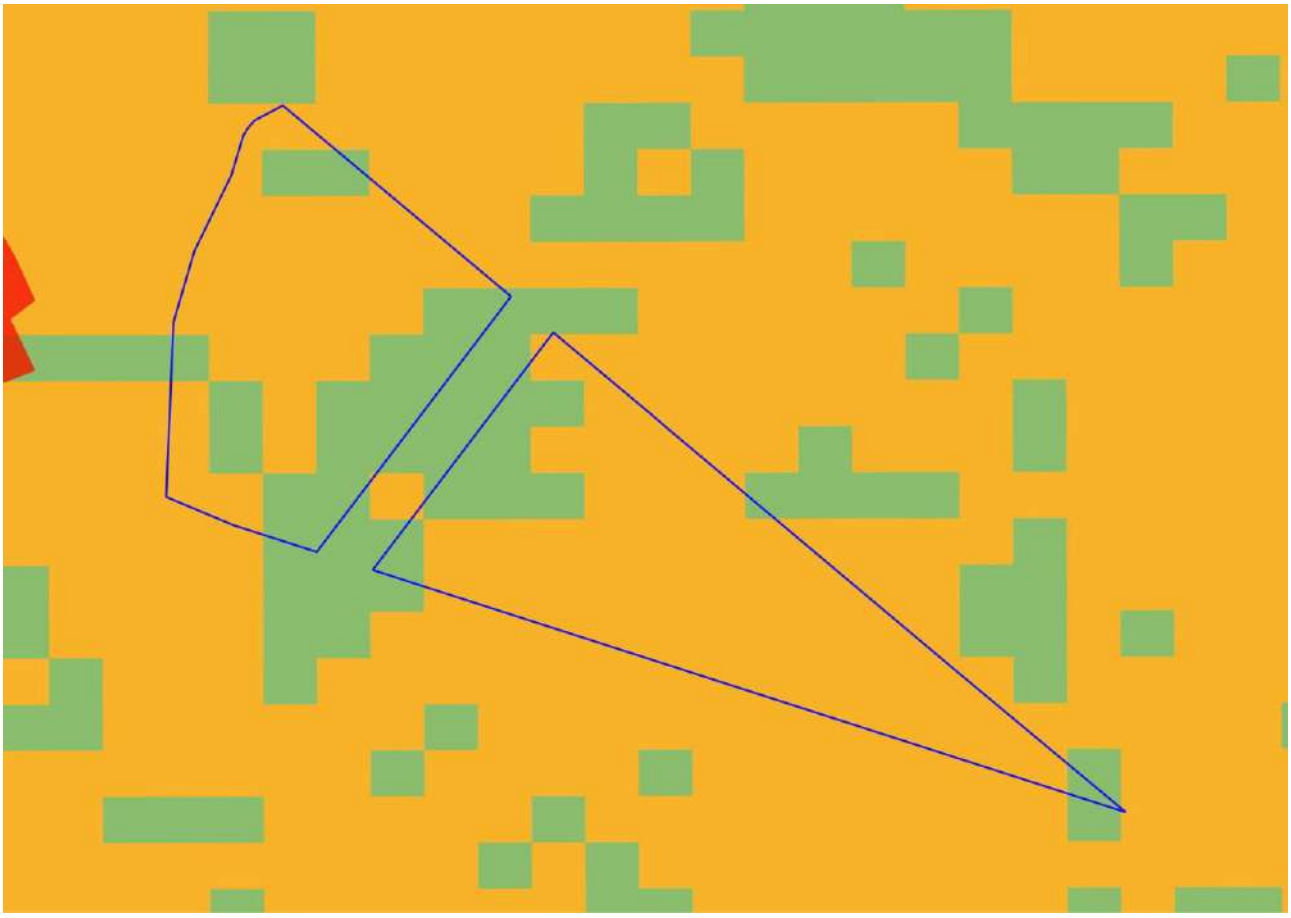


Figure 2: *The proposed agricultural footprint of the development (blue outline) overlaid on agricultural sensitivity, as given by the screening tool (green = low; yellow = medium; red = high).*

8. BASELINE DESCRIPTION OF THE AGRO-ECOSYSTEM

The arid climate (low rainfall of approximately 280 to 305 mm per annum and high evaporation of approximately 1,470 to 1,540 mm per annum) is the limiting factor for land capability, regardless of the soil capability and terrain. Moisture availability is insufficient for crop production without irrigation and the potential agricultural land use of the site is therefore limited to grazing. The land is used for the grazing of sheep and game. The land has a fairly low long term grazing capacity of 20 hectares per large stock unit. Because climate is the limiting factor that controls production potential, it is the only aspect of the agro-ecosystem description that is required for assessing the agricultural impact of this development.

9. ASSESSMENT OF AGRICULTURAL IMPACT

9.1 What constitutes an agricultural impact?

An agricultural impact is a temporary or permanent change to the future production potential of land. If a development will not change the future production potential of the land, then there is no agricultural impact. A decrease in future production potential is a negative impact and an increase is a positive impact. The significance of the agricultural impact is directly proportional to the extent of the change in production potential.

9.2 The significance of agricultural impact and the factors that determine it

As noted above, the purpose of the agricultural component in Environmental Authorisation is to ensure that South Africa balances the need for development against the need to ensure the conservation of the natural agricultural resources, including land, required for agricultural production and national food security. Impacts such as erosion that degrade the agricultural resource base, pose a threat to production potential and therefore are within the scope of an agricultural impact assessment.

When the agricultural impact of a development involves the permanent or long term non-agricultural use of potential agricultural land, as it does in this case, the focus and defining question of the agricultural impact assessment is to determine the importance, from an agricultural production point of view, of that land not being utilised for the development and kept solely for agriculture.

In other words, the significance of an agricultural impact should be evaluated by asking the question: Does the extent of the loss of future agricultural production potential that will result from this development, justify keeping the land solely for agricultural production and therefore not approving the development? If the loss is small, then it is unlikely to justify non approval. If the loss is big, then it is likely to justify it.

The extent of the loss is a direct function of two things, firstly the amount of land that will be lost and secondly, the production potential of the land that will be lost. The land's production potential must be evaluated on a scale of land capability (which equates to production potential) that is applicable across the country, because the need is to conserve the higher potential land in the country, not the lower potential land. If the land capability is below a certain threshold then its loss

as agricultural production land may be justified, depending on the importance and value of the proposed non-agricultural land use that will replace it. That threshold is determined by the scarcity of arable crop production land in South Africa and the relative abundance of land that is only good enough to be used for grazing. If land is of sufficient land capability to support viable and sustainable crop production then it is considered to be above the threshold for being conserved as agricultural production land. If land is not of sufficient land capability to support viable and sustainable crop production, then it is considered to be below the threshold and its loss as agricultural production land may be justified. When the replacing land use is something that has high national importance and benefit, such as renewable energy development, the use of agricultural land that is below the threshold is considered to be justified.

It is also important to note that renewable energy facilities have both positive and negative affects on the production potential of land (see Section 9.3) and so it is the net sum of these positive and negative effects that determines the extent of the change in future production potential.

Another aspect to consider is the scale at which the significance of the agricultural impact is assessed. The change in production potential of a farm or significant part of a farm is likely to be highly significant at the scale of that farm, but may be much less so at smaller scales. This assessment considers a regional and national scale to be the most appropriate one for assessing the significance of the loss of agricultural production potential because, as has been discussed above, the purpose is to ensure the conservation of agricultural land required for national food security.

It should be noted that, in assessing agricultural impact, the exact nature and layout of the different infrastructure within a solar energy facility has absolutely no bearing on the significance of agricultural impacts. All that is of relevance is simply the total footprint of the facility that excludes agricultural land use or impacts agricultural land, referred to as the agricultural footprint.

9.3 Impact identification and discussion

Three potential negative agricultural impacts have been identified, that are direct impacts:

1. **Loss of agricultural potential by occupation of land** - Agricultural land directly occupied by the development infrastructure will become unavailable for agricultural use, with consequent potential loss of agricultural productivity for the duration of the project lifetime. This impact is relevant only in the construction phase. No further loss of agricultural land use occurs in subsequent phases.

2. **Loss of agricultural potential by soil degradation –** This impact only occurs during the construction and decommissioning phases, but only becomes relevant once the land is returned to agricultural land use after decommissioning. Soil can be degraded by impacts in three different ways: erosion; topsoil loss; and contamination. Erosion can occur as a result of the alteration of the land surface run-off characteristics, which can be caused by construction related land surface disturbance, vegetation removal, and the establishment of hard surface areas including roads. Loss of topsoil can result from poor topsoil management during construction related excavations. Hydrocarbon spillages from construction activities can contaminate soil. Soil degradation will reduce the ability of the soil to support vegetation growth. Although the site is susceptible to soil erosion, it can be fairly easily and effectively prevented by standard best practice soil degradation control measures, as recommended and included in the EMPr.
3. **Loss of agricultural potential by dust generation** – The disturbance of the soil surface, particularly during construction, will generate dust that can negatively impact surrounding veld and farm animals.

Two positive agricultural impacts have been identified, that are indirect impacts and lead to enhanced agricultural potential through:

1. **increased financial security for farming operations -** Reliable income will be generated by the farming enterprises through the lease of the land to the energy facility. This is likely to increase their cash flow and financial security and could improve farming operations and productivity through increased investment into farming.
2. **improved security against stock theft and other crime** due to the presence of security infrastructure and security personnel at the energy facility.

The extent to which any of these impacts is likely to actually affect levels of agricultural production is small and the significance of agricultural impacts is therefore low.

9.3.1 Comments and response - interested and affected parties

Comments related to agricultural impacts associated with the proposed project were raised by Interested and Affected Parties during the review period of the Draft Scoping Report. These comments were considered during the Scoping Phase and addressed accordingly. These comments are summarised below with corresponding responses from the specialist.

KEY ISSUE	RESPONSE
Concerns were raised about the use of large areas of agricultural land and its impact on farming (Coverage of the Affected Farm Properties).	During the construction phase, one of the main activities will include removal of vegetation for the proposed infrastructure, where necessary, within the approved development footprint to facilitate the construction and/or establishment of infrastructure. Note that vegetation is planned to be trimmed within the PV array area (and not removed completely). Therefore, even though it appears that the majority of certain farms will be covered by Solar PV panels, not all the vegetation will be removed completely. In addition, with regards to the concern about the use of large areas of agricultural land and its impact on farming, in order for South Africa to develop the renewable energy generation that it urgently needs, agriculturally zoned land will need to be used for renewable energy generation. It is far more preferable to incur a cumulative loss of agricultural land that is of limited agricultural potential in a region such as the one being assessed, which has no crop production potential, and low grazing capacity, than to lose agricultural land that has a higher potential, and that is much scarcer, to renewable energy development elsewhere in the country.
Queries on the understanding of the subdivision of agricultural land act (Act 70 of 1970) in relation to the proposed developments.	An Agricultural Compliance Statement (i.e. this report) has been undertaken as part of this EIA Process, in compliance with the requirements of the Assessment Protocols published in GN 320. The Agricultural Compliance Statement provides feedback on the relevant legislation and permits required for the proposed project (See Section 6 of this report). A renewable energy facility requires approval from the National Department of Agriculture, Land Reform and Rural Development (DALRRD) if the facility is on agriculturally zoned land. There are two approvals that apply. The first is a No Objection Letter for the change in land use issued by the Deputy Director General (Agricultural Production, Health and Food Safety, Natural Resources and Disaster Management). The second required approval is a consent for long-term lease in terms of the Subdivision of Agricultural Land Act (Act 70 of 1970) (SALA). If DALRRD approval for the development has already been obtained in the form of the No Objection letter, then SALA approval should not present any difficulties. Note that SALA approval is not required if the lease is over the entire farm portion. SALA approval (if required) can only be applied for once the Municipal Rezoning Certificate and EA is in hand. The Applicant has taken cognisance of this and will apply for the relevant approval in terms of SALA once the necessary pre-requisite permits are obtained.
Queries on the potential benefits that the proposed Kudu Solar Facilities will have on the farming community of Philipstown district (Benefits to the Farming Community).	It is acknowledged that the proposed projects (at its closest point) are located about 20 km from Phillpstown. As noted in this Agricultural Compliance Statement, one of the positive impacts of the proposed projects is the improved security against stock theft and other crime due to the presence of security infrastructure and security personnel at the proposed Solar PV Facilities. It is believed that this positive impact will extend to the surround farms also. Furthermore, a Socio-Economic Assessment was also undertaken as part of this EIA, which is included in Chapter 13 of this EIA Report, which identified various positive socio-economic impacts as a result of the proposed projects. The construction phase will create various employment opportunities. Based on the Socio-Economic Assessment, the majority of the employment opportunities, specifically the low and semi-skilled opportunities, are likely to be available to

KEY ISSUE	RESPONSE
	local residents in the area. The majority of the beneficiaries are likely to be historically disadvantaged (HD) members of the community. This would represent a significant positive social benefit in an area with limited employment opportunities. In addition, the sector of the local economy that is most likely to benefit from the proposed development is the local service industry, linked to accommodation, catering, cleaning, transport, and security, etc. associated with the construction workers on the site. Operational phase benefits are also discussed in the Socio-Economic Assessment. Therefore, potential benefits of the proposed projects to the surrounding communities have been identified.
Concerns were raised regarding the agricultural sustainability of the proposed development.	This Agricultural Compliance Statement has confirmed that the proposed projects are acceptable from an agricultural perspective, and that the agricultural sensitivity of the site is less than high (mainly low and medium). The Compliance Statement also discusses the allowable development limits for renewable energy developments of more than 20 MW, as per the Agriculture Assessment Protocol of GN320, which essentially refers to the area of a particular agricultural sensitivity category that can be directly impacted (i.e. taken up by the physical footprint) by a renewable energy development. The allowable development limit for non-cropland with a land capability value of less than 8, as this site has been confirmed to be, is 2.5 ha per MW. The proposed facilities are within this limit, as described in Section 9.9 of this report. The above being said, as noted in this Agriculture Compliance Statement, the proposed development will provide reliable and predictable income to the owners of the land on which the proposed project will be constructed and operated on. This income is likely to increase their financial security and could improve farming operations and productivity through increased investment into farming - therefore improved agricultural sustainability. For neighbouring landowners, the proposed project will potentially create various impacts, such as visual impacts. However, the proposed project will have no impact on the agricultural production potential of adjacent farms, and therefore, no impact on agricultural sustainability. South Africa needs agricultural production for food security. It also urgently needs renewable energy development. In order to achieve its renewable energy generation requirements, agriculturally zoned land will inevitably need to be used for renewable energy generation. In order to ensure the sustainability of agricultural production and food security in the country, it is important that renewable energy be located in agricultural areas that have low agricultural production potential, such as the assessed site, and that scarce arable land in productive areas is not sacrificed to renewable energy. Rather than endangering agricultural sustainability, the location of this project is optimal for protecting agricultural sustainability. Furthermore, it is also important to reiterate that the Agriculture Compliance Statement has been undertaken in compliance with the Protocol for the Specialist Assessment and Minimum Report Content Requirements of Environmental Impacts on Agricultural Resources by Onshore Wind and/or Solar Energy Generation Facilities where the Electricity Output is 20 MW or more, as published in March 2020 (GN 320). The Protocols were gazetted by the National DFFE to

KEY ISSUE	RESPONSE
	ensure that the correct information and methodologies are adopted by specialists undertaking assessments as part of the EIA Process. Complying with the protocols therefore shows that relevant legislation has been adhered to in this regard.
Queries on the socio-economic benefits of the development for farmers and their employees in the greater region, as well as the fariness and equitability of involving only two landowners in the proposed developments.	Various factors were considered by the Project Developer in selecting the preferred site / study area. These factors include land availability, environmental sensitivities, irradiation levels, distance to the national grid, site accessibility, topography, current land use and landowner willingness. The Project Developer also considered adjacent farm portions and approached the landowners; however, this exercise was unsuccessful as the land had already been secured by other developers. Note that whilst income generation for the affected landowners is listed as a positive impact in the Agriculture Compliance Statement and Socio-Economic Assessment, other wider community benefits have also been identified, as noted above in the response to the comment raised regarding "Benefits to the Farming Community".

Comments related to agricultural impacts associated with the proposed project were raised by Interested and Affected Parties during the review period of the Draft EIA Report. These comments are similar to those submitted and considered during the Scoping Phase, and therefore similar responses apply. Concerns were raised about the use of large areas of agricultural land and its impact on farming (Coverage of the Affected Farm Properties); queries on the understanding of the Subdivision Of Agricultural Land Act (Act 70 of 1970) in relation to the proposed developments, and implications thereof; potential benefits that the proposed Kudu Solar Facilities will have on the farming community in the surrounding region (Benefits to the Farming Community); agricultural sustainability of the proposed development; queries on the socio-economic benefits of the development for farmers and their employees in the greater region, as well as the equitability of involving only two landowners in the proposed developments; and not distributing the benefits compared to other proposed projects; queries on the 10% rule; and notes regarding agricultural dependency. Responses have been provided in Appendix H.7 of the Final EIA Report.

9.4 Cumulative impacts

The cumulative impact of a development is the impact that development will have when its impact is added to the incremental impacts of other past, present or reasonably foreseeable future activities that will affect the same environment. It is important to note that the cumulative impact assessment for a particular project, like what is being done here, is not the same as an assessment of the impact of all surrounding projects. The cumulative assessment for this project is an assessment only of the impacts associated with this project, but seen in the context of all surrounding impacts. It is concerned with this project's contribution to the overall impact, within the context of the overall impact. But it is not simply the overall impact itself.

The most important concept related to a cumulative impact is that of an acceptable level of change to an environment. A cumulative impact only becomes relevant when the impact of the proposed development will lead directly to the sum of impacts of all developments causing an acceptable level of change to be exceeded in the surrounding area. If the impact of the development being assessed does not cause that level to be exceeded, then the cumulative impact associated with that development is not significant.

The potential cumulative agricultural impact of importance is a regional loss (including by degradation) of future agricultural production potential. The defining question for assessing the cumulative agricultural impact is this:

> What level of loss of future agricultural production potential is acceptable in the area, and will the loss associated with the proposed development, when considered in the context of all past, present or reasonably foreseeable future impacts, cause that level in the area to be exceeded?

The Department of Forestry, Fisheries and the Environment (DFFE) requires compliance with a specified methodology for the assessment of cumulative impacts. This is positive in that it ensures engagement with the important issue of cumulative impacts. However, the required compliance has some limitations and can, in the opinion of this author, result in an over-focus on methodological compliance, while missing the more important task of effectively answering the above defining question.

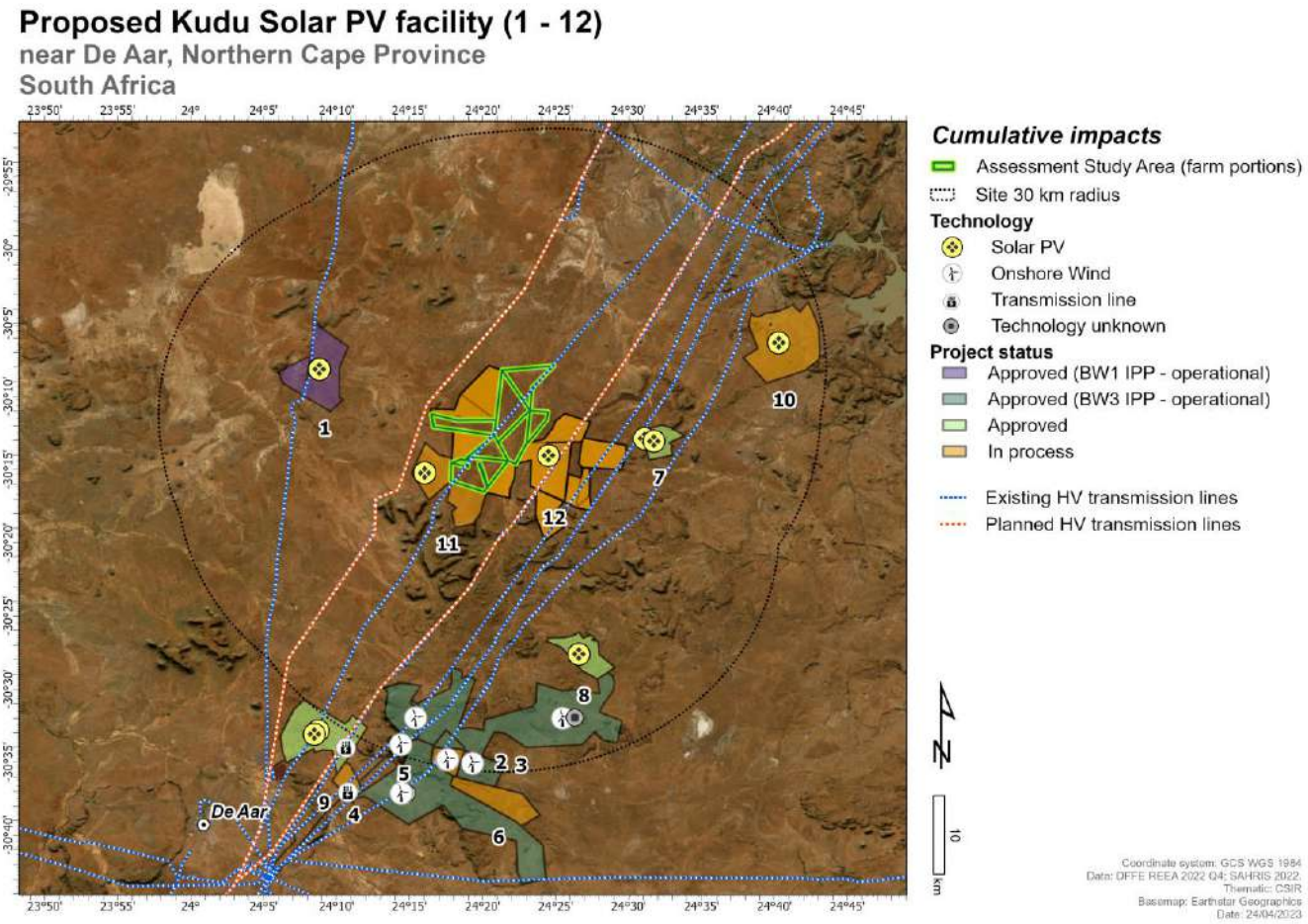


Figure 3: *Projects considered in cumulative impact assessment.*

This cumulative impact assessment has considered all renewable energy projects within a 30 km radius. These are listed in Appendix 4 of this report and shown in Figure 3. In quantifying the cumulative impact, the area of land taken out of agricultural use as a result of all the projects listed in Appendix 4 (total generation capacity of 6938 MW) will amount to a total of approximately 16,557 hectares. This is calculated using the industry standards of 2.5 and 0.3 hectares per megawatt for solar and wind energy generation respectively, as per the Department of Environmental Affairs (DEA) Phase 1 Wind and Solar Strategic Environmental Assessment (SEA) (2015). As a proportion of the total area within a 30 km radius (approximately 282,700 ha), this amounts to 5.86% of the surface area. This is within an acceptable limit in terms of loss of low potential agricultural land which is only suitable for grazing, and of which there is no scarcity in the country. This is particularly so when considered within the context of the following point.

In order for South Africa to achieve its renewable energy generation goals, agriculturally zoned land will need to be used for renewable energy generation. It is far more preferable to incur a cumulative loss of agricultural land in a region such as the one being assessed, which has no crop production potential, and low grazing capacity, than to lose agricultural land that has a higher potential, and that is much scarcer, to renewable energy development elsewhere in the country. The limits of acceptable agricultural land loss are far higher in this region than in regions with higher agricultural potential.

Note that power lines do not contribute to loss of agricultural land and are therefore not included in the calculation of affected area. The cumulative impact of grid infrastructure in the area can confidently be assessed as negligible.

All of the projects contributing to cumulative impact for this assessment have the same agricultural impacts in an almost identical agricultural environment, and therefore the same mitigation measures apply to all.

It should also be noted that renewable energy development can only be located in fairly close proximity to a substation that has available capacity. This creates cumulative impact in such places. However, this is acceptable because it also effectively protects most agricultural land in the country from renewable energy development because only a small proportion of the country's total land surface is located in close enough proximity to an available substation to be viable for renewable energy development.

Furthermore, it should be noted that there are few land uses, other than renewable energy, that are competing for agricultural land use in this area. The cumulative impact from developments, other than renewable energy, is therefore likely to be low.

As discussed above, the loss of agricultural potential by soil degradation can effectively be prevented for renewable energy developments and therefore does not pose a cumulative impact risk.

Due to all of the considerations discussed above, the cumulative impact of loss of future agricultural production potential is assessed as low. It will not have an unacceptable negative impact on the agricultural production capability of the area and it is therefore recommended that the development be approved.

9.5 Impacts of the no-go alternative

The no-go alternative considers impacts that will occur to the agricultural environment in the absence of the proposed development. There are no agricultural impacts of the no-go alternative.

The development offers an alternative income source to agriculture, but it excludes agriculture from a proportion of the land. Therefore, even though the excluded land has no crop production potential, the negative agricultural impact of the development is more significant than that of the no-go alternative, and so, purely from an agricultural impact perspective, the no-go alternative is the preferred alternative between the development and the no-go. However, the no-go option would prevent the proposed development from contributing to the environmental, social and economic benefits associated with the development of renewable energy in South Africa.

9.6 Comparative assessment of alternatives

Design and layout alternatives and technology alternatives within the footprint will make absolutely no material difference to the significance of the agricultural impacts, because it is the total footprint size (and its agricultural production potential) that determines the impact significance. Any alternative layout within the footprint is considered acceptable. Furthermore, in this agricultural environment with uniformly low production potential, the location of the solar sites within the properties will also make absolutely no material difference to the significance of the agricultural impacts.

Technology alternatives with respect to the BESS will make absolutely no material difference to the significance of the agricultural impacts. All BESS technology alternatives are acceptable.

Changes to the detailed layouts are deemed acceptable if the changes remain within the approved buildable areas / development footprints and area assessed during the Scoping and EIA Process with no-go sensitive areas avoided.

9.7 Micro-siting to minimize fragmentation and disturbance of agricultural activities

The agricultural protocol requires confirmation that all reasonable measures have been taken through micro-siting to minimize fragmentation and disturbance of agricultural activities. However, as noted above, the exact position of the footprint and all infrastructure within it will not make any material difference to agricultural impacts and disturbance.

9.8 Confirmation of linear activity impact

The protocol provision of a linear impact confirmation only makes sense when the requirement for an Agricultural Compliance Statement is based on the fact that the development is a linear activity. In this case the verified less than high agricultural sensitivity determines that an Agricultural Compliance Statement suffices, anyway, even for non-linear activities.

9.9 Impact footprint

The agricultural protocol stipulates allowable development limits for renewable energy developments of > 20 MW. Allowable development limits refer to the area of a particular agricultural sensitivity category that can be directly impacted (i.e. taken up by the physical footprint) by a renewable energy development. The agricultural footprint is defined in the protocol as the area that is directly occupied by all infrastructure, including roads, hard standing areas, buildings etc., that are associated with the renewable energy facility during its operational phase, and that result in the exclusion of that land from potential cultivation or grazing. It excludes all areas that were already occupied by roads and other infrastructure prior to the establishment of the energy facility but includes the surface area required for expanding existing infrastructure (e.g. widening existing roads). It therefore represents the total land that is actually excluded from agricultural use as a result of the renewable energy facility (the agricultural footprint).

For a solar energy facility, the agricultural footprint is considered to be the total area inside the security fence of the facility. The allowable development limit on land of low or medium agricultural sensitivity with a land capability of < 8, as this site has been verified to be, is 2.5 ha per MW. This would allow a facility of, for example 150 MW, to occupy an agricultural footprint of 150 X 2.5 = 375 hectares. For a development of multiple facilities, what matters is that the combined footprint of all the facilities is within the allowable limits. Table 1 demonstrates that not only is the combined footprint of all 12 Kudu facilities well within the allowable development limits contained in the agricultural protocol (total footprint of only 3268 ha within an allowable footprint of 5450 ha), but each of the individual facilities is as well.

Table 1: *Compliance of the Kudu solar facilities with the allowable development limits.*

Facility	Generation capacity (MW)	Agricultural footprint (ha)	Allowable development limit (ha)
Kudu 1	50	34	125
Kudu 2	50	51	125
Kudu 3	50	70	125
Kudu 4	50	70	125
Kudu 5	350	537	875
Kudu 6	150	265	375
Kudu 7	350	557	875
Kudu 8	350	542	875
Kudu 9	150	285	375
Kudu 10	150	120	375
Kudu 11	330	506	825
Kudu 12	150	231	375
Total	**2180**	**3268**	**5450**

9.10 The 10% rule

The so-called 10% rule that has been used by DALRRD is not considered to be useful or constructive for assessing the agricultural approval of this project. In this agricultural environment, the rule is likely to simply hinder solar energy development without serving any benefit to agriculture. The argument against using the rule is detailed below.

In order to limit the potential threat that solar energy development in rural areas could pose to agricultural production and to the agricultural economy of those rural areas, DALRRD created the so-called 10% rule to inform the decision of whether a solar energy development on agricultural land should be approved or not. This rule states that a solar energy facility may not utilise more than 10% of the surface area of a farm. Its aim was to ensure that each farm unit remained predominantly agricultural rather than certain farms abandoning agricultural production in favour of renewable energy generation.

The rule was established when solar energy development was new and unknown. However, it is now evident that solar energy development is less of a threat to agricultural production and the agricultural economy than it was initially feared that it might be. Solar energy development has demonstrated benefits for agriculture and has potential to be integrated into the rural agricultural economy. It is a source of much needed income into rural areas. The 10% rule is now considered unnecessary and impractical. It is likely to simply hinder solar energy development without serving any benefit to agriculture. It is far more constructive and effective to focus on integrating renewable energy with agricultural production in a way that provides benefits to agriculture and focuses on minimising loss of future agricultural production potential. This can be done by using only the production potential of land as the deciding factor for solar energy approval.

The problem with the 10% rule and only utilising up to 10% of each farm, is that it forces solar facilities to be spread across the landscape in a way that is impractical and financially non-viable and creates a much larger environmental footprint in the landscape. Furthermore it does not actually make any difference to the loss of agricultural production potential or to the impact on the agricultural economy of the area.

It is important to recognise that there is no real need to limit the amount of land occupied by solar energy facilities. Solar energy will never occupy more than a tiny proportion of the land, anyway. The total extent of South Africa's intended solar development for the foreseeable future was calculated to only occupy 0.4% of the surface area of the 8 original renewable energy development zones (REDZs) that were gazetted in February 2018 (GN 114). This was if all the country's solar development was located only in those 8 REDZs, which it is not. An additional 3 REDZs have been proclaimed since then (i.e. in February 2021 in GN 144) and much of the country's solar development is occurring outside the REDZs. This means that for the foreseeable future, solar energy will only ever occupy much less than 0.4% of land in an area. If it will only ever occupy such a small proportion of the land, anyway, it cannot replace agriculture in the rural economy and it serves no purpose to limit solar facilities to 10% of each farm. From an agricultural production and food security point of view there is only a need to preserve scarce arable land for crop production and therefore to limit solar development to land that is of insufficient land capability to support viable crop production.

9.11 Impact assessment and statement

An Agricultural Compliance Statement is not required to formally rate agricultural impacts. It is only required to indicate whether or not the proposed development will have an unacceptable impact on the agricultural production capability of the site. It must provide a substantiated

statement on the acceptability, or not, of the proposed development and a recommendation on the approval, or not of the proposed development.

Nevertheless, the agricultural impact of this proposed development is assessed here as being of low significance.

The conclusion of this assessment is that the proposed development offers a valuable opportunity for renewable energy development with very little loss of future agricultural production potential.

This is substantiated by the following points:

- The proposed development will occupy land that is of very limited land capability, which is totally insufficient for crop production. There is no scarcity of such agricultural land in South Africa and its conservation for agricultural production is not therefore a priority.
- The amount of agricultural land used by the development is well within the allowable development limits prescribed by the agricultural protocol. These limits reflect the national need to conserve valuable agricultural land and therefore to steer, particularly renewable energy developments, onto land with lower agricultural production potential.
- The proposed development offers positive impact on agriculture by way of improved financial security for farming operations, as well as security benefits against stock theft and other crime.
- The proposed development poses a low risk in terms of causing soil degradation because degradation can be adequately and fairly easily managed by standard, best practice mitigation actions.
- The proposed development will also have the wider societal benefits of generating additional income and employment in the local economy.
- In addition, the proposed development will contribute to the country's need for energy generation, particularly renewable energy that has much lower environmental and agricultural impact than existing, coal powered energy generation.
- All renewable energy development in South Africa will contribute to reducing the large agricultural impact that open cast coal mining has on highly productive agricultural land throughout the coal mining areas of the country.

Because of the above factors, the impact of the proposed development on the agricultural production capability of the site is assessed as being acceptable. Therefore, from an agricultural impact point of view, it is recommended that the development be approved.

10. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

The environmental management programme inputs for the protection of soil resources for the PV facility are presented in the tables below for each phase of the development.

For the overhead or underground power lines, and for the substations, there are no additional mitigation measures required, over and above what has already been included in the Generic Environmental Management Programmes (EMPr's) for the development and expansion for overhead electricity transmission and distribution infrastructure and of substation infrastructure for the transmission and distribution of electricity as per Government Notice 435, which was published in Government Gazette 42323 on 22 March 2019.

Table 2: *Management plan for the planning and design phase*

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of soil resources					
Erosion	That disturbance and existence of hard surfaces causes no erosion on or downstream of the site.	Design an effective system of stormwater run-off control, where it is required - that is at any points where run-off water might accumulate. The system must effectively collect and safely disseminate any run-off water from all accumulation points and it must prevent any potential down slope erosion. This is included in the stormwater management plan.	Ensure that the stormwater run-off control is included in the engineering design.	Once-off during the design phase.	Holder of the EA

Table 3: *Management plan for the construction phase*

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of soil resources					
Erosion	That disturbance and existence of hard surfaces causes no erosion on or downstream of the site.	Implement an effective system of stormwater run-off control, where it is required - that is at any points where run-off water might accumulate. The system must effectively collect and safely disseminate any run-off water from all accumulation points and it must prevent any potential down slope erosion.	Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the stormwater run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	Every 2 months during the construction phase	Environmental Control Officer (ECO)
Erosion	That vegetation clearing does not pose a high erosion risk.	Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize disturbed soil against erosion.	Undertake a periodic site inspection to record the occurrence of and re-vegetation progress of all areas that require re-vegetation.	Every 4 months during the construction phase	Environmental Control Officer (ECO)
Topsoil loss	That topsoil loss is minimised	If an activity will mechanically disturb the soil below surface in any way, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. During rehabilitation, the stockpiled topsoil must be evenly spread	Record GPS positions of all significant occurrences (that is an area of greater than 25 square metres) of below-surface soil disturbance (e.g., excavations). Record the date of topsoil stripping and replacement. Check	As required, whenever areas are disturbed.	Environmental Control Officer (ECO)

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		over the entire disturbed surface.	that topsoil covers the entire disturbed area.		

Table 4: *Management plan for the operational phase*

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of soil resources					
Erosion	That existence of hard surfaces causes no erosion on or downstream of the site.	Maintain the stormwater run-off control system. Monitor erosion and remedy the stormwater control system in the event of any erosion occurring.	Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the stormwater run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	Bi-annually	Facility Environmental Manager
Erosion	That denuded areas are re-vegetated to stabilise soil against erosion	Facilitate re-vegetation of denuded areas throughout the site	Undertake a periodic site inspection to record the progress of all areas that require re-vegetation.	Bi-annually	Facility Environmental Manager

Table 5: *Management plan for the decommissioning phase*

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of soil resources					
Erosion	That disturbance and existence of hard surfaces causes no erosion on or downstream of the site.	Implement an effective system of stormwater run-off control, where it is required - that is at any points where run-off water might accumulate. The system must effectively collect and safely disseminate any run-off water from all accumulation points and it must prevent any potential down slope erosion.	Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the stormwater run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	Every 2 months during the decommissioning phase, and then every 6 months after completion of decommissioning, until final sign-off is achieved.	Environmental Control Officer (ECO)
Erosion	That vegetation clearing does not pose a high erosion risk.	Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize disturbed soil against erosion.	Undertake a periodic site inspection to record the occurrence of and re-vegetation progress of all areas that require re-vegetation.	Every 4 months during the decommissioning phase, and then every 6 months after completion of decommissioning, until final sign-off is achieved.	Environmental Control Officer (ECO)

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Topsoil loss	That topsoil loss is minimised	If an activity will mechanically disturb the soil below surface in any way, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface.	Record GPS positions of all significant occurrences (that is an area of greater than 25 square metres) of below-surface soil disturbance (e.g., excavations). Record the date of topsoil stripping and replacement. Check that topsoil covers the entire disturbed area.	As required, whenever areas are disturbed.	Environmental Control Officer (ECO)

11. CONCLUSIONS

The entire site was verified in this assessment as being of less than high sensitivity for impacts on agricultural resources with a land capability value of 5 to 6. The agricultural production potential of the site is completely limited by the aridity of the climate, and it is therefore only suitable as grazing land.

Three potential negative agricultural impacts were identified, loss of agricultural land use, land degradation, and dust generation. Two positive agricultural impact were identified as enhanced agricultural potential through increased financial security for farming operations, and improved security against stock theft and other crime. All of these are likely to have low impact on future agricultural production potential and are therefore assessed as having low significance.

The conclusion of this assessment is that the proposed development offers a valuable opportunity for renewable energy development with very little loss of future agricultural production potential.

This is substantiated by the following points:

- The proposed development will occupy land that is of very limited land capability, which is totally insufficient for crop production. There is no scarcity of such agricultural land in South Africa and its conservation for agricultural production is not therefore a priority.
- The amount of agricultural land used by the development is well within the allowable development limits prescribed by the agricultural protocol. These limits reflect the national need to conserve valuable agricultural land and therefore to steer, particularly renewable energy developments, onto land with lower agricultural production potential.
- The proposed development offers positive impact on agriculture by way of improved financial security for farming operations, as well as security benefits against stock theft and other crime.
- The proposed development poses a low risk in terms of causing soil degradation because degradation can be adequately and fairly easily managed by standard, best practice mitigation actions.
- The proposed development will also have the wider societal benefits of generating additional income and employment in the local economy.
- In addition, the proposed development will contribute to the country's need for energy generation, particularly renewable energy that has much lower environmental and agricultural impact than existing, coal powered energy generation.

- All renewable energy development in South Africa will contribute to reducing the large agricultural impact that open cast coal mining has on highly productive agricultural land throughout the coal mining areas of the country.

Because of the above factors, the impact of the proposed development on the agricultural production capability of the site is assessed as being acceptable. Therefore, from an agricultural impact point of view, it is recommended that the development be approved.

The conclusion of this assessment on the acceptability of the proposed development and the recommendation for its approval is not subject to any conditions, other than recommended mitigation.

12. REFERENCES

Crop Estimates Consortium, 2019. *Field Crop Boundary data layer, 2019*. Pretoria. Department of Agriculture, Forestry and Fisheries.

Department of Agriculture Forestry and Fisheries, 2018. Long-term grazing capacity map for South Africa developed in line with the provisions of Regulation 10 of the Conservation of Agricultural Resources Act, Act no 43 of 1983 (CARA), available on Cape Farm Mapper. Available at: https://gis.elsenburg.com/apps/cfm/

Department of Agriculture, Forestry and Fisheries, 2017. National land capability evaluation raster data layer, 2017. Pretoria.

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DEA, 2015. Strategic Environmental Assessment for wind and solar photovoltaic development in South Africa. CSIR Report Number CSIR: CSIR/CAS/EMS/ER/2015/001/B. Stellenbosch.

Schulze, R.E. 2009. SA Atlas of Climatology and Agrohydrology, available on Cape Farm Mapper. Available at: https://gis.elsenburg.com/apps/cfm/

APPENDIX 1: SPECIALIST CURRICULUM VITAE

Johann Lanz
Curriculum Vitae

Education

M.Sc. (Environmental Geochemistry)	University of Cape Town	1996 - 1997
B.Sc. Agriculture (Soil Science, Chemistry)	University of Stellenbosch	1992 - 1995
BA (English, Environmental & Geographical Science)	University of Cape Town	1989 - 1991
Matric Exemption	Wynberg Boy's High School	1983

Professional work experience

I have been registered as a Professional Natural Scientist (Pr.Sci.Nat.) in the field of soil science since 2012 (registration number 400268/12) and am a member of the Soil Science Society of South Africa.

Soil & Agricultural Consulting **Self employed** **2002 - present**

Within the past 5 years of running my soil and agricultural consulting business, I have completed more than 170 agricultural assessments (EIAs, SEAs, EMPRs) in all 9 provinces for renewable energy, mining, electrical grid infrastructure, urban, and agricultural developments. I was the appointed agricultural specialist for the nation-wide SEAs for wind and solar PV developments, electrical grid infrastructure, and gas pipelines. My regular clients include: Zutari; CSIR; SiVEST; SLR; WSP; Arcus; SRK; Environamics; Royal Haskoning DHV; ABO; Enertrag; WKN-Windcurrent; JG Afrika; Mainstream; Redcap; G7; Mulilo; and Tiptrans. Recent agricultural clients for soil resource evaluations and mapping include Cederberg Wines; Western Cape Department of Agriculture; Vogelfontein Citrus; De Grendel Estate; Zewenwacht Wine Estate; and Goedgedacht Olives.

In 2018 I completed a ground-breaking case study that measured the agricultural impact of existing wind farms in the Eastern Cape.

Soil Science Consultant **Agricultural Consultors International (Tinie du Preez)** **1998 - 2001**

Responsible for providing all aspects of a soil science technical consulting service directly to clients in the wine, fruit and environmental industries all over South Africa, and in Chile, South America.

Contracting Soil Scientist **De Beers Namaqualand Mines** **July 1997 - Jan 1998**

Completed a contract to advise soil rehabilitation and re-vegetation of mined areas.

Publications

- Lanz, J. 2012. Soil health: sustaining Stellenbosch's roots. In: M Swilling, B Sebitosi & R Loots (eds). *Sustainable Stellenbosch: opening dialogues*. Stellenbosch: SunMedia.
- Lanz, J. 2010. Soil health indicators: physical and chemical. *South African Fruit Journal*, April / May 2010 issue.
- Lanz, J. 2009. Soil health constraints. *South African Fruit Journal*, August / September 2009 issue.
- Lanz, J. 2009. Soil carbon research. *AgriProbe*, Department of Agriculture.
- Lanz, J. 2005. Special Report: Soils and wine quality. *Wineland Magazine.*

I am a reviewing scientist for the *South African Journal of Plant and Soil*.

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

APPENDIX 2: DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

PROPOSED DEVELOPMENT OF 12 SOLAR PHOTOVOLTAIC (PV) FACILITIES (KUDU SOLAR FACILITIES 1 TO 12) AND ASSOCIATED INFRASTRUCTURE NEAR DE AAR, IN THE NORTHERN CAPE

Kindly note the following:

- This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
- This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
- A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
- All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
- All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address: Department of Environmental Affairs, Attention: Chief Director: Integrated Environmental Authorisations, Private Bag X447, Pretoria, 0001
Physical address: Department of Environmental Affairs, Attention: Chief Director: Integrated Environmental Authorisations, Environment House, 473 Steve Biko Road, Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Johann Lanz – Soil Scientist			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Johann Lanz			
Specialist Qualifications:	M.Sc. (Environmental Geochemistry)			
Professional affiliation/registration:	Registered Professional Natural Scientist (Pr.Sci.Nat.) Reg. no. 400268/12 Member of the Soil Science Society of South Africa			
Physical address:	1a Wolfe Street, Wynberg, Cape Town, 7800			
Postal address:	1a Wolfe Street, Wynberg, Cape Town, 7800			
Postal code:	7800	Cell:	082 927 9018	
Telephone:	082 927 9018	Fax:	Who still uses a fax? I don't	
E-mail:	johann@johannlanz.co.za			

2. DECLARATION BY THE SPECIALIST

I, **Johann Lanz**, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Johann Lanz – Soil Scientist (sole proprietor)

Name of Company:

30/06/2023

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, **Johann Lanz**, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Johann Lanz – Soil Scientist (sole proprietor)

Name of Company

30/06/2023

Date

SERGEANT
400 PUIA A
71520660

Signature of the Commissioner of Oaths

2023·6·30

Date

SUID-AFRIKAANSE POLISIEDIENS
CSM
WYNBERG KP
30 JUN 2023
WYNBERG CP
SOUTH AFRICAN POLICE SERVICE

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Johan Lanz

Registration Number: 400268/12

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Soil Science (Professional Natural Scientist)

Effective **15 August 2012** Expires **31 March 2024**

Chairperson

Chief Executive Officer

To verify this certificate scan this code

APPENDIX 4: PROJECTS INCLUDED IN CUMULATIVE IMPACT ASSESSMENT

DFFE Reference	CSIR Number on Map	Project Title	Technology	Capacity (MW)
12/12/20/2258	1	The Proposed Establishment of Photovoltaic (Solar Power) Farms in the Northern Cape Province - Kalkbult	Solar PV	75
12/12/20/2463/1	2	Longyuan Mulilo De Aar 2 North Wind Energy Facility	Wind	140
12/12/20/2463/2	3	Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility, and The Wind Energy Facility (North and South) Situated On The Plateau Near De Aar, Northern Cape Province	Wind	100
14/12/16/3/3/2/278	6	Proposed Castle Wind Energy Facility Project, located near De Aar, Northern Cape	Wind	118
14/12/16/3/3/2/564	7	Proposed Swartwater 75MW solar PV power facility in Petrusville within Renosterburg Local Municipality, Northern Cape	Solar PV	75
14/12/16/3/3/2/740	8	Proposed 300MW Solar Power Plant in Phillipstown area in Renosterberg Local Municipality	Solar PV	300
14/12/16/3/3/2/744	9	Proposed PV facility on farm Jakhalsfontein near De Aar	Solar PV	0
14/12/16/3/3/2/739	10	Proposed 70 - 100 MW Solar Power Plant in Petrusville	Solar PV	100
N/A (not available yet)	11	The Proposed Keren Energy Odyssey Solar PV Facilities (Odyssey Solar 1, Odyssey Solar 2, Odyssey Solar 3, Odyssey Solar 4, Odyssey Solar 5, Odyssey Solar 6, Odyssey Solar 7 And Odyssey Solar 8)	Solar PV	800
To be confirmed	12	The Proposed Development of the Crossroads (formally referred to as the Hydra B) Green Energy Cluster of Renewable Energy Facilities and Grid Connection Infrastructure	Solar PV	3050
• 14/12/16/3/3/2/2244 • 14/12/16/3/3/2/2245 • 14/12/16/3/3/2/2246 • 14/12/16/3/3/2/2247 • 14/12/16/3/3/2/2248 • 14/12/16/3/3/2/2249 • 14/12/16/3/3/2/2250 • 14/12/16/3/3/2/2251 • 14/12/16/3/3/2/2252	No number but project study area is shown	Proposed Development of 12 Solar Photovoltaic (PV) Facilities (Kudu Solar Facility 1 to 12) and associated infrastructure, near De Aar, Northern Cape Province	Solar PV	2180

DFFE Reference	CSIR Number on Map	Project Title	Technology	Capacity (MW)
• 14/12/16/3/3/2/2253 • 14/12/16/3/3/2/2254 • 14/12/16/3/3/2/2255				
• **Total solar**				6580
• **Total wind**				358
• **Total**				6938

Note: Power lines do not contribute to loss of agricultural land and are therefore not included in the calculation of affected area or the table above.



CHAPTER 7:

Terrestrial Biodiversity, Terrestrial Plant Species and Terrestrial Animal Species Assessment



CSIR
Touching lives through innovation

TERRESTRIAL BIODIVERSITY AND SENSITIVE PLANT AND ANIMAL SPECIES - SPECIALIST ASSESSMENT:

Scoping and Environmental Impact Assessment (EIA) Processes for the Proposed Development of the Kudu Solar Photovoltaic (PV) Facility 4 and associated infrastructure, near De Aar, Northern Cape province



Report prepared for:	*Report prepared by:*
CSIR – Environmental Management Services P O Box 320 Stellenbosch 7599 South Africa	Enviro-Insight CC 862 Wapadrand Rd Wapadrand Security Village 0050 South Africa

Version 1: May 2023
Version 2: July 2023

Executive Summary

Enviro-Insight CC was appointed by the CSIR to conduct the Terrestrial Biodiversity and Sensitive Plant and Animal Species Assessments for the proposed development by ABO Wind renewable energies (PTY) Ltd (hereinafter referred to as ABO Wind) of Solar Facilities, collectively referred to as Kudu. The proposed projects will make use of PV solar technology to generate electricity from energy derived from the sun. Each solar PV facility will have a range of associated infrastructure, including, but not limited to, an on-site substation complex, battery energy storage systems (BESS) and is proposed to connect to an existing 400 kV power line via dedicated 132 kV power lines. Separate specialist reports have been provided for each PV project. This report is focused on **Kudu Solar Facility 4** only.

The study area for the proposed Kudu Solar Facilities 1 to 12 is the full extent of the eight affected farm properties on which the proposed PV Facilities will be constructed. The total study area for all the Kudu Solar Facilities 1 to 12 is approximately 8 150 hectares (ha).

The study area is located in the Eastern Upper Karoo (NKu4) vegetation types, in an Ecological Support Area (ESA) and in the Platberg-Karoo Conservancy, which is a protected area (not formally)[1] as well as Important Bird and Biodiversity Areas (IBA). NKu4 is one of the largest vegetation types in the country listed as Least Threatened with a conservation target of 21%, however it is hardly protected with no areas conserved in statutory conservation areas. The ESA is due to the study area being located in the Platberg-Karoo Conservancy, the vegetation units and important wetland and river features. From a Terrestrial Biodiversity perspective, the Platberg-Karoo Conservancy and the vegetation units are important systems for grasslands and grassland associated animals, as well as important areas for the conservation of avifauna.

The findings of the site verification confirmed medium sensitivity for Terrestrial Biodiversity, and Low sensitivity for both the Animal Species Theme (excluding avifauna) and Plant Species Themes. For Terrestrial biodiversity, the overall sensitivity of the site is considered Medium overall, with some landscape features, including the Koppies, wetlands and main river courses as High sensitivity. These features need to be excluded from development as identified by the relevant specialists (refer to aquatic and avifauna assessments in Chapters 8 and 9 of this EIA Report, respectively).

Two main habitats were identified based on species composition and structure, namely 'White Grassland' and 'Watercourse'. The White Grassland is dominated by white grasses of the genera *Aristida* and *Eragrostis* interspersed with microphyllous shrubs such as *Lycium* spp. This habitat is considered moderately sensitive due to moderate species diversity and the presence of provincially protected species (of the genera *Aloe, Ruschia, Jamesbrittenia, Crassula, Haemanthus, Oxalis)*. The Watercourse habitat consists of drainage lines, some of which are smaller and poorly developed. The vegetation layer is not well-defined and is made up of woody cover in some areas but is mostly dominated by graminoids and herbaceous species. The habitat acts as a landscape corridor for the movement of many fauna species, including small mammals such as hares. It also performs important ecosystem functions such as regulating water runoff and creating suitable conditions important for the survival of many fauna species including foraging and breeding habitat. Accordingly, it is considered as high sensitivity in regard to ecosystem functioning and should therefore be protected.

No SCC were recorded for this site. Provincially protected species (NORTHERN CAPE NATURE CONSERVATION ACT NO. 9 OF 2009) include *Aloe broomii, Jamesbrittenia tysonii* and *Ruschia intricata*. Where the proposed development impact on these species, a permit application from the provincial department is required for relocation to suitable, undisturbed areas.

[1] A conservancy is a vehicle and platform for community-based conservation. It is a voluntary association of environmentally conscious land-owners and land-users who choose to cooperatively manage their natural resources in an environmentally sustainable manner without necessarily changing the land-use of their properties.

The proposed development consists of twelve solar PV facilities and associated infrastructure. Several impacts may result from the project activities, including:

- During the pre-construction phase, vegetation will be removed for the laydown area, access roads and other infrastructure as part of ground preparation. This will result in habitat loss and fragmentation.
- The proposed solar facilities consist of numerous solar panels covering most of the site. It should be noted that the area proposed for the development of all 12 solar PV facilities is approximately 3268 ha (i.e., area covered by the PV array and associated infrastructure). However, the entire site will not be cleared of vegetation. Not all vegetation will be cleared underneath the solar PV panels, but species structure and composition will likely change.
- The proposed solar panels will be mounted to maximise the amount of sunlight. This will result in maximum shading of the surroundings, and accordingly smaller, sensitive plants could be impacted on.
- As the solar panels are impervious to rain, the water will run off the panels which could increase soil erosion and runoff. Water should be collected in swales or similar stormwater design measures where necessary.
- Soil disturbance will take place as the solar panels are mounted on poles that must be firmly embedded in the soil to prevent collapse.

All the impacts assessed can be reduced through avoidance and mitigation measures. There are no residual impacts anticipated and accordingly the project can proceed, but only if sensitive areas are avoided, and the proposed mitigation measures are implemented. Some impacts such as habitat loss and ecological functioning cannot be avoided, but the overall impact for this vegetation type is medium to low significance post mitigation.

The proposed development is not located in a threatened vegetation type or ecosystem and is located in an ESA mainly due to presence of sensitive birds and watercourses. There are no high sensitivity features on site for Kudu Solar Facility 4, and no plant SCC were recorded. However, three provincially protected species occur on Kudu Solar Facility 4 and requires permits for relocation from the provincial authority.

The development of Kudu Solar Facility 4 can proceed should all no-go sensitive areas be avoided, and the recommended mitigation measures are implemented.

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Abbreviations

CBA	Critical Biodiversity Area
CI	Conservation Importance
DAEARDLR	Department of Agriculture, Environmental Affairs, Rural Development and Land Reform: Northern Cape
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ESA	Ecological Support Area
FI	Functional integrity
IUCN	International Union for Conservation of Nature
NCNCA	Northern Cape Nature Conservation Act
NFA	National Forest Act (Act 84 of 1998)
NSBA	National Spatial Biodiversity Assessment
PP	Provincially Protected
PT	Protected Tree
PV	Photovoltaic
SCC	Species of conservation concern
SEI	Site Ecological Importance

Definition

Alien Invasive Species – plants or animals that are introduced by humans, accidentally or intentionally, outside of their natural geographic range into an area where they are not naturally present.

Critical Biodiversity Area (CBA) – an area that must be maintained in a good ecological condition (natural or semi-natural state) in order to meet biodiversity targets.

Conservation importance (CI) is evaluated in accordance with recognised established internationally acceptable principles and criteria for the determination of biodiversity-related value, including the IUCN Red List of Species, Red List of Ecosystems and Key Biodiversity Areas (KBA; IUCN [2016]). The importance of a site for supporting biodiversity features of conservation concern present, e.g. populations of IUCN threatened and Near Threatened species (CR, EN, VU and NT), Rare species, range-restricted species, globally significant populations of congregatory species, and areas of threatened ecosystem types, through predominantly natural processes.

Cumulative impact – in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

Ecotone – a transition area between two habitat types or where two communities meet and integrate. It may be narrow or wide, and it may be local or regional

Endemic – a species that is naturally restricted to a particular, well-defined region.

Functional integrity (FI) of the receptor (e.g. the vegetation/ fauna community or habitat type) is defined here as the receptors' current ability to maintain the structure and functions that define it, compared to its known or predicted state under ideal conditions. Simply stated, FI is: *'A measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts.'*

IUCN Red List status – the conservation status of species, based on the IUCN Red List categories and criteria.

Rare species are those included on South Africa's National Red List as Rare or Critically Rare or Extremely Rare. These are highly restricted species that are currently not declining. However, should any development impact on a population of these species they will immediately qualify under one of the IUCN categories of threat.

Range-restricted species – the presence of terrestrial flora, vertebrate and invertebrate fauna with a global population extent of occurrence (EOO) of 10 000 km^2 or less.

Receptor resilience (RR) – The intrinsic capacity of the receptor to resist major damage from disturbance and/or to recover to its original state with limited or no human intervention.

Natural processes – natural unmanaged areas with low levels of ecological disturbance have largely intact natural processes such as pollination, seed dispersal and migration, and thus have greater intrinsic conservation importance than those that are modified through ecological disturbance.

Species of conservation concern (SCC) – includes all species that are assessed according to the IUCN Red List Criteria as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Data Deficient (DD) or Near Threatened (NT), as well as range-restricted species which are not declining and are nationally listed as Rare or Extremely Rare [also referred to in some Red Lists as Critically Rare.

For plants, species of conservation concern are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient - Insufficient Information (DDD) (http://redlist.sanbi.org/redcat.php).

TERRESTRIAL BIODIVERSITY AND SENSITIVE PLANT AND ANIMAL SPECIES ASSESSMENT

This Chapter includes the **Terrestrial Biodiversity and Sensitive Plant and Animal Species Assessments** that was prepared by Mr Corné Niemandt as part of the Scoping and Environmental Impact Assessment (S&EIA) proposed development of the Kudu Solar Photovoltaic (PV) Facilities and associated infrastructure, near De Aar, Northern Cape Province. The Animal Compliance Statement is attached as Appendix E to this report.

1. Introduction

1.1. Scope, Purpose and Objectives of this Specialist Report

Enviro-Insight CC was appointed by the CSIR to conduct the Terrestrial Biodiversity and Sensitive Plant and Animal Species Assessments for the proposed development by ABO Wind renewable energies (PTY) Ltd (hereinafter referred to as ABO Wind) of Solar Facilities, collectively referred to as Kudu. The proposed projects will make use of PV solar technology to generate electricity from energy derived from the sun. Each solar PV facility will have a range of associated infrastructure, including, but not limited to, an on-site substation complex, battery energy storage systems (BESS) and is proposed to connect to an existing 400 kV power line via dedicated 132 kV power lines. Separate specialist reports have been provided for each PV project. This report is focused on **Kudu Solar Facility 4** only.

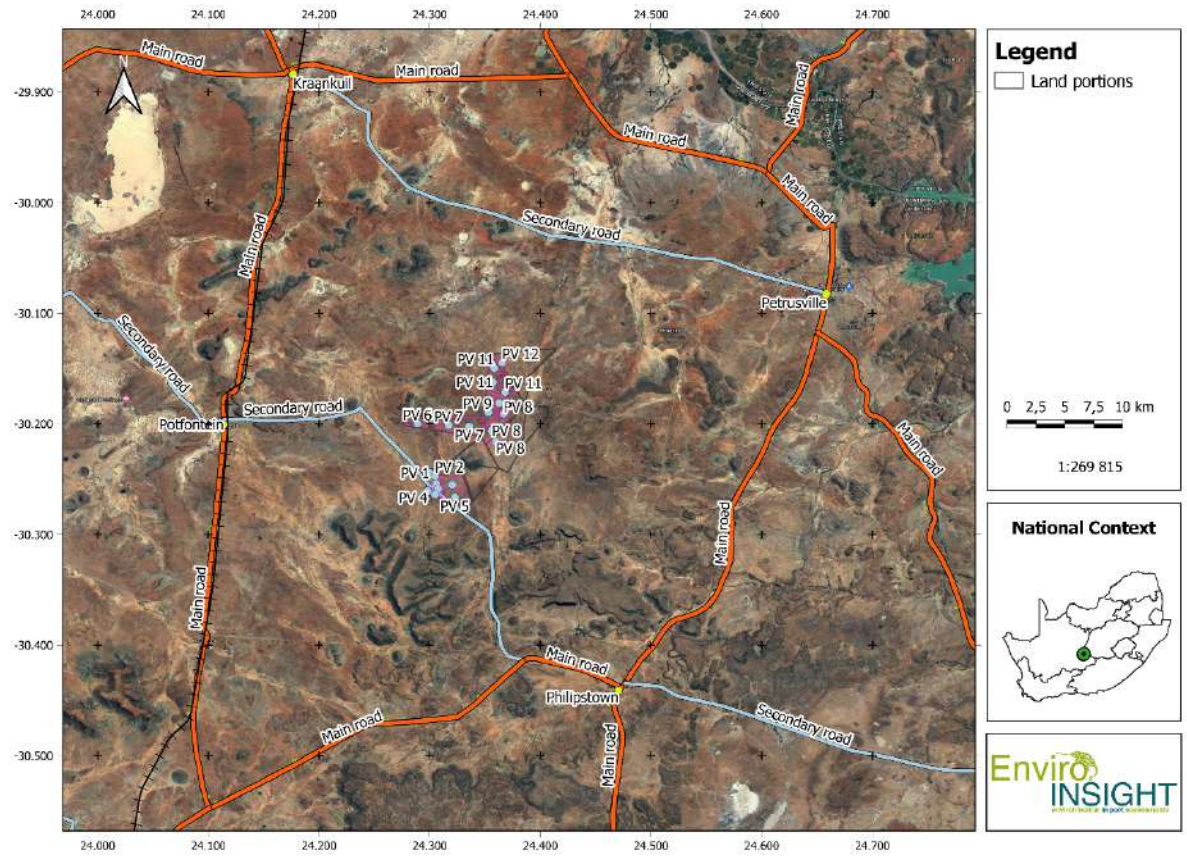


Figure 1-1: Regional location of the affected farm portions on which the proposed Kudu Solar PV Facilities will be constructed. These entire farm portions (outlined in black) are the study area for the 12 PV Facilities. Separate Environmental Assessment processes will be undertaken for the grid connection of the proposed projects (i.e. power lines, switching stations, and Main Transmission Station).

1.2. Details of Specialist

This specialist assessment has been undertaken by Corné Niemandt of Enviro-Insight CC. Corné has a MSc in Plant Science (University of Pretoria, 2015) and is professionally registered with the South African Council for Natural and Scientific Professions (SACNASP), with Registration Number 116598 in the field of Ecological Science. His curriculum vitae is included in Appendix A of this specialist report. In addition, a signed specialist statement of independence is included in Appendix B of this specialist report.

1.3. Terms of Reference

The Terms of Reference (TOR) ensures a consistent and up-to-date approach by the specialist in order to be compliant as required as part of the Environmental Impact Assessments (EIAs) being conducted for these projects. This will enable efficient review and collation of the specialist studies into the Scoping and EIA Reports, in accordance with the latest requirements of the 2014 EIA Regulations (as amended) in terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA).

The following TOR was provided:

- Comply with the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, GN 320. This specifically includes the Terrestrial Biodiversity Protocol that applies to all activities requiring EA.
- Comply with the Assessment Protocols that were published on 30 October 2020, in Government Gazette 43855, GN 1150. This specifically includes the protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species and terrestrial plant species.
- Provide a Terrestrial Biodiversity and Species Specialist Report or Compliance Statement based on the requirements documented in the Assessment Protocols published on 20 March 2020, in Government Gazette 43110, GN 320, and 30 October 2020, in Government Gazette 43855, GN 1150.
- The Specialist Assessment and/or Compliance Statement must also be in adherence to any additional relevant legislation and guidelines that may be deemed necessary. In addition, it must comply with the 2014 NEMA EIA Regulations (as amended), where applicable.
- Provide inputs to the Draft and Final Scoping Report such as a description of the affected environment and environmental sensitivities, key legislation, key issues to be addressed during the EIA Phase, high level assessment of impacts, and confirmation of scope of work for the EIA Phase.
- The specialist must undertake a site visit in order to identify the level of sensitivity assigned to the project area on the Screening Tool, and to verify and confirm this sensitivity and land-use and either compile a Terrestrial Biodiversity and Species Specialist Report or Compliance Statement, as documented in the Assessment Protocols published on 20 March 2020, in Government Gazette 43110, GN 320, and 30 October 2020, in Government Gazette 43855, GN 1150.
- Determination, description and mapping of the baseline environmental condition and sensitivity of the study area. Specify set-backs or buffers, and provide clear reasons for these recommendations. Also map the extent of disturbance and transformation of the site.
- Provide review input on the preferred infrastructure layout following the sensitivity analysis and layout identification.
- Describe the terrestrial ecology features of the project area, with focus on features that are potentially impacted by the proposed project. The description should include the major habitat forms within the study site, giving due consideration to terrestrial ecology (flora) and terrestrial ecology (fauna).
- Consider seasonal changes and long-term trends, such as due to climate change.
- Identify any species of conservation concern (SCC) or protected species on site (e.g. protected tree and provincially protected species).

- The assessment is to be based on existing information, national and provincial databases, and professional experience and a field work conducted by the specialist, as considered necessary and in accordance with relevant legislated requirements. The assessment must also consider the maps generated by the National Screening Tool.
- Identify and assess the potential direct, indirect and cumulative impacts of the proposed development on terrestrial biodiversity and species. Impact significance must be rated both without and with mitigation, and must cover the construction, operational and decommissioning phases of the project.
- Identify any protocols, legal and permit requirements that are relevant to this project and the implications thereof.
- Provide recommendations with regards to potential monitoring programmes.
- Determine mitigation and/or management measures which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts. Also identify best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts. This must be included in the EMPr. Incorporate and address all issues and concerns raised by Stakeholders, Competent Authority, I&APs and the public during the Public Participation Process (where relevant and applicable).

2. Approach and Methodology

This assessment complies with the requirements of the Terrestrial Biodiversity Protocol published in GN 320 in March 2020, as well as the Terrestrial Plant Species Protocol and Terrestrial Animal Species Protocol published in GN 1150 in October 2022.

2.1. Information Sources

Existing data layers were incorporated into a GIS to establish how the proposed study areas and associated activities interact with important terrestrial entities. Emphasis was placed on the following spatial datasets:

Data / Information	Source	Date	Type	Description
South African National Protected Areas Database (SAPAD)	Department of Forestry, Fisheries and the Environment (DFFE) Directorate: Spatial Information Management	2022, Q1	Spatial	Spatial delineation of protected areas in South Africa. Updated quarterly
South Africa Conservation Areas Database (SACAD)	DFFE Directorate: Spatial Information Management	2022, Q1	Spatial	Spatial delineation of conservation areas in South Africa. Updated quarterly
Northern Cape Critical Biodiversity Areas	Northern Cape Department of Environment and Nature Conservation	2016	Report & Spatial	Spatial conservation planning units and associated management recommendations for the Northern Cape province
National Biodiversity Assessment (NBA)	South African National Biodiversity Institute	2018	Report and Spatial	Latest assessment of South African biodiversity and ecosystems, including, vegetation types, wetlands and rivers.
National Vegetation Map (VEGMAP)	South African National Biodiversity Institute	2018	Spatial	Classify, map and sample the vegetation of South Africa, important for environmental planning, conservation management, biodiversity assessment and research in the floristically diverse region of southern Africa.

A literature review was conducted as part of the desktop study to identify the potential habitats and flora SCC present within the study area. The South African National Biodiversity Institute (SANBI) provides

an electronic database system, namely the Botanical Database of Southern Africa (BODATSA) (SANBI, 2022[2]), to access distribution records on southern African plants[3]. This is a new database which replaces the old Plants of Southern Africa (POSA) database. The POSA database provided distribution data of flora at the quarter degree grid cell (QDGC) resolution; however, the BODATSA database provides distribution data as point coordinates. The literature assessment, therefore, focussed on querying the database to generate species lists for the immediate study area and surroundings. A list of 281 species was generated on 21 February 2022 in order to increase the likelihood of obtaining a representative species list for the proposed study area.

The Red List of South African Plants website (SANBI, 2022)[4] was utilized to provide the most current account of the national status of flora. Relevant field guides and texts consulted for identification purposes in the field during the surveys included the following:

- Guide to grasses of southern Africa (Van Oudtshoorn, 2014);
- Field guide to succulents of southern Africa (Smith *et al*. 2017);
- Field guide to wild flowers of South Africa (Manning, 2019);
- Problem plants and alien weeds of South Africa (Bromilow, 2019);
- Field guide to trees of southern Africa (Van Wyk & Van Wyk, 2013), and
- *TheTreeApp* South Africa (High Branching Pty (Ltd)).

Additional information regarding ecosystems, vegetation types, and SCC included the following sources:

- The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006 as amended),
- Red List of South African Plants (Raimondo *et al*., 2009; SANBI, 2022),
- iNaturalist (https://www.inaturalist.org/).

The Animal Compliance Statement is attached as Appendix E to this report.

2.2. Habitats

The habitats present on the study area were ground-truthed by the botanist during fieldwork. Using recent cloud free satellite imagery (Sentinel 2, S2_SR/20201014T080909_20201014T083111_T34JFN), training polygons were created for the different habitats identified. These habitats included: ‘White Grassland’, ‘Shrubby Grassland’, ‘Watercourse’, ‘Koppies’, and ‘Transformed’. These were used to train a smileCART classifier in Google Earth Engine using the following S2 bands 'B2', 'B3', 'B4','B5', 'B6', 'B7', 'B8', 'B11'. A majority filter with a circle search mode, 2-pixel radius and 0 % threshold were applied to the output raster file to consolidate sliver habitats. This raster was then converted to a vector shapefile.

This delineation was performed at a high resolution to include as much detail as possible, but this also results in small or scattered areas being classified as sensitive. Sometimes these areas contain elements of the sensitive habitat, other times it may result from misclassification due to similarities in spectral properties between habitat types. Therefore, we must interpret these delineations with this in mind. Large, intact areas of sensitive habitat should be regarded as highly sensitive, while small and or patchy areas are less important to avoid as they either represent non-sensitive habitat or are fragmented and of lower functional quality.

2 http://newposa.sanbi.org/
3 Data are obtained from the National Herbarium in Pretoria (PRE), the Compton Herbarium in Cape Town (NBG & SAM) and the KwaZulu-Natal Herbarium in Durban (NH)
4 http://redlist.sanbi.org/

2.3. Site visit

A site visit was undertaken from 21-25 February and 2-3 March 2022 (wet season) by an ecologist where the Terrestrial Biodiversity and sensitive flora aspects of the survey area were evaluated. During the field surveys performed, the habitats were evaluated on foot and a series of georeferenced photographs were taken of the habitat attributes (Figure 2-1). The field surveys focused on identifying dominant flora species, main habitat types as well as the actual and potential presence of SCC (either classified as Threatened by the International Union for Conservation of Nature (IUCN) (2022), protected by the National Environmental Management: Biodiversity Act (NEMBA) (2007, as amended) or other legislation applicable provincially or nationally). Refer to the site sensitivity verification report in Appendix C of this report.

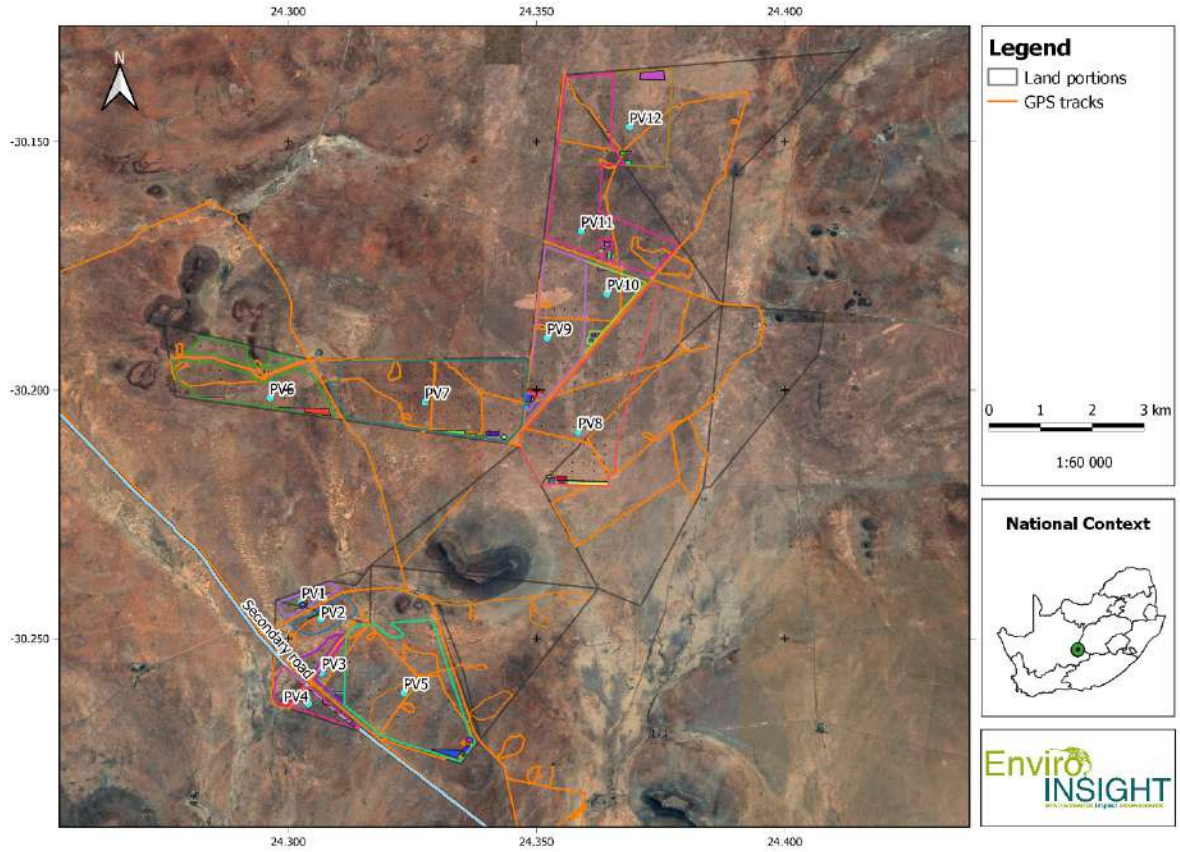


Figure 2-1: GPS tracks and georeferenced photographs taken for the study area. Note that the overhead power lines and grid corridor are the subject of a separate Environmental Assessment Process.

2.4. Site Ecological Importance (SEI)

The Terrestrial Plant Species Protocol requires specialists to identify:

- the nature and the extent of the potential impact of the proposed development on SCC occurring on the proposed development site;
- the potential impact of the proposed development on the habitat of the SCC; and
- any alternative development footprints within the preferred development site which would be of 'low' sensitivity as identified by the screening tool and verified through the site sensitivity verification.

While most of the features that will be included in the conservation importance (CI) will be provided by the screening tool, it is important to note that CI is evaluated at a **much finer spatial scale** and based

on fieldwork data collection and comprehensive desktop analyses performed by the specialist during the Environmental Authorisation (EA) process.

SEI is considered to be a function of the biodiversity importance (BI) of the receptor (e.g., SCC, the vegetation/fauna community or habitat type present on the site) and its resilience to impacts (receptor resilience [RR]) as follows:

$$SEI = BI + RR$$

BI in turn is a function of CI and the functional integrity (FI) of the receptor as follows:

$$BI = CI + FI$$

As BI is a function of CI and the FI of a receptor, BI can be derived from a simple matrix of CI and FI as follows:

Biodiversity importance		Conservation importance				
		Very high	High	Medium	Low	Very low
Functional integrity	Very high	Very high	Very high	High	Medium	Low
	High	Very high	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very low
	Low	Medium	Medium	Low	Low	Very low
	Very low	Medium	Low	Very low	Very low	Very low

From the successful evaluation of both BI and RR as described above, it is possible to evaluate SEI from the final matrix as follows:

Site ecological importance		Biodiversity importance				
		Very high	High	Medium	Low	Very low
Receptor resilience	Very low	Very high	Very high	High	Medium	Low
	Low	Very high	Very high	High	Medium	Very low
	Medium	Very high	High	Medium	Low	Very low
	High	High	Medium	Low	Very low	Very low
	Very high	Medium	Low	Very low	Very low	Very low

The SEI in relation to proposed development activities can be interpreted as follows:

- **Very High:** Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e. last remaining populations of species, last remaining good condition patches of ecosystems/ unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
- **High:** Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
- **Medium:** Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
- **Low:** Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.

- **Very Low:** Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

For a full breakdown of the SEI methodology please refer to SANBI V3.1 (2020).

2.5. Assumptions, Knowledge Gaps and Limitations

- It is assumed that all third-party information acquired is correct (e.g., GIS data and scope of work).
- The survey was conducted in the wet season. Due to the heavy rains received in the 2021/2022 summer period, the grass layer was well-developed, meaning it was tall and dense.
- Due to the nature of most biophysical studies, it is not always possible to cover every square metre of a given study area. Due to the large study area, it is possible that small individual plant SCC may have been overlooked even though care has been taken to search for specific SCC.
- The literature review for plant species identified several limitations in the use of online data platforms.

3. Description of Project Aspects relevant to Terrestrial Biodiversity and Plant and Animal Species Assessment

The proposed project consists of twelve solar PV facilities and associated infrastructure. Several impacts may result from the project activities, including:

- During the pre-construction phase, vegetation will be removed for the laydown area, access roads and other infrastructure as part of ground preparation. This will result in habitat loss and fragmentation.
- The proposed solar facilities consist of numerous solar panels covering most of the site. It should be noted that the area proposed for the development of all 12 solar PV facilities is approximately 3268 ha (i.e., area covered by the PV array and associated infrastructure). However, the entire site will not be cleared of vegetation. Not all vegetation will be cleared underneath the solar PV panels, but species structure and composition will likely change.
- The proposed solar panels will be mounted to maximise the amount of sunlight. This will result in maximum shading of the surroundings, and accordingly smaller, sensitive plants could be impacted on.
- As the solar panels are impervious to rain, the water will run off the panels which could increase soil erosion and runoff. Water should be collected in swales or similar stormwater design measures where necessary.
- Soil disturbance will take place as the solar panels are mounted on poles that must be firmly embedded in the soil to prevent collapse.

4. Baseline Environmental Description

4.1 Study Area Definition

The study area for the proposed Kudu Solar Facilities 1 to 12 is the full extent of the eight affected farm properties on which the proposed PV Facilities will be constructed. The full extent of these properties has been assessed in this study in order to identify environmental sensitivities and no-go areas. The total study area for all the Kudu Solar Facilities 1 to 12 is approximately 8 150 hectares (ha).

At the commencement of this Scoping and EIA Process, the Original Scoping Buildable Areas which fall within the study area were identified by the Project Developer following the completion of high-level environmental screening based on the Screening Tool.

Following the identification of sensitivities during the Scoping Phase, the Project Developer considered such sensitivities and formulated the Revised Scoping Buildable Areas. The Revised Scoping Buildable Areas were used to inform the design of the layout and further assessed during this EIA Phase of the project in order to identify the preferred development footprint of the proposed project on the approved site as contemplated in the accepted Scoping Report. The development footprint is where the actual development will be located, i.e. the footprint containing the PV solar arrays and associated infrastructure**.**

4.2 General Description

4.2.1. Regional Vegetation

According to Mucina & Rutherford (2006, as amended), Kudu PV4 is located in the Eastern Upper Karoo vegetation type. The study area is located in the Eastern Upper Karoo (NKu4) vegetation type (Figure 4-1). The majority of the overall study area (PV1-2 and PV6-12 with some sections of PV3 and PV5) is located in the Northern Upper Karoo, while portions of PV3 and PV5 and the entire PV4 are located in the Eastern Upper Karoo. The Besemkaree Koppies Shrubland are embedded between the two mentioned vegetation units, with a small section of PV6 overlapping it.

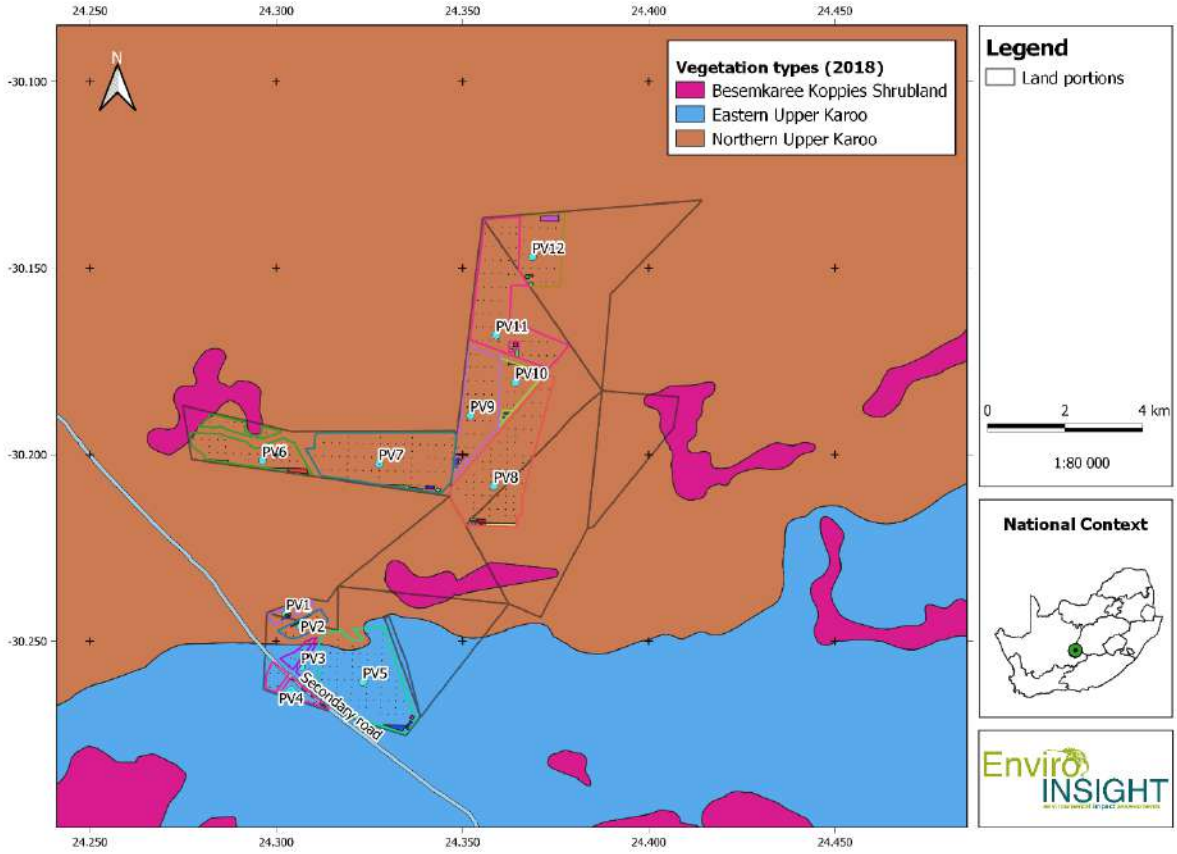


Figure 4-1: Locality of the Project in relation to the Vegetation units (SANBI, 2018). Note that the overhead power lines and grid corridor are the subject of a separate Environmental Assessment Process.

The **Eastern Upper Karoo** vegetation type is one of the largest vegetation types in the country and consists of flat and gently sloping plains vegetation dominated by dwarf microphyllous shrubs with 'white' grasses, especially *Aristida, Eragrostis* and *Stipagrostis* (Mucina & Rutherford 2006). Eastern Upper Karoo is found in the Northern, Western and Eastern Cape, between Carnarvon and Loxton in

the west, De Aar, Petrusville and Venterstad in the north and Burgersdorp and Cradock in the east, and the Great Escarpment in the south (Mucina & Rutherford 2006). The Eastern Upper Karoo is classified as Least Threatened with a national conservation target set at 21%, but less than 1% is formally protected. About 2% of the original extent has been transformed, largely due to building of dams (Mucina & Rutherford 2006); however, this could have increased in the last 16 years. Its geology consists of mudstones and sandstones of the Beaufort Group supporting duplex soils, which are vulnerable to erosion.

Table 4-1: Attributes of the Eastern Upper Karoo vegetation type (Mucina and Rutherford, 2006).

Name of vegetation type	Eastern Upper Karoo
Code as used in the Book	NKu4
Conservation Target (percent of area) from NSBA	21%
Protected (percent of area) from NSBA	0.7%
Remaining (percent of area) from NSBA	98.1%
Description of conservation status from NSBA	Least threatened
Description of the Protection Status from NSBA	Hardly protected
Area (km^2) of the full extent of the Vegetation Type	49821.32
Name of the Biome	Nama-Karoo Biome
Name of Group and Bioregion	Upper Karoo Bioregion

4.2.2. Northern Cape Conservation Plan

The Northern Cape CBA Map (2016) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole (Holness & Oosthuysen, 2016). Priorities from existing plans such as the Namakwa District Biodiversity Plan, the Succulent Karoo Ecosystem Plan, National Estuary Priorities, and the National Freshwater Ecosystem Priority Areas were incorporated. Targets for terrestrial ecosystems were based on established national targets, while targets used for other features were aligned with those used in other provincial planning processes.

CBAs are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services. The primary purpose of CBAs is to inform land-use planning in order to promote sustainable development and protection of important natural habitat and landscapes. Biodiversity priority areas are described as follows:

- *Critical biodiversity areas (CBAs)* are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses. For CBAs the impact on biodiversity of a change in land-use that results in a change from the desired ecological state is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g., loss of populations or habitat). All Freshwater Ecosystem Priority Area (FEPA) prioritized wetlands and rivers have a minimum category of CBA1, while all FEPA prioritised wetland clusters have a minimum category of CBA2.

- *Ecological support areas (ESAs)* are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of CBAs and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for CBAs. For ESAs a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway (e.g. removing a corridor results in a population going extinct elsewhere or a new plantation locally results in a reduction in stream flow at the exit to the catchment which affects downstream biodiversity). All natural non-FEPA wetlands and larger rivers have a minimum category of ESA.

The study area is located in an ESA (Figure 4-2). The ESA is due to the study area being located in the Platberg-Karoo Conservancy, the vegetation units and important wetland and river features. From a Terrestrial Biodiversity perspective, the Platberg-Karoo Conservancy and the vegetation units are important systems for grasslands and grassland associated animals, as well as important areas for the conservation of avifauna. This section of the Karoo has the highest rainfall, and provides an ecotone between the Nama Karoo and Grassland biomes. Accordingly, all developments within this ESA must undergo environmental authorisation processes, where impacts are assessed and appropriate mitigation measures provided to lower the significance of negative impacts and enhance positive impacts, where appropriate. More information on the Platberg-Karoo Conservancy is provided in the next section.

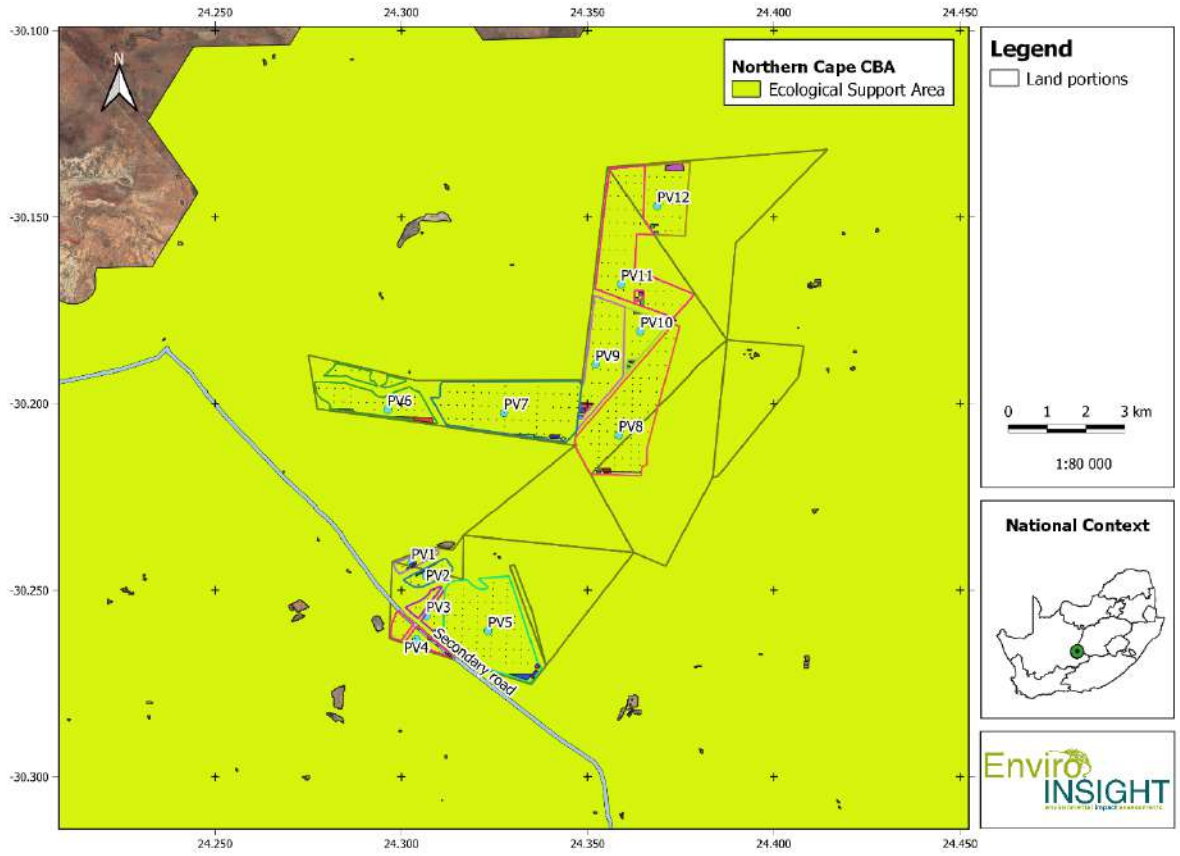


Figure 4-2: Locality of the Project in relation to the Northern Cape CBA Map (2016). Note that the overhead power lines and grid corridor are the subject of a separate Environmental Assessment Process.

4.2.3. Important Bird and Biodiversity Areas, and Protected Areas

The study area is located in the Platberg-Karoo Conservancy, which is a protected area (not formally)[5] as well as Important Bird and Biodiversity Areas (IBA) (Figure 4-3). The only formally conserved reserve in the area is the small government owned Rolfontein Nature Reserve (6,938 ha) in the north-east.

The Platberg–Karoo Conservancy was established in July 1990. In collaboration with MD Anderson of DENC, various research and environmental awareness projects were initiated, including the Karoo Large Terrestrial Bird Survey, the Blue Crane Awareness Project and 11 years of colour-ringing Blue Crane chicks. The major threat of power-line collisions was initially investigated by the Eskom/EWT partnership and MD Anderson. This covered the impact of power lines on populations of large terrestrial bird species and evaluated the effectiveness of earth-wire marking devices.

The Platberg–Karoo Conservancy IBA covers the entire districts of De Aar, Philipstown and Hanover, including suburban towns. The landscape consists of extensive flat to gently undulating plains that are broken by dolerite hills and flat-topped inselbergs. The ephemeral Brak River flows in an arc from south-east to north-west, eventually feeding into the Orange River basin. Other ephemeral rivers include the Hondeblaf, Seekoei, Elandsfontein and Ongers rivers with a network of tributaries. Vanderkloof Dam is on the north-eastern boundary.

This IBA is in the Nama Karoo and Grassland Biomes. The eastern Nama Karoo has the highest rainfall of all the Nama Karoo vegetation types and is thus ecotonal to grassland, with a complex mix of grass- and shrub-dominated vegetation types. Eight broad vegetation types are present; seven are Least Threatened and the Upper Gariep Alluvial Vegetation type is classified as Vulnerable. In addition to sensitive avifauna species, Aardwolf *Proteles cristatus*, aardvark *Orycteropus afer*, bat-eared fox *Otocyon megalotis* and black-footed cat *Felis nigripes* (Vulnerable) are present.

The land is used primarily for grazing and agriculture. Commercial livestock farming is mostly extensive wool and mutton production, with some cattle and game farming. Less than 5% of this IBA is cultivated under dry-land or irrigated conditions and includes lucerne and prickly pear *Opuntia ficus-indica* orchards. Threats in the area include overgrazing, which results in a depletion of palatable plant species, erosion, and encroachment by Karoo shrubs. The result is loss of suitable habitat and a decrease in the availability of food for large terrestrial birds. Centre-pivot irrigated croplands using underground water are increasing and agriculture is intensifying.

Renewable energy developments are a new threat. About 20 applications for EA have been submitted according to the South African Renewable Energy EIA Application Database (REEA_OR_2022_Q2, DFFE 2022) of which thirteen wind and solar developments have been approved for development within this IBA (https://www.birdlife.org.za/iba-directory/platberg-karoo-conservancy/). All the large trigger species are highly susceptible to collisions with wind turbines. All the trigger species are predicted to be moderately susceptible to the various impacts of solar-energy facilities.

[5] A conservancy is a vehicle and platform for community-based conservation. It is a voluntary association of environmentally conscious landowners and land-users who choose to cooperatively manage their natural resources in an environmentally sustainable manner without necessarily changing the land-use of their properties.

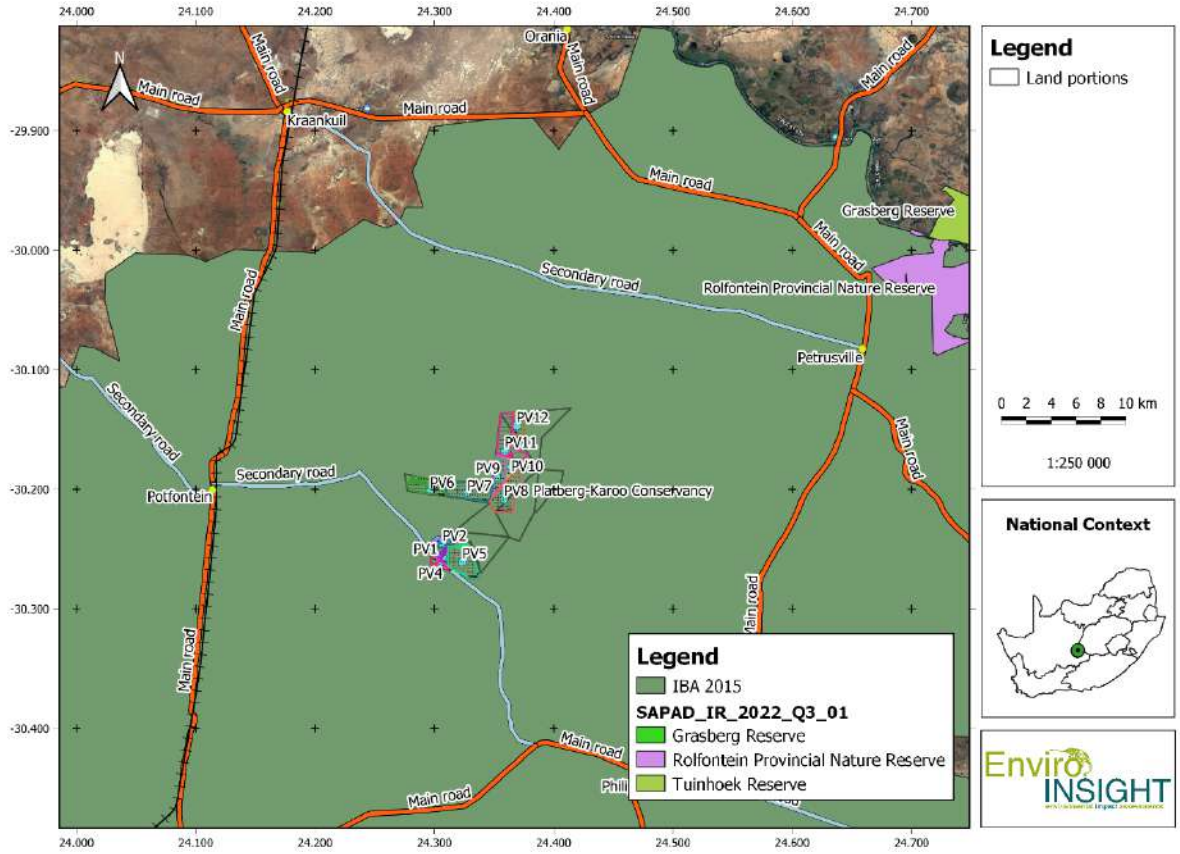


Figure 4-3: Locality of the Project in relation to the Platberg-Karoo Conservancy. Note that the overhead power lines and grid corridor are the subject of a separate Environmental Assessment Process.

4.2.4. Current Impacts

The land within the study area is currently being used for livestock grazing, with some game animals such as springbok. Accordingly, infrastructure such as homesteads, livestock pens, windpumps, waterpoints, gravel farm roads and fences are located on the properties. Furthermore, existing overhead powerlines runs through the study area. Other impacts include the presence of alien invasive species, mainly *Prosopis* species and planted *Eucalyptus* and *Opuntia* species. In some areas, *Opuntia* has spread into the grassland. Refer to Figure 4-4 for an illustration of such impacts.

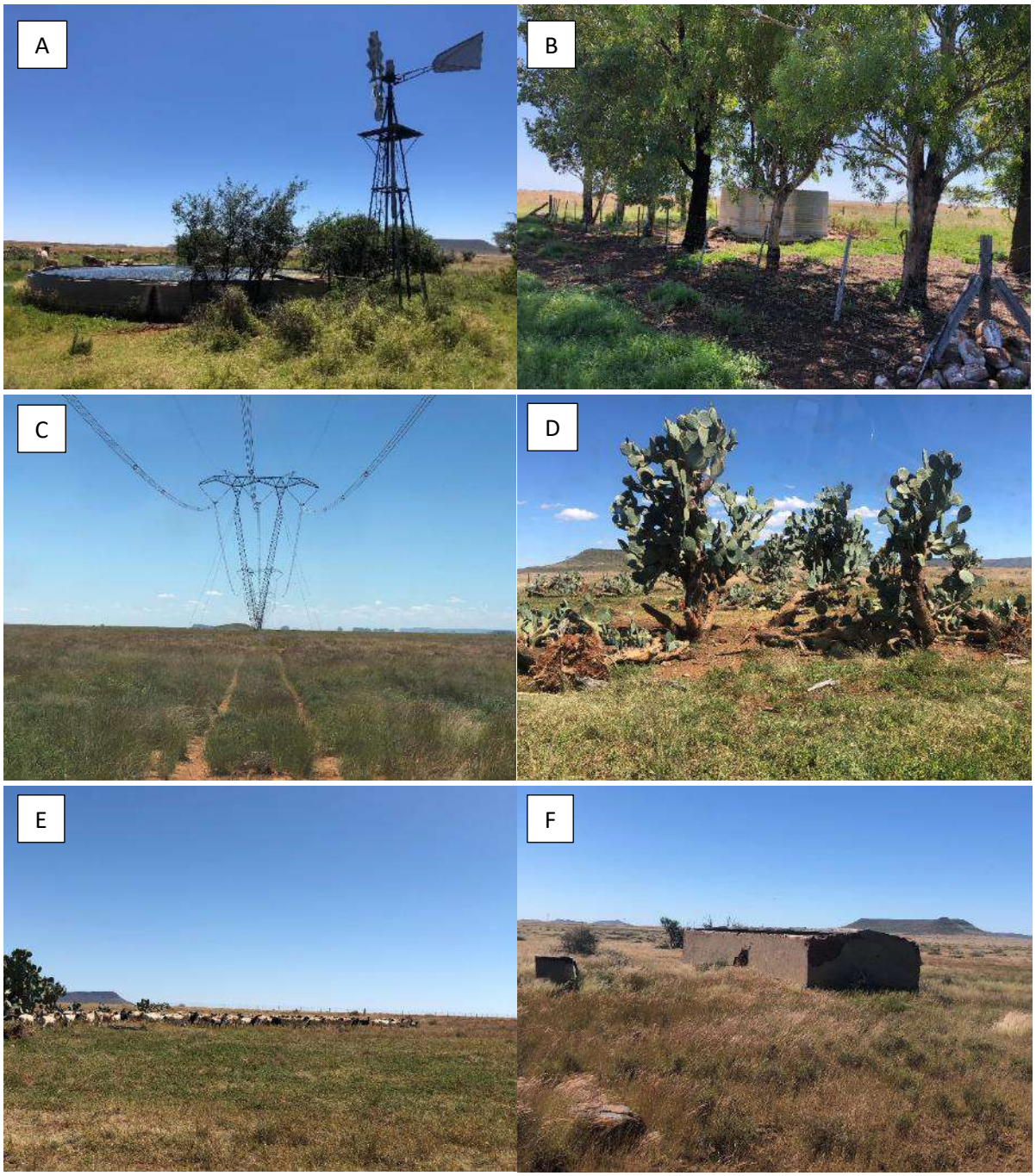


Figure 4-4: Current impacts of the study area. A = Windpump and waterpoint; B = Fenced camp with planted Eucalyptus and water point; C = Powerlines; D = Planted Opuntia; E = Livestock; and F = Abandoned structure.

4.3 Project Specific Description

Two main habitats were identified based on species composition and structure, namely 'White Grassland', and 'Watercourse' (Figure 4-5). In addition, 'Transformed' areas were included which makes up existing roads, homesteads and bare soil.

Georeferenced photographs were taken to assist in both the site characterisation as well as the sensitivity analysis and provide lasting evidence for future queries. The specialist coverage is considered optimal as every habitat was surveyed, taking into consideration the large study area.

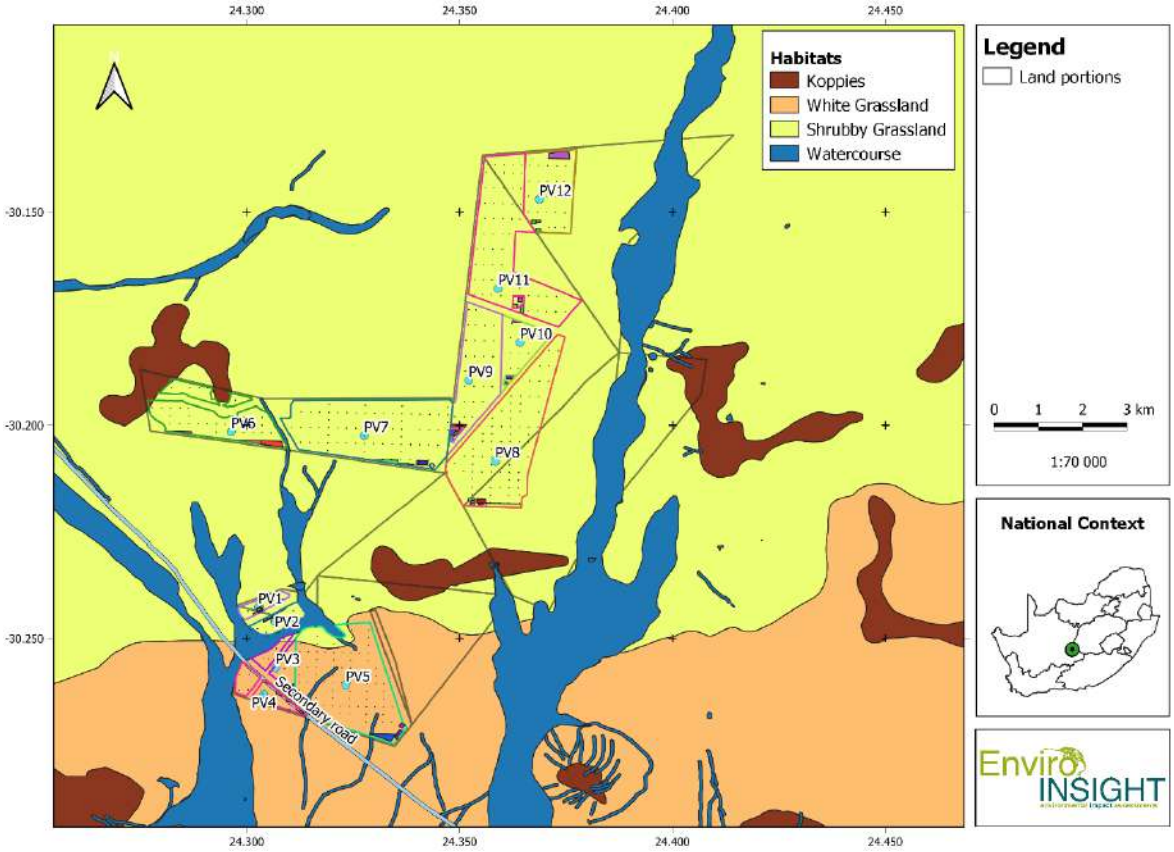


Figure 4-5: Main habitats identified for the study area.

White Grassland

This habitat is dominated by white grasses of the genera *Aristida* and *Eragrostis* interspersed with microphyllous shrubs such as *Lycium* spp. (Figure 4-6). This habitat is considered moderately sensitive due to moderate species diversity and the presence of provincially protected species (of the genera *Aloe, Ruschia, Jamesbrittenia, Crassula, Haemanthus, Oxalis).* The habitat provides suitable foraging and nesting habitat for fauna species, including reptile like Puffadders and Cobras, small mammals like squirrels and mongoose, and grassland birds.

Dominant species recorded include:

- shrubs – *Lycium cinereum, Ricinus communis*
- grasses – *Aristida congesta* subsp *congesta, Aristida uniforms, Aristida canescens, Aristida diffusa, Chloris virgata, Enneapogon cenchroides, Eragrostis chloromelas, Eragrostis curvula, Eragrostis nindensis, Eragrostis obtusa, Eragrostis plana, Heteropogon contortus, Sporobolus fimbriatus, Stipagrostis ciliata, Stipagrostis obtusa, Themeda triandra*
- succulent shrubs – *Ruschia intricata.*
- succulents – *Aloe broomii*
- *Herbs – Indigofera alternans*, *Jamesbrittenia tysonii*



Figure 4-6: Typical features of the White Grassland occurring in the southern section of the study area.

Watercourse

The Watercourse habitat consists of drainage lines, some of which are smaller and poorly developed. The vegetation layer is not well-defined and is made up of woody cover in some areas but is mostly dominated by graminoids and herbaceous species (Figure 4-7).

Dominant species include:

- trees – *Searsia lancea*
- shrubs – *Asparagus suaveolens*, *Euclea crispa, Diospyros lycioides, Lycium cinereum*, *Galenia africana, Rhigozum trichotomum, Tarchonanthus minor.*
- grasses – *Aristida congesta, Themeda triandra*, *Eragrostis curvula*
- Sedges – *Afroscirpoides dioeca, Schoenoplectus sp., Cyperus sp. Juncus sp.*

The Watercourse habitat acts as a landscape corridor for the movement of many fauna species, including small mammals such as hares. The Watercourse habitat also performs important ecosystem functions such as regulating water runoff and creating suitable conditions important for the survival of many fauna species including foraging and breeding habitat.



Figure 4-7: Watercourse habitat throughout the study area.

4.3.1 Solar Facility 4 and associated infrastructure

This PV facility consists of several sections which is mainly located in the White Grassland habitat, interspersed between the Watercourse habitat and powerlines.

No SCC were recorded for this site. Provincially protected species (NORTHERN CAPE NATURE CONSERVATION ACT NO. 9 OF 2009) include *Aloe broomii, Jamesbrittenia tysonii and Ruschia intricata.* Where the proposed development impact on these species, a permit application from the provincial department is required for relocation to suitable, undisturbed areas.

Provincially Protected Species

Note that many species are widespread and not of any conservation concern but protected due to the fact that the Northern Cape Nature Conservation Act (2009) protects entire families of flowering plants irrespective of whether some members are rare or common. The implication is that a comprehensive list of species occurring within the footprint of the proposed infrastructure is required and a permit application submitted for any of those listed as protected. A walk-through survey prior to the commencement of construction activities is therefore required for the approved layout in order to identify the relevant species and obtain the number of applicable plants for which permits are required for their relocation or destruction, as required.

Table 4-2: Summary of observed occurrence of plant SCC on the sites showing status as Provincially Protected (PP) and Protected Tree (PT) with proposed actions and estimated number of specimens.

Site	Protected Plants (status)	Proposed management action	Approximate number of specimens on site	Comment on buffers & potential risks to obtaining permit
PV4	*Aloe broomii* (PP)	Obtain Plant Removal Permit from provincial authority	Approximately 3 individuals were recorded. Smaller individuals could occur in the high, dense grassland	Permit for relocation required.
	Ruschia intricata (PP)	Obtain Plant Removal Permit from provincial authority	Approximately 15 individuals recorded. Smaller individuals could occur in the high, dense grassland.	Permit for relocation / destruction required.
	Jamesbrittenia tysonii (PP)	Obtain Plant Removal Permit from provincial authority	Approximately 3 individuals recorded. This is a small plant so more can occur in the high, dense grassland.	Permit for relocation / destruction required.

4.4. Identification of Environmental Sensitivities

4.4.1. Sensitivities identified by the National Web-Based Environmental Screening Tool

The assessment and minimum reporting requirements of the Terrestrial Biodiversity protocol are associated with a level of environmental sensitivity identified by the screening tool. The requirements for terrestrial biodiversity are for landscapes or sites which support various levels of biodiversity[6]. A

[6] The Terrestrial Biodiversity theme is assessed at a higher level than species level and incorporates both biotic and abiotic components. This section deals with maintaining corridors, addressing climate change by protecting certain areas, maintaining and conserving ecosystem processes etc., and is not assessed for individual species, but rather describes the dominant vegetation composition and structure, to an extent.

screening report was generated on 9 February 2022[7] for the study area (full extent of the eight properties). The following section is applicable to the entire project study area.

Based on the screening report generated, the Terrestrial Biodiversity Combined Sensitivity Theme (Figure 4-10) is indicated as Very High as the proposed projects are located in an ESA. Accordingly, a Terrestrial Biodiversity Specialist Assessment must be conducted based on the Protocols (published on 20 March 2020). The ESA is due to the site being in the Platberg-Karoo Conservancy (not formally protected), the vegetation units and important wetland and river features – refer to section 4.2 above for more details on this. The Terrestrial Biodiversity theme therefore includes information on avifauna and aquatic features, which is not discussed in detail in this report – the relevant specialist assessments with regards to these specific taxa and features must be read in combination with this report to obtain a holistic view of the environment and in order to determine and assess relevant impacts from the proposed PV facilities on these features and taxa. The vegetation itself is not considered sensitive but do provide important feeding and breeding habitat for fauna. The relevant buffers indicated in the avifauna assessment must be incorporated into the layout design, and where necessary these areas must be avoided from development (as has been achieved, refer to Chapter 9 of this EIA Report for the Avifauna Assessment). Important river and wetland features occur in the landscape, which are vital for ecosystem services, maintaining connectivity in the landscape, and act as important habitats for many fauna species. Accordingly, the overall sensitivity of the site is considered Medium, with some landscape features, including the Koppies, wetlands and main river courses as High sensitivity. These features need to be excluded from development as identified by the relevant specialists (refer to aquatic and avifauna assessments in Chapters 8 and 9 of this EIA Report, respectively). For the grid connection, (although subject to a separate assessment) the Terrestrial Biodiversity theme is considered Medium sensitivity. The main impacts will be on avifauna in terms of collision risk – refer to the avifauna report for more details on this.

The Plant species theme indicates Low and Medium sensitivity (Figure 4-9) due to suitable habitat for one SCC, namely *Tridentea virescens*. This species has an extensive, but very sporadic distribution from the south-eastern corner of Namibia to De Aar, Hopetown and Beaufort West in South Africa (Bruyns 2005). Specimens are usually found in stony ground or hard loam in floodplains and they are often associated with shrubs of *Lycium* or *Rhigozum trichotomum*. No individuals were recorded during the survey for any of the PV sites. Even though *Lycium* and *Rhigozum spp.* are present throughout the study area, it does not always indicate suitable habitat for the species as the species tends to be sporadic. The species has a moderate likelihood of occurring on the study area, especially towards the northern boundary of Kudu PV12.

[7] Screening Tool Reports generated at a later stage are aligned with the findings of the report generated on 9 February 2022.

The Animal species theme is indicated as Medium sensitivity due to the presence of sensitive avifauna species (not addressed in this report), while the remaining taxa groups are considered to be low. Accordingly, only a compliance statement is required (refer to Appendix E for more details).

Prior to commencing with a specialist assessment, the current use of the land and the potential environmental sensitivity of the site under consideration as identified by the screening tool had to be confirmed by undertaking a site sensitivity verification.

Site verification was undertaken in February 2022 by a SACNASP registered ecologist. The purpose of this preliminary on-site inspection was to confirm the current use of the land and environmental sensitivities as identified by the screening tool. The findings of the site verification, which included a desktop assessment, confirmed the Very High environmental sensitivity of the Terrestrial Biodiversity theme and Low sensitivity for all other animal taxa groups. The plant species theme indicated the possibility of the sensitive species to occur on the northern boundary of the study area, but was not recorded during the survey. The initial desktop review focused mainly on the BRAHMS Online BODATSA database. The species lists generated from existing botanical reports within the listed vegetation units were also scrutinised and included in the expected species list. The findings of the site verification confirmed Low sensitivity for the Plant Species Theme for Kudu PV4.

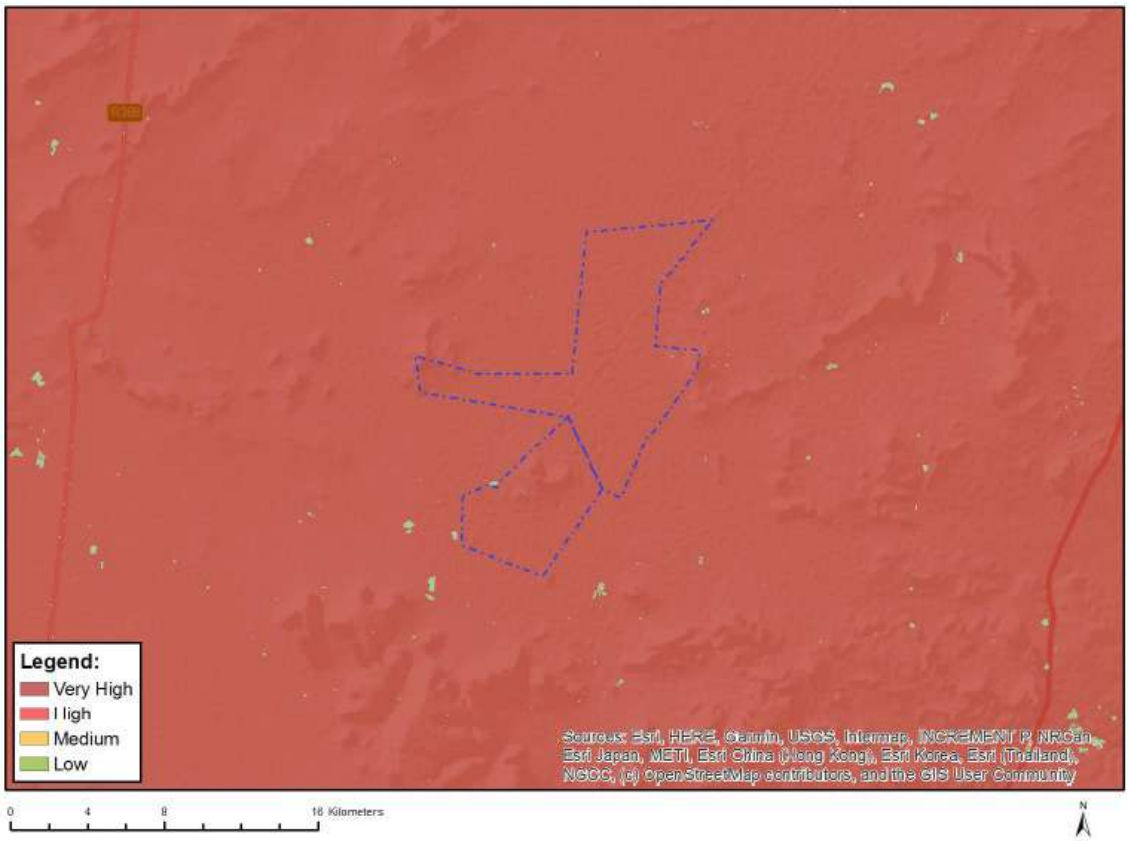


Figure 4-8: Map of relative Terrestrial Biodiversity theme sensitivity.

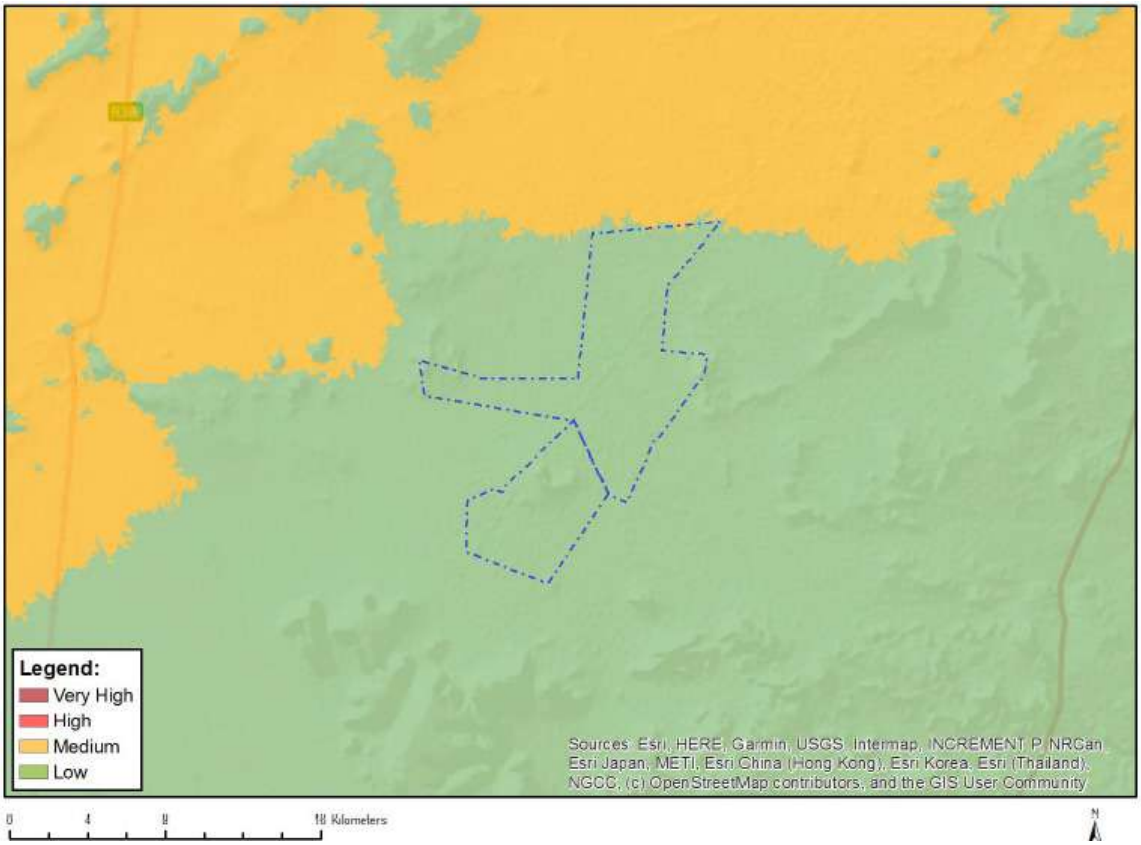


Figure 4-9: Map of relative Plant Species theme sensitivity.

4.4.2. Specialist Sensitivity Analysis and Verification

Site Ecological Importance (SEI)

The results of the SEI are indicated in the Tables below for each habitat. While most of the features that will be included in the conservation importance (CI) will be provided by the screening tool, it is important to note that CI is evaluated at a **much finer spatial scale** and based on fieldwork data collection and comprehensive desktop analyses performed by the specialist during the Environmental Authorisation (EA) process. The reasons indicated below are based on the criteria in the guidelines selected for each relevant habitat.

Conservation importance (CI):

The following reasons based on the criteria in the guidelines were selected for each relevant habitat.

Habitat	Criteria	CI
Watercourse	> 50% of receptor contains natural habitat with potential to support SCC	Medium
White Grassland	> 50% of receptor contains natural habitat with potential to support SCC.	Medium

Functional integrity (FI):

The following reasons based on the criteria in the guidelines were selected for each relevant habitat.

Habitat	Criteria	FI
Watercourse	High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches. No or minimal current negative ecological impacts with no signs of major past disturbance (e.g. ploughing).	Very High
White Grassland	Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts (e.g. few livestock utilising area) with no signs of major past disturbance (e.g. ploughing) and good rehabilitation potential.	High

Receptor Resilience (RR)

The following reasons based on the criteria in the guidelines were selected for each relevant habitat.

Habitat	Criteria	RR
Watercourse	Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of returning to a site once the disturbance or impact has been removed.	Medium
White Grassland	Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a low likelihood of returning to a site once the disturbance or impact has been removed.	Low

Determination of Site Ecological Importance (SEI)

Habitat	CI	FI	BI = CI+FI	RR	SEI= BI+RR
Watercourse	Medium	Very High	High	Medium	**High**
White Grassland	Medium	High	Medium	Low	**High**

It is very important to note that SEI is specific to the proposed development activities and cannot be meaningfully compared between different proposed projects with different associated activities on the same spatial location.

Even though all four habitats are indicated as High (pre-mitigation), after mitigation measures have been incorporated, both Grassland habitats can be considered as **Medium**, taking the following into account:

- the White Grassland is characteristic of the Eastern Upper Karoo vegetation type, where less than 1% is protected and transformation is moderate to low. Accordingly, it is listed as least threatened as large areas are still intact. It has the potential to support endemic species, where the necessary mitigation measures, including permit applications and reduced layouts have been considered. Lastly, the capacity to recover to its original state after a major disturbance without human intervention, is low, as grasslands generally take long periods (several decades) to return to a natural state (is very difficult if not impossible to restore them fully to their former state) with about only 50% of the original species composition and functionality remaining. Considering that limited topsoil will be removed (no ploughing or blasting taking place - transformation of the grassland will not occur) and some vegetation cover will still remain, the habitat has some genetic material to enhance restoration efforts post development.

- After avoidance of infrastructure and additional mitigation measures, the Watercourse habitat can be considered as medium sensitivity (refer to the separate Aquatic Assessment in Chapter 8 of the EIA Report). Refer to the Sensitivity Analysis Summary Statement below.

The sensitivity map for the entire study area is indicated in Figure 4 10 while the sensitivity map specific for Kudu Solar Facility 4 is indicated in Figure 4 11 below. For Kudu Solar Facility 4, no habitats are considered highly sensitive which must be avoided. Proposed mitigation measures could include changes to project infrastructure design to limit the amount of habitat impacted. The PV solar arrays and associated infrastructure were focused in areas identified as medium sensitivity and lower (all highly sensitive areas have been avoided), should the appropriate mitigation measures be implemented.

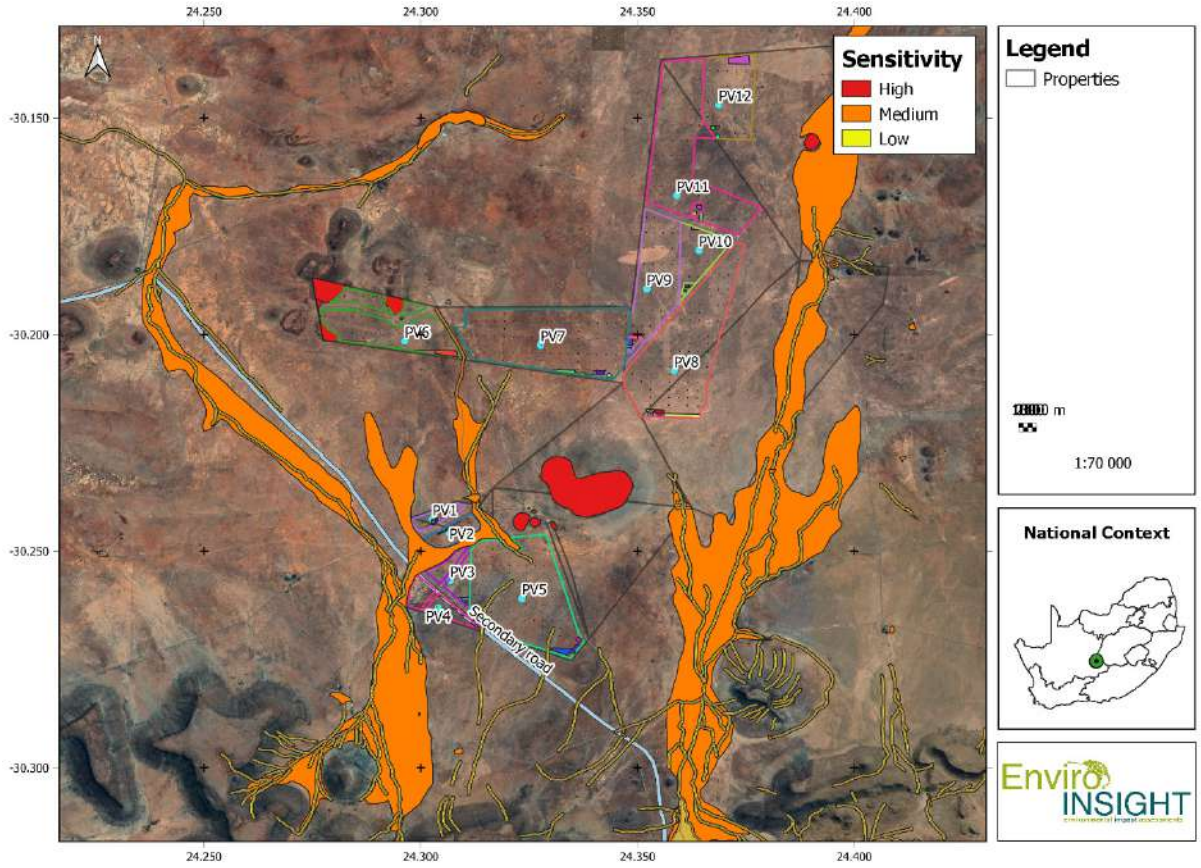
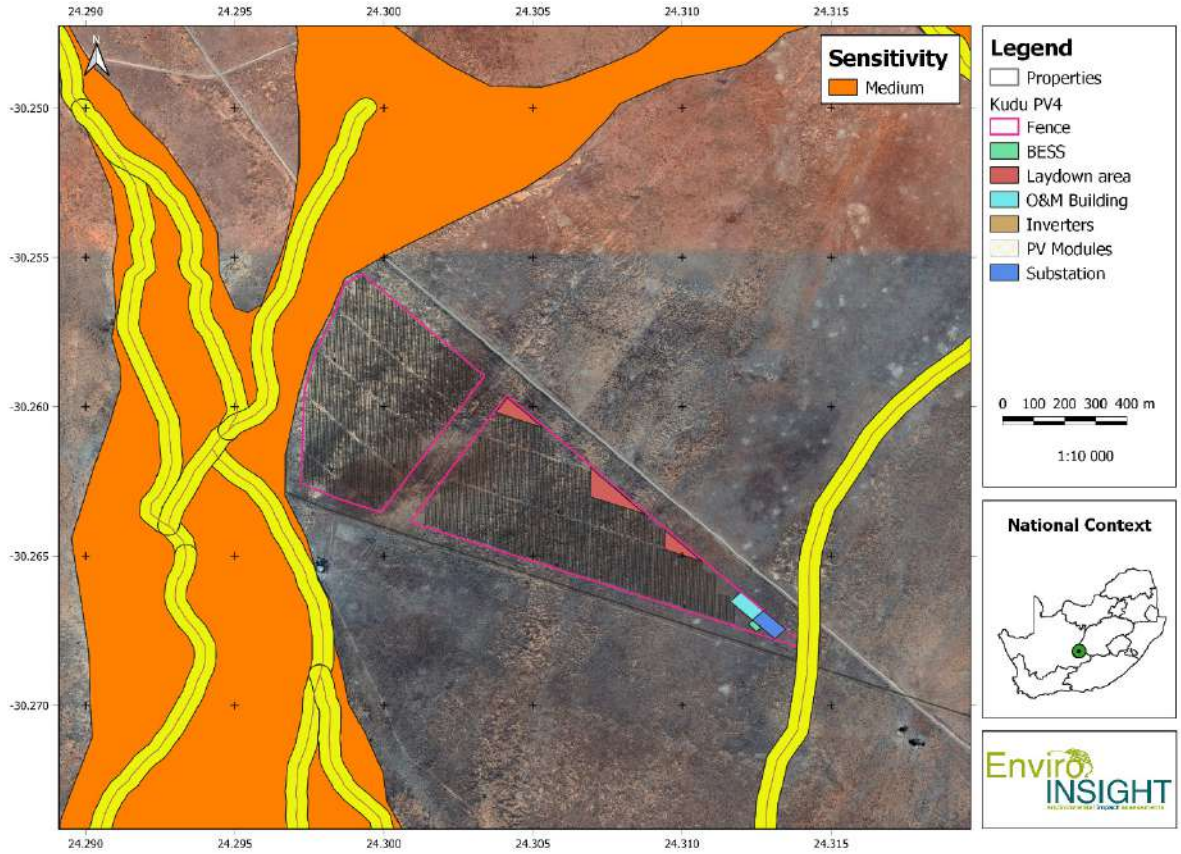


Figure 4-10: Sensitivity map for Kudu Solar Facilities 1-12.



The yellow areas indicated above are regarded as low sensitivity

Figure 4-11: Sensitivity map for Kudu Solar Facility 4.

From a mapping aesthetic perspective, the larger on-site substation complex, internal roads and access road are not displayed on the map above, however they have been considered in this assessment, along with all project components discussed in the project description. Refer to Chapter 2 of the EIA Report for additional layout maps.

4.4.2.1. Kudu Solar Facility 4 and associated infrastructure

The Watercourse habitat is identified as a medium sensitivity feature which must be buffered and mitigated as per the Aquatic Biodiversity report. The Watercourse habitat is critical for the continuation of important ecosystem services from a Terrestrial ecological point of view. The proposed mitigation measures suggested in this report as well as the aquatic biodiversity report could reduce the impact which could make it possible to develop within the proposed buffer area as suggested by the aquatic specialist.

4.4.3. Sensitivity Analysis Summary Statement

The sensitivity maps generated (Figure 4-11) is based on the SEI as follows:

- Highly sensitive features:
  - The Koppies are high sensitivity features which must be avoided by development activities. This is not relevant for PV4. Only limited development activities of low impact will be acceptable.
  - Linear infrastructure such as roads and overhead powerlines can cross the Watercourse, but it is advised to construct pylons outside the buffer areas.

  - Linear infrastructure such as roads and overhead powerlines should not cross the Koppies, and pylons should not be constructed in this habitat.
  - No sensitive plants were recorded, however several provincially protected species as well as a protected tree species were recorded. The Koppies habitat will assist in protecting many of the provincially protected species as well as a protected tree species.
- Medium sensitive areas:
  - The White Grassland habitat is considered moderately sensitive owing to its pristine nature with limited major impacts, mostly concentrated at homesteads, cattle camps and watering holes. Restoration efforts post-construction for temporary laydown areas are critical, as well as after the decommissioning of the facilities.
  - The Watercourse sensitivity is medium.
  - The larger tributary: the delineated edge of the surrounding floodplain wetland features. No buffer area was deemed to be required by the aquatic specialist considering that the floodplain is a wide transitional area between the tributary and the surrounding terrestrial areas.
  - Smaller streams and drainage features that are indicated to be of medium sensitivity: at least 35m for the watercourse or the delineated edge of wetland features to allow for the movement of water along these streams.
- Very Low sensitive areas – existing Transformed areas.

Note that the detailed layout shown in Figure 4-11 is considered acceptable from a terrestrial biodiversity, plant and animal species perspective. Changes to the detailed layouts post Environmental Authorisation (should such be granted) are deemed acceptable if the changes remain within the approved buildable areas / development footprints, and area assessed during this Scoping and EIA Process (with the avoidance of no-go sensitive areas).

5. Alternative Development Footprints

The Terrestrial Biodiversity Protocol (GN 320) states that the assessment must identify any alternative development footprints within the preferred site which would be of a low sensitivity as identified by the screening tool and verified through the site sensitivity verification. The protocol further states that a motivation must be provided if there were development footprints identified as per the latter that were identified as having a “low” terrestrial biodiversity sensitivity and were not considered appropriate.

The Plant Species Protocol (GN 1150) states that the study must identify any alternative development footprints within the preferred site which would be of “low” or “medium” sensitivity as identified by the screening tool and verified through the site sensitivity verification. The protocol further states that a motivation must be provided if there were any development footprints identified as per the latter that were identified as having “low” or “medium” terrestrial plant species sensitivity and were not considered appropriate.

At the commencement of this EIA Process, the specialists considered the entire study area, which included the Original Scoping Buildable Areas (during scoping). Following the identification of sensitivities and other considerations by the developer, Revised Scoping Buildable Areas were determined at the end of the Scoping Phase. The Original and Revised Scoping Buildable Areas served as development footprints. The aim of the EIA Phase is to identify the preferred development footprint or layout within the approved site as contemplated in the accepted Scoping Report, which in this case is the Study Area. The proposed development footprint within the preferred development site (i.e. study area) has been amended through the project assessment process to ensure that it will not be located within high sensitivity areas.

This report focuses on the development footprint for Kudu Solar Facility 4, which is considered suitable from a terrestrial biodiversity, plants and animal species perspective, as the sensitivities identified above have been taken into consideration. Development in high sensitivity areas is avoided by the layout, and only areas of medium or low sensitivity are considered for this project. There are no development footprints identified that are not considered appropriate.

In addition, the entire study area was assessed in this Scoping and EIA Process. Furthermore, as indicated in Chapter 5 of the EIA Report, no other site alternatives were considered as the site was deemed feasible based on various site suitability factors. Therefore, no other alternative development footprints of low or medium sensitivity were identified and not considered appropriate for this study.

6. Issues, Risks and Impacts

6.1 Identification of Potential Impacts/Risks

The potential impacts identified during the S&EIA are listed below:

Construction Phase

I. Potential impact 1: Fragmentation and loss of habitat and sensitive features
- The total developable area is estimated to be 3268 ha based on the based on the development footprints. Refer to the Chapter 2 of the EIA Report for the estimated area of each PV Facility. The solar arrays will be positioned approximately 3.5m above ground, and groundworks will be minimal for these areas. Vegetation cover will still remain, albeit at a lower species composition and structure.
- It is estimated that approximately 90 ha will be cleared for internal roads in total for all 12 PV projects. Refer to the Chapter 2 of the EIA Report for the estimated area to be cleared for the internal roads needed for each facility. This will result in loss of vegetation and will increase habitat fragmentation as small islands of vegetation will remain. The functionality of these vegetation patches will be reduced.
- The Watercourse habitat has high habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches.
- The Grassland habitat has good habitat connectivity with potentially functional ecological corridors with minor current negative ecological impacts.
- The Watercourse habitat will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, where species have a moderate likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of returning to a site once the disturbance or impact has been removed. Accordingly, their resilience is considered to be medium.
- The significance of the impact is considered High (before the implementation of mitigation measures) and should be avoided from the development.

II. Potential impact 2: Loss of protected species
- Several provincially protected species (refer to Table 4-2) occur on site which must either be relocated prior to construction or alternative measures made (depending on comments received from the provincial authority - refer to Table 4-2 for site specifics). A permit application is required for submission to the relevant provincial department where the proposed development will impact on these species.
- Without mitigation measures this impact is rated with a high significance, and with mitigation the significance is reduced to low.

III. Potential impact 3: Introduction and spread of alien invasive species
- Alien and invasive species are more likely to establish in disturbed areas due to construction activities.
- Currently, alien invasive species are dominant in the Watercourse habitat and where existing infrastructure are located, such as homesteads and livestock pens.
- Vehicles can also transport seeds from other areas and introduce new species previously unknown to the area.
- Without mitigation measures this impact is rated with a moderate significance, and with mitigation the significance is reduced to moderate-low.

IV. Potential impact 4: Increased erosion and soil compaction
- Erosion is likely to occur where vegetation has been cleared.
- Heavy machinery and vehicles operated during the construction phase will lead to soil compaction. Plants cannot readily establish in compacted soil, since the soil is too hard for root penetration.
- Water infiltration is less in compacted areas and the runoff is higher, which could lead to increased erosion.
- It is expected that internal routes will cross the Watercourse habitat. This may result in damage to the habitat, including changes in flow patterns, functionality and erosion.
- Erosion increases the sediment load in the watercourses, resulting in increased sedimentation downstream of the disturbance. Sedimentation may cause a blockage and alter the characteristics of the watercourse.
- Without mitigation measures this impact is rated with a moderate significance, and with mitigation the significance is reduced to low.

V. Potential impact 5: Littering and General Pollution
- The site camp and construction activities are potential sources of pollution, including hydrocarbons, construction material, domestic waste and sewage.
- Pollution may inhibit plant growth.
- It can cause soil and water pollution if not managed appropriately.
- Pollution will be localised to the site, but several pollutants may spread due to water runoff.
- Without mitigation measures this impact is rated with a moderate significance, and with mitigation the significance is reduced to low.

Operational Phase

I. Potential impact 1: Increase in alien invasive species
- After construction, alien invasive species could have established in optimal conditions.
- If not managed, these species can spread and reduce plant species diversity and could alter species composition.
- Without mitigation measures this impact is rated with a moderate significance, and with mitigation the significance is reduced to low.

II. Potential impact 2: Loss of species composition and diversity
- The shading effect from solar panels is likely to affect the species composition and diversity, and may result in some bare patches. Numerous shrubs will be removed, where only the herbaceous and grass layers remain.
- Emerging seedlings of protected species may also be affected by the shading. Protected tree species and sensitive species may therefore not regenerate in the developed area.
- Large numbers of seedlings are not expected during the project cycle for protected trees.
- Without mitigation measures this impact is rated with a moderate significance.

III. Potential impact 3: Littering and General Pollution
- The most likely type of pollutants are hydrocarbons spilled when refuelling vehicles, leakages from poorly maintained vehicles, spillage from maintaining machinery on site and littering at the site office or security gate.
- Without mitigation measures this impact is rated with a moderate significance, and with mitigation the significance is reduced to low.

Decommissioning Phase

I. Potential impact 1: Alien invasive species management
- During this phase, machinery can disturb the soil which can create optimal conditions for seeds to sprout.
- Vehicles can also transport seeds from other areas and introduce new species previously unknown to the area.
- Without mitigation measures this impact is rated with a moderate significance, and with mitigation the significance is reduced to low.

II. Potential impact 2: Loss of habitat
- Some vegetation may be destroyed during decommissioning, which may result in loss of species composition and diversity. Decommissioned areas must be rehabilitated to restore the habitats.
- Without mitigation measures this impact is rated with a low significance, and with mitigation the significance is reduced to very low.

6.2 Cumulative Impacts

Note that for cumulative impacts, other Wind and Solar projects, as well as EGI projects, within a 30 km radius are considered during the EIA Phase. The projects considered in the cumulative assessment are shown in Figure 6-1 below and Table 6-1. Note that each project has been assigned a number, and the number is shown in Table 6-1 with additional project specific information.

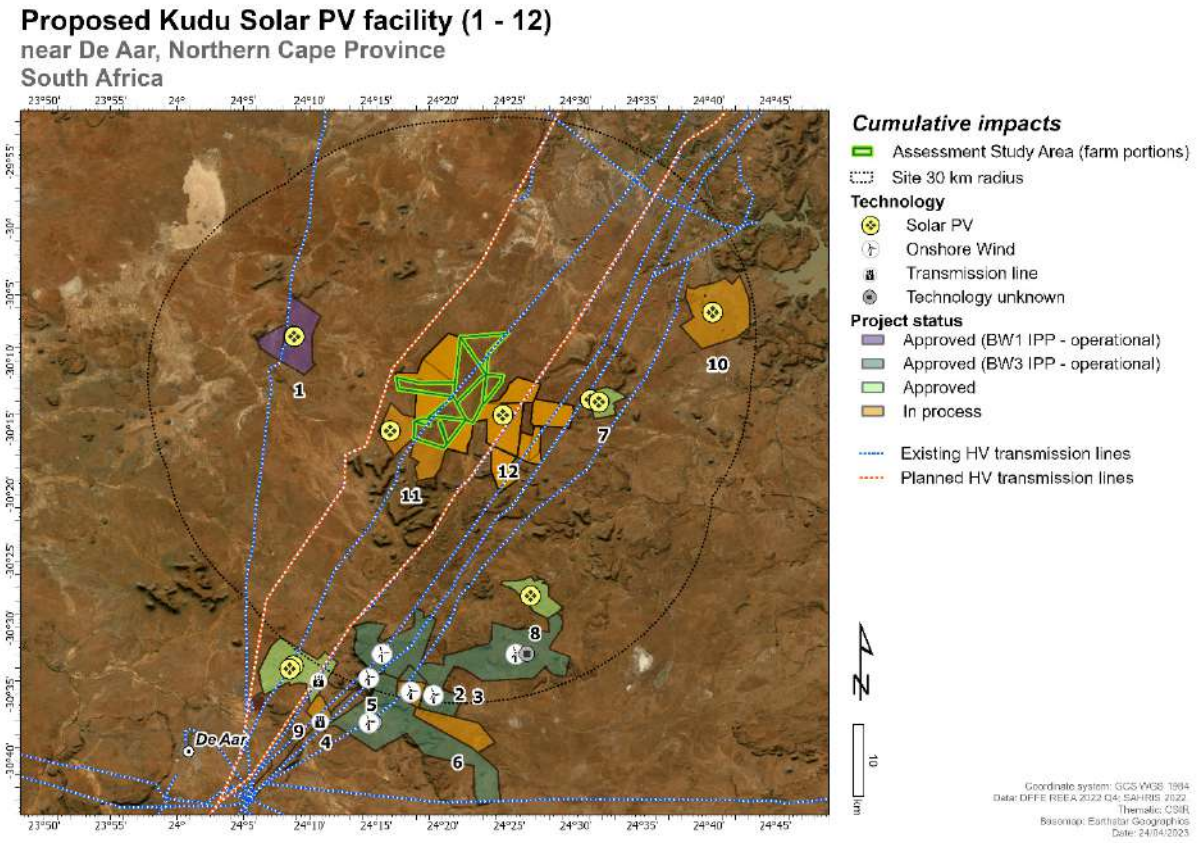


Figure 6-1: Map illustration of the proposed renewable energy projects, located within 30 km of the proposed Kudu Solar Facilities, considered in the Cumulative Impact Assessment (in addition to the Kudu Solar Facilities) (Source: DFFE REEA, Quarter 4, 2022; and SAHRIS).

Table 6-1: Proposed renewable energy projects, located within 30 km of the proposed Kudu Solar Facilities, considered in the Cumulative Impact Assessment (Source: DFFE REEA, Quarter 4, 2022; and SAHRIS).

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE
1	• 12/12/20/2258 • 12/12/20/2258/1	Solar PV	75	Approved and Preferred Bidder (Operational)	• The Proposed Establishment of Photovoltaic (Solar Power) Farms in the Northern Cape Province - Kalkbult
2	• 12/12/20/2463/1 • 12/12/20/2463/1/2 • 12/12/20/2463/1/A2 • 12/12/20/2463/1/AM3 • 12/12/20/2463/1/AM4 • 12/12/20/2463/1/AM5	Onshore Wind	140	Approved and Preferred Bidder (Operational)	• Longyuan Mulilo De Aar 2 North Wind Energy Facility • Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility • The Wind Energy Facility (North and South) situated on the Plateau Near De Aar, Northern Cape Province
3	• 12/12/20/2463/2 • 12/12/20/2463/2/AM2	Onshore Wind	100	Approved and Preferred Bidder (Operational)	• Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility • The Wind Energy Facility (North and South) Situated on The Plateau Near De Aar, Northern Cape Province
4	• 14/12/16/3/3/1/1166 14/12/16/3/3/1/1166/AM3 14/12/16/3/3/1/1166/AM4	Transmission line	132	Approved	• Basic Assessment for the proposed construction of a 132 kV transmission line corridor adjacent to the existing Eskom transmission line from Longyuan Mulilo De Aar 2 North Wind Energy Facility (WEF) to the Hydra Substation in De Aar, Northern Cape
5	• 14/12/16/3/3/1/785	Transmission line	132	Approved	• Proposed construction of two 132kV transmission lines from the South & North Wind Energy Facilities on the Eastern Plateau (De Aar 2) near De Aar, Northern Cape.
6	• 14/12/16/3/3/2/278 • 14/12/16/3/3/2/278/1 • 14/12/16/3/3/2/278/2	Onshore Wind	118	Approved	• Proposed Castle Wind Energy Facility Project, located near De Aar, Northern Cape
7	• 14/12/16/3/3/2/564 • 14/12/16/3/3/2/564/AM1 • 14/12/16/3/3/2/564/AM2	Solar PV	75	To be confirmed	• Proposed Swartwater 75MW solar PV power facility in Petrusville within Renosterburg Local Municipality, Northern Cape
8	• 14/12/16/3/3/2/740	Solar PV	300	Approved	• Proposed 300MW Solar Power Plant in Phillipstown area in Renosterberg Local Municipality
9	• 14/12/16/3/3/2/744	Solar PV	0	Approved	• Proposed PV facility on farm Jakhalsfontein near De Aar
10	• 14/12/16/3/3/2/739	Solar PV	70 - 100	To be confirmed	• Proposed 70 - 100 MW Solar Power Plant in Petrusville
11	• Not issued yet (it is understood that the project is still within the pre-application stage)	Solar PV	800 (Maximum)	Pre-Application	• The Proposed Keren Energy Odyssey Solar PV Facilities (Odyssey Solar 1, Odyssey Solar 2, Odyssey Solar 3, Odyssey Solar 4, Odyssey Solar 5, Odyssey Solar 6, Odyssey Solar 7 And Odyssey Solar 8)

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE
12	• To be confirmed	Solar PV	3050	Scoping	• The Proposed Development of the Crossroads (formally referred to as the Hydra B) Green Energy Cluster of Renewable Energy Facilities and Grid Connection Infrastructure, Pixley Ka Seme District Municipality, Northern Cape Province. The Cluster entails the development of up to 21 solar energy facilities, with the Scoping and EIA Processes consisting of three phases. Phases 1, 2 and 3 consist of 9, 6 and 6 solar facilities, respectively. The Phase 1 Scoping and EIA Processes were launched in January 2023.
Study area shown on map	• 14/12/16/3/3/2/2244 • 14/12/16/3/3/2/2245 • 14/12/16/3/3/2/2246 • 14/12/16/3/3/2/2247 • 14/12/16/3/3/2/2248 • 14/12/16/3/3/2/2249 • 14/12/16/3/3/2/2250 • 14/12/16/3/3/2/2251 • 14/12/16/3/3/2/2252 • 14/12/16/3/3/2/2253 • 14/12/16/3/3/2/2254 • 14/12/16/3/3/2/2255	Solar PV	2180	Scoping and EIA Process underway	• Proposed Development of 12 Solar Photovoltaic (PV) Facilities (Kudu Solar Facility 1 to 12) and associated infrastructure, near De Aar, Northern Cape Province
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• Hydra Roodekuil 2
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• Hydra Roodekuil 1
Shown on map as Existing HV Lines	• N/A	Transmission Line	765	Existing Power Line	• Beta Hydra 2
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• Hydra Perseus 3
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• Van Der Kloof Roodekuil 2
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• Van Der Kloof Roodekuil 1
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• Beta Hydra 1
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• Hydra Perseus 2

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• Kalkbult/Kareeboschpan 1
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• Roodekuil/Orania 1
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Perseus to Gamma 2nd 765 kV line • Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Relocate Beta-Hydra 765kV line to form Perseus-Hydra 1st 765kV line • Cape Corridor Phase 2: Zeus - Hydra 765kV Integration
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Perseus to Gamma 2nd 765 kV line • Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line

I. Cumulative impact 1: Habitat loss and fragmentation

- The Eastern Upper Karoo vegetation type is not considered threatened, but sensitive features still exist within these vegetation types and on the study area.
- The total developable area for all twelve PV facilities and associated infrastructure is 3268 ha, but the entire site will not be cleared of vegetation. The basal layer will still maintain the grass and herbaceous layer, but shrubs will be removed which will alter the vegetation structure and species composition. In addition, additional loss will be due to internal road network. This accounts for <1% loss of the original vegetation type extent, which is not considered significant.
- Koppies and Watercourse habitats still remain important ecological features in terms of ecosystem functioning, climate refugia, landscape corridors and harbouring endemic species. Avoiding these habitats as indicated, will reduce the total sensitive areas for development which in turn will reduce the overall cumulative impacts.

6.3 Summary of Issues identified during the Public Consultation Phase

The potential terrestrial biodiversity issues identified during the Scoping and EIA Process include:

- Destruction of sensitive fauna and flora species.
- Increase in alien and invasive species which require management.
- Fauna electrocutions with electric fences.
- Potential for Giant bull frogs to occur on site.
- The heat island effect on reptiles.
- Destruction of *Hippotragus niger* (Sable Antelope) habitat.

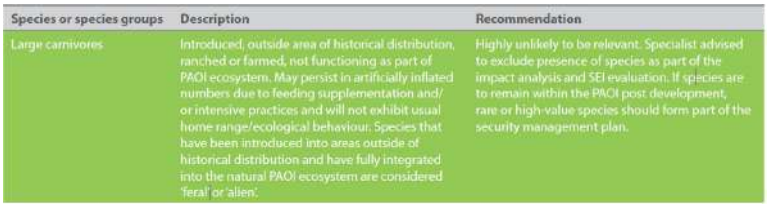
The issues raised are summarised below in Table 6-2.

Table 6-2: Comments Received from Stakeholders during the Public Consultation Phase.

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I&AP	**KEY ISSUE**	**RESPONSE**
02/02/2023 (Letter received via email) Northern Cape Department of Agriculture, Environmental Affairs, Rural Development and Land Reform: Environmental Research and Development (ERD) (Natalie Uys)	Fauna and flora permits will be needed from the department for handling/ removing/ relocating/ destroying all specially protected and protected flora and fauna. Estimated numbers for species that need to be removed must be provided for permit approval.	The need for fauna and flora permits has been addressed in this Terrestrial Biodiversity and Species Assessment. Estimated numbers of species that need to be removed will be provided during the preconstruction walkdown of the site for permit approval. A walkdown is required in order to identify and quantify the protected species that will be impacted on by the approved layout. All relevant permits will be applied for prior to construction, after EA is issued, should such authorisation be granted.
As above	*Boscia albitrunca* is protected under both the National Forest Act and under the Northern Cape Nature Conservation Act. Estimated densities must be calculated or the actual number of trees to be removed must be provided for permit purposes. Contact person for DFFE Forestry in the Northern Cape is Jacoline Mans, Jmans@dffe.gov.za.	As noted in this report, a permit for the removal of *Boscia albitrunca* from the Northern Cape DFFE under the National Forest Act will be required should the proposed development impact on any individuals. Estimated densities need to be calculated or the actual number of trees to be removed provided for permit purposes. The relevant contact person (as indicated) will be contacted as necessary. All relevant permits will be applied for prior to construction, after EA is issued, should such authorisation be granted.
As above	Please take note that *Olea europaea subsp. africana* is a protected tree under the Northern Cape Nature Conservation Act.	*Olea europaea subsp. africana* is one of the species recorded associated with the Koppies habitat. The Koppies, however, will be avoided by the proposed project, and more specifically related to Kudu Solar Facility 6 only.
As above	Alien and invasive species management must be done throughout the lifetime of the projects. Please take note that cacti species such as *Opuntia* spp cannot dumped at general waste sites without prior treatment (drying/chemical). Please liaise with Dr Thabiso Mokotjomela, 073 324 6118, mokotjomela@sanbi.org.za, on the management and disposal of cacti.	In terms of current impacts on site, impacts include the presence of alien invasive species, mainly *Prosopis* species and planted *Eucalyptus* and *Opuntia* species. In some areas, *Opuntia* has spread into the grassland. These specific recommendations regarding the management of cacti species such as *Opuntia* spp. are noted and are included in the Project Environmental Management Programme (EMPr).
As above	The availability of foundational and baseline data for the Northern Cape is limited and as a result the Screening Tool has limitations and shortcomings when assessing impacts for this area. Proper site surveys are for that reason critically important and always recommended.	The specialists involved in this assessment are aware of this and have undertaken proper site surveys as noted in the Site Sensitivity Verifications in Appendix C of this report. In terms of the Terrestrial Biodiversity and Species Assessment, a detailed survey was carried out by the specialist. The Screening Tool report is a guideline which was used along with available literature and other data for the area to inform the Site Sensitivity Verification and field survey.
As above	The initial vegetation map generated for the site reflects the limitations as mentioned before reflecting the gaps in the National Vegetation Map.	The comment is unclear and does not have a significant impact on the outcome of the assessment. Any limitations that exist within existing tools or datasets can be rectified after the site surveys, but the data collected did not change the status of the vegetation unit and no sensitive species were recorded during the survey.
As above	I.t.o. the terrestrial biodiversity please assess, mitigate and	The Animal Compliance Statement included as Appendix E to this Terrestrial Biodiversity and Species Assessment notes that Leopard

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I&AP	**KEY ISSUE**	**RESPONSE**
	make provision for in the EMPR the following: a) Please take note that tortoise populations are affected by the following: i. electrocutions with electric fences. ii. predations by crows – (relates to waste management).	tortoise (a generalist tortoise) is found in a variety of habitats including arid and mesic savannah, thorn scrub and grasslands. The species was recorded in the south and north of the study area, and it can be deduced that the species occurs throughout the study area. Various impact management actions have been included in the compliance statement with regards to faunal management. Littering and general pollution is also identified as a potential impact, with various mitigation measures, which are included in the EMPr. This will ensure that the construction site is managed appropriately in terms of waste, and therefore reduce the likelihood of predation by crows.
As above	I.t.o. the terrestrial biodiversity please assess, mitigate and make provision for in the EMPR the following: a) Giant bull frogs were found in De Aar area in pans after the recent rains. Most of the injuries and mortalities to this species occurs from collision with vehicles when moving between their breeding sites (pans) and their burrows. Their burrows can range from 200m to 1km from the pans and they are capable of estivating underground for 7 years. Herbicide and pesticide use should also be restricted near the sites (Yetman, undated). Please liaise with EWT in this regard.	Response from Luke Verburgt (herpetofauna specialist): The Animal Compliance Statement included as Appendix E to this Terrestrial Biodiversity and Species Assessment made use of the Frog Atlas of Southern Africa (FrogMAP, 2022), and Amphibian Species of Conservation Concern (SCC) information was obtained from Du Preez and Carruthers (2017). Various impact management actions have been included in the compliance statement with regards to faunal management, including road mortalities, such as: ▪ All vehicle speeds associated with the project should be monitored and should be limited to 40 km/h (maximum) during the construction phase. ▪ As roadkills are currently considered high for this area, a roadkill monitoring programme (inclusive of wildlife collisions record keeping) should be established. Where needed, Animex fences must be installed to direct animals to safe road crossings. Finally, mitigation should be adaptable to the onsite situation which may vary over time. The various mitigation measures have been included in the EMPr. Furthermore, neither the Screening Tool Report nor the FrogMap data indicates the presence of the species in the area. *Pyxicephalus adspersus* (Giant Bullfrog, hereafter GB) is not considered to be a species of conservation concern as it has been evaluated as Least Concern (see: http://speciesstatus.sanbi.org/assessment/last-assessment/1533/). In addition, this species has not been previously recorded on the quarter degree grid cells (3024AD, 3024AB) which are overlapped by the project study area, so it is not common in the area. However, it is still considered moderately likely that this species could occur across the project study area. Because the pans and watercourses were already delineated and excluded from development infrastructure, it is only considered necessary to provide additional mitigation for this species if it is being impacted upon by vehicles operating in the PV and construction area. This will require an Environmental Control Officer (ECO) to record all incidences of GB roadkills in a spatial database to allow evaluation of hotspots of activity and migration corridors. Should this occur, mitigation will need to be applied to these areas through the creation of “frog underpasses” in combination with drift fences allowing migration to occur while continuing the safe operation of vehicles in the project area. It is, however, good practice to ensure that the majority of construction activity takes place during the dry winter months when frogs are inactive to limit the potential for roadkill (temporal avoidance). The pans have been identified by the Aquatic specialist, and are currently buffered by 50 m. Note that only one pan occurs within the study area. The large floodplains are not buffered as the aquatic specialist noted no buffer is needed; and the smaller watercourses are buffered by 35 m (as noted in Chapter 8 of this EIA Report). A 50 m buffer around pans is considered sufficient for GBs to breed successfully. Note that the raised solar panels will still allow for foraging options and migration to and from the breeding

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		pans by this species, so this habitat is not considered completely removed from utilisation by GBs. New roads developed for the proposed project that will be regularly travelled/patrolled should ideally be placed >100 m from a pan and should be regularly inspected by an ECO to assess roadkills. Note that existing roads do run within 100 m of the mapped pan. If there is increased traffic expected from the development (at least during the construction phase this is a reasonable assumption), then the relevant portion of the existing road close to the pan should be monitored for roadkills also so that mitigation can be applied if necessary. Herbicide and pesticide used as part of control measures should be approved by the ECO prior to application, taking all sensitive features into account.
As above	I.t.o. the terrestrial biodiversity please assess, mitigate and make provision for in the EMPR the following: b) The following are concerns i.t.o. of the cumulative footprint of the 12 x PV's and should be assessed: i. The heat island effect (local warming, impacts on reptiles etc.). ii. Lake effect on insects (e.g. insects have been lying eggs on panels instead of pans). iii. Insect mortalities (security lights at these sites at night attract insects). iv. Bat impacts (bats are attracted to by the security lights). Various bat species have been recorded around Vanderkloof and in De Aar.	▪ Heat island effect (local warming) impacts on reptiles etc.: This has not been studied in the SA context, and accordingly the impacts are not well known. Generally, the construction of solar farms removes most of the vegetative cover and rocky material at the surface, which would make much of the solar farm unsuitable for the survival of the original small mammal or reptile community. Given that none of these represent species of conservation concern, these habitats are not excluded from the development. Thus, the impact of the heat-island is of little significance. ▪ Lake effect on insects: Should appropriate buffers be applied to watercourses, it is less likely for aquatic insects to lay eggs on these structures. Studies have found that in general insects avoided solar cells with nonpolarizing white borders and white grates. Fragmenting panels solar-active area does lessen their attractiveness to polarotactic insects. The design of solar panels and collectors and their placement relative to aquatic habitats will likely affect populations of aquatic insects that use polarized light as a behavioural cue. Accordingly, appropriate mitigation measures have been applied to reduce the potential impacts. This is not considered a fatal flaw. ▪ Insect mortalities: The Animal Compliance Statement (included as Appendix E to this Terrestrial Biodiversity and Species Assessment) provides various proposed impact management actions. One of the impact management actions that relates to this comment is the recommendation to "reduce exterior lighting to that necessary for safe operation and implement operational strategies to reduce spill light. Use down-lighting from non-UV lights where possible, as light emitted at one wavelength has a low level of attraction to insects. This will reduce the likelihood of attracting insects and their predators. Insects generally see three colours of light, Ultraviolet (UV), blue and green. Bright white or bluish lights (mercury vapor, white incandescent and white florescent) are the most attractive to insects. Yellowish, pinkish, or orange (sodium vapor, halogen, dichroic yellow) are the least attractive to most insects. ▪ Bat impacts: Assessing bats is not a requirement for solar facilities, and there are no formal guidelines in this regard. No Species of Conservation Concern were identified by the Screening Tool or during the initial site sensitivity verification. The watercourses have been buffered accordingly by the Aquatic Specialist, which is the most important foraging habitat for bats.
20/01/2023 Letter (received via email on 20/01/2023) Department of Forestry, Fisheries and the Environment:	Need for the indication of the location/ habitat of the *Hippotragus niger* (Sable Antelope) in the final layout plan, along with a suitable buffer zone. DFFE (PV 1,2, and 3)	As indicated in the Animal Compliance Statement (Appendix E of this report), the Sable Antelope is an introduced species i.e. it does not occur naturally in the area and it was introduced to the country, therefore occurs outside its area of historical distribution, is possibly ranched or farmed or free roaming. **Importantly it does not function as part of the study area ecosystem**. It is believed that the individual sited came from an adjacent property, which has high fences. The adjacent property owner is believed to have game on their land. It is suggested that the developer come to an agreement with the adjacent landowner to consider appropriate measures for the current bordering fences to prohibit the Sable to move between the

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I&AP	**KEY ISSUE**	**RESPONSE**
Chief Directorate: Integrated Environmental Authorisations (Ms Milicent Solomons; Acting Chief Director: Integrated Environmental Authorisations; Letter signed by: Mahlatse Shubane; Enquiries: Ms Olivia Letlalo)		two properties. Once this is achieved, there are no further mitigation measures required. As further indicated in the Animal Compliance Statement, even though animals were sighted at specific locations, they can occur across the study area (or site) as they move around to feed. **Accordingly, the animals mentioned in the Animal Compliance Statement should not be associated with a specific PV facility and the possible impacts and proposed mitigation measures will be applicable for all PV facilities**. However, the only exclusion can be that of the Sable Antelope, which is unlikely to venture of further away from the adjacent property. Based on this, it is not vital to show the habitat in which it was found in the layout plan. Furthermore, based on the above, a buffer zone is not required.
As above	Query as to why a full animal assessment is not required as part of the impact analysis and SEI evaluation. DFFE (PV 1,2, and 3)	The Species Environmental Assessment Guideline (2022[8]), which must be used as per the requirements of the Terrestrial Animal Species Protocol (GN 1150), states the following (direct extract, Page 89) in relation to the Sable:  Species or species groups: Large carnivores Description: Introduced, outside area of historical distribution, ranched or farmed, not functioning as part of PAOI ecosystem. May persist in artificially inflated numbers due to feeding supplementation and/or intensive practices and will not exhibit usual home range/ecological behaviour. Species that have been introduced into areas outside of historical distribution and have fully integrated into the natural PAOI ecosystem are considered 'feral' or 'alien'. Recommendation: Highly unlikely to be relevant. Specialist advised to exclude presence of species as part of the impact analysis and SEI evaluation. If species are to remain within the PAOI post development, rare or high-value species should form part of the security management plan. Based on the reasons above (i.e. it is an introduced species, likely to occur on the adjacent property and the need for an agreement between the developer and the adjacent landowner to consider appropriate measures for the bordering fences to restrict the Sable from entering the PV Facility; and based on recommendation of the Species Environmental Assessment Guideline), it is not necessary to include the presence of this species as part of the impact analysis and Site Ecological Importance (SEI) evaluation, and accordingly a full animal assessment is not required.

Comments related to terrestrial biodiversity, plant and animal species impacts associated with the proposed project were raised by Interested and Affected Parties during the review period of the Draft EIA Report. Some of the comments raised by the DFFE are similar to those submitted and considered during the Scoping Phase, and therefore similar responses apply. Comments were raised on the applicability of geographical areas in Listing Notice 3 in terms of the proposed project; the indigenous vegetation types affected; clarity on the sensitivity of grassland and watercourse habitats; and queries on the Sable Antelope (specific comment from the DFFE in terms of Kudu Solar Facility 1 to 3). Responses have been provided in Appendix H.7 of the Final EIA Report.

[8] South African National Biodiversity Institute (SANBI). 2020. *Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa.* South African National Biodiversity Institute, Pretoria. Version 3.1. 2022.

7. Impact Assessment

7.1 Potential Impacts during the Construction Phase

The potential impacts identified during the construction phase are discussed below.

Potential impact: Fragmentation and loss of habitat and sensitive features.

Refer to Section 6 of this chapter for a description of this potential impact, which is rated as negative with a site specific spatial extent, long term duration, low reversibility and moderate irreplaceability, as well as a severe consequence and very likely probability, rendering the pre-mitigation significance as High. With mitigation, the impact is rated as moderate significance. The potential mitigation measures are discussed in the table below.

Potential impact: Loss of protected species.

Refer to Section 6 of this chapter for a description of this potential impact, which is rated as negative with a site specific spatial extent, long term duration, irreversible reversibility and high irreplaceability, as well as a severe consequence and very likely probability, rendering the pre-mitigation significance as High. With mitigation, the impact is rated as low significance. The potential mitigation measures are discussed in the table below.

Potential impact: Introduction and spread of alien invasive species.

Refer to Section 6 of this chapter for a description of this potential impact, which is rated as negative with a local spatial extent, medium term duration, moderate reversibility and low irreplaceability, as well as a substantial consequence and likely probability, rendering the pre-mitigation significance as Moderate. With mitigation, the impact is rated as moderate-low significance. The potential mitigation measures are discussed in the table below.

Potential impact: Increased erosion and soil compaction.

Refer to Section 6 of this chapter for a description of this potential impact, which is rated as negative with a site-specific spatial extent, medium term duration, moderate reversibility and moderate irreplaceability, as well as a substantial consequence and likely probability, rendering the pre-mitigation significance as Moderate. With mitigation, the impact is rated as low significance. The potential mitigation measures are discussed in the table below.

Potential impact Littering and General Pollution.

Refer to Section 6 of this chapter for a description of this potential impact, which is rated as negative with a local spatial extent, short to medium term duration, moderate reversibility and low irreplaceability, as well as a substantial consequence and likely probability, rendering the pre-mitigation significance as Moderate. With mitigation, the impact is rated as low significance. The potential mitigation measures are discussed in the table below.

Table 7-1: Potential Impacts during the Construction Phase.

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Habitat loss and fragmentation	*Status*	*Negative*	*High*	• *No development should take place within High sensitivity areas or buffer zones. Accordingly, the Koppies habitat (where relevant) should be avoided. The Watercourse habitats of medium sensitivity should be avoided, as recommended by the Aquatic specialist in Chapter 8 of this EIA Report.* • *No construction related activities, such as the site camp, storage of materials, temporary roads or ablution facilities may be located in the high sensitivity areas.*	*Moderate*	*Medium*
	Spatial Extent	*Site specific*				
	Duration	*Long term*				
	Consequence	*Severe*				
	Probability	*Very Likely*				
	Reversibility	*Low*				
	Irreplaceability	*Moderate*				
Loss of protected species	*Status*	*Negative*	*High*	*Where the approved layout designs impact on individuals, permit applications are required for either the relocation or destruction of provincially protected species (Northern Cape Nature Conservation Act No.9 of 2009) and for protected trees in terms of the National Forests Act No. 84 of 1998.*	*Low*	*High*
	Spatial Extent	*Site specific*				
	Duration	*Long term*				
	Consequence	*Severe*				
	Probability	*Very Likely*				
	Reversibility	*Irreversible*				
	Irreplaceability	*High*				
Increased alien invasive species	*Status*	*Negative*	*Moderate*	*Implement an alien and invasive species control and monitoring plan in terms of NEMBA. Alien invasive species establishment and spreading should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with such plants.*	*Moderate to Low*	*Medium*
	Spatial Extent	*Local*				
	Duration	*Medium term*				
	Consequence	*Substantial*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low irreplaceability*				
Increased erosion and soil compaction	*Status*	*Negative*	*Moderate*	• *Utilise existing access routes as far as possible.* • *Confine the movement of vehicles to the access routes to and from the site and to the construction areas.* • *Do not drive in the natural veld.* • *Rehabilitate new vehicle tracks and areas where the soil has been compacted as soon as possible.* • *Monitor the entire site for signs of erosion throughout the construction phase of the project.* • *Refer to the Aquatic Biodiversity Specialist Assessment Report for mitigation measures relevant to watercourse crossings and development close to watercourses.*	*Low*	*Medium*
	Spatial Extent	*Site specific*				
	Duration	*Medium term*				
	Consequence	*Substantial*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Moderate*				

Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
Littering and general pollution	*Status*	*Negative*	*Moderate*	• *The site camp must not be located in high sensitivity areas and their buffer zones.* • *Dangerous goods may not be stored within 100 m of a watercourse.* • *Hydrocarbon fuels must be stored in a secure, bunded area.* • *Sufficient waste disposal bins must be available on site and clearly marked. Skip bins may be required during the construction phase which must be emptied on a regular basis by an approved/licenced waste disposal contractor. Proof of disposal to be kept on file.* • *Ablution facilities must be located outside sensitive areas and their buffer zones.* • *Portable ablution facilities must be regularly cleaned and maintained in good working condition.* • *Any spillage from ablution facilities must be cleaned up immediately and disposed of in an appropriate manner.* • *Vehicles must be in good working condition, with no oil, water, or fuel leaks. Vehicles must be regularly inspected, and any problems corrected.* • *Refuelling may only take place in an appropriate, bunded area. Refuelling may not take place in sensitive areas.* • *Hydrocarbon spills must be contained and cleaned up immediately. Spill kits must be available on site in case of accidental spillage.*	*Low*	*Medium*
	Spatial Extent	*Local*				
	Duration	*Short to Medium term*				
	Consequence	*Substantial*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				

7.2 Potential Impacts during the Operational Phase

The potential impacts identified during the operational phase are discussed below.

Potential impact: Loss of species composition and diversity.

Refer to Section 6 of this chapter for a description of this potential impact, which is rated as negative with a site-specific spatial extent, medium term duration, moderate reversibility and moderate irreplaceability, as well as a substantial consequence and likely probability, rendering the pre-mitigation significance as Moderate. With mitigation, the impact is rated as moderate significance. The potential mitigation measures are discussed in the table below.

Potential impact: Increase in alien invasive species.

Refer to Section 6 of this chapter for a description of this potential impact, which is rated as negative with a local spatial extent, medium term duration, moderate reversibility and low irreplaceability, as well as a substantial consequence and likely probability, rendering the pre-mitigation significance as Moderate. With mitigation, the impact is rated as low significance. The potential mitigation measures are discussed in the table below.

Potential impact Littering and General Pollution.

Refer to Section 6 of this chapter for a description of this potential impact, which is rated as negative with a local spatial extent, short to medium term duration, moderate reversibility and low irreplaceability, as well as a substantial consequence and likely probability, rendering the pre-mitigation significance as Moderate. With mitigation, the impact is rated as low significance. The potential mitigation measures are discussed in the table below.

Table 7-2: Potential Impacts during the Operational Phase.

Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
OPERATIONAL PHASE						
Loss of species composition and diversity	*Status*	*Negative*	*Moderate*	• *The loss of species composition and diversity cannot be mitigated due to a permanent structure which will change microclimatic conditions for the life of the facility operation.* • *Implement appropriate rehabilitation measures to restore each habitat to a natural state that is representative of the respective vegetation type after construction.*	*Moderate*	*Medium*
	Spatial Extent	*Site specific*				
	Duration	*Medium term*				
	Consequence	*Substantial*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Moderate*				
Increased alien invasive species	*Status*	*Negative*	*Moderate*	*Follow an alien and invasive species control and monitoring plan in terms of NEMBA by implementing appropriate control methods.*	*Low*	*Medium*
	Spatial Extent	*Local*				
	Duration	*Medium term*				
	Consequence	*Substantial*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				
Littering and general pollution	*Status*	*Negative*	*Moderate*	• *Vehicles must be in good working condition, with no oil, water or fuel leaks.* • *Vehicles must be regularly inspected, and any problems corrected.* • *Refuelling may only take place in an appropriate, designated bunded area.*	*Low*	*Medium*
	Spatial Extent	*Local*				
	Duration	*Short to Medium term*				
	Consequence	*Substantial*				
	Probability	*Likely*				

Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
	Reversibility	*Moderate*		• *Any spillages must be reported immediately and dealt with appropriately.* • *Spill kits must be available on site in case of accidental spillage.* • *Sufficient waste disposal bins must be available on site and clearly marked.*		
	Irreplaceability	*Low*				

7.3 Potential Impacts during the Decommissioning Phase

The potential impacts identified during the decommissioning phase are discussed below.

Potential impact: Loss of habitat.

Refer to Section 6 of this chapter for a description of this potential impact, which is rated as negative with a site specific spatial extent, short term duration, low reversibility and moderate irreplaceability, as well as a moderate consequence and likely probability, rendering the pre-mitigation significance as Low. With mitigation, the impact is rated as Very Low significance. The potential mitigation measures are discussed in the table below.

Potential impact: Increase in alien invasive species.

Refer to Section 6 of this chapter for a description of this potential impact, which is rated as negative with a local spatial extent, medium term duration, moderate reversibility and low irreplaceability, as well as a substantial consequence and likely probability, rendering the pre-mitigation significance as Moderate. With mitigation, the impact is rated as low significance. The potential mitigation measures are discussed in the table below.

Table 7-3: Potential Impacts during the Decommissioning Phase.

Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
DECOMMISSIONING PHASE						
Loss of habitat	*Status*	*Negative*	*Low*	*The loss of vegetation is unavoidable within the approved layout development footprint, but sensitive areas must be avoided. Implement appropriate rehabilitation measures to restore each habitat to a natural state that is representative of the respective vegetation type after decommissioning.*	*Very Low*	*Medium*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Moderate*				
	Probability	*Likely*				
	Reversibility	*Low*				
	Irreplaceability	*Moderate*				
Increased alien invasive species	*Status*	*Negative*	*Moderate*	*Follow an alien and invasive species control and monitoring plan in terms of NEMBA by implementing appropriate control methods.*	*Low*	*Medium*
	Spatial Extent	*Local*				
	Duration	*Medium term*				
	Consequence	*Substantial*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				
	Irreplaceability	*Low*				

7.4 Cumulative Impacts

The potential cumulative impacts identified during the construction phase are discussed below.

Potential impact: Loss of habitat.

Refer to Section 6 of this chapter for a description of this potential impact, which is rated as negative with a local spatial extent, permanent duration, low reversibility and moderate irreplaceability, as well as a substantial consequence and very likely probability, rendering the pre-mitigation significance as moderate. With mitigation, the impact is rated as Moderate significance. The potential mitigation measures are discussed in the table below.

Table 7-4: Cumulative Impacts.

Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
CONSTRUCTION PHASE						
Loss of habitat / vegetation	*Status*	*Negative*	*Moderate*	*Transformation is considered low for this vegetation type but increased renewable developments could change this.*	*Moderate*	*Medium*
	Spatial Extent	*Local*				
	Duration	*Permanent*				
	Consequence	*Substantial*				
	Probability	*Very Likely*				
	Reversibility	*Low*				
	Irreplaceability	*Moderate*				

7.5 Battery Energy Storage System

A Lithium-Ion BESS and Vanadium Redox Flow (VRF) BESS were both considered for the proposed project. For Redox Flow BESS, various chemical compositions are likely, such as Vanadium. Refer to Chapter 15 of this EIA Report for a High-Level Safety, Health and Environment Risk Assessment, which provides high level information on the safety, health and environmental risks of the BESS technologies.

With Lithium-Ion BESS, the most significant hazard with battery units is the possibility of thermal runaway and the generation of toxic and flammable gases. The flammable gases generated may ignite leading to a fire which accelerates the runaway process and may spread the fire to other infrastructure and possibly set the grassland ablaze which could cause a run-a-way fire and cause damage in the area if not controlled. As highlighted in Chapter 15, thermal runaway could happen at any point during transport to the facility, during construction or operation at the facility or during decommissioning and safe making for disposal. In terms of a worst conceivable case container fires, the significant impact zone is likely to be limited to within 10m of the container and mild impacts to 20m. Several preventative and mitigative measures have been proposed in Chapter 15 of the EIA Report in order to prevent potential fires.

No BESS is located in a sensitive area, but all are located within the grassland. Accordingly, the necessary measures need to be put in place to limit potential fires, including considering a fire break[9], if possible, around each Kudu PV facility (this is a worst-case scenario). However, as a containerised approach including the usual good practice of separation between containers which will be applied for this project, the impacts are likely restricted to events to one container at a time, the main risks being close to the containers i.e., to transport drivers, employees at the facilities and first responders to incidents.

[9] A natural or constructed barrier used to stop or check fires that may occur.

For Redox Flow BESS, the most significant hazard with VRF battery units is the possibility of spills of corrosive and environmentally toxic electrolyte. Several preventative and mitigative measures have been proposed in Chapter 15 in order to contain potential spillage.

The type of BESS technology will have no influence on terrestrial biodiversity, therefore both are considered viable options. There are no fatal flaws associated with the proposed Kudu 4 SEF battery installation for either technology types.

7.6 No-Go Alternative

The no-go alternative is the option of not undertaking the proposed activity or any of its alternatives, implying a continuation of the current situation / status quo.

The no-go alternative means the project does not get developed and no transformation or disturbance of topsoil and vegetation takes place, and no removal of provincially protected species are required. The baseline conditions signify the two grasslands, the Northern Upper Karoo and the Eastern Upper Karoo, remain as is with all current impacts still present, including livestock pens, waterpoints, windpumps, alien invasive species, fences and existing overhead powerlines. Furthermore, impacts on ecosystem functions including biodiversity protection, water regulation, quantity and quality, protection of medicinal plants, and climate refugia habitats will not be impacted on, and will continue as normal.

Should the development not proceed, the landowners will continue to utilise the grassland (baseline - dominant land use) for grazing purposes and creates an opportunity for the land to be used for other means, should the landowner, for example, wish to do other developments on site. Any development considered for this site, should result in a net benefit to society and should avoid undesirable negative impacts.

It must be noted however, that not approving this project does not exclude other renewable energy projects from being developed in this area. Accordingly, since this area is not considered an exclusion zone for development, multiple applications for renewable energy has and is being submitted to the competent authority for approval. Therefore, the no-go alternative cannot be looked in isolation and must take into account the regional land use and other developments to determine the ‘sense of place’ and whether this development will significantly impact on the baseline conditions in a regional context.

8. Impact Assessment Summary

The summary assessment for terrestrial biodiversity for the Kudu Solar Facility is provided in Table 8-1. All the impacts assessed can be reduced through avoidance and mitigation measures. There are no residual impacts anticipated and accordingly the project can proceed, but only if sensitive areas are avoided, and the proposed mitigation measures are implemented. Some impacts such as habitat loss and ecological functioning cannot be avoided, but the overall impact for this vegetation type is medium to low significance post mitigation.

Table 8-1: Terrestrial Biodiversity - Overall Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	Moderate
Operational	Low
Decommissioning	Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Moderate
Cumulative - Operational	Low
Cumulative - Decommissioning	Low

9. Legislative and Permit Requirements

The following legislation and guidelines are applicable to the proposed development:

- Northern Cape Nature Conservation Act (No. 9 of 2009)
- National Forests Act (No. 84 of 1998, as amended)
- Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the NEMA (1998), published on 20 March 2020, in Government Gazette 43110, GN No. 320, with regards to Terrestrial Biodiversity.
- Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the NEMA (1998), published on 30 October 2020, in Government Gazette 43855, GN 1150 with regards to Terrestrial Animal and Plant Species.
- SANBI. 2020. Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa. South African National Biodiversity Institute, Pretoria. Version 3.1.2022.
- Alien and Invasive Species lists in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).

The following permits are required where the development impacts directly on these species:

- Relocation permits for provincially protected species (Refer to Table 4-2) from the Northern Cape Department Agriculture, Environmental Affairs, Rural Development and Land Reform under the Northern Cape Nature Conservation Act (No.9 of 2009)

10. Environmental Management Programme Inputs

Management Plan for the Design / Pre-construction Phase

Impact	Mitigation/ Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Impact and loss of fauna as a result of operational activities	To reduce the loss of and impact on fauna	• Provide critter paths through the fence line to allow species access to site and in order to escape. • Ensure that the live electrical fence wire is not placed at ground level.	• Identify where fauna may be affecting operations of site (burrows etc.). Consider redress if necessary. • Include paths through the fence line, where appropriate. Generally, this should be done towards natural areas and away from construction sites and busy roads.	• Once-off	Project Developer, Engineers
Destruction / clearance of indigenous and protected vegetation	Ensure compliance with relevant Provincial and National legislation in respect of habitat and species permits.	Ensure the necessary permits or licenses are identified and applied for as applicable for removal of indigenous vegetation, especially for protected species. Provincially protected species must be avoided during the construction activities where it will be impacted on by construction activities. Alternatively, permits for the rescue i.e. removal and translocation or destruction, where relevant, of any of these protected species must be applied for and granted by the provincial authority. Await response and provision of permit (as required) from the relevant Authorities prior to the removal of the indigenous species (if required). Once these permits are obtained, search and rescue must be undertaken for the relevant indigenous species prior to the commencement of construction activities.	• Review the findings of the Specialist Assessments and consider legislative requirements in respect of loss of indigenous and protected vegetation. • Review the approved site plan with the ECO and appoint a suitable terrestrial ecologist to undertake a walk-through of the final approved site layout prior to construction. • Contact the relevant Provincial and National Environmental Authorities to discuss and confirm if any protected species need to be relocated or rescued and undertake the required permit application processes. • Appoint a suitable specialist and/or contractor to undertake plant search and rescue for the plants earmarked for removal and/or relocation as per the approved permits.	• Once-off	Project Developer and ECO/Specialist / Contractor

Impact	Mitigation/ Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Impact on ecological succession and animal re-colonisation	Allow for ecological succession and animal re-colonisation.	Apply appropriate space between consecutive PV panels to allow for sunlight to reach the basal vegetation and monitor ecological succession and animal re-colonisation.	Implement appropriate spacing between consecutive PV panels and verify that this is undertaken by reviewing the approved designs.	Once-off	Project Developer
Loss of natural vegetation in and outside development footprint area and veld degradation.	Reduced loss of natural vegetation and veld degradation within the development footprint and the surrounding area.	Ensure that the footprint required for the proposed project activities is kept at a minimum	Verify that the proposed project area is determined and outlined prior to the commencement of the construction phase by undertaking visual inspections.	Once-off	Project Developer, ECO

Management Plan for the Construction Phase (Including pre- and post-construction activities)

Impact	Mitigation/ Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Loss of natural vegetation in and outside development footprint area and veld degradation.	Reduced loss of natural vegetation and veld degradation within the development footprint and the surrounding area.	• Sensitive habitats and areas outside of the project development area should be clearly demarcated as no go areas during the construction phase to avoid accidental impacts. • Workers should not be allowed outside the demarcated construction areas or camps or beyond the boundaries of the solar PV facility itself, i.e. they will not be allowed to wander across the undeveloped parts of each site. No development or activities should take place in the high sensitivity areas. • No development should take place within High sensitivity areas or buffer zones.	• Strict control over the behaviour of construction workers, restricting activities to within demarcated areas for construction. • ECO must monitor activities and record and report non-compliance. • Strict control and proper education of staff to prevent misconduct. If ECO is absent, there should be a designated Environmental Officer (EO) present to deal with any urgent issues.	Daily	ECO and Contractor

Impact	Mitigation/ Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		Accordingly, the Koppies habitat (where relevant) should be avoided. • No construction related activities, such as the site camp, storage of materials, temporary roads or ablution facilities may be located in the high sensitivity areas. • Minimise loss of natural vegetation. • Only clear areas designated for development.			
		• The proposed project footprint must be demarcated to reduce unnecessary disturbance beyond the proposed project area	Carry out visual inspections to ensure strict control over the behaviour of staff in order to restrict activities to within demarcated areas.	Weekly	ECO
		• Unnecessary impacts on surrounding natural vegetation must be avoided during construction. No construction vehicles should be allowed to drive around the veld. All construction vehicles should strictly remain on properly demarcated roads.	• Strict control over the behaviour of construction workers, restricting activities to within demarcated areas for construction. • Include periodical site inspection in environmental performance reporting that specifically records occurrence or not of off-road vehicle tracks in specific areas.	Daily	ECO and Contractor
		• Undertake re-vegetation and rehabilitation of disturbed areas as soon as possible after construction. Stockpile the shallow topsoil layer separately from the subsoil layers. Reinstate the topsoil layers (containing seed and vegetative material) when construction is complete to allow the plants to rapidly re-colonise the bare soil areas. Re-seed with locally-sourced seed of indigenous grass species that were recorded on site during the pre-construction phase.	• Undertake audits following the construction phase and report any non-compliance.	Daily	ECO and Contractor

Impact	Mitigation/ Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		• The collection, hunting or harvesting of any plants (or 'veldkos'), fuel wood or animals at the site during construction should be strictly forbidden and the staff should be educated to prevent this from happening. • Indigenous vegetation must not be removed or damaged.	• Strict control over the behaviour of construction workers, restricting activities to within demarcated areas for construction. • Carry out Environmental Awareness Training. • Conduct audits of the signed attendance registers. • Issue fines where relevant as per specifications in their contracts. • Ensure that environmental awareness programmes are implemented.	• Once-off training and ensure that all new staff is inducted. • Weekly during construction phase.	ECO and Contractor
		Fires should only be allowed within fire-safe demarcated areas. Open fires must be prohibited. Appropriate fire safety training should also be provided to staff that are to be on site for the duration of the construction phase.	• Strict control over the behaviour of construction workers, restricting activities to within demarcated areas. • Ensure fire safety requirements are well. understood and respected by workers (by providing basic fire safety training).	Daily	ECO and Contractor
Loss of provincially protected species and their habitats	Minimise impacts on protected species.	• A plant rescue operation must be initiated to confirm that no SSC are located within the development footprint. • Should any of the listed / protected species need to be removed, the requisite provincial and/or national permits must be obtained prior to the removal of the species.	• Project Developer must ensure that a suitable terrestrial ecologist is appointed to undertake a final walk-through of the final approved site prior to commencement of construction to identify SCC requiring Search and Rescue or avoidance. • Monitor activities and record and report non-compliance. • Apply for relevant permits with relevant authorities.	• Once-off prior to the commencement of construction • Daily monitoring required	Project Developer, Specialist and ECO

Impact	Mitigation/ Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Disturbance of terrestrial fauna and flora on site due to construction workers and activities, including the impact of littering and pollution	To advise construction staff of the requirements in respect of management of flora and fauna on site during the construction phase.	• Establish a recording method in order to monitor the construction activities, including species presence within site, mortalities and observations.	• Establish database of species, observations, conditions, impacts etc. • Construction personnel should advise on the findings and presence of fauna on site.	Daily to weekly	ECO
As above	Minimise the disturbance to flora and fauna in the surrounding area as a result of littering and pollution. Reduce the amount of littering and pollution within and around the construction site	• The site camp must not be located in high sensitivity areas and their buffer zones. • Ablution facilities must be located outside sensitive areas and their buffer zones. • Dangerous goods may not be stored within 100 m of a watercourse.	• Monitor the placement of the site camp, ablution facilities and dangerous goods via visual inspections, and record and report any non-compliance.	Once-off prior to construction and as required during the construction phase.	ECO
As above	As above	• Sufficient waste disposal bins must be available on site and clearly marked. Skip bins may be required during the construction phase which must be emptied on a regular basis by an approved/licenced waste disposal contractor. Proof of disposal to be kept on file.	• Monitor general waste generation by construction staff and collection, as well as the provision of bins and/or skips via audits throughout the construction phase. • Monitor the handling of general waste on site via site audits and record non-compliance and incidents. • Monitor waste disposal slips and waybills via site audits and record non-compliance and incidents.	Daily or Weekly	ECO and Contractor

Impact	Mitigation/ Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
As above	As above	• Portable ablution facilities must be regularly cleaned and maintained in good working condition. • Any spillage from ablution facilities must be cleaned up immediately and disposed of in an appropriate manner.	• Conduct visual inspections to verify that portable ablution facilities are cleaned and maintained regularly, and report any non-compliance. • Monitor if spillages have taken place and if so, are removed immediately and correctly. Monitor waste disposal slips and waybills via site audits and record non-compliance and incidents.	• Daily During spills	ECO
As above	As above	• Hydrocarbon fuels must be stored in a secure, bunded area. • Vehicles must be in good working condition, with no oil, water, or fuel leaks. Vehicles must be regularly inspected, and any problems corrected. • Refuelling may only take place in an appropriate, bunded area. Refuelling may not take place in sensitive areas. • Hydrocarbon spills must be contained and cleaned up immediately. Spill kits must be available on site in case of accidental spillage.	• Monitor the storage and handling of dangerous goods and hazardous materials on site via site audits and record non-compliance and incidents. • Undertake visual inspections to ensure that vehicles are in good working condition with no leaks, and that they are regularly serviced. Record non-compliance and incidents • Monitor the refuelling process and its location and record the occurrence of any spillages. • Monitor if spillages have taken place and if they are removed correctly.	Weekly	ECO and Contractor
Increased erosion and soil compaction	Reduced erosion and soil compaction caused by construction activities	• Utilise existing access routes as far as possible. • Confine the movement of vehicles to the access routes to and from the site and to the construction areas. • Do not drive in the natural veld.	• Construction access roads must be demarcated clearly. Undertake site inspections to verify. • Strict control over the behaviour of construction workers, restricting activities to within demarcated areas for construction. • Include periodic site inspection in environmental performance	Weekly	ECO and Contractor

Impact	Mitigation/ Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
			reporting that specifically records occurrence or not of off-road vehicle tracks in specific areas.		
As above	As above	• Rehabilitate new vehicle tracks and areas where the soil has been compacted as soon as possible. • Monitor the entire site for signs of erosion.	• Ensure that this is taken into consideration during the construction and record any non-compliance. • Undertake regular monitoring for erosion to ensure is reduced and rectified as soon as possible.	Weekly	Contractor and ECO
As above	As above	• Refer to the Aquatic Biodiversity Specialist Assessment Report for mitigation measures relevant to watercourse crossings and development close to watercourses.	• Ensure that this is taken into consideration during the construction and record any non-compliance.	Monthly	ECO and Contractor
Faunal road mortality as a result of increased vehicles travelling to and within the site.	Minimise loss of fauna as a result of road mortalities.	• To ensure that animals are not attracted to the site (and potentially resulting in increased road mortality), the waste collection bins and skips should be covered with suitable material, where appropriate, and the site camp must be kept clean on a daily basis.	• Monitor the activities via visual inspections, and record and report any non-compliance.	Daily	ECO and Contractor
As above	As above	• All vehicle speeds associated with the project should be monitored and should be limited to 40 km/h (maximum) during the construction phase. • Conduct inspections of the fence line to address any animals that may be affected by the fence, i.e. stuck or casualties.	• Carry out Environmental Awareness Training. • Conduct audits of the signed attendance registers. • Conduct weekly inspections of the fence line to address any animals that may be affected by the fence.	• Once-off training and ensure that all new staff are inducted. • Monthly. • Weekly record keeping. A register of all faunal sightings indicating date of siting;	Project Developer, ECO and Contractor

Impact	Mitigation/ Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
				species affected; position of species (specific or indicative) and other observations should be established.	
Impact and loss of fauna as a result of the fence line and exclusion of fauna from site resulting in ecological change within the site	To reduce incidental mortality and injury of fauna within the construction area.	• Conduct inspections of the fence line to address any animals that may be affected by the fence, i.e. stuck or casualties.	• Conduct weekly inspections of the fence line to address any animals that may be affected by the fence.	Weekly record keeping. A register of all faunal sightings indicating date of siting; species affected; position of species (specific or indicative) and other observations should be established.	Project Developer and ECO
Increased alien invasive species	Avoid establishment and reduce the spread of alien invasive plants due to the project activities.	• Implement an ongoing monitoring programme for alien invasive vegetation for the construction phase to detect and quantify any alien invasive species that may become established within the construction site.	• Ongoing monitoring should be undertaken according to an approved method statement that makes use of alien clearing methods as provided by the Working for Water Programme and outlined on Resources | Department of Environmental Affairs (https://www.dffe.gov.za/projectsprogrammes/wfw/resources#mannuals).	Ongoing. Monitoring and control measures should take place at least biannually (every six months).	ECO and Contractor

Impact	Mitigation/ Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
			• Herbicide and pesticide used as part of control measures should be approved by the ECO prior to application, taking all sensitive features into account.		
Loss of vegetation by increased degradation and reduced ecosystem services	Rehabilitation post-construction by replacing topsoil and re-seeding. Refer to vegetation type for list of dominant species.	• Re-vegetation of disturbed surfaces must occur immediately after construction activities are completed. Allow natural vegetation recruitment from the topsoil unless the vegetation cover is insufficient. Re-seed with locally-sourced seed of indigenous grass species that were recorded on site pre-construction or by using a commercial seed mix indigenous to the area.	• Compare vegetation establishment on rehabilitated areas to surroundings natural vegetation. • Rehabilitate the following areas: - Road verges after road construction is completed. - transformed portions of the site not developed. - Areas where pockets of alien invasive species have been removed. • A list of indigenous plants used during rehabilitation must be approved by the ECO prior to commencement of rehabilitation activities.	As recommended by the specialist / ECO	Appointed Botanist and ECO

Management Plan for the Operational Phase

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Vegetation management on site and loss of species composition and diversity	Manage vegetation throughout the site to avoid conflict with operations of the proposed PV facility and reduce ecological degradation.	• Monitor rehabilitation efforts post-construction phase.	• Compare vegetation establishment on rehabilitated areas to surroundings natural vegetation	At the end of the growing season and then as recommended by the specialist	Appointed Botanist and ECO
Impact and loss of fauna as a result of operational activities	To reduce the loss of and impact on fauna	• Avoidance of damage to infrastructure by faunal activity as well as impact on fauna as a result of the site infrastructure. • Identify impact of burrowing and other faunal activities on the fence line and operations activities. • Undertake the management of faunal intrusion through the fence, including possible mortalities. • Conduct inspections of the fence line to address any animals that may be affected by the fence. • Promote and support faunal presence and activities within the proposed PV facility, where possible.	• Identify where fauna may be affecting operations of site (burrows etc.). Consider redress if necessary. • Conduct regular (daily) inspections of the fence line to address any animals that may be affected by the fence. • Monitor the activities via visual inspections, and record and report any non-compliance. • Induction / toolbox talks should be promoted where general awareness is created to prevent faunal disturbance.	• Daily to weekly record keeping. • A register of all faunal sightings indicating date of siting; species affected; position of species (specific or indicative) and other observations should be established.	ECO and Operations and Maintenance Contractor
Impact and loss of fauna as a result of the fence line and exclusion of fauna from site resulting in ecological change within the site.	To reduce the impact and loss of fauna from site as a result of their exclusion from the area due to fencing	• Conduct inspections of the fence line to address any animals that may be affected by the fence, i.e. stuck or casualties.	• Conduct weekly inspections of the fence line to address any animals that may be affected by the fence.	Weekly record keeping. A register of all faunal sightings indicating date of siting; species affected; position of species (specific or indicative) and	Project Developer and ECO

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
				other observations should be established.	
Impact of electrical light pollution (ELP) around the site	The avoidance of electrical light pollution through prudent positioning of external lighting.	• The operational personnel and staff should be made aware of the presence of fauna within the proposed project area. • Driving is not allowed at night, where possible.	• Carry out Environmental Awareness Training. • Conduct audits of the signed attendance registers.	• Once-off training and ensure that all new staff are inducted. • Monthly	ECO and Operations and Maintenance Contractor
Faunal and avifaunal road mortality as a result of increased vehicles travelling to and within the site.	Minimise loss of fauna as a result of road mortalities.	• To ensure that animals are not attracted to the site (and potentially resulting in increased road mortality), the waste collection bins and skips should be covered with suitable material, where appropriate, and the offices must be kept clean on a daily basis.	• Monitor the activities via visual inspections, and record and report any non-compliance.	Daily	ECO and Operations and Maintenance Contractor
Increased alien invasive species	Avoid establishment and reduce the spread of alien invasive plants due to the project activities.	• Implement an ongoing monitoring programme for alien invasive vegetation for the operational phase to detect and quantify any alien invasive species that may become established within the operational site.	• Ongoing monitoring should be undertaken according to an approved method statement that makes use of alien clearing methods as provided by the Working for Water Programme and outlined on Resources | Department of Environmental Affairs (https://www.dffe.gov.za/projectsprogrammes/wfw/resources#mannuals). • Herbicide and pesticide used as part of control measures should be approved by the ECO prior to application, taking	Ongoing. Monitoring and control measures should take place at least biannually (every six months) for the first 3 years of the project and should be adjusted as required based on the first 3 years results / success rate.	ECO and Project Developer

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
			all sensitive features into account.		
Disturbance of terrestrial fauna and flora on site due to operational workers and activities, including the impact of littering and pollution	Minimise the disturbance to flora and fauna in the surrounding area as a result of littering and pollution. Reduce the amount of littering and pollution within and around the operational site	• Sufficient waste disposal bins must be available on site and clearly marked.	• Monitor general waste generation by operational staff and collection, as well as the provision of bins and/or skips via audits throughout the operational phase.	Daily or Weekly	ECO
As above	As above	• Vehicles must be in good working condition, with no oil, water, or fuel leaks. • Vehicles must be regularly inspected, and any problems corrected. • Refuelling may only take place in an appropriate, designated bunded area. • Any spillages must be reported immediately and dealt with appropriately. • Spill kits must be available on site in case of accidental spillage.	• Undertake visual inspections to ensure that vehicles are in good working condition with no leaks, and that they are regularly serviced. Record non-compliance and incidents • Monitor the refuelling process and its location and record the occurrence of any spillages. • Monitor if spillages have taken place and if they are removed correctly.	Weekly	ECO

Management Plan for the Decommissioning Phase

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Rehabilitation of flora on site	Re-vegetation of the disturbed site is aimed at approximating as near as possible the natural vegetative conditions prevailing prior to construction.	• The loss of vegetation is unavoidable within the approved layout development footprint, but sensitive areas must be avoided. • Implement appropriate rehabilitation measures to restore each habitat to a natural state after decommissioning. • The effort must benefit the potential faunal species that may find refuge on the site. • All natural areas must be rehabilitated with species indigenous to the area. Re-seed with locally-sourced seed of indigenous grass species that were recorded on site pre-construction. • Rehabilitation must be executed in such a manner that surface run-off will not cause erosion of disturbed areas.	• Monitor the placement of decommissioning activities via visual inspections, and record and report any non-compliance. • Final external audit of area to confirm that area is rehabilitated to an acceptable level.	Once-off	Project Developer with advice from specialist
Increased alien invasive species	Avoid establishment and reduce the spread of alien invasive plants due to the project activities.	• Implement an ongoing monitoring programme for alien invasive vegetation for the decommissioning phase to detect and quantify any alien invasive species that may become established within the decommissioning site.	• After all infrastructure is removed, a final site inspection should be done and all remaining plants must be cleared. • Herbicide and pesticide used as part of control measures should be approved by the ECO prior to application, taking all sensitive features into account.	Once-off	ECO and Project Developer

11. Final Specialist Statement and Authorisation Recommendation

11.1 Statement and Reasoned Opinion

The proposed development is not located in a threatened vegetation type or ecosystem and is located in an ESA mainly due to presence of sensitive birds. There are no high sensitivity features on site, and no plant SCC were recorded. However, three provincially protected species occur on Kudu Solar Facility 4 and requires permits for relocation from the provincial authority.

The development of Kudu Solar Facility 4 can proceed should all no-go sensitive areas be avoided, and the recommended mitigation measures are implemented.

11.2 EA Condition Recommendations

- Vegetation clearing must be limited to the development footprint.
- Walk down of the approved site prior to construction activities to record all provincially protected species that will be impacted on by the development.
- Submit the necessary permit application with the provincial authority prior to construction for the relocation of provincially protected species. Copies of the permits must be kept on site by the ECO.
- Implement appropriate rehabilitation measures to restore each habitat to a natural state that is representative of the respective vegetation type after construction and decommissioning.
- Topsoil from excavations must be salvaged and reapplied during rehabilitation.
- No alien and invasive plant species may be used for rehabilitation purposes; only indigenous species of the area / vegetation type may be used.
- Cleared alien vegetation may not be dumped on adjacent natural vegetation during clearing but must be temporarily stored in a demarcated area and disposed of at a legal facility.
- Removal of alien and invasive species, monitoring and follow-up procedures must be implemented as indicated in the report and based on best practice guidelines.
- Electric fencing must not have any strands within 30cm of the ground which still remain as an effective security barrier while allowing smaller mammals and reptiles to pass through.
- Carry out Environmental Awareness Training throughout the construction period and conduct audits of signed attendance registers to ensure compliance with the EMPr and EA conditions.

12. References

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Mucina, L. and Rutherford, M.C. (Eds.) 2010. The vegetation of South Africa, Lesotho and Swaziland. Strelizia 19. South African National Biodiversity Institute, Pretoria

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT. 2004 (Act NO 10 of 2004): Publication of lists of critically endangered, endangered, vulnerable and protected species.

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South African National Biodiversity Institute (SANBI). (2020). Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa. South African National Biodiversity Institute, Pretoria. Version 3.1. 2022.

Van Wyk, B.-E. and Smith, G. (2003). Guide to aloes of South Africa. (2nd ed.). Briza Publications, Pretoria.

Victor, J.E. (2009). *Tridentea virescens* (N.E.Br.) L.C.Leach. National Assessment: Red List of South African Plants version 2020.1.

Appendices

Appendix A: Specialist Expertise

Personal details

Full Name Corné Niemandt

DOB May 1989

Nationality RSA

Email corne@enviro-insight.co.za

Project relevance

Corné is an ecologist who mainly operates as a botanist since 2012. Corné has worked on renewable energy projects, particularly in the Northern - and Western Cape provinces. Relevant recent projects include the Botterblom WEF (Loeriesfontein), Aggeneys WEF, Bloemsmond Solar Facilities (Keimoes), Bergrivier WEF (Gouda), and Pofadder WEF. Corné has a good understanding of the Nama Karoo system and associated vegetation types and has successfully identified species of conservation concern in question for the relevant projects, making him suitable for this work. Corné has also submitted permit application with the competent authorities before, and has written search and rescue plans for SCC before.

Memberships & Certificates

- SACNASP Registered Professional Natural Scientist in the field of Ecological Science - Registration Number: 116598
- South African Association of Botanists (2018-current)
- International Association for Impact Assessment South Africa (2018-current)
- IAIAsa Gauteng Branch Committee member (2021-2023)
- GDARD EAP Forum Committee member (2020-2022)
- SAEON Graduate Student Network Membership (2013-2019)
- Invitation from Golden Key International Honour Society (2010)

Employment

Corné has operated mainly as a terrestrial biodiversity specialist and has compiled more than 40 terrestrial biodiversity and plant species assessments, and several rehabilitation and alien invasive species management plans.

2017 - present	Environmental Assessment Practitioner, Environmental Control Officer (ECO) and Ecological Specialist at Enviro-Insight CC. Responsible for writing BA and EIA reports, conducting ecological assessments, writing ECO reports, GIS mapping, and project management.
2016 - 2017	Ecologist and Consultant at Bokamoso Landscape Architects and Environmental Consultants CC Responsible for conducting ecological assessments as part of the EIA process and compile EIAs, BAs and WULAs.

2015	Freelance (7 weeks) for Ecotone Freshwater Consultants CC
2012 - 2015	Tutor for first year Botany modules, University of Pretoria. Responsible for assisting students during practicals and managing demonstartors.
2014 - 2015	Organiser of journal club for the Ecology unit, Department of Plant Science, University of Pretoria.
2014	Guest lecturer for botany honours module BOT 788: Vegetation classification, Department of Plant Science, University of Pretoria.
2014	Mentoring third year student part of mentorship programme, Department Plant Science.
2013	Invasive plant species survey for M2 Environmental Connections.
2012	WULA and Aquatic Assistant at MENCO
2012	Fieldwork at Richard Bay Minerals part of coastal dune rehabilitation programme

Education

Completed Degrees and Institution

2015	M.Sc. Plant Science, University of Pretoria, Pretoria, South Africa
2012	B.Sc. (Hons) Zoology, University of Pretoria, Pretoria, South Africa
2011	B.Sc. Ecology, University of Pretoria, Pretoria, South Africa
2007	Merensky High School, Tzaneen, Limpopo Province, South Africa

Publications & Contributions

Niemandt, C. and Greve, M. 2016. Fragmentation metric proxies provide insights into historical biodiversity loss in critically endangered grassland. Agriculture, Ecosystems and Environment 235, 172–181. doi.org/10.1016/j.agee.2016.10.018

Niemandt, C., Kovacs, K.M., Lydersen, C., Dyer, B.M., Isaksen, K., Hofmeyr, G.J.G., & de Bruyn, P.J.N. 2015. Chinstrap and macaroni penguin diet and demography at Nyrøysa, Bouvetøya, Southern Ocean. Antarctic Science. doi:10.1017/S0954102015000504

Courses attended

- Introduction to Environmental Impact Assessment and Auditing (Department of Geography, Geoinformatics and Meteorology).
- Basic Wetland Workshop (Gauteng wetland forum, DWS, GDARD, ARC).
- R for basic statistics (Department Plant Science, University of Pretoria).
- Basic statistics (Department Plant Science, University of Pretoria).
- General Linear Modelling (Department Plant Science, University of Pretoria).
- Georeferencing course (SANBI).
- Spatial Analysis with ArcGIS (ESRI, South Africa).

Conferences and Workshops

Attended

- IAIAsa Gauteng Branch Event. Incorporating Biodiversity and Wetland Offsets into the EIA process, Midrand, 24 July 2019.
- IAIAsa Gauteng Branch Event. Integration of Climate Change Assessments in EIA's, Midrand, 15 May 2019.
- IAIAsa Gauteng Branch Event. SAHRA Heritage Workshop, Midrand, 26 February 2019.
- IAIAsa 2018 Energy symposium, Midrand, 17 August 2018.
- IAIA18. 38th Annual Conference of the International Association for Impact Assessment. Durban, South Africa, 16-19 May 2018.
- Section 21 (c) and (i) water use authorisation training. Department of Water and Sanitation, Sub-Directorate In-stream Water Use, February 2018
- IAIA Webinar: Accessing and interpreting biodiversity information for high-level biodiversity screening. 10 April 2018.

Contributions

- Spatial changes in vegetation cover over time in a highly threatened vegetation complex, Limpopo Province. 41st SAAB Annual Conference, Tshipise (University of Venda), January 2015.
- Anthropogenic impacts on a highly threatened vegetation complex, Limpopo province. XXth AETFAT Congress, Stellenbosch, January 2014.
- Anthropogenic impacts on a highly threatened vegetation complex, Limpopo province. Biodiversity Southern Africa Conference, Cape Town, December 2013.
- Land use change and the effects of habitat fragmentation on a highly threatened vegetation complex, Limpopo province. GSN SAEON Indibano Conference, Cape Town, August 2013.
- Spatial changes in vegetation cover over time in a highly threatened vegetation complex, Limpopo Province. 41st SAAB Annual Conference, Tshipise (University of Venda), January 2015.

Software Skills



Appendix B: Specialist Statement of Independence

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 - 12), near De Aar, Northern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

Details of Specialist, Declaration and Undertaking Under Oath

Page 1 of 3

1. SPECIALIST INFORMATION

Specialist Company Name:	Enviro-Insight CC			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100
Specialist name:	Corné Niemandt			
Specialist Qualifications:	MSc Plant Science, University of Pretoria BSc (Honours) in Zoology, University of Pretoria BSc Ecology, University of Pretoria			
Professional affiliation/registration:	SACNASP (116598) International Association for Impact Assessment South Africa (2018-2023) The Botanical Society of South Africa (2022-2023) South African Association of Botanists (2018-2022)			
Physical address:	Unit 8, Oppidraai Office Park 862 Wapadrand Road, Wapadrand, Pretoria			
Postal address:	Unit 8, Oppidraai Office Park 862 Wapadrand Road, Wapadrand, Pretoria			
Postal code:	0050	Cell:	073 405 5708	
Telephone:	012 807 0637	Fax:		
E-mail:	corne@enviro-insight.co.za			

2. DECLARATION BY THE SPECIALIST

I, **Corné Niemandt**, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

Enviro-Insight CC

Name of Company:

04/07/2023

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, **Corné Niemandt**, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.



Signature of the Specialist

Enviro-Insight CC

Name of Company

04/07/2023

Date



Signature of the Commissioner of Oaths

04 / 07 / 2023

JACQUES GEORGE BASCH
Commissioner of Oaths
Chartered Accountant (SA)
Ex Officio
862 WAPADRAND ROAD
WAPADRAND 0081 PRETORIA

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

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PROJECT TITLE

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2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
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473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Enviro-Insight CC			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100
Specialist name:	Samuel David Laurence			
Specialist Qualifications:	BSc (Honours) Wildlife Management, University of Pretoria			
Professional affiliation/registration:	SACNASP (400450/13) Private Security Regulatory Authority (PSIRA), Johannesburg, South Africa Birds and Renewable Energy Specialist Group (BARESG)			
Physical address:	Unit 8, Oppidraai Office Park 862 Wapadrand Road, Wapadrand, Pretoria			
Postal address:	Unit 8, Oppidraai Office Park 862 Wapadrand Road, Wapadrand, Pretoria			
Postal code:	0050	Cell:	072 437 1742	
Telephone:	012 807 0637	Fax:		
E-mail:	sam@enviro-insight.co.za			

2. DECLARATION BY THE SPECIALIST

I, **Samuel David Laurence**, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

Enviro-Insight CC

Name of Company:

07/07/2023

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, **Samuel David Laurence**, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.



Signature of the Specialist

Enviro-Insight CC

Name of Company

07/07/2023

Date



Signature of the Commissioner of Oaths

07 July 2023

Date



KERRY AUGUST
Commissioner of Oaths
Master HR Professional (MHRP)
Member Number: 53544596
25 Bordeaux Close
Stellenbosch
7600

Details of Specialist, Declaration and Undertaking Under Oath

Appendix C: Site Sensitivity Verification

Prior to commencing with the specialist assessment in accordance with the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014 (as amended) and the environmental theme protocols (March 2020, October 2020), a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

The details of the site sensitivity verification are noted below:

Date of Site Visit	21 -22 February 2022
Specialist Name	Corné Niemandt
Professional Registration Number	116598
Specialist Affiliation / Company	Enviro-Insight CC

The following section provides information on what was done as part of the site sensitivity verification process.

Screening Report and Literature review

Terrestrial Biodiversity
The Very High sensitivity category was scrutinised by assessing the relevant sources of information, such as the Northern Cape CBA Map (2016). Accordingly, the reason for being listed as an Ecological Support Area (ESA) was assessed prior to the site visit to ensure that the relevant sensitive features were included in the survey.

Sensitive Plant Species
The screening report highlighted the area as Medium sensitivity due to suspected habitat for SCC based on occurrence records for these species collected prior to 2002 and/or is based on habitat suitability modelling. The presence or likely presence of the SCC identified by the screening tool, must be confirmed. Where SCC are found on site or have been **confirmed to be likely present**, a Terrestrial Plant Species Specialist Assessment must be submitted in accordance with the requirements specified for “very high” and “high” sensitivity in the Terrestrial Plant Species protocol of GN1150. Similarly, where no SCC are found on site during the investigation or if the presence is confirmed to be unlikely, a Terrestrial Plant Species Compliance Statement must be submitted.

The relevant sensitive species indicated in the screening report was assessed in terms of suitable habitat, location and flowering period prior to the site visit. Relevant sources include:

- iNaturalist (https://www.inaturalist.org/)
- GBIF (https://www.gbif.org/)
- SANBI Red List of South African plants version 2021 (http://redlist.sanbi.org/index.php)
- Plants of southern Africa: Botanical Database of Southern Africa (BODATSA) (http://posa.sanbi.org/sanbi/Explore)

The most recent aerial imagery from Google Earth was used in order to identify the different habitats for each site. This information was then ground-truthed during the survey.

Based on this initial work, the specialist expected that a full Terrestrial Biodiversity Impact Assessment and Terrestrial Plant Species Specialist Assessment was required.

Site visit

A site visit was undertaken from 21-22 February 2022 to confirm the site sensitivity based on the screening report outcome. The specialist considered this only a formality as suitable habitat was present on site for the SCC (*T. virescens*), and ESA had to be assessed. Based on the initial findings, a full assessment was carried out for both the Terrestrial Biodiversity and Terrestrial Plant Species themes in order to comply with the protocols.

The site visit confirmed the Very High[10](VH) Terrestrial Biodiversity theme owing to the nature of semi-natural grassland (grazing has a moderate to low impact) and natural koppies on site (Figure C1-1). The ESA has important ecosystem functions and promotes ecological processes required for a healthy system. The Besemkaree Koppies Shrubland specifically is included as important vegetation types for maintaining ecological process and combating climate change. Furthermore, they act as important corridors in the landscape and could be vital for combating climate change in the future. It is the specialists opinion that the Terrestrial Biodiversity theme can be considered Medium sensitivity, once the Koppies and relevant aquatic features have been avoided. It does not represent a fatal flaw to the project.

For the Plant Species theme, the identified suitable habitat for *Tridentea virescens* had to be further assessed, and accordingly the medium sensitivity rating was upgraded to comply with a Terrestrial Plant Species Specialist Assessment. *Tridentea virescens* has been recorded previously near to De Aar and could possibly occur on site.



Figure C1-1: The land is in a semi-natural state as grazing activities are the main impact currently.

[10] This theme only distinguishes between Low and Very High (VH) sensitivity. ESA in our opinion cannot be VH as it is not irreplaceable areas, and depending on what ecological features it is based on, can be regarded as Medium or High.

Appendix D: Impact Assessment Methodology

The impact assessment includes:

- *the nature, status, significance and consequences of the impact and risk;*
- *the extent and duration of the impact and risk;*
- *the probability of the impact and risk occurring;*
- *the degree to which impacts and risks can be mitigated;*
- *the degree to which the impacts and risks can be reversed; and*
- *the degree to which the impacts and risks can cause loss of irreplaceable resources.*

Terminology used in impact assessment can overlap. To avoid ambiguity, please note the following clarifications (that are based on NEMA and the EIA Regulations):

- *The term environment is understood to have a broad interpretation that includes both the natural (biophysical) environment and the socio-economic environment. The term socio-ecological system is also used to describe the natural and socio-economic environment and the interactions amongst these components.*
- *Significance = Consequence x Probability, which means that significance is equivalent to risk.*
- *The impact can have a positive or negative status. The significance of a negative impact may be called a risk, and the significance of a positive impact may be called an opportunity.*

The following principles are to underpin the application of this methodology:

- *Transparent and repeatable process - specialists are to describe the thresholds and limits they apply in their assessment, wherever possible.*
- *Adapt parameters to context (where justified) – the methodology proposes some thresholds (e.g. for spatial extent, in Step 3 below), however, if the nature of the impact requires a different definition of the categories of spatial extent, then this can be provided and described.*
- *Combination of a quantitative and qualitative assessment – where possible, specialists are to provide quantitative assessments (e.g. areas of habitat affected, decibels of noise, number of jobs), however, it is recognised that not all impacts can be quantified, and then qualitative assessments are to be provided.*

As per the DFFE Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect and cumulative:

- *Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.*
- *Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.*
- *Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.*

The impact assessment methodology includes the aspects described below.

- ***Step 1**: **Nature** of impact/risk - The type of effect that a proposed activity will have on the environment.*

- ***Step 2**: **Status** - Whether the impact/risk on the overall environment will be:*
    - *Positive - environment overall will benefit from the impact/risk;*
    - *Negative - environment overall will be adversely affected by the impact/risk; or*
    - *Neutral - environment overall not be affected.*

- ***Step 3**: **Qualitatively** determine the **consequence** of the impact/risk by identifying the **a) SPATIAL EXTENT; b) DURATION; c) REVERSIBILITY; AND d) IRREPLACEABILITY**.*

    - ***A) Spatial extent** – The size of the area that will be affected by the impact/risk:*
        - *Site specific;*
        - *Local (<10 km from site);*
        - *Regional (<100 km of site);*
        - *National; or*
        - *International (e.g. Greenhouse Gas emissions or migrant birds).*

    - ***B) Duration** – The timeframe during which the impact/risk will be experienced:*
        - *Very short term (instantaneous);*
        - *Short term (less than 1 year);*
        - *Medium term (1 to 10 years);*
        - *Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration)); or*
        - *Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).*

    - ***C) Reversibility** of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):*
        - *High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);*
        - *Moderate reversibility of impacts;*
        - *Low reversibility of impacts; or*
        - *Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).*

    - ***D) Irreplaceability** of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):*
        - *High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);*
        - *Moderate irreplaceability of resources;*
        - *Low irreplaceability of resources; or*
        - *Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).*

*Some of the criteria are quantitative (e.g. spatial extent and duration) and some may be described in a quantitative or qualitative manner (e.g. reversibility and irreplaceability). The specialist then combines these criteria in a qualitative manner to determine the **consequence**.*

The consequence terms ranging from slight to extreme must be calibrated per Specialist Study so that there is transparency and consistency in the way a risk/impact is measured. For example, from a biodiversity and ecology perspective, the consequence ratings could be defined according to a

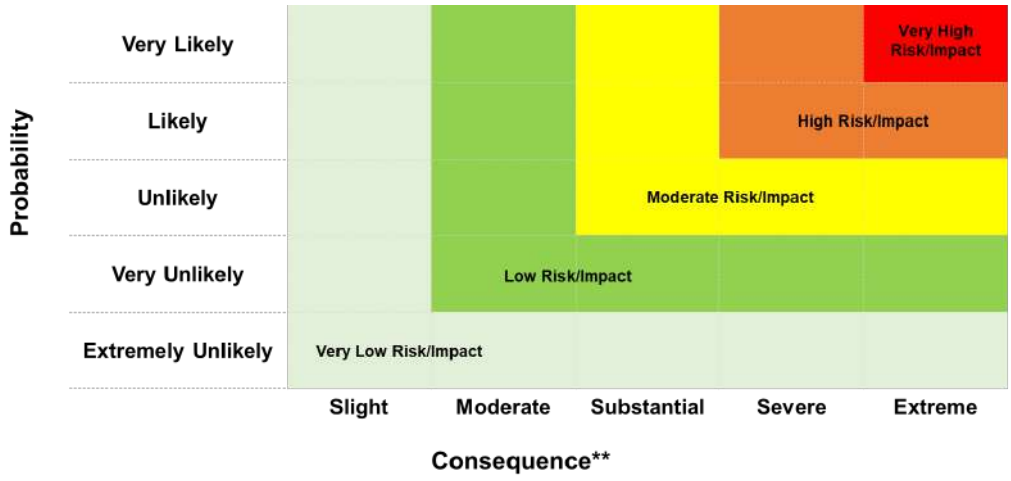
reduction in population or occupied area in relation to Species of Conservation Concern (SCC) status, ranging from slight consequence for defined areas of Least Concern, to extreme consequence for defined areas that are Critically Endangered. For example, from a social perspective, a slight consequence could refer to small and manageable impacts, or impacts on small sections of the community; a moderate consequence could refer to impacts which affect the bulk of the local population negatively or may produce a net negative impact on the community; and an extreme consequence could refer to impacts which could result in social or political violence or institutional collapse.

- ***Consequence*** *– The anticipated consequence of the risk/impact is generally defined as follows:*
    - *Extreme (extreme alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they permanently cease);*
    - *Severe (severe alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease);*
    - *Substantial (substantial alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease;*
    - *Moderate (notable alteration of natural or socio-economic systems, patterns or processes, i.e. where the natural or socio-economic environment continues to function but in a modified manner; or*
    - *Slight (negligible and transient alteration of natural or socio-economic systems, patterns or processes, i.e. where natural systems/environmental or socio-economic functions, patterns, or processes are not affected in a measurable manner, or if affected, that effect is transient and the system recovers).*

- ***Step 4****: Rate the* ***probability*** *of the impact/risk using the criteria below:*

    - ***Probability*** *– The probability of the impact/risk occurring:*
        - *Extremely unlikely (little to no chance of occurring);*
        - *Very unlikely (<30% chance of occurring);*
        - *Unlikely (30-50% chance of occurring)*
        - *Likely (51 – 90% chance of occurring); or*
        - *Very Likely (>90% chance of occurring regardless of prevention measures).*

- ***Step 5****: Use both the* ***consequence*** *and* ***probability*** *to determine the* ***significance*** *of the identified impact/risk (qualitatively as shown in Figure 1). Significance definitions and rankings are provided below:*



[Qualitatively determined based on Spatial Extent, Duration, Reversibility and Irreplaceability]

Figure 1. Guide to assessing risk/impact significance as a result of consequence and probability.

- ***Significance*** *– Will the impact cause a notable alteration of the environment?*
    - *Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
    - *Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
    - *Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);*
    - *High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and*
    - *Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).*

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- *Very low = 5;*
- *Low = 4;*
- *Moderate = 3;*
- *High = 2; and*
- *Very high = 1.*

The specialists must provide a written supporting motivation of the assessment ratings provided.

- ***Step 6****: Determine the* ***Confidence Level*** *– The degree of confidence in predictions based on available information and specialist knowledge:*
    - *Low;*
    - *Medium; or*
    - *High.*

Appendix E: Animal Compliance Statement

ANIMAL COMPLIANCE STATEMENT

Scoping and Environmental Impact Assessment (EIA) Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities (Kudu Solar Facilities 1-12) and associated infrastructure, near De Aar, Northern Cape province

MAY 2022

by

Samuel Laurence

Pr.Sci.Nat. Zoological and Ecological Science

Corné Niemandt

Pr.Sci.Nat. Ecological Science

Specialist details

Specialists	Contact details	SACNASP registration	Experience
Samuel David Laurence	sam@enviro-insight.co.za	Zoological and Ecological Sciences - 400450/13	15
Corné Niemandt	corne@enviro-insight.co.za	Ecological Science - 116598	7

Statement of independence

We, Samuel David Laurence and Corné Niemandt, as the appointed terrestrial animal specialists, hereby declare/affirm the correctness of the information provided in this compliance statement, and that we:

- meet the general requirements to be independent and have no business, financial, personal or other interest in the proposed development and that no circumstances have occurred that may have compromised my objectivity; and
- are aware that a false declaration is an offence in terms of regulation 48 of the EIA Regulations (2014).



Samuel Laurence



Corné Niemandt

23 May 2022

Date

Site Inspection Details

A site visit was undertaken by an ecologist (Mr Corné Niemandt) to confirm the low sensitivity for terrestrial animal species (excluding avifauna), and to confirm that the proposed development will have no significant impact on Species of Conservation Concern (SCC). The desktop analysis including database search and literature review was done by Mr Sam Laurence.

Date	21-22 February 2022
Duration	Two days (±16 hours)
Season	Wet season
Season Relevance	Conditions were optimal due to good rains.

Methodology

Desktop Study

Relevant databases, field guides and texts were consulted for the literature study which included the following:

- The online Virtual Museum (VM) facility of the Animal Demography Unit (ADU) of the University of Cape Town (http://vmus.adu.org.za) was queried for the presence of mammal (MammalMAP, 2022), reptile (ReptileMAP, 2022) and amphibian (FrogMAP, 2022) SCC within the quarter degree grid cell (QDGC) in which the proposed development resides;
- Mammal SCC information was obtained from Child *et al.,* (2016);
- Reptile SCC information was obtained from Bates *et al.,* (2014); and
- Amphibian SCC information was obtained from Du Preez and Carruthers (2017).

Species nomenclature follows the aforementioned references throughout this document except for herpetofauna where nomenclature for reptiles follows ReptileMAP (2022) as new distribution data and taxonomic changes have already occurred since publication of Bates *et al.,* (2014). Similarly, the Frog Atlas of Southern Africa (FrogMAP, 2022) provides information on the geographic distributions of amphibians and keeps up to date with the latest taxonomic changes. The use of these online facilities is justified as it not only includes the latest verified publicly contributed data but also a complete record of the museum material in South Africa. The applicability of the information obtained from the literature sources was evaluated for the study area and the subsequent recommendations are to be used by the Applicant to drive the development process in accordance with the relevant legislation.

Field survey

- The specialist investigated the study area on foot and by vehicle for two days.
- All twelve[11] PV facilities were investigated for animal signs and sightings.
- Since no SCC (excluding avifauna) were flagged by the screening report or desktop assessment, the survey was brief.

[11] The total number of PV projects decreased to 12 following the specialist site work, as well as other considerations such as discussions with landowners and the capacity limits of Bidding Window 6, as described in the main report.

- For each PV site the habitat was characterised, photographs were taken and the likelihood of any SCC being present were assessed.
- All fauna observed during the site survey were photographed (where possible).

Assumptions and limitations

- It is assumed that all third-party information used (e.g. GIS data and satellite imagery) is correct at the time of generating this report.
- The survey was restricted to a single season (early dry season), but it is not considered necessary to perform an additional survey due to the absence of SCC.
- The Avifauna assessment is not part of this report and is dealt with under the relevant theme and presented in a separate report. Where relevant from a Terrestrial Biodiversity perspective, short descriptions are included. For instance, to describe the functionality of a habitat.

Results

Sampling

Random walk transects were done, covering all major habitats on site within each of the twelve[12] PV facilities. At each sample site the habitat was characterised, photographs were taken and the likelihood of any SCC being present was assessed. The below table indicates species recorded on site.

[12] Refer to the footnote above regarding the number of PV projects.

Table 1: Recorded species and site description.

Description	Habitat[13]	Photo
Hippotragus niger niger Sable Antelope Vulnerable Provincially Protected	Sable Antelope are grazers of perennial grasses and are found mainly in medium to tall grasslands. However, these intact grasslands are highly threatened in South Africa and only 10% are well protected. It is important to note that the species has been introduced to the country, therefore occurring outside its area of historical distribution, is possibly ranched or farmed or free roaming, but importantly does not function as part of the study area ecosystem. It is possible that this individual came from the surrounding farm next to PV1 (furthest corner to the south), evident from the high fences. It is suggested that the developer come to an agreement with the adjacent landowner to consider appropriate measures for the current bordering fences to prohibit the Sable to move between the two properties. A Sable within a solar facility will not be ideal and could cause damage to infrastructure. The species is protected and may not be killed or injured. However, it is not necessary to include the presence of this species as part of the impact analysis and SEI evaluation, and accordingly a full animal assessment is not required.	
Stigmochelys pardalis Leopard tortoise Least Concern Provincially Protected	This is a generalist tortoise that is found in a variety of habitats including arid and mesic savannah, thorn scrub and grasslands. Tortoises are important seed dispersers as they eat large quantities of plants and their faeces or scats are full of undamaged seeds. The species was recorded in the south at PV5, PV6, and PV7, as well as in the north at PV11 and PV12. It can be deduced that the species occur throughout the study area.	

[13] Even though animals were sighted at specific locations, they can occur across the study area as they move around to feed. Accordingly, the mentioned animals should not be associated with a specific PV facility and the possible impacts and proposed mitigation measures will be applicable for all PV facilities. Perhaps the only exclusion can be that of the Sable, which is unlikely to venture of further away from the adjacent property.

Description	Habitat[13]	Photo
Xerus inauris Cape Ground Squirrel Least Concern Provincially Protected	They have a preference for open terrain with little bush cover and a substrate suitable for burrowing, occurring on open calcareous ground on the fringes of dry pans, watercourses and floodplains, on open overgrazed ground, and in open grassland or karroid areas, providing the substrate is suitable.	
Raphicerus campestris Steenbok Least Concern Provincially Protected	The species prefers open grassland (tall grass), avoiding craggy or mountainous terrain. Recorded in PV5.	

Description	Habitat[13]	Photo
Hystrix africaeaustralis Porcupine Least Concern Provincially Protected	Cape porcupines inhabit shrublands and grasslands, rural gardens and arable lands. Their day-time shelter is thought to include rock crevices, caves and abandoned burrows or other types of holes, which they have excavated or modified to their own requirements. Cape porcupines are crucial members of a healthy ecosystem due to their positive influence on the landscapes through biotic (foraging) and abiotic (soil turnover) impacts.	
Genetta genetta Small-spotted genet Least Concern Provincially Protected	Prefers more arid and more open areas; also arid shrubveld and dry riverine forest. This roadkill was recorded at the south at PV5, PV6 and the grid connection.	

Description	Habitat[13]	Photo
Antidorcas marsupialis Springbok Least Concern Provincially Protected	The species occurs in open, dry shrubby veld, grass plains or dry riverbeds. It is not confined to a specific property. Arrangement will have to be made with the landowners so that the species does not occur within a property where the PV arrays are placed	
Lepus saxatilis Scrub hare Least Concern Provincially Protected	Prefers thickets with patches of grasslands. The species is primarily found in savanna woodland and scrub areas, but can occur in grasslands occasionally (but avoid open grass plains). It occurs throughout the study area.	
Phacochoerus africanus Common warthog Least Concern Provincially Protected	Prefers savannah with open areas around pans and waterholes. Species was recorded at PV8 and east of PV8 in tall grassland with shrubs, close to the watercourse.	**No image available**
Otocyon megalotis Bat eared fox Least Concern	Several bird species benefit from this species during winter, as they consume termites which are dug up. They also influence vegetation structure by digging.	**No image available**

Description	Habitat[13]	Photo
Provincially Protected		
Bitis arietans Puff Adder Least Concern	Occurs in a wide variety of habitats, but is more abundant where bushy cover occurs. It was recorded in the northern section of the study area, at PV 11 and 12.	**No image available**
Ictonyx striatus *Striped polecat* Least Concern Provincially Protected	Highly adaptable species which exhibit a wide habitat tolerance, as they are found in open grassland, savannah woodland, thornbush, rocky habitats, agricultural areas, forest, and even desert (usually along drainage lines, provided there is some scrub cover). The species was recorded along the roads while driving to sites in the northern section of the study area.	**No image available**
Naja nivea Cape cobra Least Concern	Inhabits arid karoo, open fynbos and grassland habitats throughout its range. Within its range it is a habitat generalist which adapts well to urban environments. Species was recorded crossing the road at the southern boundary of the study area.	**No image available**

Proposed impact management actions

- Vegetation clearing close to the watercourse should be minimised and where necessary, appropriate storm water management should be put in place to limit erosion potential of exposed soil, such as placing sedimentation trapping to prevent exposed soils from spilling into the watercourse (if necessary).
- The watercourse and its buffer areas should be demarcated and fenced off prior to construction to exclude the watercourse from development activities.
- Buffer zones are allocated to sensitive or important habitat features to alleviate the effect of habitat loss, habitat fragmentation, disturbances, increased isolation and edge effects.
- All vehicle speeds associated with the project should be monitored and should be limited to 40 km/h (maximum) during the construction phase.
- As roadkills are currently considered high for this area, a roadkill monitoring programme (inclusive of wildlife collisions record keeping) should be established. Where needed, Animex fences must be installed to direct animals to safe road crossings. Finally, mitigation should be adaptable to the onsite situation which may vary over time.
- Reduce direct mortalities by allowing for fauna to cross the roads. Where applicable, this can be achieved by constructing fauna underpasses under the roads (large culverts or large open-ended concrete pipes laid into the raised roads). These underpasses should be used in conjunction with "fauna barriers" which prevent the most susceptible small fauna from crossing the roads on the surface by directing them towards the underpasses where they can cross under the roads safely. It is important to note that utilization of underpasses is strongly dependent on animal body size (larger culverts are more successful) and the surrounding habitat.
- All staff operating motor vehicles must undergo an environmental induction training course that includes instruction on the need to comply with speed limits, to respect all forms of wildlife (especially reptiles and amphibians) and, wherever possible, prevent accidental road kills of fauna. Drivers not complying with speed limits should be subject to penalties.
- Excavated trenches must be left open for as short a time as possible to avoid acting as dispersal barriers or traps.
- All open excavated trenches must have escape points with an angle of less than 45° to allow for trapped animals to escape.
- Equipment with low noise emissions must be used to not disrupt ecological life cycles (breeding, migration, feeding) of animals. Do not unnecessarily disturb faunal species, especially during the breeding season and juveniles.
- Reduce exterior lighting to that necessary for safe operation and implement operational strategies to reduce spill light. Use down-lighting from non-UV lights[14] where possible, as light emitted at one wavelength has a low level of attraction to insects. This will reduce the likelihood of attracting insects and their predators.
- All staff should be subjected to an induction training program where appropriate conservation principles, safety procedures, snake bite avoidance and first aid treatment are taught. Several staff members should complete a snake handling course to safely remove snakes from construction areas.

[14] Insects generally see 3 colours of light, Ultraviolet (UV), blue and green. Bright white or bluish lights (mercury vapor, white incandescent and white florescent) are the most attractive to insects. Yellowish, pinkish, or orange (sodium vapor, halogen, dichroic yellow) are the least attractive to most insects.

Conclusion

This compliance statement is applicable to the study area as described in the Scoping Report. The study area is in a natural or semi-natural state (due to presence of alien invasive species), and accordingly it is of a medium to low sensitivity for terrestrial animal species.

One animal SCC was recorded, namely Sable Antelope, however, since this is an introduced species and it is believed that the species are from the adjacent property a full animal assessment is not required. The species could still be included as part of the construction and operational management plan, as the species moves between the two properties.

Almost all fauna species recorded on the property are provincially protected, including species under Schedule 1 and 2 of the Northern Cape Nature Conservation Act (No. 9 of 2009). Should it be necessary to capture and relocate any of these animals prior or during construction, or during the operational phase of the project, a permit application with the provincial authority is required. No species may be killed or injured during any phase of the project.

The above management actions should be included in the Environmental Management Programme to reduce fatalities and minimise impacts on animals that do occur on the study area.

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CHAPTER 8:

Aquatic Biodiversity and Species Assessment



CSIR
Touching lives through innovation

AQUATIC BIODIVERSITY AND SPECIES SPECIALIST REPORT: Scoping and Environmental Impact Assessment (EIA) Processes for the Proposed Development of the Kudu Solar Photovoltaic Facility 4 and associated infrastructure, near De Aar, Northern Cape Province



Report prepared for:	*Report prepared by:*
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Version 2: July 2023



The aquatic features within the study area comprise ephemeral unnamed tributaries of the Orange River. The larger watercourses flow along the eastern and western extents of the study area, flowing in a northerly direction to join the Orange River downstream of Van der Kloof Dam. Associated with these larger watercourses are wide floodplains. Smaller watercourses and drainage features drain into the larger river corridors. The watercourses and associated wetlands and floodplains are in a largely natural to moderately modified ecological condition due to the low level of impact in the area. It is recommended that the larger watercourses, floodplains and wetlands within the site are not allowed to degrade further from their current ecological condition of largely natural to moderately modified.

The catchments of the tributaries of the Orange River in which the proposed project is not located within any FEPA river sub-catchments. The only Freshwater Ecosystem Priority Areas (FEPA) Wetland within the study area is a largely artificial wetland associated with a farm dam or erosion control structure and is thus not considered of high aquatic biodiversity conservation significance. There is also a natural depression wetland that is within the valley floor of the river system to the west of the study area that is mapped as a FEPA Wetland. Both wetlands are located outside of the proposed activities and are unlikely to be impacted by the proposed project. The artificial wetland is more than 100 m from the proposed activities, while the natural wetland is more than 3 km from any of the proposed activities. The National FEPA Wetlands, as well as the wider river floodplains associated with the unnamed tributaries of the Orange River located in the eastern and western portions of the wider study area, have been included in the National Wetland Map version 5. The wider floodplain areas have been excluded from the proposed development area for the project.

In the 2016 Northern Cape CBA mapping, the entire area within and surrounding the study area is mapped as Ecological Support Areas. In addition, wetland habitats included in the National FEPA Wetland mapping and smaller wetlands that are located largely within the river floodplain areas have been mapped as aquatic CBAs. None of these mapped wetlands occurs within the project areas, with the closest mapped wetland being the artificial FEPA wetland that is more than 100 m from the proposed development area. The aquatic CBAs are thus unlikely to be impacted by the proposed project activities.

The deemed sensitivity for the larger unnamed tributaries of the Orange River and their floodplains is medium while the smaller feeder streams, drainage lines and dams are deemed to be low. The recommended buffer area between the aquatic features and the project components to ensure these aquatic ecosystems are not impacted by the proposed activities is as follows:

- *The larger tributary: the delineated edge of the surrounding floodplain wetland features. No buffer area is deemed to be required considering that the floodplain is a wide transitional area between the tributary and the surrounding terrestrial areas; and*
- *Smaller streams and drainage features that are indicated to be of medium sensitivity: at least 35 m for the watercourse or the delineated edge of wetland features to allow for the movement of water along these streams.*
- *In addition, with regards to the BESS, it should preferably not be placed within 100 m of major rivers, watercourses and wetlands.*

With mitigation, the potential freshwater impacts of the proposed PV Facility for the construction, operation and decommissioning phases are likely to be very low. One can also expect that the cumulative impact of the proposed project would not be significant provided mitigation measures are implemented.

Based on the findings of this specialist assessment, there is no reason from a freshwater perspective, why the proposed activity (with the implementation of the above-mentioned mitigation measures) should not be authorized. The proposed development footprint within the preferred development site (i.e. study area) has been amended through the project assessment process to ensure that it will be within aquatic ecosystem areas of "low" sensitivity as identified by the national web-based environmental screening tool and verified through the initial Site Sensitivity Verification and is thus considered appropriate areas for development.

The risk assessment determined that the proposed development of the PV poses a low risk of impacting aquatic habitat, water flow and water quality. The water use activities associated with the proposed project could potentially be authorised through the general authorisations for Section 21(c) and (i) water uses. The GA for groundwater use in Quaternary Catchments D33B and D62F, where the proposed project study area is located, is limited to 45 m^3/ha/a for the property extent where the abstraction is proposed. Should more than this be required for the proposed project, an integrated water use licence application would be required for the associated project. Various assessments of the current groundwater use and sustainability of the proposed groundwater use would need to be undertaken in support of such an application. The disposal of sewage from the developed site is likely to be stored in conservancy tanks for removal and treatment at the nearby wastewater treatment works of the local authority. This low volume would be within the GA for Section 21 (g) water use activities.

Recommended mitigation measures:

Construction phase:

- *Implement recommended development setbacks to minimise works within aquatic ecosystems (i.e. recommended buffer of at least 35 m for the smaller drainage features; and setback from the wider floodplain adjacent to the larger rivers)*
- *Clearing of indigenous vegetation should not take place within the aquatic features and the recommended buffers.*
- *Rehabilitate disturbed aquatic habitats by revegetating them with suitable local indigenous vegetation.*
- *Water use for construction should be minimised as much as possible. The water should be obtained from an existing water allocation or other viable water sources for construction purposes.*
- *The road crossing structures should be designed to not impede flow in watercourses - low water crossing is preferred. Use existing crossings, as best as possible and where allowable.*
- *The existing road infrastructure, particularly within the floodplain, should be utilised as far as possible to access new infrastructure to minimise the overall disturbance. It is recommended that any new linear type of infrastructure crossings over watercourses be placed where there are existing structures or road crossings within the watercourse corridors, where possible.*
- *Avoid disturbing aquatic habitats.*
- *Construction materials brought onto the site should be free of alien plant seeds. Sources of alien seed should be prevented from being brought onto the site with imported materials.*
- *Rehabilitate disturbed aquatic habitats once construction works are complete.*
- *Undertake monitoring for the growth of alien vegetation during the construction and post-construction phases.*
- *Any work within aquatic features should be undertaken in the dry season where possible.*

- *Sediment traps should be used where necessary.*
- *Construction sites and laydown areas should be located within the assessed buildable areas/development footprints.*
- *Good housekeeping and site management measures must be implemented at the laydown areas and the construction site as per the project Environmental Management Programme (EMPr) and monitored by the appointed Environmental Control Officer (ECO).*

Operation phase:

- *The medium-sensitivity aquatic habitats should be avoided in the layout design, with only low-sensitivity habitats being disturbed during construction.*
- *Invasive alien plant growth and signs of erosion should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with invasive alien plants.*
- *Should any disturbance of aquatic habitats occur that is not associated with an improvement of the ecological condition, the habitat should be rehabilitated immediately following the disturbance activity by returning the habitat to the condition prior to that disturbance.*
- *Develop a stormwater management plan for the proposed development that addresses the stormwater runoff from the developed areas.*
- *Stormwater run-off infrastructure must be designed to mitigate both the flow and water quality impacts of any stormwater leaving the developed areas. The runoff should rather be dissipated over a broad area covered by natural vegetation or managed using appropriate shaping of the road with berms or channels and swales adjacent to hardened surfaces where necessary. Should any erosion features develop, they should be stabilised immediately.*
- *A sustainable water supply should be sought.*
- *Sewage generated within the site should be discharged to a conservancy tank that is properly serviced and regularly evacuated to nearby wastewater treatment works.*

Decommissioning phase:

- *Minimise works within aquatic ecosystems. If the project layout avoided these areas, the decommissioning works would also be able to avoid aquatic habitats as delineated. Note that all aquatic areas recommended for avoidance have been avoided in the EIA phase layout identification.*
- *Rehabilitate and revegetate disturbed areas, where required.*
- *Mitigation and follow-up monitoring of residual impacts (alien vegetation growth and erosion) may be required.*
- *The road network should be returned to that resembling pre-construction, with all additional roads removed where possible.*
- *Decommissioning activities within aquatic features should be undertaken in the dry season where possible.*
- *Sediment traps should be used where necessary.*
- *Laydown areas should be placed within the approved PV footprint and layout.*
- *Good housekeeping measures should be implemented as per the project EMPr and monitored by the appointed ECO. This should specifically address on-site stormwater management and prevention of pollution during decommissioning. Any stormwater that does arise within the decommissioning site must be handled appropriately to trap sediments and pollutants.*



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BA	Basic Assessment
CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DWA(F)	Department of Water Affairs (and Forestry)
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EI&ES	Ecological Importance and Ecological Sensitivity
EMPr	Environmental Management Program
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Area
GA	General Authorisation
GG	Government Gazette
GIS	Global Information System
GN	Government Notice
ha	hectare
HI	Habitat Integrity
IPP	Independent Power Producer
IUCN	International Union for Conservation of Nature
kW	kilowatt
MMP	Maintenance Management Plan
MW	megawatt
NCBSP	Northern Cape Biodiversity Sector Plan
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Area
NWA	National Water Act
ONA	Other Natural Areas
PA	Protected Area
PES	Present Ecological Status
REC	Recommended Ecological Condition
SANBI	South African National Biodiversity Institute
SEA	Strategic Environmental Assessment
SCC	Species of Conservation Concern
WMA	Water Management Area
WUL	Water Use License
WULA	Water Use License Application



Definitions	
Aquifer	A geological formation that has structures or textures that hold water or permit appreciable water movement through them.
Catchment	The area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through a surface flow to a common point or common points
Critical Biodiversity Areas	Areas that are required to meet biodiversity targets for species, ecosystems or ecological processes and infrastructure.
Drainage feature	A minor channel down which surface water naturally concentrates and flows that are poorly defined and usually does not contain any distinctive riparian and aquatic vegetation or habitat.
Ecological Importance and Sensitivity	The rating of any given wetland or river reaches that provides an indication of the ecological importance of the aquatic system using criteria such as conservation needy habitat or species, protected ecosystems or unique habitat observed. The sensitivity is then derived by assessing the resilience the habitat exhibits under stress as a result of changes in flow or water quality.
Ecological Support Areas	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of Protected Areas or Critical Biodiversity Areas and are often vital for delivering ecosystem services.
Other Natural Areas	Areas that have not been identified as a priority in the biodiversity spatial plans but retain most of their natural character and perform a range of biodiversity and ecological infrastructure functions. Although they have not been prioritised for meeting biodiversity targets, they are still an important part of the natural ecosystem.
Pans or Depression wetlands	A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water. It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.
Perennial / Non-perennial rivers	Perennial rivers are those rivers that exhibit a continuous flow of water throughout the year except during extreme drought conditions. Non-perennial rivers are those rivers that have no flow for at least a part of the year. These rivers are seasonal.
Present Ecological State	The current ecological condition of a watercourse as measured against the deviation from the natural or pre-impacted condition of the system
Protected Areas	Areas that are formally protected by law and recognised in terms of the National Environmental Management: Protected Areas Act. This includes gazetted private Nature Reserves and Protected Environments concluded via a stewardship programme.
Riparian habitat	The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with composition and physical structure distinct from those of adjacent land areas
River FEPA	Rivers currently in a good condition (A or B ecological category) that have been identified to achieve biodiversity targets for river ecosystems and threatened/near-threatened fish species. They should remain in a good condition to contribute to the biodiversity goals of the country.
Watercourse	(a) a river or spring; (b) a natural channel in which water flows regularly or intermittently; (c) a wetland, lake or dam into which, or from which, water flows; and (d) any collection of water which the Minister of DWS may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks;
Water management area	An area established as a management unit in the national water resource strategy within which a catchment management agency will conduct the protection, use, development, conservation, management and control of water resources

Wetland	Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.
Wetland FEPA	Wetlands currently in good condition (A or B ecological category) that have been identified to achieve biodiversity targets for river ecosystems and threatened/near-threatened fish species. They should remain in good condition to contribute to the biodiversity goals of the country.

8. AQUATIC BIODIVERSITY AND SPECIES SPECIALIST ASSESSMENT

This chapter includes the Aquatic Biodiversity and Species Specialist Assessment that was prepared by Ms Antonia Belcher as part of the Scoping and Environmental Impact Assessment (EIA) Process for the proposed development of the Kudu Solar Facility 4 and associated infrastructure, near De-Aar, Northern Cape Province (Figure 1).

1 Introduction

1.1 Scope, Purpose and Objectives of this Specialist Report

The Kudu project will entail the proposed development of Solar PV Facilities, as well as associated infrastructure and Electrical Grid Infrastructure (EGI). Each solar PV facility will have a range of associated infrastructure, including, but not limited to, an on-site substation complex, battery energy storage systems (BESS) and is proposed to connect to an existing 400 kV power line via dedicated 132 kV power lines. During the scoping phase, the specialists considered the entire study area, with the development of up to 14 Solar PV Facilities. However, following the identification of sensitivities, discussions with landowners and other considerations such as the capacities of the Bidding Window 6, the proposed projects were re-clustered and a total of up to 12 Solar PV Facilities are being proposed.

Separate specialist reports have been provided for each PV project. This report is focused on **Kudu Solar Facility 4** only (hereafter referred to as the "Kudu Solar Facility" or "proposed project").

This report provides information in terms of the aquatic constraints within the project area and the associated aquatic ecosystem impacts for the proposed activities, and it complies with the Aquatic Biodiversity Protocol published in Government Notice (GN) 320 in March 2020. A table showing such compliance is captured in Appendix E of this chapter.

1.2 Details of Specialist

This specialist assessment has been undertaken by Toni Belcher. She is registered with the South African Council for Natural and Scientific Professions (SACNASP), with Registration Number 400040/10 in the fields of Ecological Science and Environmental Science. A curriculum vitae is included in Appendix A of this specialist assessment. In addition, a signed specialist statement of independence is included in Appendix B of this specialist assessment. Dana Grobler has reviewed the report. He is registered with SACNASP (Registration Number 002272) in the following fields of practice Environmental Science, Water Resources Science and Aquatic Science.

1.3 Terms of Reference

The Terms of Reference for this specialist report are as follows:

- Comply with the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, GN 320. This specifically includes the Aquatic Biodiversity Protocol that applies to all activities requiring EA. This protocol replaces the requirements of Appendix 6 of the 2014 National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations (as amended).
- The specialist must undertake a site visit in order to identify the level of sensitivity assigned to the project area on the Screening Tool and to verify and confirm this sensitivity and land use and either compile an

Aquatic Biodiversity and Species Specialist Report or Compliance Statement, as documented in the Assessment Protocols published on 20 March 2020, in Government Gazette 43110, GN 320.

- Provide a Site Sensitivity Verification Report based on the requirements documented in the Assessment Protocols published on 20 March 2020, in Government Gazette 43110, GN 320.
- Provide inputs to the Draft and Final Scoping Reports to include a description of the affected environment and environmental sensitivities, key legislation, key issues to be addressed during the EIA Phase, a high-level assessment of impacts, and confirmation of the scope of work for the EIA Phase.
- Provide an Aquatic Biodiversity and Species Specialist Report or Compliance Statement based on the requirements documented in the Assessment Protocols published on 20 March 2020, in Government Gazette 43110, GN 320.
- The Specialist Assessment and/or Compliance Statement must also be in adherence to any additional relevant legislation and guidelines that may be deemed necessary.
- Determination, description and mapping of the baseline environmental condition and sensitivity of the study area. Specify setbacks or buffers, and provide clear reasons for these recommendations. Also, map the extent of disturbance and transformation of the site. This environmental screening will inform each project layout. The initial screening process is required to further refine the focus areas and identify developable areas.
- Provide review input on the preferred infrastructure layout following the sensitivity analysis and layout identification.
- Describe the aquatic ecology features of the project area, with a focus on features that are potentially impacted by the proposed project. The description should include the major habitat forms within the study site, giving due consideration to aquatic ecology (flora), aquatic ecology (fauna), and freshwater ecosystems/wetlands.
- Consider seasonal changes and long-term trends, such as due to climate change.
- Identify any species of conservation concern or protected species on site.
- The assessment is to be based on existing information, national and provincial databases and professional experience and fieldwork conducted by the specialist, as considered necessary and in accordance with relevant legislated requirements. The assessment must also consider the maps generated by the National Screening Tool.
- Identify and assess the potential direct, indirect and cumulative impacts of the proposed development on aquatic biodiversity and species. Impact significance must be rated both without and with mitigation and must cover the construction, operational and decommissioning phases of the project.
- Identify and delineate wetlands that may occur on the site using the relevant protocols established.
- Compile a Risk Matrix (Appendix A to GN R509 of 2016) and determine if a Water Use License (WUL) is required and, if so, determine the requirements thereof.
- Identify any additional protocols, and legal and permit requirements that are relevant to the project and the implications thereof.
- Provide recommendations with regard to potential monitoring programmes.
- Determine mitigation and/or management measures which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts. Also, identify best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts, which be included in the Environmental Management Programme (EMPr). An EMPr has been compiled for all project infrastructure at the PV facility, and a Generic EMPr has also been compiled for the on-site substation complex.

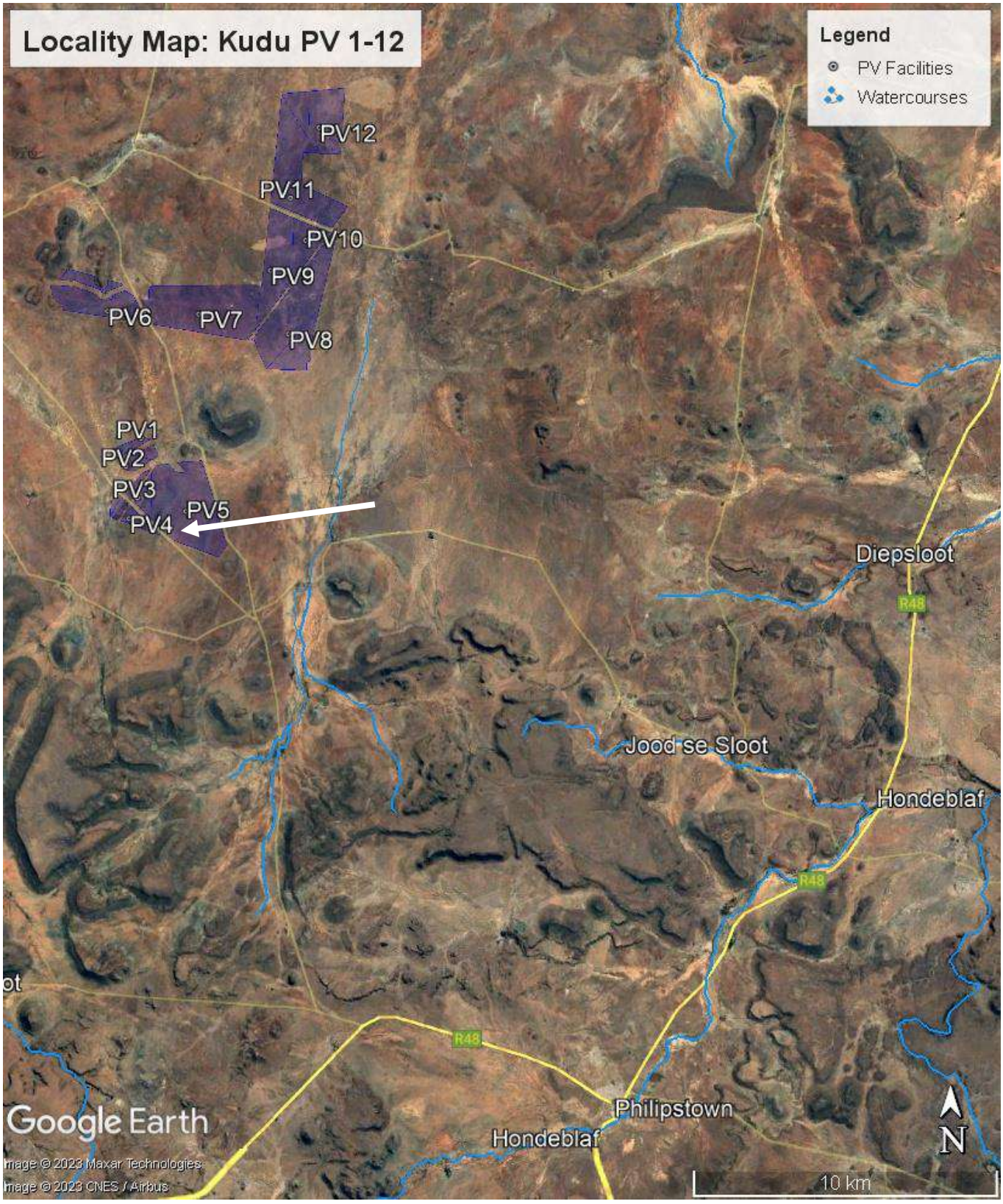


Figure 1. Locality map for the proposed project. This report deals with Kudu Solar Facility 4 (PV 4).

2 Approach and Methodology

Input into this report was informed by a combination of desktop assessments of existing freshwater ecosystem information for the study area and surrounding catchments, as well as by a more detailed assessment of the freshwater features on the various farm portions that comprise the study area.

The study area was visited on 4 March 2022 to verify the aquatic features occurring on the site. No additional site visits are deemed necessary. The field visit comprised delineation, characterisation and integrity assessments of the aquatic habitats within the study area. Mapping of the freshwater features was undertaken using a GPS Tracker and mapped in PlanetGIS and Google Earth Professional.

The following techniques and methodologies were utilised to undertake the assessments:

1. The guideline document, "A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas" document, as published by the former Department of Water Affairs and Forestry (DWAF) (currently operating as the Department of Water and Sanitation (DWS)) (2005), was followed for the delineation of the wetland areas. According to the delineation procedure, the wetlands were delineated by considering the following wetland indicators: terrain unit indicator, soil form indicator, soil wetness indicator and vegetation indicator.

2. The wetlands were subsequently classified according to their hydro-geomorphic determinants based on a classification system devised by Kotze *et al*. (2009) and the South African National Biodiversity Institute (SANBI) (2009). Notes were made on the levels of degradation in the wetlands based on field experience and a general understanding of the types of systems present.

3. A Present Ecological State (PES) assessment was conducted for each hydro-geomorphic wetland unit identified and delineated within the study area.

4. The functional wetland assessment technique, WET-EcoServices, developed by Kotze *et al.* (2009), was used to indicate the ecological benefits and services provided by delineated wetland habitats. This technique consists of assessing a combination of desktop and infield criteria to identify the importance and level of functioning of the wetland units within the landscape.

5. The present ecological condition of the watercourses was determined using national River Health Programme methodologies as described in this report.

6. The ecological importance and ecological sensitivity (EI&ES) assessment of the wetlands and watercourses was conducted according to the guidelines as developed by DWAF (1999); and

7. Recommendations are made concerning the adoption of buffer zones within the study area, based on the wetlands' functioning and site characteristics.

2.1 Information Sources

A summary of the main information sources used in this assessment is provided in Table 1 below:

Table 1. Information Sources for the Aquatic Biodiversity Assessment

Data / Information	Source	Date	Type	Description
Satellite imagery	Google Earth	May 2002 to November 2021	Spatial	Recent history of aerial imagery for the site
Northern Cape Biodiversity Sector Plan (NCBSP)	Northern Cape Department of Economic Development, Environmental Affairs and Tourism (now Northern Cape Department of Agriculture, Environmental Affairs, Rural Development and Land Reform (DAEARDLR))	2016	Report & Spatial	Spatial conservation planning units and associated management recommendations for the Northern Cape province
National Biodiversity Assessment	South African National Biodiversity Institute (SANBI)	2018	Report and Spatial	Latest assessment of South African biodiversity and ecosystems, including wetlands and rivers.
National Vegetation Map	SANBI	2018	Report and Spatial	Latest national vegetation type mapping
South African Atlas of Climatology and Agrohydrology	R.E. Schulze	2012	Spatial	Climate data
Aquifer classification and Groundwater Resource Assessment information	Department of Water and Sanitation (DWS)	2005, 2012 and 2013	Spatial	Mapping of aquifer class, type, yields, susceptibility and Vulnerability as well as depths, recharge and quality
National Soil types	Environmental Potential Atlas (ENPAT)		Spatial	Mapping of soil types
National Freshwater Ecosystem Priority Areas (FEPA)	Council for Scientific and Industrial Research (CSIR)	2011	Report and spatial	Mapping of areas of aquatic ecosystem conservation importance
National River Present Ecological Status, Ecological Importance and Ecological Sensitivity	Former Department of Water Affairs (DWA) now operating as the DWS	2012	Spreadsheets and spatial	River reach assessments of ecological importance, sensitivity and condition
National Wetland Map 5	CSIR and SANBI – South African National Biodiversity Assessment 2018	2018	Spatial	Mapping of wetland habitats

2.2 Assumptions, Knowledge Gaps and Limitations

Limitations and uncertainties often exist within the various techniques adopted to assess the condition of ecosystems. The methodologies and techniques used in this assessment have been developed nationally and are typically of a rapid nature, as is required for this aquatic biodiversity impact assessment.

Very limited aquatic features occur within the study area and surrounding area. No baseline long-term monitoring was undertaken as part of this assessment. There is also very little existing information available for the aquatic features within the study area. Data was utilised for adjacent aquatic ecosystems where available. The nature of the proposed activities, however, also allows them to be placed some distance from any significant mapped aquatic features such that the likely impacts would be of a very low significance. It is usually the associated infrastructure that has the potential to have a greater impact on the aquatic features. The impacts of roads and powerlines on the aquatic features are, however, well understood and can be effectively mitigated to ensure the impacts remain of low significance. The preferred mitigation measure is to limit the disturbance to aquatic features as far as possible by avoiding and minimising the number of crossings and providing adequate buffer areas. This will also ensure that the cumulative impacts will remain of low significance.

The level of aquatic assessment undertaken was considered to be adequate for this study. No further fieldwork will be required. The ground-truthing of aquatic features was undertaken during autumn, during the rainfall period and when the use of vegetation as an indicator was possible. As it was not possible to cover the entire study area in a high level of detail, extrapolation of the areas ground-truthed to those not covered was done using the latest available aerial imagery for the site and is deemed to be sufficient for this assessment.

2.3 Consultation Processes Undertaken

No consultation was deemed to be required with landowners or neighbouring landowners during the course of preparing this specialist report. The standard public participation process was held as part of the scoping phase of the study and the comments received from that process have been responded to and considered in terms of this assessment and the constraints mapping. Comments raised during the EIA Phase have been considered accordingly, where relevant.

3 Description of Project Aspects Relevant to Aquatic Biodiversity

In terms of the potential aquatic ecosystem impacts of the proposed development, it is typically the footprint of the development and its associated infrastructure, placed in or adjacent to aquatic features, that may alter the aquatic habitat, have water quality impacts or modify the runoff in the aquatic ecosystems within the area. The proposed project is shown in Figure 2.



Figure 2. Proposed project elements under consideration in this specialist assessment. Note that the full extent of the land portions (shown in yellow) serves as the study area. This report is focused on Kudu Solar Facility 4 (PV4).

The proposed project is envisaged to consist of the following components:

- Solar PV Facilities: PV Panel Structures comprise single-axis tracking structures, dual-axis tracking, or fixed tilt mounting. Mono- or bifacial solar modules are also proposed.
- On-site substation complex (extending approximately 8 ha) per PV Facility that may include: On-site Independent Power Producer (IPP) or Facility Substation (+-1 ha), a BESS (+-1 ha), and a switching station and collector station (+-2ha).
- Temporary Laydown Area: up to 7 ha.

- New internal service roads will need to be established, and these would either comprise farm (compacted dirt/gravel) roads or be paved.
- Main site access: Up to 8 m during construction and operation. Existing roads will be used as far as practically achievable. These roads may need to be widened and upgraded.
- Internal underground lines of up to 33 kV (22 kV or 33 kV). In some instances, the internal lines may need to be routed above ground.
- Auxiliary buildings to be developed include but are not limited to an Operation and Maintenance building, site office, staff lockers, bathrooms, warehouses, etc. with a combined footprint of up to 0.5 ha (i.e., 5000 m^2).

Water use requirements for the proposed project comprise approximately 9 000 m^3 per year for a ± 18-month construction period and approximately 1 000 m^3 per year for an approximate 20-year operational lifespan of the solar energy facility. Water is to be sourced either from the local authority, a third-party supplier or from groundwater on site.

4 Baseline Environmental Description

4.1 Study Area Definition

The **study area** for the proposed Kudu Solar Facilities 1 to 12 is the full extent of the eight affected farm properties on which the proposed PV Facilities will be constructed. The full extent of these properties has been assessed in this study in order to identify environmental sensitivities and no-go areas. The total study area for all the Kudu Solar Facilities 1 to 12 is approximately 8 150 hectares (ha).

At the commencement of this Scoping and EIA Process, the **Original Scoping Buildable Areas** which fall within the study area were identified by the Project Developer following the completion of high-level environmental screening based on the Screening Tool.

Following the identification of sensitivities during the Scoping Phase, the Project Developer considered such sensitivities and formulated the **Revised Scoping Buildable Areas.** The **Revised Scoping Buildable Areas** were used to inform the design of the layout, and further assessed during this EIA Phase of the project in order to identify the preferred development footprint of the proposed project on the approved site as contemplated in the accepted Scoping Report. The **development footprint** is where the actual development will be located, i.e. the footprint containing the PV solar arrays and associated infrastructure.

The terms site and study area are used synonymously in this report.

4.2 General Description

The study area in which the PV facilities under consideration are to be constructed is located in the Pixley ka Seme District Municipality. The site is approximately 50 km northeast of De Aar. Smaller towns of Philipstown, Petrusville and Van der Kloof occur within a 40 km radius of the site. The surrounding area comprises largely farmed areas that are mostly used for livestock grazing.

The majority of the landscape consists of flat to slightly undulating plains with shallow valleys and small hilltops that are drained by non-perennial (ephemeral), northward-flowing tributaries of the Orange River. General drainage within the study area is from south to north. The elevation of the study area ranges from approximately 1250 to 1350 m.a.s.l. Table 2 provides an overview and summary of the water resource information for the study area.

Table 2: Key water resources information for the proposed project development area

Descriptor	Name/details	Notes
Water Management Area (WMA)	Mostly in the Upper Orange WMA with less than 10% in the Lower Orange WMA	
Catchment Area	Unnamed ephemeral tributaries of the middle reach of the Orange River	
Quaternary Catchment	D33B (Upper Orange) and D62F (Lower Orange)	
Present Ecological State	Not assessed as ephemeral systems that do not contain much aquatic habitat but rather exist as drainage features within the landscape	DWS (2012) assessment for nearby watercourses
Ecological Importance (EI) and Ecological Sensitivity (ES)	EI (D33B): Low; (D62F): High ES (D33B): Very low; (D62F) Moderate	
Location of the centre of the study area	30°13'03" S	Latitude
	24° 20'34"E	Longitude

4.2.1 Geology and Soils

Shales of the Volksrust Formation, Ecca Group as well as Dwyka Group sedimentary rock underly the wider area with intrusions of Karoo Dolerite sills and sheets. Superficial deposits of calcrete, surface limestone, and hardpan cover large areas. Soils tend to be variable, comprising shallow to deep, red-yellow, freely drained soils or shallow Glenrosa and Mispah forms.

4.2.2 Climate, Hydrology and Geohydrology

For the study area, the summers are hot; the winters are short, cold, and windy; and it is dry and mostly clear year-round. Average temperatures vary from 9 ^{o}C in June/July to 23 ^{o}C in January. The wet season occurs from mid-November to mid-April, with March tending to be the wettest month (45 mm on average) and July the driest month (2 mm on average). The mean annual rainfall for the area is 287 mm. The site is not in a Strategic Water Source Area for surface or groundwater.

Due to the climatic conditions of the area, the watercourses and the wetland areas that occur in the area are ephemeral (non-perennial), only containing water for short periods, immediately following local rainfall events. A dominant feature of the larger rivers is the alluvial floodplains that are characterised by multiple channels that are interchangeably used during higher flow events. These sandy floodplains tend to have mostly bare beds, with vegetation occurring in clumps along the bed and more densely along the banks. The ephemeral watercourses are highly dependent on groundwater discharge.

A minor fractured aquifer occurs within the area. The water table typically occurs at depths of about 9.5 m below ground level, and the yield of the aquifer is less than 2 litres a second. Both groundwater quality tends to be fresh with natural electrical conductivity concentrations of less than 300 mS/m. The estimated groundwater recharge in the area is 12.2 mm/a. The aquifer is of low susceptibility and vulnerability.

4.2.3 Vegetation

The study area lies near the eastern edge of the Nama Karoo biome and is mapped according to the national vegetation types (Mucina and Rutherford, 2006, updated in 2009, 2012 and 2018) as being of the vegetation type Northern Upper Karoo which is considered to be least threatened. The vegetation cover is generally

dominated by sparse dwarf karroid scrub and tufted grass with bare patches of sand in between. Portions of the area are in a disturbed condition, most likely as a result of livestock grazing.

Along the larger watercourse, the common reed *Phragmites australis* and *Juncus* spp. Dominate with some discernible riparian vegetation comprising larger shrubs such as *Searsia pyroides* along the banks. The smaller ephemeral streams have no visible aquatic vegetation.

4.2.4 Aquatic Habitats and Biota

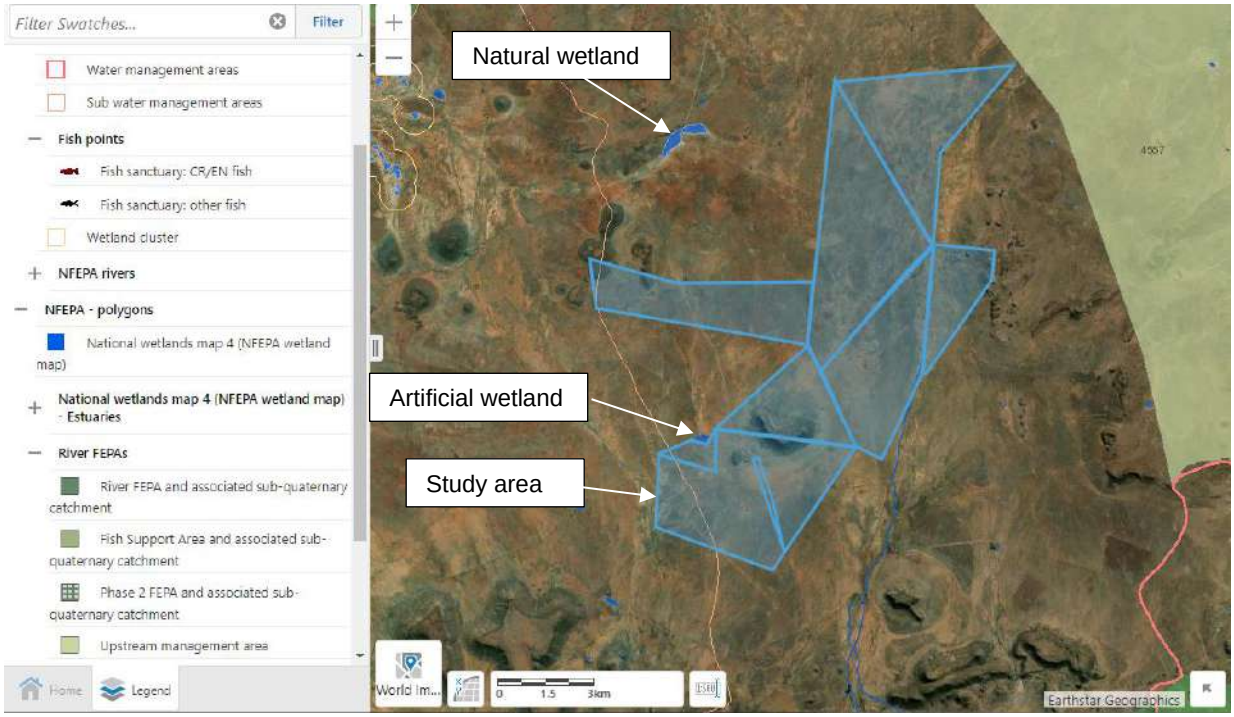
The aquatic features within the study area comprise ephemeral unnamed tributaries of the Orange River. The larger watercourses flow along the eastern and western extents of the study area, flowing in a northerly direction to join the Orange River downstream of Van der Kloof Dam. Associated with these larger watercourses are wide floodplains. Smaller watercourses and drainage features drain into the larger river corridors.

The ephemeral streams and floodplains provide aquatic habitat to a diverse array of faunal species that are adapted to the brief periods of inundation to carry out much of their life phases. Amphibians such as the Poynton's River Frog (*Amietia poyntoni),* Tandy's sand frog (*Tomopterna tandyi*), African bullfrog, (*Pyxicephalus adspersus*), Pygmy Toad (*Poyntonophrynus vertebralis*) and Karoo Toad, *Vandijkophrynus gariepensis* use the inundated pools for breeding. Other biota that use the temporary wet habitats comprise migratory birds and many invertebrates such as water fleas (*Daphnia* spp.) and tadpole shrimps (*Triops* spp.*)*. Connectivity between aquatic ecosystems and the surrounding terrestrial landscape is essential for supporting the fauna of these ecosystems.

4.2.5 Aquatic Biodiversity Sensitivity and Conservation Importance

The catchments of the tributaries of the Orange River in which the proposed project is located are not within any National Freshwater Ecosystem Priority Area (FEPA) river sub-catchments (Figure 3, top). The only FEPA Wetland within the study area is a largely artificial wetland associated with a farm dam or erosion control structure and is thus not considered of high aquatic biodiversity conservation significance. There is also a natural depression wetland that is within the valley floor of the river system to the west of the study area that is mapped as a FEPA Wetland. Both wetlands are located outside of the proposed activities and are unlikely to be impacted by the proposed project. The artificial wetland is more than 100 m from the proposed activities, while the natural wetland is more than 3 km from any of the proposed activities.

The National FEPA Wetlands, as well as the wider river floodplains associated with the unnamed tributaries of the Orange River located in the eastern and western portions of the wider study area, have been included in the National Wetland Map version 5 (Figure 3, bottom). The wider floodplain areas have been excluded from the proposed development area for the project.



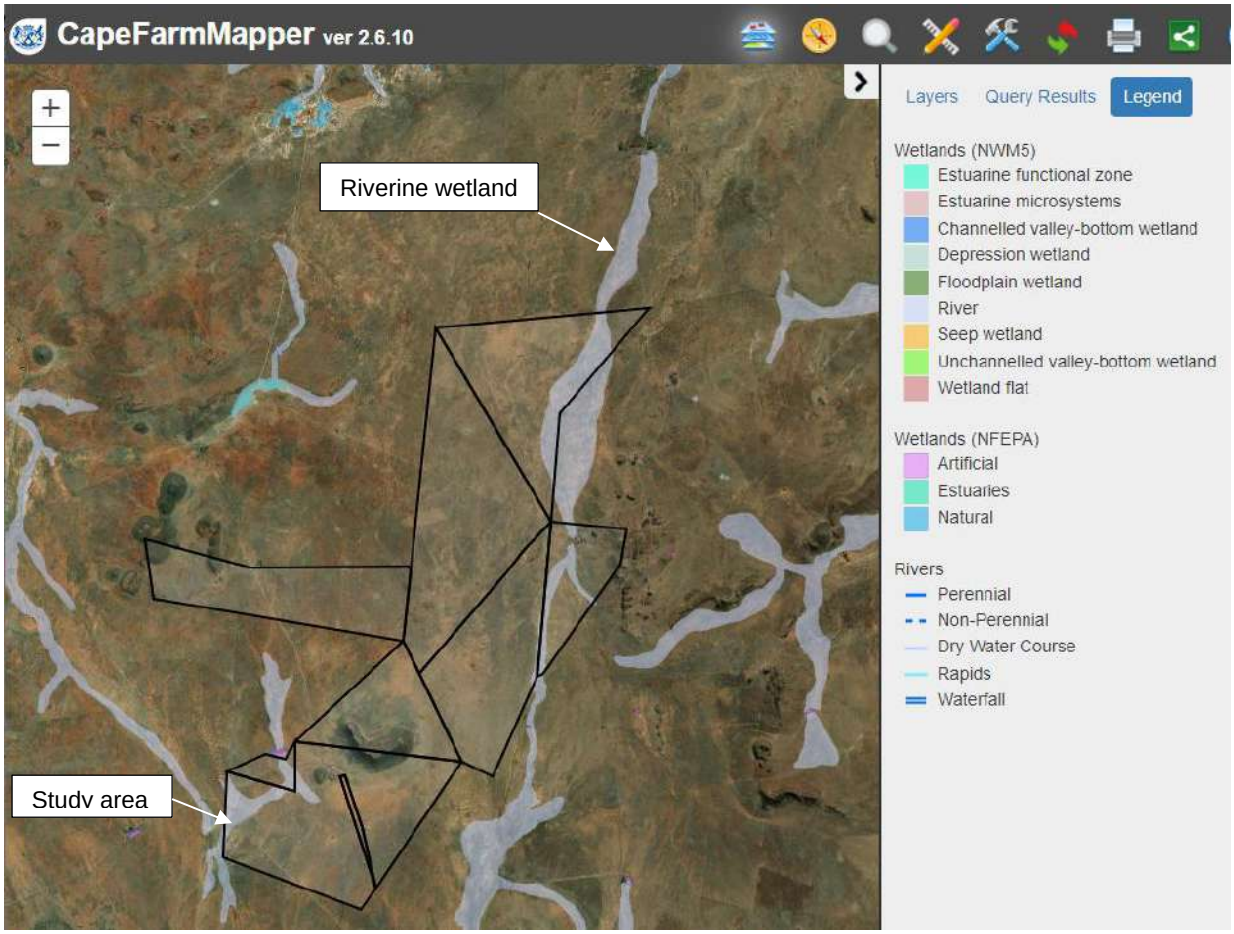


Figure 3. National Wetland Map 5 and FEPA Wetlands within the wider study area (CSIR 2019 and 2011 respectively, obtained from CapeFarmMapper, May 2022)

In the 2016 Northern Cape Critical Biodiversity Areas (CBAs) mapping (Figure 4), the entire area within and surrounding the study area is mapped as Ecological Support Areas. In addition, wetland habitats included in the National FEPA Wetland mapping and smaller wetlands that are located largely within the river floodplain areas have been mapped as aquatic CBAs. None of these mapped wetlands occurs within the project areas, with the closest mapped wetland being the artificial FEPA wetland that is more than 100 m from the proposed development area. The aquatic CBAs are thus unlikely to be impacted by the proposed project activities.

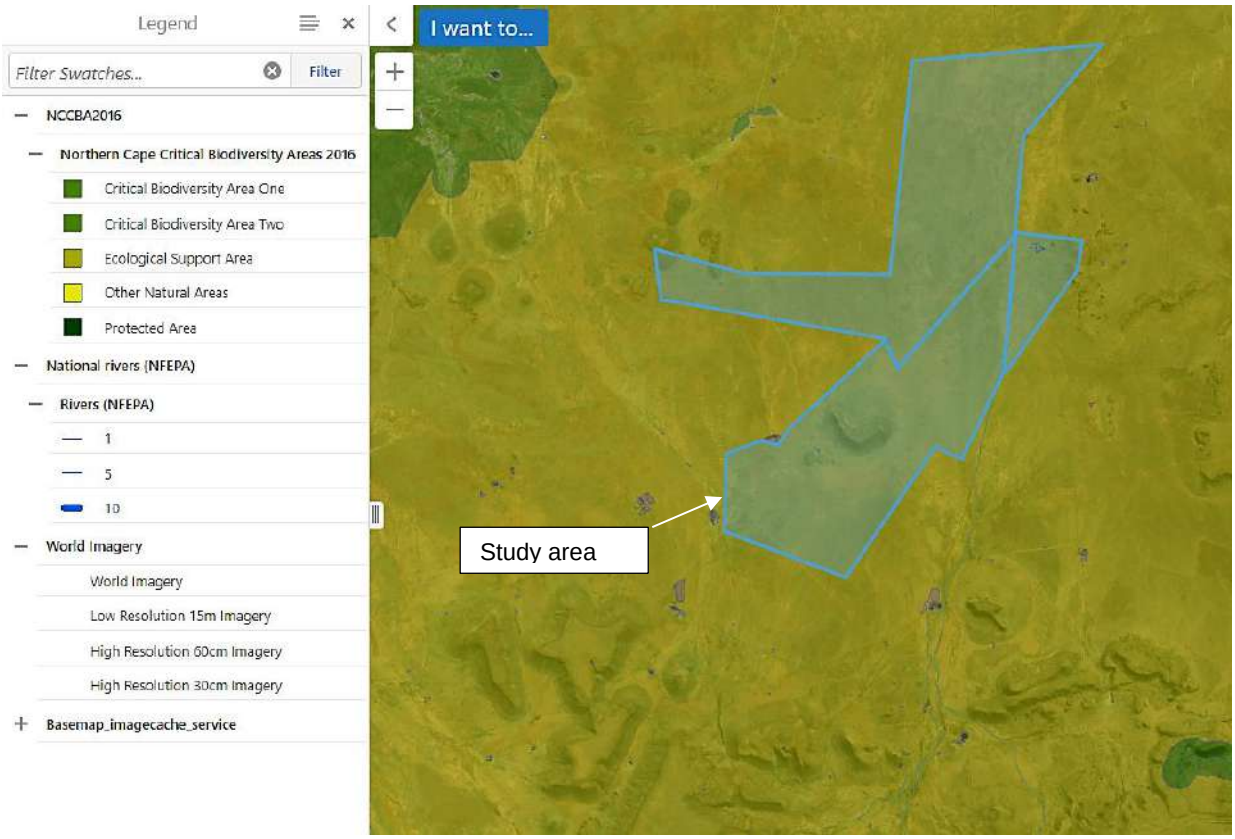


Figure 4. 2016 Northern Cape Critical Biodiversity Areas map for the study area (obtained from SANBI Biodiversity GIS in May 2022)

4.2.6 Aquatic Ecological Integrity

The rivers in the study area comprise unnamed tributaries of the Orange River System that joins the river downstream of Van der Kloof Dam. The larger watercourses all mostly drain in a northerly direction. The rivers can all be characterised as foothill and lowland rivers within the Nama Karoo Ecoregion. The watercourses and associated wetlands and floodplains are in a largely natural to moderate condition due to the low level of impact in the area. It is recommended that the larger watercourses, floodplains and wetlands within the site are not allowed to degrade further from their current ecological condition of largely natural to moderately modified.

The larger watercourse channels tend to be shallow and wide, often with an associated floodplain. The substrate comprises a mix of gravel and alluvium. Wetland areas tend to comprise depressions on the valley floor that occur as a perched feature on calcrete layers. The vegetation for the larger watercourses usually comprises indigenous grasses (*Eragrostis* and *Stipagrostis* species and *Themeda triandra*) with distinct

riparian vegetation comprising larger shrubs such as *Searsia pyroides* and *Melianthus comosus* (Figure 5). The smaller ephemeral streams and drainage features within the study area do not have a distinct channel or vegetation. Wetland areas contain *Phragmites australis* in the larger features, while the smaller features contain some wetland indicator species such as *Schoenoplectus* spp. (Figure 6).

Impacts on the watercourses in the study area are associated with agricultural encroachment, livestock grazing and infrastructure (road and powerline) construction and maintenance. The ephemeral aquatic ecosystems are particularly vulnerable to changes in hydrology as they are specifically adapted to the sporadic flow conditions that naturally occur. Contaminants and sediment are not regularly flushed from these streams.



Figure 5. View of the larger tributary to the east of the proposed project area



Figure 6. Small wetland habitats that occur in the north-western extent of the study area

4.3 Project Specific Environmental Description

The aquatic features within the study area are described below.

Kudu Solar Facility 4 and its associated infrastructure is located on the western extent of Remaining Extent of Portion 3 of the Farm Bas Berg No. 88. A wider floodplain of an unnamed tributary of the Orange River crosses the site from the south-west to the north of the site. This floodplain wetland of the unnamed tributary is not included in the FEPA Wetland (only an artificial wetland associated with an instream dam immediately to the north of the site) or CBA mapping but is included in the National Wetland Map 5 (NWM5). It is recommended that the proposed project activities be located outside of the floodplain area (shown in Figure 7). The floodplain area is lower-lying than the rest of the site, and the vegetation is indicative of periodic inundation and a seasonal increase in soil wetness.

The above aquatic constraint and recommendations have been taken into consideration in the proposed layout and development footprint. The development footprint and detailed layout are acceptable and are shown in Figure 10. Changes to the detailed layouts are deemed acceptable if the changes remain within the approved buildable areas/development footprints with the aquatic no-go sensitive areas avoided.

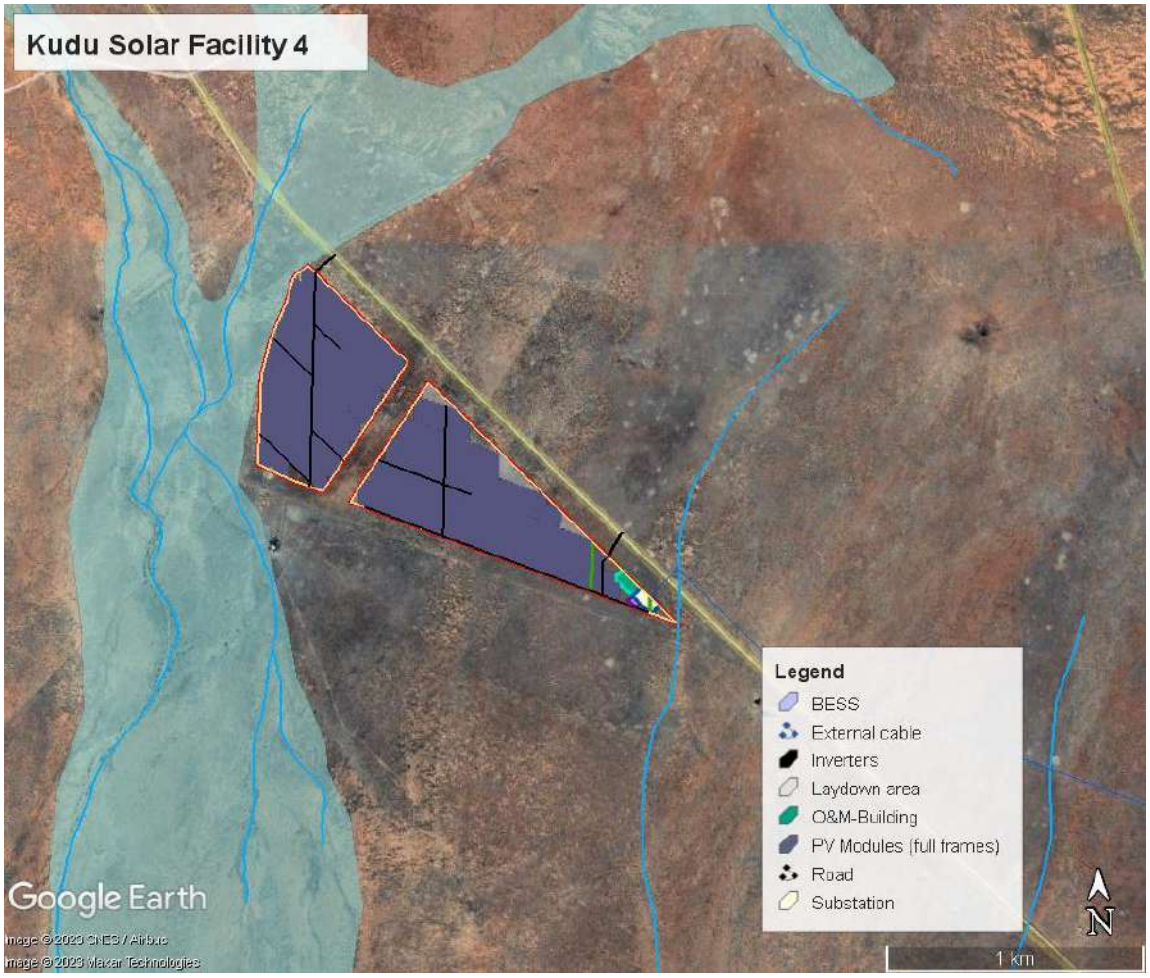


Figure 7. Development Footprint for Kudu Solar Facility 4 (red polygon shows the outer fence line), shown together with the mapped aquatic features (light blue areas and lines). The green outlined area is the on-site substation complex, which has also been assessed in this study. The external cable shown above is the subject of separate assessments (i.e. EGI Projects 13 to 26).

4.4 Identification of Environmental Sensitivities

4.4.1 Sensitivities Identified by the National Web-Based Environmental Screening Tool (Screening Tool)

The Screening Tool has indicated that the wider area surrounding the study area is generally of low Aquatic Biodiversity Combined Sensitivity (Figure 8). The very high sensitivity mapped within the study site is linked to the mapped wetlands in the National Wetland Map version 5 (the wider river floodplains associated with the unnamed tributaries of the Orange River located in the eastern and western portions of the wider study area), as mentioned in Section 4.2.5 and shown in Figure 3. The proposed project components should avoid the areas indicated as being of very high sensitivity such that they are only located in areas of low sensitivity.

The Aquatic Biodiversity Combined Sensitivity follows in the sub-sections.

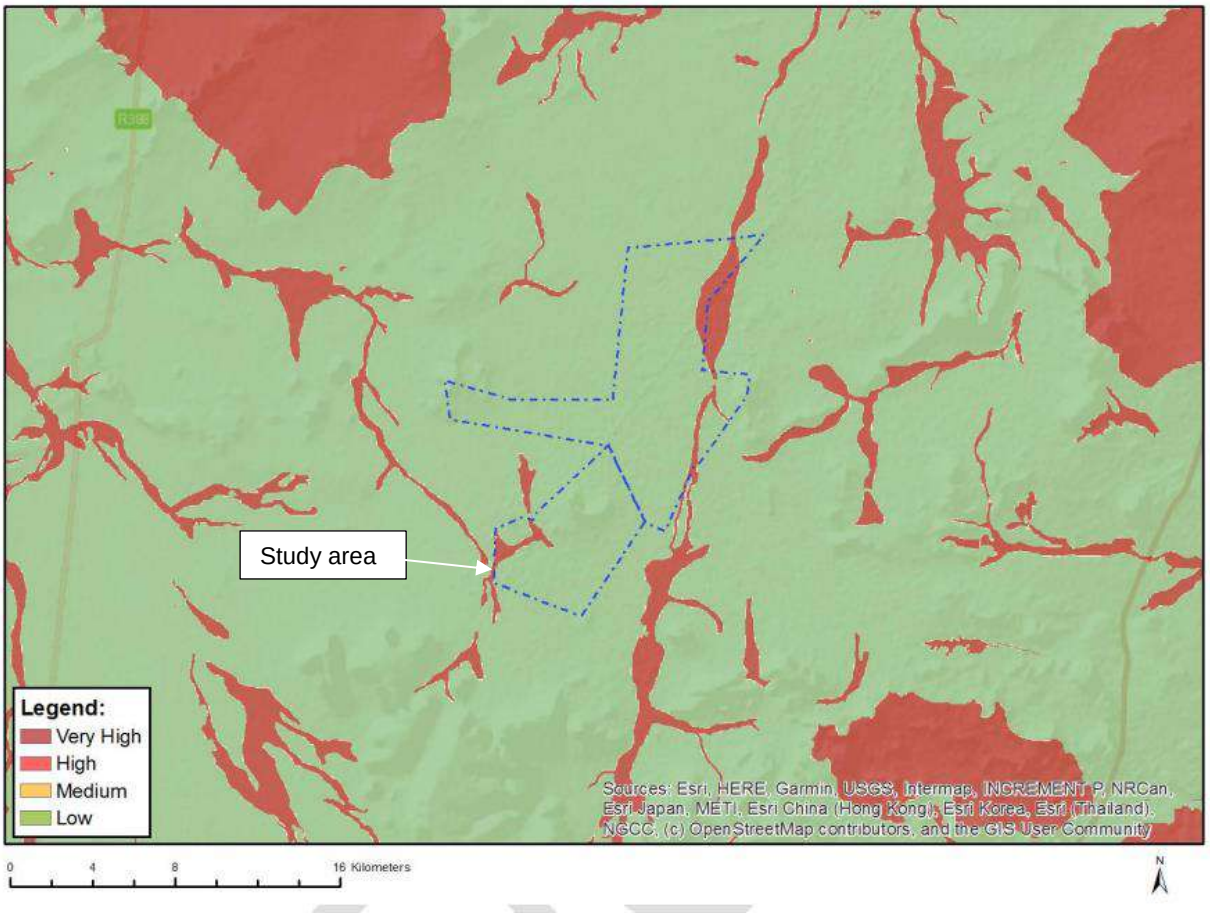


Figure 8. DFFE Screening Tool map of the study area and surrounding area for the mapped Aquatic Biodiversity Combined Sensitivity.

The wider floodplain of an unnamed tributary of the Orange River that crosses the site of Kudu Solar Facility 4 and its associated infrastructure and is included in the NWM5, has been mapped as very high Aquatic Biodiversity Combined Sensitivity in the Screening Tool. The remainder of the site is located within areas mapped as being of low Aquatic Biodiversity Combined Sensitivity in the Screening Tool. It is recommended that the proposed project activities be located outside of the floodplain area such that they only take place within the areas of the site mapped as being of low sensitivity. Note that all aquatic areas recommended for avoidance have been avoided in the EIA phase layout identification.

4.4.2 Specialist Sensitivity Analysis and Verification

The aquatic constraints of the wider study area, in terms of their aquatic ecosystem sensitivities, are shown below in Figure 9 and in more detail in Figure 10. The larger watercourses and associated floodplains, as well as wetland areas within the study area, are deemed to be of **medium aquatic ecological sensitivity**. The smaller watercourses and drainage lines that should not pose an aquatic ecosystem constraint to the proposed are considered to be of **low aquatic ecological sensitivity**.

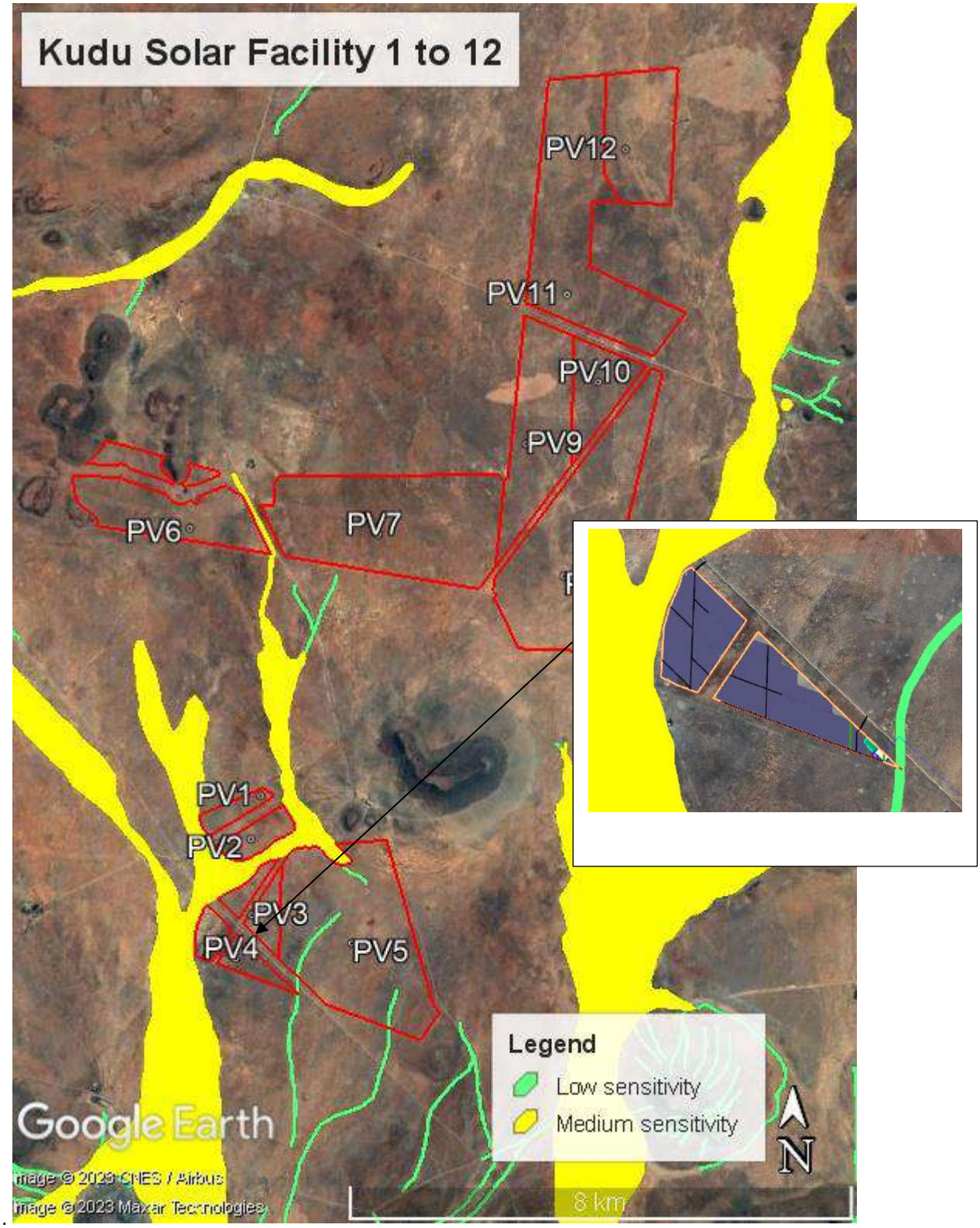


Figure 9. Google Earth image showing the mapped aquatic sensitivities for the proposed projects. This report is focused on Kudu Solar Facility 4 shown in the insert which can be seen in greater detail in Figure 10.

Based on the present ecological condition (largely natural to moderately modified) and ecological importance and sensitivity, as well as the recommended ecological condition of the watercourses (largely natural to moderately modified), buffers have been recommended to protect these ecosystems. The recommended buffer area between the aquatic features and the project components to ensure these aquatic ecosystems are not impacted by the proposed activities is as follows:

- The larger tributary: the delineated edge of the surrounding floodplain wetland features (assigned as medium sensitivity). No buffer area is deemed to be required considering that the floodplain is a wide transitional area between the tributary and the surrounding terrestrial areas; and
- Smaller streams and drainage features that are indicated to be of medium sensitivity: at least 35 m for the watercourse or the delineated edge of wetland features to allow for the movement of water along these streams.
- The Battery Energy Storage System (BESS) should preferably not be placed within 100 m of major rivers, watercourses and wetlands.
- Pans: One pan was found within the study area on Remaining Extent of the farm Wolve Kuilen No. 42. A 50 m buffer around this pan has been recommended. It does not intersect with the development footprint.

Note that the features that have been allocated a low sensitivity (dams and minor drainage features) do not need to be avoided by the proposed development. These aquatic features are primarily of an artificial nature or do not contain any significant aquatic ecosystem habitat and functionality.

The aquatic ecosystem sensitivity (medium for the unnamed tributaries of the Orange River and their floodplains and low for the smaller feeder streams, drainage lines and dams) with aquatic constraints as discussed in the previous section is shown and discussed in more detail below.

The wider floodplain of an unnamed tributary of the Orange River that crosses the study area in the vicinity of Kudu Solar Facility 4 is considered to be of medium aquatic ecosystem sensitivity. The proposed project activities will be located outside of this floodplain area in the Proposed Development Footprint for Kudu Solar Facility 4. Some access roads do cross water courses for the entire project, which would be acceptable provided the recommended mitigation is implemented. For road crossings, the sensitivities are not regarded as no-go. The external powerline will need to cross aquatic features but can be adequately mitigated to have a very low to negligible aquatic ecosystem impact (note that this will be subjected to a separate assessment, as part of Projects 13 to 26).

Therefore, the development footprint of Kudu Solar Facility 4 is deemed to be low sensitivity from an aquatic biodiversity perspective. However, there are medium and low sensitivity areas within the wider study area (preferred site).

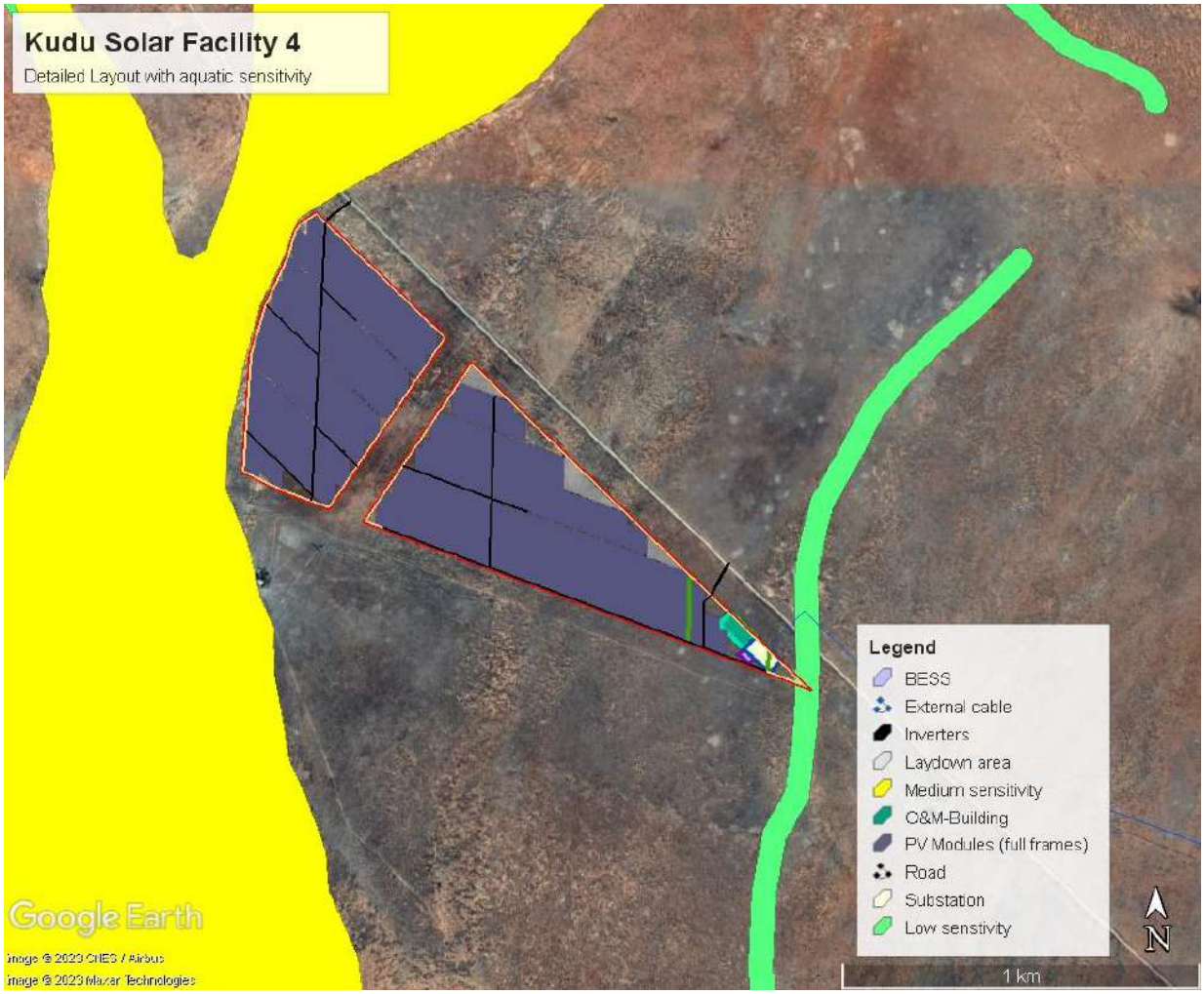


Figure 10. Proposed Development Footprint for Kudu Solar Facility 4 shown together with the sensitivities of the mapped aquatic features. The green outlined area is the on-site substation complex, which has also been assessed in this study. The external cable shown above is the subject of separate assessments (i.e. EGI Projects 13 to 26).

4.4.3 Sensitivity Analysis Summary Statement

The deemed sensitivity for the larger unnamed tributaries of the Orange River and their floodplains is medium while the smaller feeder streams, drainage lines and dams are deemed to be low. The site sensitivity verification report is included in Appendix C.

5 Alternative Development Footprints

The Aquatic Biodiversity Protocol (GN 320) states that the assessment must identify alternative development footprints within the preferred site which would be of a low sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate. The protocol further states that motivation must be provided if there were any development footprints identified as per the latter that were identified as having “low” aquatic biodiversity sensitivity and that was not considered appropriate. The proposed development footprint within the preferred development site (i.e. study area) has been amended through the project assessment process to ensure that it will be within aquatic ecosystem

areas of “low” sensitivity as identified by the screening tool and verified through the initial Site Sensitivity Verification and is thus considered appropriate areas for development. There are no development footprints identified that are not considered appropriate.

Furthermore, as indicated in Chapter 5 of the EIA Report, no other site alternatives were considered as the site was deemed feasible based on various site suitability factors. Therefore, no other alternative development footprints of low sensitivity were identified and not considered appropriate for this study.

6 Issues, Risks and Impacts

6.1 Identification of Potential Impacts/Risks

The issues, risks and impacts discussed in this section would apply to those sites where aquatic features were delineated and have been discussed in the previous sections of this report.

There are medium and low sensitivity areas within the wider study area (preferred site), and the development footprint avoids these. Therefore, based on this and from a best environmental practice perspective, it is considered important to still discuss and rate the potential impacts in the next section.

Most of the potential aquatic ecosystem impacts of the proposed activities are likely to take place during the construction phase. These potential impacts and the associated issues identified include:

- The direct disturbance of aquatic habitats within the watercourses with the associated impacts on sensitive aquatic biota. Construction activities within watercourses could result in the disturbance or destruction of sensitive habitats and any listed and or protected plant or animal species. If the construction activities are outside of any aquatic habitats and the recommended buffers, they would be unlikely to modify aquatic habitats and impact biota to such an extent that the present or future desired state of the watercourses would be compromised. No Resource Quality Objectives exist for the watercourses concerned; however, the proposed activities are unlikely to prevent these objectives from being met.

- The direct removal of indigenous riparian and instream vegetation will indirectly reduce the ecological integrity and functionality of the watercourses. Construction works, in particular, could result in the direct loss of riparian vegetation that provides ecosystem services within the site. This would occur especially when new access roads are required or road upgrades will widen any current road crossings. The impact would only be very localised at the proposed road crossings and would not impact the wider river reaches of the watercourses. With rehabilitation, this impact could be reduced to a negligible level.

- Demand for water for construction could indirectly place stress on the existing available water resources. During construction, more water is required than during the operation phase to suppress dust and use in concrete batching. This water would be required for a 1–2-year period while construction works are ongoing. Water could be sourced from 1) the Local Municipality (most likely either trucked in or otherwise made available for collection at the Water Treatment Plant via a metered standpipe); 2) a third-party water supplier which may include private services company; 3) existing boreholes on site (based on the findings of the Geohydrological Assessment and relevant registration or licence requirements); or 4) new boreholes drilled on site, which will be subject to complete and separate geohydrological testing and applicable licencing. Given the limited water availability in the area, it is advised that water be obtained off-site for construction. However, the groundwater specialist on the EIA team has indicated that sufficient

groundwater exists for associated water use. Refer to the Geohydrology Assessment in Chapter 16 of this EIA Report.

- Indirect alien vegetation infestation within the aquatic features due to disturbance. The current presence of alien vegetation on the site is limited. Sources of alien seed should be prevented from being brought onto the site with imported materials. Monitoring during construction and post-construction for the growth of alien vegetation can mitigate this potential impact.

- Indirect increased sedimentation and risks of contamination of surface water runoff during construction. During construction, the earthworks near watercourses will expose and mobilise soil as well as construction materials and chemicals that may indirectly end up in the water resources. Any spills during transport or while works are conducted in proximity to a watercourse also have the potential to indirectly affect the surrounding biota. Given the low rainfall in the area, if work is undertaken during the drier periods of the year, this impact would be unlikely.

During the operational phase, potential impacts would include:

- The direct ongoing disturbance of aquatic features and associated vegetation along access roads or adjacent to infrastructure that needs to be maintained. As for the disturbance of aquatic features described under construction impacts, the direct disturbance of aquatic habitat is unlikely if the activities are located outside the mapped aquatic features and the recommended buffers.

- Modified runoff characteristics from hardened surfaces have the indirect potential to result in the erosion of watercourses. Limited hardening of surfaces will take place as a result of the proposed projects that may concentrate and convey runoff with its associated erosion.

- Any structures within the watercourses associated with the proposed project must not indirectly impede flow in the watercourses. Given the episodic flow in the watercourses, the structures at the road crossings should consist of low water crossings that will not impede water or sediment movement.

- Water supply (and possibly sanitation services) may be required for the operation phase. The various water supply options are indicated above. The water could potentially be provided from groundwater without any aquatic ecosystem impacts as the groundwater specialist has indicated there is sufficient groundwater available for use in the project. Refer to the Geohydrology Assessment in Chapter 16 of this EIA Report. However, new boreholes should not be sited within or immediately adjacent to watercourses where they would potentially be indirectly impacting the subsurface flow in the watercourses. The baseflow in the watercourse is important in maintaining aquatic vegetation and some aquatic biota. The larger flows in the watercourses are unlikely to be impacted by the proposed project.

During the decommissioning phase, potential impacts would include:

- The direct disturbance of aquatic habitats within the watercourses with the associated impacts on sensitive aquatic biota. Decommissioning activities within watercourses could result in the disturbance or destruction of sensitive habitats and any listed and or protected plant or animal species and indirectly reduce the ecological integrity and functionality of the watercourses. The impact would only be very localised at the road crossings and would not impact the wider river reaches of the watercourses. With rehabilitation, this impact could be reduced to a negligible level.

- Indirect alien vegetation infestation within the aquatic features due to disturbance. The current presence of alien vegetation on the site is limited. Sources of alien seed should be prevented from being brought onto the site with imported materials. Monitoring the post-decommissioning phase for the growth of alien vegetation can mitigate this potential impact.

- Indirect increased sedimentation and risks of contamination of surface water runoff during decommissioning. Works near watercourses will expose and mobilise soil as well as materials and chemicals that may indirectly end up in the water resources. Any spills during transport or while works are conducted in proximity to a watercourse also have the potential to indirectly affect the surrounding biota. Given the low rainfall in the area, if work is undertaken during the drier periods of the year, this impact would be unlikely.

The cumulative impact of the project activities, together with the existing activities in the area, could have the potential to reduce the integrity of the watercourses if not properly mitigated and managed. By implementing suitable buffers (i.e. wider floodplain for the larger rivers and 35 m for the smaller watercourses) along the watercourses and minimising the works within the river/stream corridors, the impact of the proposed project activities would be low and unlikely to impact the integrity of the aquatic ecosystems from a cumulative perspective.

6.2 Summary of Issues Identified during the Public Consultation Phase

During the scoping phase consultation process, the following comments were received that relate to aquatic biodiversity. These comments related more to the faunal specialist assessment but are responded to below in terms of relevance to aquatic ecosystems.

Table 3. Comments Received from Stakeholders during the Public Consultation Phase

Comment	Commenter	Response
Giant bullfrogs were found in De Aar area in pans after the recent rains. Most of the injuries and mortalities to this species occur from collisions with vehicles when moving between their breeding sites (pans) and their burrows. Their burrows can range from 200m to 1km from the pans and they are capable of estivating underground for 7 years. Herbicide and pesticide use should also be restricted near the sites (Yetman, undated).	Northern Cape Department of Agriculture, Environmental Affairs, Rural Development and Land Reform: Environmental Research and Development (ERD)	Response from the herpetologist on the ecology team: Firstly, *Pyxicephalus adspersus* (Giant Bullfrog, hereafter GB) is not considered to be a species of conservation concern as it has been evaluated as Least Concern (see: http://speciesstatus.sanbi.org/assessment/last-assessment/1533/). Secondly, this species has not been previously recorded on the quarter-degree grid cells (3024AD, 3024AB) which are overlapped by the project area, so it is not common in the area. However, it is still considered moderately likely that this species could occur across the project area. Because the pans and watercourses were already delineated and excluded from development infrastructure, it is only considered necessary to provide additional mitigation for this species if it is being impacted by vehicles operating in the PV area. This will require an ECO to record all incidences of GB roadkills in a spatial database to allow evaluation of hotspots of activity and migration corridors. Should this occur, mitigation will need to be applied to these areas through the creation of "frog underpasses" in combination with drift fences allowing migration to occur while continuing the safe operation of vehicles in the project area. It is, however, good practice to ensure that the majority of construction activity takes place during the dry winter months when frogs are inactive to limit the potential for roadkill (temporal avoidance). The pans are currently buffered by 50 m. The large floodplains are not buffered as the aquatic specialist noted no buffer is needed; and the smaller watercourses are buffered by 35 m. A 50 m buffer around pans is considered sufficient for GBs to breed successfully. Note that the raised

Comment	Commenter	Response
		solar panels will still allow for foraging options and migration to and from the breeding pans by this species, so this habitat is not considered completely removed from utilisation by GBs. New roads developed for the proposed project that will be regularly travelled/patrolled should ideally be placed >100 m from a pan and should be regularly inspected by an ECO to assess road kills. Note that only one pan was found within the study area on the Remaining Extent of the farm Wolve Kuilen No. 42. A 50 m buffer around this pan has been recommended. It does not intersect with the development footprint. Although a 50 m Aquatic buffer is applied to the pan, the development is more than 50 m from the pan identified. It is specifically more than 2 km away from the development footprints.

Comments were also received on the availability of groundwater. The project geohydrologist has responded to these comments in the relevant Geohydrology Assessment in Chapter 16 of this EIA Report. From an aquatic ecology perspective, this specialist is in agreement with the responses. In particular, the following points with regard to groundwater have been included in this assessment:

- *The GA for groundwater use in Quaternary Catchments D33B and D62F, where the proposed project study area is located, is limited to 45 m3/ha/a for the property extent where the abstraction is proposed. Should more than this be required for the proposed project, an integrated water use licence application would be required for the associated project.*
- *The water table typically occurs at depths of about 9.5 m below ground level, and the yield of the aquifer is less than 2 litres a second.*
- *The estimated groundwater recharge in the area is 12.2 mm/a. The aquifer is of low susceptibility and vulnerability.*

The demand for water during the construction phase could place pressure on the existing available water resources. This impact is assessed in the section below.

Minor comments related to aquatic biodiversity impacts associated with the proposed project were raised by Interested and Affected Parties during the review period of the Draft EIA Report. These comments mainly related to chemical pollution of grazing land; and recommendations around water use licence applications and general authorisations. Responses have been provided in Appendix H.7 of the Final EIA Report.

7 Impact Assessment

The impacts have been assessed according to the methodology captured in Appendix D of this chapter.

The potential aquatic biodiversity impacts of the proposed activities are likely to be low in terms of any potential impact on aquatic habitat, biota, water quality, or flow for all phases of the proposed development.

7.1 Potential Impacts during the Construction Phase

The main types of impacts are degradation of the ecological condition of aquatic ecosystems and water quality impacts during the construction phase. These impacts are detailed further and expanded on below.

7.1.1 Direct Impact 1: Disturbance of aquatic habitat and impact to aquatic biota:

Construction of the solar facility and associated infrastructure will require some disturbance of the surface area and removal of vegetation cover for clearing and preparation of the various project component footprints. This impact is rated as negative, with a site-specific spatial extent, short-term duration, high reversibility and low irreplaceability. The impact is rated with a slight consequence and unlikely probability, resulting in a very low impact significance without the implementation of mitigation measures. Should the proposed activities be setback from the aquatic features according to the recommendation in Section 4 of this report (i.e. the recommended buffer of at least 35 m for the smaller drainage features; and setback from the wider floodplain adjacent to the larger rivers), the potential impact would also be of very low significance.

7.1.2 Direct Impact 2: Removal of indigenous aquatic vegetation and associated loss of aquatic ecological integrity and functionality:

As indicated above, the removal of indigenous riparian and instream vegetation will reduce the ecological integrity and functionality of the watercourses. Construction works could result in the loss of riparian vegetation that provides ecosystem services within the site, especially where new access roads are required, or road upgrades will widen any current road crossings. This impact is rated as negative, with a site-specific spatial extent, medium-term duration, high reversibility and low irreplaceability. The impact is rated with a slight consequence and very unlikely probability, resulting in a very low impact significance without the implementation of mitigation measures. Recommended mitigation measures include the implementation of the recommended development setbacks to minimise works within aquatic ecosystems, as well as clearing of indigenous vegetation, which should not take place within the aquatic features and the recommended buffers, and rehabilitating disturbed aquatic habitats by revegetating with suitable local indigenous vegetation. With the implementation of mitigation measures, the impact significance would also be rated as very low.

7.1.3 Direct Impact 3: Water supply for construction and stress on available water resources

As indicated above, the demand for water during the construction phase could place pressure on the existing available water resources. This impact is rated as negative, with a local spatial extent, long-term duration, moderate reversibility, and moderate irreplaceability. The impact is rated with a moderate consequence and extremely unlikely probability, resulting in a very low impact significance without the implementation of mitigation measures. The recommended mitigation measures include minimising water use for construction as much as possible, and that the water should be obtained from an existing water allocation or other viable water sources for construction purposes. With the implementation of mitigation measures, the impact significance would also be rated as very low.

7.1.4 Direct Impact 4: Road crossing structures may impede flow in the aquatic features

Loss of riparian vegetation that provides ecosystem services within the site and impeding of flow in the aquatic features would occur especially where new access roads are required, or road upgrades will widen any current road crossings. As noted above, the impact would only be very localised at the proposed road crossings and would not impact the wider river reaches of the watercourses. This impact is rated as negative, with a site-specific spatial extent, long-term duration, high reversibility, and low irreplaceability. The impact is rated with a slight consequence and unlikely probability, resulting in a very low impact significance without the implementation of mitigation measures. The recommended mitigation measures include designing the road crossing structures in a manner that does not impede flow in watercourses, with low water crossings being preferred. In addition, making use of existing crossings is also recommended, as best as possible and

where allowable. The existing road infrastructure, particularly within the floodplain, should be utilised as far as possible to access new infrastructure to minimise the overall disturbance. It is recommended that any new linear type of infrastructure crossings over watercourses be placed where there are existing structures or road crossings within the watercourse corridors, where possible. With the implementation of mitigation measures, the impact significance would also be rated as very low.

7.1.5 Direct Impact 5: Alien vegetation infestation within the aquatic features due to disturbance

This potential impact deals with alien vegetation infestation within the aquatic features due to disturbance. The current presence of alien vegetation on the site is limited. This impact is rated as negative, with a site-specific spatial extent, medium or long-term duration, high reversibility, and low irreplaceability. The impact is rated with a moderate consequence and unlikely probability, resulting in a low impact significance without the implementation of mitigation measures. The recommended mitigation measures include:

- Avoid disturbing aquatic habitats;
- Construction materials brought onto the site should be free of alien plant seeds. Sources of alien seed should be prevented from being brought onto the site with imported materials;
- Rehabilitate disturbed aquatic habitats once construction works are complete; and
- Undertake monitoring for the growth of alien vegetation during the construction and post-construction phases.

With the implementation of mitigation measures, the impact significance would be rated as very low.

7.1.6 Direct Impact 6: Increased sedimentation and contamination of surface water runoff from construction activities

This potential impact deals with increased sedimentation and risks of contamination of surface water runoff during the construction phase as discussed in Section 5.1. Concrete foundations will need to be constructed. A construction camp with a temporary laydown area and the concrete batching plant would likely need to be placed within the site for the construction works. There is thus also the potential for some water quality impacts associated with the batching of concrete, from hydrocarbon spills or associated with the other construction activities on the site. This impact is rated as negative, with a site-specific spatial extent, short-term duration, high reversibility, and low irreplaceability. The impact is rated with a slight consequence and likely to unlikely probability, resulting in a very low impact significance without the implementation of mitigation measures. The recommended mitigation measures include:

- Any works within aquatic features should be undertaken in the dry season where possible;
- Sediment traps should be used where necessary;
- Construction sites and laydown areas should be located within the assessed buildable areas/development footprints; and
- Good housekeeping and site management measures must be implemented at the laydown areas and the construction site as per the project Environmental Management Programme (EMPr) and monitored by the appointed Environmental Control Officer (ECO). This should specifically address on-site stormwater management and prevention of pollution during construction. Any stormwater that does arise within the construction sites must be handled appropriately to trap sediments and pollutants.

With the implementation of mitigation measures, the impact significance would be rated as very low.

7.1.7 Impact Summary Tables: Construction Phase

The summary impact table for the potential aquatic ecosystem impacts discussed above is provided on the following pages.

Table 4. Impact table for the potential aquatic biodiversity impacts of the project during the construction phase

Impact	Impact Criteria		Significance Ranking (Pre-Mitigation)	Potential mitigation measures	Significance Ranking (Post-Mitigation)	Confidence Level
Disturbance of aquatic habitat and the associated impact on sensitive aquatic biota	Status	Negative	Very low (5)	▪ Implement recommended development setbacks to minimise works within medium sensitivity aquatic ecosystems (i.e. recommended buffer of at least 35 m for the smaller drainage features; and setback from the wider floodplain adjacent to the larger rivers)	Very low (5)	High
	Spatial Extent	Site-specific				
	Duration	Short term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	Low				
Removal of indigenous aquatic vegetation and associated loss of aquatic ecological integrity and functionality	Status	Negative	Very low (5)	▪ Implement development setbacks to minimise works within aquatic ecosystems (i.e. recommended buffer of at least 35 m for the smaller drainage features; and setback from the wider floodplain adjacent to the larger rivers). ▪ Clearing of indigenous vegetation should not take place within the aquatic features and the recommended buffers. ▪ Rehabilitate disturbed aquatic habitats by revegetating them with suitable local indigenous vegetation.	Very low (5)	High
	Spatial Extent	Site-specific				
	Duration	Medium-term				
	Consequence	Slight				
	Probability	Very Unlikely				
	Reversibility	High				
	Irreplaceability	Low				
Water supply for construction and the associated stress on available water resources	Status	Negative	Very low (5)	▪ Water use for construction should be minimised as much as possible. The water should be obtained from an existing water allocation or other viable water sources for construction purposes.	Very low (5)	High
	Spatial Extent	Local				
	Duration	Long term				
	Consequence	Moderate				
	Probability	Extremely Unlikely				
	Reversibility	Moderate				
	Irreplaceability	Moderate				
Road crossing structures may impede flow in the aquatic features	Status	Negative	Very low (5)	▪ The road crossing structures should be designed to not impede flow in watercourses - low water crossing is preferred. Use existing crossings, as best as possible and where allowable.	Very low (5)	High
	Spatial Extent	Site specific				
	Duration	Long term				
	Consequence	Slight				

Impact	Impact Criteria		Significance Ranking (Pre-Mitigation)	Potential mitigation measures	Significance Ranking (Post-Mitigation)	Confidence Level
	Probability	Unlikely		▪ The existing road infrastructure, particularly within the floodplain, should be utilised as far as possible to access new infrastructure to minimise the overall disturbance. It is recommended that any new linear type of infrastructure crossings over watercourses be placed where there are existing structures or road crossings within the watercourse corridors, where possible.		
	Reversibility	High				
	Irreplaceability	Low				
Alien vegetation infestation may occur within the aquatic features due to disturbance	Status	Negative	Low (4)	▪ Avoid disturbing aquatic habitats as far as possible. ▪ Construction materials brought onto the site should be free of alien plant seeds. Sources of alien seed should be prevented from being brought onto the site with imported materials. ▪ Rehabilitate disturbed aquatic habitats once construction works are complete. ▪ Undertake monitoring for the growth of alien vegetation during the construction and post-construction phases.	Very low (5)	High
	Spatial Extent	Site specific				
	Duration	Medium or long term				
	Consequence	Moderate				
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	Low				
Increased sedimentation and risks of contamination of surface water runoff may result from construction works	Status	Negative	Very low (5)	▪ Any work within aquatic features should be undertaken in the dry season where possible. ▪ Sediment traps should be used where necessary. ▪ Construction sites and laydown areas should be located within the assessed buildable areas/development footprints. ▪ Good housekeeping and site management measures must be implemented at the laydown areas and the construction site as per the project Environmental Management Programme (EMPr) and monitored by the appointed Environmental Control Officer (ECO).	Very low (5)	High
	Spatial Extent	Site specific				
	Duration	Short term				
	Consequence	Slight				
	Probability	Likely to Unlikely				
	Reversibility	High				
	Irreplaceability	Low				

7.2 Potential Impacts during the Operational Phase

The main impacts during the operational phase include degradation of the ecological condition of aquatic ecosystems; modification of flow and water quality; erosion; and alien vegetation invasion in aquatic features. These are discussed in detail below.

During the operation phase, the solar arrays will operate largely unattended and with low maintenance required for more than 20 years. The hard surfaces created by the development may lead to increased runoff, in particular on surfaces with a steeper gradient. This may lead to increased erosion and sedimentation of the downslope areas. A localised long-term impact (more than 20 years) of low intensity could be expected that would have a very low overall significance post-mitigation in terms of its impact on the identified aquatic ecosystems in the area. The only potentially toxic or hazardous materials which would be present in relatively small amounts would be lubricating oils and hydraulic and insulating fluids. Therefore, contamination of surface or groundwater or soils is highly unlikely.

7.2.1 Direct Impact: Ongoing disturbance of aquatic features and associated vegetation along access roads or adjacent to the infrastructure that needs to be maintained.

This impact relates to the ongoing disturbance of aquatic features and associated vegetation along access roads or adjacent to the infrastructure that needs to be maintained. However, the disturbance of aquatic habitat is unlikely if the activities are located outside the mapped aquatic features and the recommended buffers. The impact may also result in the indirect impact of the invasion of the disturbed aquatic habitats with alien vegetation and an increased potential for erosion within the disturbed areas that reduces the ecological integrity of the associated aquatic ecosystems. This impact is rated as negative, with a site-specific spatial extent, long-term duration, moderate reversibility, and low irreplaceability. The impact is rated with a slight to moderate consequence and likely to unlikely probability, resulting in a low to very low impact significance without the implementation of mitigation measures. The recommended mitigation measures include avoiding the medium-sensitivity aquatic habitats in the layout design, with only low-sensitivity habitats being disturbed during construction and operations. Monitoring and removal of invasive alien vegetation and signs of erosion within the disturbed areas is also recommended. Disturbance of these habitats would only result in a negligible alteration to aquatic ecosystems and processes. With the implementation of mitigation measures, the impact significance would be rated as very low.

7.2.2 Direct Impact: Modified runoff characteristics from hardened surfaces has the potential to result in erosion of adjacent watercourses.

This impact relates to the modified runoff characteristics from hardened surfaces, such as at the substation and along access roads, which has the potential to result in the erosion of nearby watercourses. Limited hardening of surfaces will take place that may concentrate and convey runoff with its associated erosion. This impact is rated as negative, with a site-specific spatial extent, long-term duration, moderate reversibility, and low irreplaceability. The impact is rated with a slight consequence and unlikely probability, resulting in a very low impact significance without the implementation of mitigation measures. The recommended mitigation measures include developing a stormwater management plan for the proposed development that addresses the stormwater runoff from the developed areas. Furthermore, stormwater run-off infrastructure must be designed to mitigate both the flow and water quality impacts of any stormwater leaving the developed areas. The runoff should rather be dissipated over a broad area covered by natural vegetation or managed using appropriate shaping of the road with berms or channels and swales adjacent to hardened surfaces where necessary. Should any erosion features develop, they should be stabilised immediately. With the implementation of mitigation measures, the impact significance would be rated as very low.

7.2.3 Direct Impact: Water supply and water quality impacts (e.g. contamination from sewage) as a result of the operation of the proposed Solar Facility and associated infrastructure.

This impact relates to water supply and water quality impacts (e.g. contamination from sewage) as a result of the operation of the proposed Solar Facility and associated infrastructure. This impact is rated as negative, with a site-specific spatial extent, long-term duration, low reversibility, and low irreplaceability. The impact is rated with a slight consequence and unlikely probability, resulting in a very low impact significance without the implementation of mitigation measures. The recommended mitigation measures include seeking a sustainable water supply, and ensuring that sewage generated at the facility should be discharged to a conservancy tank that is properly serviced and regularly evacuated to nearby wastewater treatment works. With the implementation of mitigation measures, the impact significance would be rated as very low.

The water consumption impact associated with the operation of the proposed PV infrastructure would be negligible as the water requirement during this phase is very low.

7.2.4 Impact Summary Tables: Operation Phase

The summary impact table for the potential aquatic ecosystem impacts discussed above is provided on the following page.

Table 5. Impact table for the potential aquatic biodiversity impacts of the project during the operation phase

Impact	Impact Criteria		Significance Ranking (Pre-Mitigation)	Potential mitigation measures	Significance Ranking (Post-Mitigation)	Confidence Level
Ongoing disturbance of aquatic features and associated vegetation along access roads or adjacent to the infrastructure that needs to be maintained	Status	Negative	Low to very low (4-5)	▪ The medium-sensitivity aquatic habitats should be avoided in the layout design, with only low-sensitivity habitats being disturbed during construction. ▪ Invasive alien plant growth and signs of erosion should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with invasive alien plants. ▪ Should any disturbance of aquatic habitats occur that is not associated with an improvement of the ecological condition, the habitat should be rehabilitated immediately following the disturbance activity by returning the habitat to the condition prior to that disturbance.	Very low (5)	High
	Spatial Extent	Site specific				
	Duration	Long term				
	Consequence	Slight to moderate				
	Probability	Likely to Unlikely				
	Reversibility	Moderate				
	Irreplaceability	Low				
Modified runoff characteristics from hardened surfaces at the substation and along access roads has the potential to result in erosion of adjacent watercourses	Status	Negative	Very low (5)	▪ Develop a stormwater management plan for the proposed development that addresses the stormwater runoff from the developed areas. ▪ Stormwater run-off infrastructure must be designed to mitigate both the flow and water quality impacts of any stormwater leaving the developed areas. The runoff should rather be dissipated over a broad area covered by natural vegetation or managed using appropriate shaping of the road with berms or channels and swales adjacent to hardened surfaces where necessary. Should any erosion features develop, they should be stabilised immediately.	Very low (5)	High
	Spatial Extent	Site specific				
	Duration	Long term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	Moderate				
	Irreplaceability	Low				
Water supply and water quality impacts (e.g. contamination from sewage) as a result of the operation of the site	Status	Negative	Very low (5)	▪ A sustainable water supply should be sought. ▪ Sewage generated within the site should be discharged to a conservancy tank that is properly serviced and regularly evacuated to nearby wastewater treatment works.	Very low (5)	High
	Spatial Extent	Site specific				
	Duration	Long term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	Low				
	Irreplaceability	Low				

7.3 Potential Impacts during the Decommissioning Phase

The main impacts include degradation of the ecological condition of aquatic ecosystems; modification of flow and water quality; erosion; and alien vegetation invasion in aquatic features. These are discussed below in detail.

7.3.1 Direct Impact: Increased disturbance of aquatic habitat due to the increased activity on the site:

During decommissioning, the potential freshwater impacts will be very similar to that of the Construction Phase, although the potential for water quality and flow-related risks will be lower. This specific potential impact relates to increased disturbance of aquatic habitat due to the increased activity on the site. This impact is rated as negative, with a site-specific spatial extent, short-term duration, high reversibility, and low irreplaceability. The impact is rated with a slight consequence and unlikely probability, resulting in a very low impact significance without the implementation of mitigation measures. The recommended mitigation measures include minimising works within aquatic ecosystems (if the project layout avoided these areas, the decommissioning activities would also be able to avoid aquatic habitats within the study area); and ensuring that disturbed areas are rehabilitated and re-vegetated where required. Mitigation and follow-up monitoring of residual impacts (alien vegetation growth and erosion) may be required. The road network should be returned to that resembling pre-construction, with all additional roads removed where possible. With the implementation of mitigation measures, the impact significance would be rated as very low.

7.3.2 Direct Impact: Increased sedimentation and risks of contamination of surface water runoff:

This specific potential impact relates to increased sedimentation and risks of contamination of surface water runoff. This impact is rated as negative, with a site-specific spatial extent, short-term duration, high reversibility, and low irreplaceability. The impact is rated with a slight consequence and unlikely probability, resulting in a very low impact significance without the implementation of mitigation measures. The recommended mitigation measures include:

- Decommissioning activities within aquatic features should be undertaken in the dry season, where possible;
- Sediment traps should be used where necessary;
- Laydown areas should be placed within the approved PV footprint and layout; and
- Good housekeeping and site management measures should be implemented as per the project EMPr and monitored by the appointed ECO. This should specifically address on-site stormwater management and prevention of pollution during decommissioning. Any stormwater that does arise within the decommissioning site must be handled appropriately to trap sediments and pollutants.

With the implementation of mitigation measures, the impact significance would be rated as very low.

7.3.3 Impact Summary Tables: Decommissioning Phase

The summary impact table for the potential aquatic ecosystem impacts discussed above is provided on the following pages.

Table 6. Impact table for the potential aquatic biodiversity impacts of the project during the decommissioning phase

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
Increased disturbance of aquatic habitat due to the increased activity on the site	Status	Negative	Very low (5)	▪ Minimise works within aquatic ecosystems. If the project layout avoided these areas, the decommissioning works would also be able to avoid aquatic habitats as delineated. Note that all aquatic areas recommended for avoidance have been avoided in the EIA phase layout identification. ▪ Rehabilitate and revegetate disturbed areas, where required. ▪ Mitigation and follow-up monitoring of residual impacts (alien vegetation growth and erosion) may be required. ▪ The road network should be returned to that resembling pre-construction, with all additional roads removed where possible.	Very low (5)	High
	Spatial Extent	Site specific				
	Duration	Short term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	Low				
Increased sedimentation and risks of contamination of surface water runoff	Status	Negative	Very low (5)	▪ Decommissioning activities within aquatic features should be undertaken in the dry season where possible. ▪ Sediment traps should be used where necessary. ▪ Laydown areas should be placed within the approved PV footprint and layout. ▪ Good housekeeping measures should be implemented as per the project EMPr and monitored by the appointed ECO. This should specifically address on-site stormwater management and prevention of pollution during decommissioning. Any stormwater that does arise within the decommissioning site must be handled appropriately to trap sediments and pollutants.	Very low (5)	High
	Spatial Extent	Site specific				
	Duration	Short term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	Low				

7.4 Cumulative Impacts

7.4.1 Direct Impact: Increased disturbance and degradation of aquatic habitat:

Land use in the area currently consists of low-density livestock farming. Current land and water use impacts on the aquatic features within the larger study area are therefore low to very low significance. The nature of the proposed PV project allows it to have minimal impact on the surface water features, provided the project elements are placed far enough away from the freshwater features to not impact them significantly, as has been recommended. If the proposed project also makes use of existing disturbed areas such as roads, the impacts on the aquatic ecosystems will be further reduced and provides an opportunity to improve the current road infrastructure through the construction of low water crossings or properly sized box culverts instead of pipe culverts that are prone to blocking. ***One could thus expect that the cumulative impact of the proposed project would not be significant provided mitigation measures are implemented.***

During the construction phase and decommissioning phase, the potential cumulative impact of increased disturbance of the aquatic habitat due to the increased activity in the wider area is rated as a negative impact, with a site specific spatial extent, short-term duration, slight consequence, unlikely probability, high reversibility and low irreplaceability. The significance is rated as very low both without and with the implementation of mitigation measures.

The above also applies to the potential cumulative impact of degradation of the ecological condition of aquatic ecosystems during the operational phase.

Mitigation measures are discussed in Table 7 below.

The proposed or approved renewable energy projects and EGI that are within a 30km radius of the proposed projects are shown in Figure 11. The DWS quaternary catchment boundaries (cream lines) are also shown on the image as potential areas of influence in terms of water resources. In terms of renewable energy projects within the same quaternary catchment as this project study area (D33B and D62F), it is only Crossroads PV, Keren PV and Swartwater PV that would potentially impact the surface and groundwater resources. Availability of water is a limiting factor in the further development of this area, however, the water requirements of the project during the operation phase will be low. Surface water is not proposed as a water source for the construction and operational phases, as discussed above and in Chapter 2 of the EIA Report. However, groundwater is proposed as one of the potential water sources (either from existing boreholes or new boreholes). The latter will be subjected to separate assessment processes). The Geohydrology Assessment in Chapter 16 of this EIA Report has sufficiently assessed the impact of the proposed projects on groundwater resources, including the use of groundwater during the relevant project phases.

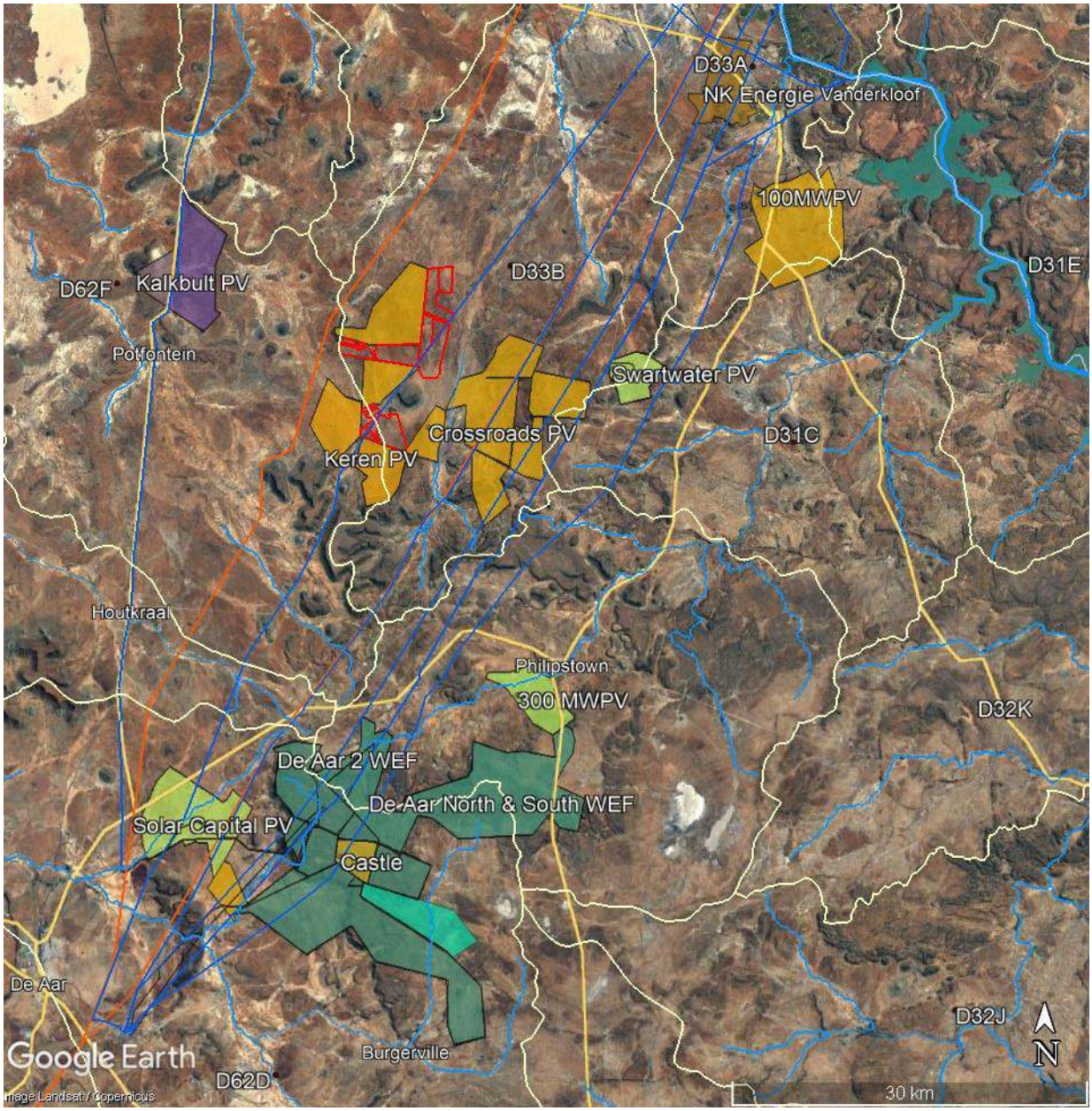


Figure 11. Google Earth image showing the location of the proposed or approved renewable energy projects and EGI within a 30km radius of the current proposed project. The DWS quaternary catchment boundaries (cream lines) are also shown on the image as potential areas of influence in terms of water resources. In terms of renewable energy projects within the same quaternary catchment as this project (D33B and D62F), it is only Crossroads PV, Keren PV and Swartwater PV that would potentially impact the surface and groundwater resources.

7.4.2 Impact Summary Tables: Cumulative Impacts

The summary impact table for the potential aquatic ecosystem impacts discussed above is provided on the following page.

Table 7. Impact table for the potential cumulative aquatic biodiversity impacts of the project during the construction, operation and decommissioning phases

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Increased disturbance of aquatic habitat due to the increased activity in the wider area	Status	Negative	Very low (5)	▪ Minimise works within aquatic ecosystems as far as possible. Construct in the dry season where possible. ▪ Rehabilitate disturbed areas. ▪ Rationalise infrastructure as far as possible by sharing the infrastructure or using existing disturbed areas. ▪ Manage stormwater impacts.	Very low (5)	High
	Spatial Extent	Site specific				
	Duration	Short term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	Low				
OPERATION PHASE						
Degradation of ecological condition of aquatic ecosystems	Status	Negative	Very low (5)	▪ Monitor and manage for impacts such as alien vegetation growth and erosion. ▪ Limit disturbance and rehabilitate disturbed areas. ▪ Ensure there is sufficient stormwater management to prevent erosion of watercourses. ▪ Ensure road crossing structures are properly designed to prevent blockage in the watercourses or erosion. ▪ Limit and monitor water use.	Very low (5)	High
	Spatial Extent	Site specific				
	Duration	Short term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	Low				
DECOMMISSIONING PHASE						
Increased disturbance of aquatic habitat due to the increased activity in the wider area	Status	Negative	Very low (5)	▪ Decommissioning works near aquatic features should preferably be undertaken in the dry season where possible. ▪ Minimise disturbance and rehabilitate.	Very low (5)	High
	Spatial Extent	Site specific				
	Duration	Short term				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	Low				

7.5 Battery Energy Storage System

A Lithium-Ion BESS and Redox Flow BESS were both considered for the proposed project. For Redox Flow BESS, various chemical compositions are likely, such as Vanadium. Refer to Chapter 15 of this EIA Report for a High-Level Safety, Health and Environment Risk Assessment, which provides high-level information on the safety, health and environmental risks of the BESS technologies.

Both BESS technologies have been considered in this assessment. The proposed BESS within the site is not of aquatic ecosystem concern, given that the aquatic ecosystems are avoided and adequately buffered. Either BESS technology would thus be suitable.

7.6 No-Go Option

The watercourses and associated wetlands and floodplains are in a largely natural to moderate condition due to the low level of impact in the area. The no-go option will thus result in no additional impacts on aquatic biodiversity and will result in the ecological status quo being maintained, which will be to the advantage of aquatic systems and biodiversity. However, with that being said, no fatal flaws were discovered in the course of the investigations for the proposed Kudu Solar Facility. The potential aquatic ecosystem impact significance for the proposed activities, with mitigation, is rated as very low.

8 Impact Assessment Summary

This section provides the overall impact significance findings following the implementation of the proposed mitigation measures. These are shown in the table below:

Table 8. Overall Impact Significance (Post Mitigation)

Phase	Overall Impact Significance
Nature of Impact	Negative
Construction	Very low
Operational	Very low
Decommissioning	Very low
Cumulative – Construction	Very low
Cumulative – Operational	Very low
Cumulative – Decommissioning	Very low

9 Legislative and Authorisation Requirements

The main legislation associated with the protection of aquatic ecosystems and water resources over and above the NEMA, is the National Water Act (Act 36 of 1998, as amended) (NWA). The purpose of the NWA is to provide a framework for the equitable allocation and sustainable management of water resources. Both surface and groundwater sources are redefined by the Act as national resources which cannot be owned by any individual and rights which are not automatically coupled to land rights, but for which prospective users must apply for authorisation and register as users. The NWA also provides measures to prevent, control and remedy the pollution of surface and groundwater sources.

The Act aims to regulate the use of water and activities (as defined in Part 4, Section 21 of the NWA), which may impact water resources through the categorisation of ‘listed water uses’ encompassing water

abstraction and flow attenuation within catchments as well as the potential contamination of water resources, where the Department of Water and Sanitation (DWS) is the administering body in this regard. Defined water use activities require approval from DWS in the form of a General Authorisation (GA) or a Water Use Licence (WUL). There are restrictions on the extent and scale of listed activities for which GAs apply. According to the preamble to Part 6 of the NWA, 1998, "*This Part established a procedure to enable a responsible authority, after public consultation, to permit the use of water by publishing general authorisations in the Gazette*…" and further states that "*The use of water under a general authorisation does not require a licence until the general authorisation is revoked, in which case licensing will be necessary*…"

The GAs for Section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA were last revised in 2016 (Government Notice R509 of 2016). Determining if a water use licence is required for these water uses is now associated with the risk of degrading the ecological status of a watercourse. A low risk of impact could be authorised in terms of a GA. The risk of the proposed development altering the ecological integrity of the adjacent aquatic ecosystems, if mitigated as recommended, is likely to be low such that the associated water use activities in terms of Section 21 (c) (impeding or diverting flow in a watercourse) or Section 21 (i) (changing the bed, banks, course or characteristics of a watercourse) would fall within the ambit of the GAs. A risk assessment, summarised in Table 9, has been undertaken to inform the Section 21 (c) and (i) water use authorisation process for Kudu Solar Facility 4 and its associated infrastructure.

Table 9. A summary of the risk assessment for the proposed development

Phases	Activity	Aspect	Impact	Significance	Risk Rating
Construction	Construction of PV facilities and the associated infrastructure within the development footprints, taking into account the aquatic constraints as indicated in this report	Accessing site; Limited clearing of vegetation and movement of soil and construction of infrastructure and PV modules	Disturbance of aquatic habitat, runoff and water quality impacts	52.25	L
Operation	Maintenance of the PV facilities and associated infrastructure	Disturbance associated with maintenance works; altered stormwater runoff at the site		33	L
Decommissioning	Removal of PV facilities and associated infrastructure and rehabilitation of the site	Disturbance associated with decommissioning and rehabilitation works		33	L

The GA for groundwater use in Quaternary Catchments D33B and D62F, where the proposed project study area is located, is limited to 45 m^3/ha/a for the property extent where the abstraction is proposed. Should more than this be required for the proposed project, an integrated water use licence application would be required for the associated project. Various assessments of the current groundwater use and sustainability of the proposed groundwater use would need to be undertaken in support of such an application. Refer to the Geohydrology Assessment in Chapter 16 of this EIA Report for additional information in this regard.

The disposal of sewage from the developed site is likely to be stored in conservancy tanks for removal and treatment at the nearby wastewater treatment works of the local authority. This low volume would be within the GA for Section 21 (g) water use activities.

10 Environmental Management Programme Inputs

The following mitigation measures and impact management actions are recommended to minimise the potential impacts of the proposed activities on the aquatic features within the site. These measures should be addressed in the EMPr for the Construction and Operation Phases of the proposed project.

Table 10. Environmental Management Program Recommendations

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
DESIGN PHASE					
FRESHWATER ECOLOGY IMPACTS					
Potential impact on freshwater ecology as a result of the proposed PV and associated infrastructure.	Limit the disturbance of aquatic habitats. Minimise potential to modify flow/hydraulics-related impacts and increase the potential for erosion.	▪ Ensure the final layout of the PV facility and associated infrastructure avoids watercourses and recommended buffers as far as possible; utilisation should be made of existing disturbed areas where possible. The medium-sensitivity aquatic habitats should be avoided in the layout design, with only low-sensitivity habitats being disturbed during construction. Note that this has been achieved in the EIA Phase, whereby the recommended development setbacks (i.e. recommended buffer of at least 35 m for the smaller drainage features; and setback from the wider floodplain adjacent to the larger rivers) have been adopted in the identification of the development footprints. The recommended avoidance areas have been avoided. ▪ Construction sites and laydown areas should be located within the assessed buildable areas/development footprints. ▪ A comprehensive stormwater management plan should be compiled for the compacted surfaces within the site by the project engineer with input from the freshwater specialist. The plan should aim to reduce the intensity of runoff from the developed area, particularly on the steeper slopes and reduce the intensity of the discharge into the adjacent drainage lines. Where necessary measures to dissipate flow intensity or protect erosion should be included in the plan. The plan should encourage infiltration rather than runoff and should prevent the impedance of surface or sub-surface flows. The plan should also mitigate any contaminated runoff from the construction and operation activities from being discharged into any of the aquatic features within the site. ▪ Stormwater run-off infrastructure must be designed to mitigate both the flow and water quality impacts of any stormwater leaving the developed areas. The runoff should rather be dissipated over a broad area covered by natural vegetation or managed using appropriate shaping of the road with berms or channels and swales adjacent to hardened surfaces where necessary. Should any erosion features develop, they should be stabilised immediately. ▪ Adequate erosion mitigation measures should be incorporated into designs;	Ensure that this is taken into consideration during the planning and design phase.	During the design cycle and before construction commences.	Holder of the EA

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		▪ Use existing crossings, as best as possible and where allowable. The existing road infrastructure, particularly within the floodplain, should be utilised as far as possible to access new infrastructure to minimise the overall disturbance. It is recommended that any new linear type of infrastructure crossings over watercourses be placed where there are existing structures or road crossings within the watercourse corridors, where possible. For any new infrastructure placed within the watercourses: The structure should not impede or concentrate the flow in the watercourse, and should prevent blockages and erosion. It is recommended that low-water crossings should be utilised. Any rubble or waste associated with the construction works within the aquatic features should be removed once construction is complete. ▪ A sustainable water supply should be sought. Water consumption requirements for the construction and operation of the proposed project if not obtained from an authorised water user within the area, must be authorised by the DWS. ▪ No liquid waste should be discharged into any of the aquatic features within the site without the approval of the DWS. Wastewater should be properly contained on-site and removed to a licensed wastewater treatment facility that can treat the wastewater.			

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
CONSTRUCTION PHASE					
FRESHWATER ECOLOGY IMPACTS					
Potential impact on freshwater ecology as a result of the proposed PV and associated infrastructure.	Limit the disturbance of aquatic habitats. Limit the potential for contamination/pollution of aquatic ecosystems.	▪ Avoid disturbing aquatic habitats as far as possible. ▪ Minimise works within aquatic ecosystems as far as possible. ▪ For all project-related components within the site, the aquatic features of medium sensitivity should be treated as no-go areas during the construction phase. ▪ Any activities that require construction within the delineated aquatic features and the recommended buffers should be described in method statements that are approved by the Environmental Control Officer (ECO). ▪ Rehabilitation of any disturbed areas within the aquatic features and the recommended buffer areas should be undertaken immediately following completion of the disturbance activity according to rehabilitation measures as included in a method statement for that specific activity as described above. ▪ Invasive alien plant growth should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with invasive alien plants. ▪ Any works within aquatic features should be undertaken in the dry season where possible. ▪ Sediment traps should be used where necessary. ▪ Ablution facilities should not be placed within 100m of any of the aquatic features delineated within the site; ▪ Liquid dispensing receptacles (e.g. lubricants, diesel, shutter oil etc.) must have drip trays beneath them/beneath the nozzle fixtures. Material safety data sheets (MSDS) must be available on site (if required) where products are stored so that in the event of an incident, the correct action can be taken. Depending on the types of materials stored on site during the construction activities, suitable product recovery materials must be readily available. Vehicles should ideally be washed at their storage yard as opposed to on site. ▪ Proper waste management should be undertaken within the site with facilities provided for the on site disposal of waste and the removal of stored waste to the nearest registered solid waste disposal facility.	▪ Monitoring that no-go areas and buffer areas are adhered to should be undertaken on an ongoing basis for the duration of the construction phase. ▪ Ongoing monitoring of the implementation of method statements should be undertaken. ▪ Ongoing monitoring of any rehabilitation measures, where required, should be undertaken. ▪ Ongoing monitoring of invasive alien plants within the site should be undertaken according to an approved method statement that makes use of alien clearing methods as provided by the Working for Water Programme and outlined on Resources | Department of Environmental Affairs (dffe.gov.za). Monitoring and control measures should take place at least biannually (every six months) for the construction phase. ▪ Ongoing visual inspections to ensure that no spills or risk of surface water contamination occur. ▪ Ongoing visual inspections to ensure that no sedimentation or solid water from the construction activities occur in adjacent surface water ecosystems.	Ongoing during construction	Proponent/ contractor and ECO

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		▪ Clearing of indigenous vegetation should not take place within the aquatic features and the recommended buffers. ▪ Rehabilitate disturbed aquatic habitats once construction works are complete by revegetating them with suitable local indigenous vegetation. ▪ Water use for construction should be minimised as much as possible. The water should be obtained from an existing water allocation or other viable water sources for construction purposes. ▪ Construction materials brought onto the site should be free of alien plant seed. Sources of alien seed should be prevented from being brought onto the site with imported materials. ▪ Good housekeeping and site management measures must be implemented at the laydown areas and the construction site as per the project Environmental Management Programme (EMPr) and monitored by the appointed ECO. ▪ Rationalise infrastructure as far as possible by sharing the infrastructure or using existing disturbed areas. ▪ Manage stormwater impacts.			

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
OPERATION PHASE					
FRESHWATER ECOLOGY IMPACTS					
Potential impact on freshwater ecology as a result of the proposed PV and associated infrastructure.	Limit the disturbance of aquatic habitat; Minimise potential to modify flow/hydraulics-related impacts and increase the potential for erosion; Control of invasive alien plants in riparian zones and wetland areas; Limit the potential for contamination/pollution of aquatic ecosystems	▪ Invasive alien plant growth and signs of erosion should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with invasive alien plants. Ongoing control of invasive alien plants within the site should be undertaken. ▪ Invasive alien plant material that has been cleared should be removed from the riparian zones and not left on the river banks or burnt within the riparian zone and buffer area. ▪ Ongoing monitoring of the road crossing structures, in particular before the rainfall period, should be undertaken to ensure that the integrity of the structures is intact and that they are not blocked with sediment or debris. Ongoing monitoring post large rainfall events should also be undertaken to identify and address any erosion occurring within the watercourses. ▪ Sewage generated within the site should be discharged to a conservancy tank that is properly serviced and regularly evacuated to nearby wastewater treatment works. ▪ Limit disturbance and rehabilitate disturbed areas. ▪ Ensure there is sufficient stormwater management to prevent erosion of watercourses. ▪ Limit and monitor water use.	▪ Monitoring that no-go areas and buffer areas are adhered to should be undertaken on an ongoing basis. ▪ Ongoing monitoring of any rehabilitation measures, where required, should be undertaken. ▪ Ongoing monitoring of invasive alien plants within the site should be undertaken according to an approved method statement that makes use of alien clearing methods as provided by the Working for Water Programme and outlined on Resources | Department of Environmental Affairs (dffe.gov.za). Monitoring and control measures should take place at least biannually (every six months) for the first 3 years of the project. ▪ Ongoing visual inspections to ensure that no spills or risk of surface water contamination occur. ▪ Ongoing visual inspections to ensure that no sedimentation or solid water from the operational activities occur in adjacent surface water ecosystems.	Ongoing during operation	Proponent/ contractor

Impact	Mitigation/ Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
DECOMMISSIONING PHASE					
FRESHWATER ECOLOGY IMPACTS					
Potential impact on freshwater ecology as a result of the potential decommissioning of the proposed PV and associated infrastructure.	Limit the disturbance of aquatic habitats.	▪ For all project-related components within the site, the aquatic features of medium sensitivity should be demarcated by the appointed ECO before the commencement of the decommissioning activities and treated as no-go areas during the decommissioning phase. ▪ Minimise works within aquatic ecosystems. If the project layout avoided these areas, the decommissioning works would also be able to avoid aquatic habitats as delineated. Note that all aquatic areas recommended for avoidance have been avoided in the EIA phase layout identification. ▪ Any activities that require decommissioning activities within the delineated aquatic features and the recommended buffers should be described in method statements that are approved by the ECO. ▪ Rehabilitate and revegetate disturbed areas, where required. ▪ Rehabilitation of any disturbed areas within the aquatic features and the recommended buffer areas should be undertaken immediately following the completion of the disturbance activity according to rehabilitation measures as included in a method statement for that specific activity. ▪ Control of invasive alien plants within the site should be undertaken according to the approved method statement. ▪ Mitigation and follow-up monitoring of residual impacts (alien vegetation growth and erosion) may be required. ▪ The road network should be returned to that resembling pre-construction, with all additional roads removed where possible. ▪ Decommissioning activities within aquatic features should be undertaken in the dry season where possible. ▪ Sediment traps should be used where necessary. ▪ Laydown areas should be placed within the approved PV footprint and layout. ▪ Good housekeeping measures should be implemented as per the project EMPr and monitored by the appointed ECO. This should specifically address on-site stormwater management and prevention of pollution during decommissioning. Any stormwater that does arise within the decommissioning site must be handled appropriately to trap sediments and pollutants.	▪ Monitoring that no-go areas are adhered to should be undertaken on an ongoing basis for the duration of the decommissioning phase. ▪ Ongoing monitoring of the implementation of method statements and rehabilitation measures should be undertaken in the decommissioning phase. ▪ Ongoing monitoring of invasive alien plants within the site should be undertaken according to an approved method statement that makes use of alien clearing methods as provided by the Working for Water Programme and outlined on Resources | Department of Environmental Affairs (dffe.gov.za).	Ongoing during decommissioning	Proponent/ contractor and ECO

Monitoring Requirements

Daily compliance monitoring of the implementation of the measures as laid out in the EMPr and associated method statements should be undertaken by the Site Manager in conjunction with the Environmental Control Officer (ECO). A record of the monitoring undertaken during the operation phase maintenance management activities should be kept.

Visual inspections and photographs should be taken weekly upstream and downstream of sites where construction activities will need to take place within aquatic features. Once the construction activities have ceased, the frequency of the monitoring can be reduced to monthly until DWS is satisfied that the site is adequately rehabilitated.

Ongoing monitoring of invasive alien plant growth and erosion within the aquatic features and the recommended buffers biannually (every six months) for the construction phase and the first three operational years of the project. Monitoring should preferably take place before the rainfall period and following high rainfall events.

11 Final Specialist Statement and Authorisation Recommendation

11.1 Statement and Reasoned Opinion

The aquatic features within the study area comprise ephemeral unnamed tributaries of the Orange River. The larger watercourses flow along the eastern and western extents of the study area, flowing in a northerly direction to join the Orange River downstream of Van der Kloof Dam. Associated with these larger watercourses are wide floodplains. Smaller watercourses and drainage features drain into the larger river corridors. The watercourses and associated wetlands and floodplains are in a largely natural to moderate condition due to the low level of impact in the area. It is recommended that the larger watercourses, floodplains and wetlands within the site are not allowed to degrade further from their current ecological condition of largely natural to moderately modified.

The catchments of the tributaries of the Orange River in which the proposed project is located are not within any FEPA river sub-catchments. The only FEPA Wetland within the study area is a largely artificial wetland associated with a farm dam or erosion control structure and is thus not considered of high aquatic biodiversity conservation significance. There is also a natural depression wetland that is within the valley floor of the river system to the west of the study area that is mapped as a FEPA Wetland. Both wetlands are located outside of the proposed activities and are unlikely to be impacted by the proposed project. The artificial wetland is more than 100 m from the proposed activities, while the natural wetland is more than 3 km from any of the proposed activities.

The National FEPA Wetlands, as well as the wider river floodplains associated with the unnamed tributaries of the Orange River located in the eastern and western portions of the wider study area, have been included in the National Wetland Map version 5. The wider floodplain areas have been excluded from the proposed development area for the project.

In the 2016 Northern Cape CBA mapping, the entire area within and surrounding the study area is mapped as Ecological Support Areas. In addition, wetland habitats included in the National FEPA Wetland mapping and smaller wetlands that are located largely within the river floodplain areas have been mapped as aquatic CBAs. None of these mapped wetlands occurs within the project areas, with the closest mapped wetland

being the artificial FEPA wetland that is more than 100 m from the proposed development area. The aquatic CBAs are thus unlikely to be impacted by the proposed project activities.

The deemed sensitivity for the larger unnamed tributaries of the Orange River and their floodplains is medium while the smaller feeder streams, drainage lines and dams are deemed to be low.

With mitigation, the potential freshwater impacts of the proposed PV Facility for the construction, operation and decommissioning phases are likely to be very low significance. One can also expect that the cumulative impact of the proposed project would not be significant provided mitigation measures are implemented.

Based on the findings of this specialist assessment, there is no reason from a freshwater perspective, why the proposed activity (with the implementation of the above-mentioned mitigation measures) should not be authorised. The proposed development footprint within the preferred development site (i.e. study area) has been amended through the project assessment process to ensure that it will be within aquatic ecosystem areas of “low” sensitivity as identified by the screening tool and verified through the initial Site Sensitivity Verification and is thus considered appropriate areas for development.

The risk assessment determined that the proposed development of the PV poses a low risk of impacting aquatic habitat, water flow and water quality. The water use activities associated with the proposed project could potentially be authorised through the general authorisations for Section 21 (c) and (i) water uses. The GA for groundwater use in Quaternary Catchments D33B and D62F, where the proposed project study area is located, is limited to 45 m^3/ha/a for the property extent where the abstraction is proposed. Should more than this be required for the proposed project, an integrated water use licence application would be required for the associated project. Various assessments of the current groundwater use and sustainability of the proposed groundwater use would need to be undertaken in support of such an application. Refer to the Geohydrology Assessment in Chapter 16 of this EIA Report for additional information in this regard. The disposal of sewage from the developed site is likely to be stored in conservancy tanks for removal and treatment at the nearby wastewater treatment works of the local authority. This low volume would be within the GA for Section 21 (g) water use activities.

11.2 EA Condition Recommendations

The recommended buffer area between the aquatic features and the project components to ensure these aquatic ecosystems are not impacted by the proposed activities is as follows:

- The larger tributary: the delineated edge of the surrounding floodplain wetland features (assigned as medium sensitivity). No buffer area is deemed to be required considering that the floodplain is a wide transitional area between the tributary and the surrounding terrestrial areas.
- Smaller streams and drainage features that are indicated to be of medium sensitivity: at least 35 m for the watercourse or the delineated edge of wetland features to allow for the movement of water along these streams. In addition, with regards to the BESS, it should preferably not be placed within 100 m of major rivers, watercourses and wetlands.
- Pans: One pan was found within the study area on the Remaining Extent of the farm Wolve Kuilen No. 42. A 50 m buffer around this pan has been recommended. It does not intersect with the development footprint. Although a 50 m Aquatic buffer is applied to the pan, the development is more than 50 m from the pan identified. It is specifically more than 2 km away from the development footprints.

Note that the features that have been allocated a low sensitivity (artificial features and minor drainage channels) do not need to be avoided by the proposed development as they do not have any significant aquatic habitat or functionality that would be lost.

Recommended mitigation measures to be included in the environmental authorisation are as follows:

Construction phase:

- Implement recommended development setbacks to minimise works within aquatic ecosystems (i.e. recommended buffer of at least 35 m for the smaller drainage features; and setback from the wider floodplain adjacent to the larger rivers)
- Clearing of indigenous vegetation should not take place within the aquatic features and the recommended buffers.
- Rehabilitate disturbed aquatic habitats by revegetating them with suitable local indigenous vegetation.
- Water use for construction should be minimised as much as possible. The water should be obtained from an existing water allocation or other viable water sources for construction purposes.
- The road crossing structures should be designed to not impede flow in watercourses - low water crossing is preferred. Use existing crossings, as best as possible and where allowable.
- The existing road infrastructure, particularly within the floodplain, should be utilised as far as possible to access new infrastructure to minimise the overall disturbance. It is recommended that any new linear type of infrastructure crossings over watercourses be placed where there are existing structures or road crossings within the watercourse corridors, where possible.
- Avoid disturbing aquatic habitats.
- Construction materials brought onto the site should be free of alien plant seeds. Sources of alien seed should be prevented from being brought onto the site with imported materials.
- Rehabilitate disturbed aquatic habitats once construction works are complete.
- Any work within aquatic features should be undertaken in the dry season where possible.
- Sediment traps should be used where necessary.
- Construction sites and laydown areas should be located within the assessed buildable areas/development footprints.
- Good housekeeping and site management measures must be implemented at the laydown areas and the construction site as per the project EMPr and monitored by the appointed ECO.

Operation phase:

- The medium-sensitivity aquatic habitats should be avoided in the layout design, with only low-sensitivity habitats being disturbed during construction.
- Invasive alien plant growth and signs of erosion should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with invasive alien plants.
- Should any disturbance of aquatic habitats occur that is not associated with an improvement of the ecological condition, the habitat should be rehabilitated immediately following the disturbance activity by returning the habitat to the condition prior to that disturbance.
- Develop a stormwater management plan for the proposed development that addresses the stormwater runoff from the developed areas.
- Stormwater run-off infrastructure must be designed to mitigate both the flow and water quality impacts of any stormwater leaving the developed areas. The runoff should rather be dissipated over a broad area covered by natural vegetation or managed using appropriate shaping of the road with berms or channels and swales adjacent to hardened surfaces where necessary. Should any erosion features develop, they should be stabilised immediately.
- A sustainable water supply should be sought.

- Sewage generated within the site should be discharged to a conservancy tank that is properly serviced and regularly evacuated to nearby wastewater treatment works.

Decommissioning phase:

- Minimise works within aquatic ecosystems. If the project layout avoided these areas, the decommissioning works would also be able to avoid aquatic habitats as delineated. Note that all aquatic areas recommended for avoidance have been avoided in the EIA phase layout identification.
- Rehabilitate and revegetate disturbed areas, where required.
- Mitigation and follow-up monitoring of residual impacts (alien vegetation growth and erosion) may be required.
- The road network should be returned to that resembling pre-construction, with all additional roads removed where possible.
- Decommissioning activities within aquatic features should be undertaken in the dry season where possible.
- Sediment traps should be used where necessary.
- Laydown areas should be placed within the approved PV footprint and layout.
- Good housekeeping measures should be implemented as per the project EMPr and monitored by the appointed ECO. This should specifically address on-site stormwater management and prevention of pollution during decommissioning. Any stormwater that does arise within the decommissioning site must be handled appropriately to trap sediments and pollutants.

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Appendix A: Specialist Expertise

TONI BELCHER

Full Name	Antonia Belcher
Cell Number	083 883 8055
Email	toni@bluescience.co.za
Address	53 Dummer St, Somerset West, 7130
Profession	Aquatic Ecologist and Environmental Management (P. Sci. Nat. 400040/10)
Years in Profession	31+ years

Toni Belcher worked for the Department of Water Affairs and Forestry for more than 17 years. During this period, she worked for the Directorate Water Quality Management, the Institute for Water Quality Studies and the Western Cape Regional Office and has built up a wide skills base on water resource management and water resource quality for rivers, estuaries and the coastal marine environment. Since leaving the Department in 2007, she has been working in her private capacity and was co-owner of BlueScience (Pty) Ltd, working in the field of water resource management and has been involved in more than 500 aquatic ecosystem assessments for environmental impact assessment and water use authorisation purposes. In 2006 she was awarded a Woman in Water award for Environmental Education and was a runner up for the Woman in Water prize for Water Research.

Professional Qualifications:

1984 Matriculation Lawson Brown High School
1987 B.Sc. – Mathematics, Applied Mathematics University of Port Elizabeth
1989 B.Sc. (Hons) – Oceanography University of Port Elizabeth
1998 M.Sc. – Environmental Management (*cum laude*) Potchefstroom University

Key Skills:

Areas of specialisation: Aquatic ecosystem assessments, Monitoring and evaluation of water resources, Water resource legislation and authorisations, River classification and Resource Quality Objectives, River Reserve determination and implementation, Water Quality Assessments, Biomonitoring, River and Wetland Rehabilitation Plans, Catchment management, River maintenance management, Water education.

Summary of Experience:

1987 – 1988 Part-time field researcher, Department of Oceanography, University of Port Elizabeth
1989 – 1990 Mathematics tutor and administrator, Master Maths, Randburg and Braamfontein Colleges, Johannesburg
1991 – 1995 Water Pollution Control Officer, Water Quality Management, Department of Water Affairs, Pretoria
1995 – 1999 Hydrologist and Assistant Director, Institute for Water Quality Studies, Department of Water Affairs and Forestry, Pretoria
1999 – 2007 Assistant and Deputy Director, Water Resource Protection, Western Cape Regional Office, Department of Water Affairs, Cape Town
2007 – 2012 Self-employed
2013 – 2020 Senior Aquatic Specialist and part owner, BlueScience
2020 – present Self employed, Associate of BlueScience

Dana Grobler

NATIONALITY:	South African
PROFESSION:	Professional Environmental Scientist (*Pr. Sci. Nat* 400058/93)
POSITION:	Director: BlueScience (Pty) Ltd
SPECIALISATION:	Water resources management and IWRM
YEARS EXPERIENCE:	30
CONTACT DETAILS:	BlueScience (Pty) Ltd, PO Box 455, Somerset Mall, 7137
TELEPHONE:	+27 (0)21 851 0555 (Business Cape Town)

EDUCATION AND PROFESSIONAL STATUS

HED (1989)	Higher Education Diploma (Biology and Mathematics), University of Pretoria, South Africa
BSc (Hons) (1987)	University of Pretoria, South Africa. Terrestrial plant ecology.

PROFESSIONAL MEMBERSHIP

Registered Environmental Scientist - South African Council for Natural Scientific Professions (No 400058/93)
Member of the Southern African Society for Aquatic Scientists
Member of the Water Institute of Southern Africa (WISA)
Member of the South African Branch of the International Association of Impact Assessments (IAIA)
Member of the South African Botanical Society

SUMMARISED EMPLOYMENT RECORD

2013 -	Director BlueScience® (Pty) Ltd
2003 – 2013	Managing member of Blue Science ®Consulting cc.
2006 – 2012	Managing member of Blue Science® Consulting cc and Associate of WAMTechnology cc.
1999 – 2006	Independent Consultant.
1997 - 1999	Assistant Director, Institute for Water Quality Services, Department of Water Affairs and Forestry
1994 - 1996	Principle Hydrologist, Institute for Water Quality Services, Department of Water Affairs and Forestry (Roodeplaat Dam, Pretoria).
1992 - 1994	Senior Hydrologist, Institute for Water Quality Services, Department of Water Affairs and Forestry (Roodeplaat Dam, Pretoria).
1988 - 1992	Hydrologist, Institute for Water Quality Studies, Department of Water Affairs and Forestry (Roodeplaat Dam, Pretoria).

KEY EXPERIENCE RECORD and project involvement

- Project manager for the compilation of Maintenance and Management Plans for the Upper Berg River, Upper Olifants River, and the Poesjesnels, Konings and Keysers Rivers
- Project manager for the design and rehabilitation of the Klein Zeekoevlei Wetland Somerset West
- Project manager for the rehabilitation and re-vegetation of the Teslaarsdal wetland rehabilitation project
- Project manager for the Ecological Reserve Determination in the Sandveld (G30 and F60 Catchments)
- Project manager for the Berg River riparian zone restoration project. A 3-year Department of Environmental Affairs and Development Planning (South Africa) project.
- Project manager for the restoration and rehabilitation of vegetation 14km of pipeline routes in the Steenbras deep water aquifer water supply area (a City of Cape Town project);
- Project manager and rehabilitation advisor for the implementation of the Eerste River rehabilitation project in Stellenbosch. A two-year project (Client Remgro);
- Compilation of an alien invasive plant removal plan for Cape Town Film Studios, Faure Cape Town.
- Freshwater impact assessment studies and water use authorisation applications for various proposed developments.
- More than 20 power line and substation applications and more than 15 alternative energy projects.

Appendix B: Specialist Statement of Independence

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 - 12), near De Aar, Northern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

Details of Specialist, Declaration and Undertaking Under Oath

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1. SPECIALIST INFORMATION

Specialist Company Name:	Toni Belcher Sole Proprietary			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	Level 4 EME	Percentage Procurement recognition	
Specialist name:	Toni Belcher			
Specialist Qualifications:	M.Sc			
Professional affiliation/registration:	SACNASP (400040/10 Ecological and Environmental Science)			
Physical address:	53 Dummer Street, Somerset West			
Postal address:	53 Dummer Street, Somerset West			
Postal code:	7130	Cell:	+27 82 883 8055	
Telephone:	+27 82 883 8055	Fax:	-	
E-mail:	toni@BlueScience.co.za			

2. DECLARATION BY THE SPECIALIST

I, Antonia Belcher, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

Toni Belcher Sole Proprietary

Name of Company:

18 May 2023

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Antonia Belcher, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Toni Belcher Sole Proprietary

Name of Company

18 May 2023

Date

Signature of the Commissioner of Oaths

2023/05/18

Date

SOUTH AFRICAN POLICE SERVICE
COMMUNITY SERVICE CENTRE
2023 -05- 17
SOMERSET WEST
AMAPOLISA OMZANTSHI AFRICA

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
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NEAS Reference Number:	DEA/EIA/
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1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

SPECIALIST INFORMATION

Specialist Company Name:	BlueScience (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	Level 4 EME	Percentage Procurement recognition	
Specialist name:	Dana Grobler			
Specialist Qualifications:	B.Sc (Hons)			
Professional affiliation/registration:	002272			
Physical address:	Unit 13 | Technostell Building | 9 Quantum Street | Technopark | Stellenbosch | 7600			
Postal address:	PO Box 455, Somerset Mall			
Postal code:	7137	Cell:	-	
Telephone:	021 851 0555	Fax:	-	
E-mail:	dana@bluescience.co.za			

1. DECLARATION BY THE SPECIALIST

I, Daniel Frederik Grobler, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

BlueScience (Pty) Ltd

Name of Company:

18 May 2023

Date

Details of Specialist, Declaration and Undertaking Under Oath

2. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Daniel Frederik Grobler, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

BlueScience (Pty) Ltd

Name of Company

18 May 2023

Date

Signature of the Commissioner of Oaths

2023/05/18

Date

SOUTH AFRICAN POLICE SERVICE
COMMUNITY SERVICE CENTRE
2023 -05- 17
SOMERSET WEST
AMAPOLISA OMZANTSHI AFRICA

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Daniel Frederik Grobler

Registration Number: 002272

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Environmental Science (Professional Natural Scientist)
Water Resources Science (Professional Natural Scientist)
Aquatic Science (Professional Natural Scientist)

Effective **13 May 1993** Expires **31 March 2024**

Chairperson

Chief Executive Officer

To verify this certificate scan this code

Appendix C: Site Sensitivity Verification

Prior to commencing with the Aquatic Biodiversity Specialist Assessment in accordance with the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity (Government Notice 320, dated 20 March 2020), a site sensitivity verification was undertaken to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

The details of the site sensitivity verification are noted below:

Date of Site Visit	4 March 2022
Specialist Name	Toni Belcher
Professional Registration Number	400040/10
Specialist Affiliation / Company	-

The proposed site for the **Solar Photovoltaic (PV) Facilities and associated infrastructure, near De-Aar, Northern Cape Province**, was assessed in terms of its aquatic biodiversity sensitivity using a desktop analysis using available aquatic ecosystem mapping, aerial imagery and a site visit, undertaken on 4 March 2022. A literature survey was also undertaken to determine any aquatic biodiversity sensitivities that may occur in the surrounding area.

The field visit comprised delineation, characterisation and integrity assessments of the aquatic habitats within the site. Mapping of the freshwater features was undertaken using a GPS Tracker and mapped in PlanetGIS and Google Earth Professional.

The following techniques and methodologies were utilised to undertake the assessments:

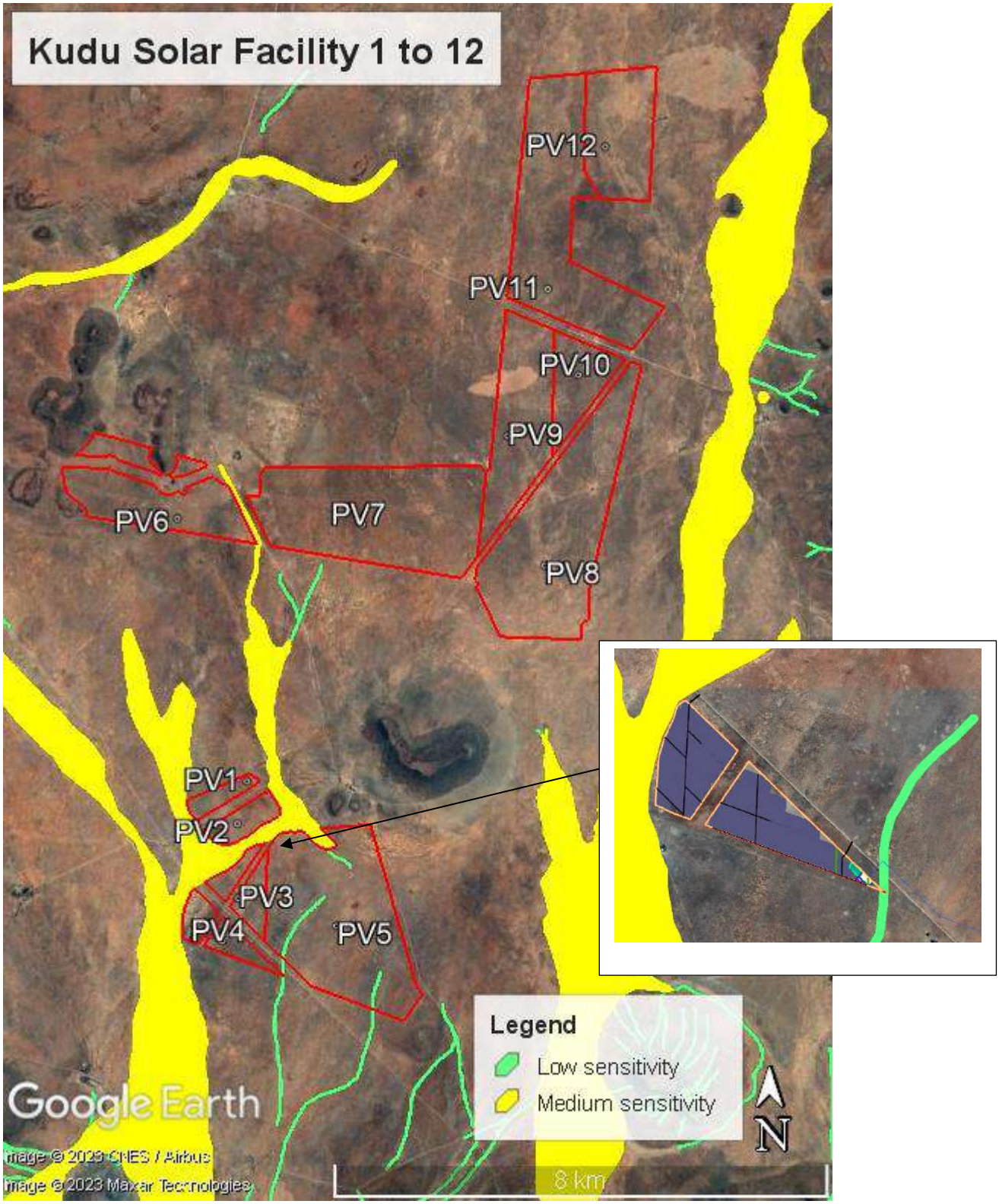
- The guideline document, “A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas” document, as published by the former Department of Water Affairs and Forestry (DWAF) (2005) (currently operating as the Department of Water and Sanitation (DWS), was followed for the delineation of the aquatic habitats;
- The present ecological condition of the watercourses was determined using the National River Health Programme and Wet-Health methodologies;
- The ecological importance and ecological sensitivity (EI&ES) assessment of the watercourses was conducted according to the guidelines as developed by DWAF (1999); and
- Recommendations made concerning the adoption of buffer zones within the study area were based on watercourse functioning and site characteristics as well as the DWS buffer tool.

The aquatic features within the study area comprise ephemeral unnamed tributaries of the Orange River. The larger watercourses flow along the eastern and western extents of the study area, flowing in a northerly direction to join the Orange River downstream of Van der Kloof Dam. Associated with these larger watercourses are wide floodplains. Smaller watercourses and drainage features drain into the larger river corridors. The rivers can all be characterised as foothill and lowland rivers within the Nama Karoo Ecoregion. The watercourses and associated wetlands and floodplains are in a largely natural to moderately modified condition due to the low level of impact in the area. It is recommended that the larger watercourses, floodplains and wetlands within the site are not allowed to degrade further from their current ecological condition of largely natural to moderately modified.

Impacts on the watercourses in the study area are associated with agricultural encroachment, livestock grazing and infrastructure (road and powerline) construction and maintenance. The ephemeral aquatic ecosystems are particularly vulnerable to changes in hydrology as they are specifically adapted to the sporadic flow conditions that naturally occur. Contaminants and sediment are not regularly flushed from these streams.

The Screening Tool has indicated that the wider area surrounding the site is generally of low Aquatic Biodiversity Combined Sensitivity. The very high sensitivity mapped within the study site is linked to the mapped wetlands in the National Wetland Map version 5 (the wider river floodplains associated with the unnamed tributaries of the Orange River located in the eastern and western portions of the wider study area). The proposed project components have avoided the areas indicated as being of very high sensitivity such that they are only located in areas of low sensitivity.

Below is the aquatic ecosystem sensitivity mapping for the study area, based on the site verification assessment undertaken.



Google Earth image showing the mapped aquatic sensitivities for the proposed projects. This report is focused on Kudu Solar Facility 4 shown in the insert.

Appendix D: Impact Assessment Methodology

The impact assessment includes:

- *the nature, status, significance and consequences of the impact and risk;*
- *the extent and duration of the impact and risk;*
- *the probability of the impact and risk occurring;*
- *the degree to which impacts and risks can be mitigated;*
- *the degree to which the impacts and risks can be reversed; and*
- *the degree to which the impacts and risks can cause loss of irreplaceable resources.*

Terminology used in impact assessment can overlap. To avoid ambiguity, please note the following clarifications (that are based on NEMA and the EIA Regulations):

- *The term environment is understood to have a broad interpretation that includes both the natural (biophysical) environment and the socio-economic environment. The term socio-ecological system is also used to describe the natural and socio-economic environment and the interactions amongst these components.*
- *Significance = Consequence x Probability, which means that significance is equivalent to risk.*
- *The impact can have a positive or negative status. The significance of a negative impact may be called a risk, and the significance of a positive impact may be called an opportunity.*

The following principles are to underpin the application of this methodology:

- *Transparent and repeatable process - specialists are to describe the thresholds and limits they apply in their assessment, wherever possible.*
- *Adapt parameters to context (where justified) – the methodology proposes some thresholds (e.g. for spatial extent, in Step 3 below), however, if the nature of the impact requires a different definition of the categories of spatial extent, then this can be provided and described.*
- *Combination of a quantitative and qualitative assessment – where possible, specialists are to provide quantitative assessments (e.g. areas of habitat affected, decibels of noise, number of jobs), however, it is recognised that not all impacts can be quantified, and then qualitative assessments are to be provided.*

As per the DFFE Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect and cumulative:

- *Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.*
- *Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.*
- *Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.*

The impact assessment methodology includes the aspects described below.

- ***Step 1**: **Nature** of impact/risk - The type of effect that a proposed activity will have on the environment.*

- ***Step 2**: **Status** - Whether the impact/risk on the overall environment will be:*
    - *Positive - environment overall will benefit from the impact/risk;*
    - *Negative - environment overall will be adversely affected by the impact/risk; or*
    - *Neutral - environment overall not be affected.*

- ***Step 3**: **Qualitatively** determine the **consequence** of the impact/risk by identifying the **a) SPATIAL EXTENT; b) DURATION; c) REVERSIBILITY; AND d) IRREPLACEABILITY**.*

    - ***A) Spatial extent** – The size of the area that will be affected by the impact/risk:*
        - *Site specific;*
        - *Local (<10 km from site);*
        - *Regional (<100 km of site);*
        - *National; or*
        - *International (e.g. Greenhouse Gas emissions or migrant birds).*

    - ***B) Duration** – The timeframe during which the impact/risk will be experienced:*
        - *Very short term (instantaneous);*
        - *Short term (less than 1 year);*
        - *Medium term (1 to 10 years);*
        - *Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration)); or*
        - *Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).*

    - ***C) Reversibility** of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):*
        - *High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);*
        - *Moderate reversibility of impacts;*
        - *Low reversibility of impacts; or*
        - *Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).*

    - ***D) Irreplaceability** of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):*
        - *High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);*
        - *Moderate irreplaceability of resources;*
        - *Low irreplaceability of resources; or*
        - *Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).*

*Some of the criteria are quantitative (e.g. spatial extent and duration) and some may be described in a quantitative or qualitative manner (e.g. reversibility and irreplaceability). The specialist then combines these criteria in a qualitative manner to determine the **consequence**.*

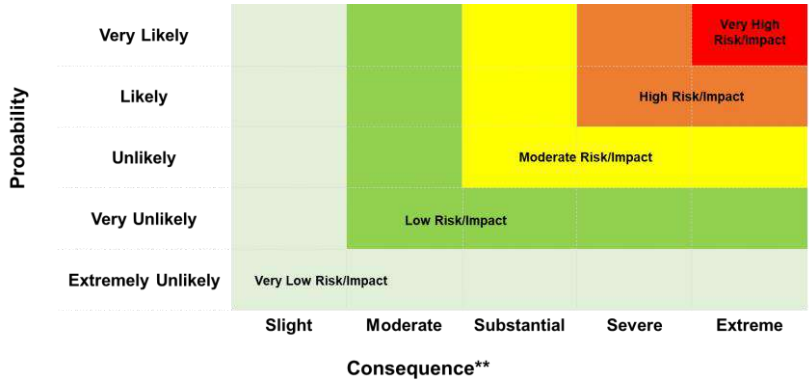
The consequence terms ranging from slight to extreme must be calibrated per Specialist Study so that there is transparency and consistency in the way a risk/impact is measured. For example, from a biodiversity and ecology perspective, the consequence ratings could be defined according to a reduction in population or occupied area in relation to Species of Conservation Concern (SCC) status, ranging from slight consequence for defined areas of Least Concern, to extreme consequence for defined areas that are Critically Endangered. For example, from a social perspective, a slight consequence could refer to small and manageable impacts, or impacts on small sections of the community; a moderate consequence could refer to impacts which affect the bulk of the local population negatively or may produce a net negative impact on the community; and an extreme consequence could refer to impacts which could result in social or political violence or institutional collapse.

- ***Consequence*** *– The anticipated consequence of the risk/impact is generally defined as follows:*
    - *Extreme (extreme alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they permanently cease);*
    - *Severe (severe alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease);*
    - *Substantial (substantial alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease;*
    - *Moderate (notable alteration of natural or socio-economic systems, patterns or processes, i.e. where the natural or socio-economic environment continues to function but in a modified manner; or*
    - *Slight (negligible and transient alteration of natural or socio-economic systems, patterns or processes, i.e. where natural systems/environmental or socio-economic functions, patterns, or processes are not affected in a measurable manner, or if affected, that effect is transient and the system recovers).*

- ***Step 4****: Rate the* ***probability*** *of the impact/risk using the criteria below:*

    - ***Probability*** *– The probability of the impact/risk occurring:*
        - *Extremely unlikely (little to no chance of occurring);*
        - *Very unlikely (<30% chance of occurring);*
        - *Unlikely (30-50% chance of occurring)*
        - *Likely (51 – 90% chance of occurring); or*
        - *Very Likely (>90% chance of occurring regardless of prevention measures).*

- ***Step 5****: Use both the* ***consequence*** *and* ***probability*** *to determine the* ***significance*** *of the identified impact/risk (qualitatively as shown in Figure 1). Significance definitions and rankings are provided below:*



[Qualitatively determined based on Spatial Extent, Duration, Reversibility and Irreplaceability]

Figure 1. Guide to assessing risk/impact significance as a result of consequence and probability.

- ***Significance*** *– Will the impact cause a notable alteration of the environment?*
    - *Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
    - *Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
    - *Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);*
    - *High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and*
    - *Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).*

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- *Very low = 5;*
- *Low = 4;*
- *Moderate = 3;*
- *High = 2; and*
- *Very high = 1.*

The specialists must provide a written supporting motivation of the assessment ratings provided.

- ***Step 6****: Determine the* ***Confidence Level*** *– The degree of confidence in predictions based on available information and specialist knowledge:*
    - *Low;*
    - *Medium; or*
    - *High.*

Appendix E: Compliance with the Aquatic Biodiversity Protocol (GN 320, 20 March 2020)

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	Section where this has been addressed in the Specialist Report
2.3. The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects: 2.3.1. a description of the aquatic biodiversity and ecosystems on the site, including; a) aquatic ecosystem types; and b) presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns;	Section 4.2, Section 4.3 and Section 4.4
2.3.2. the threat status of the ecosystem and species as identified by the screening tool;	Section 4.3 and Section 4.4
2.3.3. an indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the given status (i.e. if the site includes a wetland or a river freshwater ecosystem priority area or sub catchment, a strategic water source area, a priority estuary, whether or not they are free -flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area); and	Section 4.2
2.3.4. a description of the ecological importance and sensitivity of the aquatic ecosystem including: a) the description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); and b) the historic ecological condition (reference) as well as present ecological state of rivers (in- stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater).	Section 4.2
2.4. The assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate.	Section 5
2.5. Related to impacts, a detailed assessment of the potential impacts of the proposed development on the following aspects must be undertaken to answer the following questions: 2.5.1. Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal? 2.5.2. Is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present? 2.5.3. How will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include: a) impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes);	Section 4.4 and Section 6

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	Section where this has been addressed in the Specialist Report
b) will the proposed development change the sediment regime of the aquatic ecosystem and its sub -catchment (e.g. sand movement, meandering river mouth or estuary, flooding or sedimentation patterns); c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g. at the source, upstream or downstream portion, in the temporary I seasonal I permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.); and d) to what extent will the risks associated with water uses and related activities change;	
2.5.4. how will the proposed development impact on the functioning of the aquatic feature? This must include: a) base flows (e.g. too little or too much water in terms of characteristics and requirements of the system); b) quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over -abstraction or instream or off stream impoundment of a wetland or river); c) change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley- bottom wetland to a channelled valley -bottom wetland); d) quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); e) fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and f) the loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.);	Section 6 and 7
2.5.5. how will the proposed development impact on key ecosystems regulating and supporting services especially: a) flood attenuation; b) streamflow regulation; c) sediment trapping; d) phosphate assimilation; e) nitrate assimilation; f) toxicant assimilation; g) erosion control; and h) carbon storage?	Section 6 and 7
2.5.6. how will the proposed development impact community composition (numbers and density of species) and integrity (condition, viability, predator - prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Section 6 and 7
2.6. In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: a) size of the estuary; b) availability of sediment; c) wave action in the mouth; d) protection of the mouth; e) beach slope;	N/A

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	Section where this has been addressed in the Specialist Report
f) volume of mean annual runoff; and g) extent of saline intrusion (especially relevant to permanently open systems).	
2.7. The findings of the specialist assessment must be written up in an Aquatic Biodiversity Specialist Assessment Report that contains, as a minimum, the following information:	
2.7.1. contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	Section 1.2 and Appendix A
2.7.2. a signed statement of independence by the specialist;	Appendix B
2.7.3. a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 2
2.7.4. the methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant;	Section 2
2.7.5. a description of the assumptions made, any uncertainties or gaps in knowledge or data;	Section 2.2
2.7.6. the location of areas not suitable for development, which are to be avoided during construction and operation, where relevant;	Section 4.4
2.7.7. additional environmental impacts expected from the proposed development;	Section 7
2.7.8. any direct, indirect and cumulative impacts of the proposed development on site;	Section 6 and Section 7
2.7.9. the degree to which impacts and risks can be mitigated;	Section 7
2.7.10. the degree to which the impacts and risks can be reversed;	Section 7
2.7.11. the degree to which the impacts and risks can cause loss of irreplaceable resources;	Section 7
2.7.12. a suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies;	Section 4.4
2.7.13. proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr);	Section 10
2.7.14. a motivation must be provided if there were development footprints identified as per paragraph 2.4 above that were identified as having a "low" aquatic biodiversity sensitivity and that were not considered appropriate;	Not Applicable
2.7.15. a substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not; and	Section 11.1
2.7.16. any conditions to which this statement is subjected.	Section 11.2
2.8. The findings of the Aquatic Biodiversity Specialist Assessment must be incorporated into the Basic Assessment Report or the Environmental Impact Assessment Report including the mitigation and monitoring measures as identified, that are to be included in the EMPr.	This Aquatic Biodiversity and Species Assessment serves as Chapter 8 of the EIA Report, and the findings therefore are included herein. The mitigation and monitoring measures are also included herein, as well as in the EMPrs included as Appendix I and Appendix J of the EIA Report.

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	Section where this has been addressed in the Specialist Report
2.9. A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	This Aquatic Biodiversity and Species Assessment serves as Chapter 8 of the EIA Report, and it has been signed (refer to Appendix B of this chapter).



CHAPTER 9:

Avifauna Assessment



CSIR
Touching lives through innovation

AVIFAUNAL SPECIALIST ASSESSMENT REPORT:

Scoping and Environmental Impact Assessment (EIA) Process for the Proposed Development of a Solar Photovoltaic Facility (Kudu Solar Facility 4) and associated infrastructure, near De Aar, Northern Cape Province



Report prepared for:	*Report prepared by:*
CSIR – Environmental Management Services P O Box 320 Stellenbosch 7599 South Africa	Chris van Rooyen Consulting P.O Box 2676 Fourways 2055 South Africa

V1: 26 April 2023



The Project Applicant, Kudu Solar Facility 4 (Pty) Ltd, is proposing to develop the Kudu Solar Photovoltaic (PV) cluster and associated Electricity Grid Infrastructure (EGI) near De Aar in the Northern Cape. The Kudu Project will entail the proposed development of up to 12 Solar PV Facilities, as well as their associated infrastructure and EGI.

This Avifauna Specialist Assessment is focused on the full extent of the Study Area. The proposed Solar Facilities will make use of PV solar technology to generate electricity from energy derived from the sun. Each solar PV facility will have a range of associated infrastructure, including, but not limited to, an on-site substation complex, battery energy storage systems (BESS) and is proposed to connect to an existing 400 kV power line via dedicated 132 kV power lines.

It is estimated that each PV facility will have a capacity ranging from up to 50 MWac to 350 MWac. Each of the PV facilities would be its own project and would require its own, separate Environmental Authorisation (EA).

This report serves as the Avifaunal Specialist Assessment Report input that was prepared as part of the Scoping and Environmental Impact Assessment (S&EIA) for the proposed Kudu Solar Photovoltaic (PV) cluster. The EGI components would be subjected to a separate Environmental Assessment process.

Separate reports have been compiled for each PV facility. This report covers the Kudu Solar Facility 4 and associated infrastructure.

1. Avifauna

A total of 85 species could potentially occur within the Broader Area where the project is located (see Appendix 9.E). Of these, 21 are classified as priority species for solar developments. Of the 21 priority species, 17 were recorded during the monitoring, and 15 priority species have a medium to high probability of occurring regularly in the Study Area. Five SCC were recorded during the site surveys, namely Blue Crane, Martial Eagle, Verreaux's Eagle, Cape Vultures and White-backed Vulture.

2. Identification of Potential Impacts/Risks

The potential impacts identified in the course of the study are listed below.

Construction Phase

- Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure.

Operational Phase

- Displacement due to habitat transformation associated with the presence of the solar PV plant and associated infrastructure
- Collisions with the solar panels
- Entrapment in perimeter fences
- Electrocutions in the onsite substation complex
- Electrocution of priority species on the internal 33kV powerlines.

Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning of the solar PV plant and associated infrastructure.

Cumulative Impacts

- Displacement due to disturbance associated with the construction and decommissioning of the solar PV plants and associated infrastructure.
- Displacement due to habitat transformation associated with the presence of the solar PV plants and associated infrastructure.
- Collisions with the solar panels.
- Entrapment in perimeter fences.
- Electrocutions in the onsite substation complexes.
- Electrocution of priority species on the internal 33kV powerlines.

3. Sensitivities identified by the National Web-Based Environmental Screening Tool

The Screening Tool currently assigns a low to medium sensitivity to birds as per the Animal Species Theme. However, based on the field surveys, the classification of **High** sensitivity for avifauna is proposed **for all 12** proposed development footprints. None of the development footprints has a specific habitat feature that distinguishes it from the rest of the Study Area which would warrant a lesser rating. The Kudu Solar Facility 4 has a **High sensitivity for avifauna**.

4. Specialist Sensitivity Analysis and Verification

4.1 Very High sensitivity: No Go

4.1.1 All infrastructure exclusion zones

Verreaux's Eagle nest: A 1km all infrastructure exclusion zone is recommended to prevent the displacement of the breeding pair during the construction phase due to disturbance. In addition, the buffer area will reduce the risk of injury to the juvenile bird due to collision with the solar panels, when it starts flying and practicing its hunting technique around the nest. None of the development footprints fall within this zone. The 1km no disturbance buffer is based on personal observations, and is also the recommended no disturbance buffer in the latest best practice guidelines for Verreaux's Eagles and wind farm developments. (Ralston – Patton, S & Murgatroyd M. 2021. Verreaux's Eagles and Wind Farms. Guidelines for impact assessment, monitoring, and mitigation. Second edition. Birdlife South Africa). In any event, the closest development area is located 2km away from the Verreaux's Eagle nest which is more than adequate to prevent any disturbance of the breeding birds.

4.1.2 Solar panel exclusion zones (other infrastructure allowed)

Waterpoints: Surface water in this semi-arid habitat is crucially important for priority avifauna and many non-priority species. The development footprints and the immediate surrounding area contain several boreholes which are sources of surface water. It is preferable to leave some open space where possible with no solar panels, for birds to access and leave the surface water area unhindered[1]. Surface water is also important area for raptors to hunt birds which congregate around water troughs, and they should have enough space for fast aerial pursuit. This will also benefit Blue Cranes which prefer to breed close to water bodies. It is noted that the area surrounding the development footprints contain several boreholes that will not be affected by the proposed development, and these boreholes will ensure that the local avifauna will still have access to adequate sources of surface water.

4.2 High sensitivity zones

The entire Study Area is a high sensitivity zone due to the potential presence of several Species of Conservation Concern (SCCs) (see Section 4.4.1) including Ludwig's Bustard, Secretarybird, Martial Eagle, Cape Vulture and White-backed Vulture which could utilise the whole Study Area for foraging. However, these species do not require specific avoidance measures at this stage because there is still adequate habitat available outside the Study Area.

[1] While some of the waterpoints in the development footprint will be removed, the applicant has agreed to retain some water points which will be buffered by a minimum circular solar panel exclusion zone of 50m. The removal of some of the water points will therefore not be a significant impact.

5. Impact Assessment Summary

The overall impact significance is provided in the table below, in terms of pre- and post-mitigation.

Overall Impact Significance (Pre- and Post-Mitigation)

Phase	**Overall Impact Significance (Pre-Mitigation)**	**Overall Impact Significance (Post Mitigation)**
Construction	Moderate (3)	Low (4)
Operational	Low (4) to Moderate (3)	Very Low (5) to Low (4)
Decommissioning	Moderate (3)	Low (4)
Nature of Impact	**Overall Impact Significance**	**Overall Impact Significance**
Cumulative - Construction	Moderate (3)	Low (4)
Cumulative - Operational	High (2)	Moderate (3)
Cumulative - Decommissioning	Moderate (3)	Low (4)

6. Final Specialist Statement and Authorisation Recommendation

The proposed Kudu Solar Facility 4 will have a range of potential pre-mitigation impacts on priority avifauna ranging from low to high, which is expected to be reduced to medium and low with the appropriate mitigation. No fatal flaws were discovered during the investigations. The Project is supported with the understanding that all mitigation measures provided in this report will be strictly implemented.



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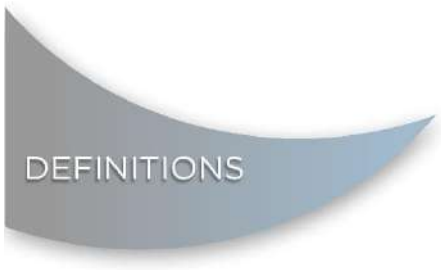
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ABBREVIATIONS

Abbreviations	
BLSA	BirdLife South Africa
DFFE	Department of Forestry, Fisheries and the Environment
NEMA	National Environmental Management Act 107 of 1998 (as amended)
REDZ	Renewable Energy Development Zone
S&EIA	Scoping and Environmental Impact Assessment
SABAP	South African Bird Atlas Project
SACNASP	South African Council for Natural and Scientific Professions
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
SEF	Solar Energy Facility



Definitions	
Priority species	South African Red Data species, South African endemics and near-endemics, raptors and waterbirds.
Broader Area	The area encompassed by the 9 pentads where the project is located.
Study Area	The area covered by the eight land parcels where the solar PV projects will be located, totalling approximately 8 150 hectares.
Development Footprint	The area where the actual development will be located, i.e. the footprint containing the PV solar arrays and associated infrastructure. Original Scoping Buildable Areas were considered at the commencement of the EIA Process and following the identification of sensitivities and other considerations, Revised Scoping Buildable Areas were determined at the end of the Scoping Phase. The Original and Revised Scoping Buildable Areas served as development footprints. The aim of the EIA Phase is to identify the preferred development footprint or layout within the approved site as contemplated in the accepted Scoping Report, which in this case is the Study Area.
Pentad	A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km.

9. AVIFAUNAL SPECIALIST ASSESSMENT REPORT

This chapter includes the Avifaunal Specialist Assessment Report that was prepared by Chris van Rooyen and Albert Froneman of Chris van Rooyen Consulting, as part of the Scoping and Environmental Impact Assessment (EIA) Process for the proposed development of the Kudu Solar Facility 4 and associated infrastructure, near De-Aar, Northern Cape Province.

9.1 Introduction

The Project Applicant, Kudu Solar Facility 4 (Pty) Ltd, is proposing to develop the Kudu Solar Photovoltaic (PV) cluster and associated Electricity Grid Infrastructure (EGI). The Kudu Project will entail the proposed development of up to 12 Solar PV Facilities, as well as their associated infrastructure and EGI. The EGI components would be subjected to a separate Environmental Assessment process.

It is estimated that each PV facility will have a capacity ranging from up to 50 MWac to 350 MWac. Each of the PV facilities would be its own project and would require its own, separate Environmental Authorisation (EA). Separate reports have been compiled for each PV facility. **This report covers the Kudu Solar Facility 4 and associated infrastructure**.

9.1.1 Scope, Purpose and Objectives of this Specialist Assessment Report

The purpose of the report is to determine the main issues and potential impacts of the proposed project on avifauna, through a combination of desktop analysis and field work. The report was prepared to provide inputs to the EIA Process for the project as required by the EIA Regulations promulgated in terms of the National Environmental Management Act 107 of 1998, as amended, (NEMA). This Specialist Assessment Report fulfils the requirements of the Animal Species Protocol published in Government Notice (GN) 1150 in October 2020, as well as the Species Environmental Assessment Guideline (Version 3.1, 2022) published by the South African National Biodiversity Institute (SANBI), and the BirdLife South Africa (BLSA) Guideline for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa.

9.1.2 Details of Specialists

This specialist assessment has been undertaken by Chris van Rooyen and Albert Froneman of Chris van Rooyen Consulting. Chris van Rooyen works in association with and under the supervision of Albert Froneman, who is registered with the South African Council for Natural and Scientific Professions (SACNASP), with Registration Number 400177/09 in the field of Zoological Science.

Chris van Rooyen (Avifaunal Specialist) vanrooyen.chris@gmail.com

Chris has decades of experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global

expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous power line and renewable energy projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Albert Froneman (Avifaunal Specialist) albert.fronmena@gmail.com

Albert has a Master of Science degree in Conservation Biology from the University of Cape Town and started his career in the natural sciences as a Geographic Information Systems (GIS) specialist at Council for Scientific and Industrial Research (CSIR). In 1998, he joined the Endangered Wildlife Trust where he headed up the Airports Company South Africa – EWT Strategic Partnership, a position he held until he resigned in 2008 to work as a private ornithological consultant. Albert's specialist field is the management of wildlife, especially bird related hazards at airports. His expertise is recognized internationally; in 2005 he was elected as Vice Chairman of the International Bird Strike Committee. Since 2010, Albert has worked closely with Chris van Rooyen in developing a protocol for pre-construction monitoring at wind energy facilities, and he is currently jointly coordinating pre-construction monitoring programmes at several renewable energy facilities. Albert also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

A curriculum vitae is included in Appendix 9.A of this chapter. In addition, a signed specialist statement of independence is included in Appendix 9.B of this chapter.

9.1.3 Terms of Reference

The overall terms of reference for this assessment report are as follows, as per the accepted Plan of Study for the EIA:

- Describe the methodology used to undertake the Site Sensitivity Verification, impact assessment and site inspection, including equipment and modelling used where relevant;
- State the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;
- Describe the mean density of observations/number of sample sites per unit area of site inspection observations, where possible, as noted in the Species Environmental Assessment Guideline;
- Describe the affected environment from an avifaunal perspective, including the details of all Species of Conservation Concern (SCC) found or suspected to occur on site, ensuring sensitive species are appropriately reported, as well as consideration of the surrounding habitats and avifaunal features (e.g. Ramsar sites, Important Bird Areas, wetlands, migration routes, feeding, roosting and nesting areas, etc.);

- Finalise the findings and outcomes of the pre-construction avifaunal monitoring programme that was conducted over a period of six months in accordance with the BLSA guideline for Solar PV developments (i.e. Regime 2);
- Describe and map bird habitats on the site, based on on-site monitoring, desk-top review, collation of available information, studies in the local area and previous experience. The assessment must also consider the maps generated by the Screening Tool. Include a section indicating how the Screening Tool was interrogated and whether classification of the site is accurate or not. If not, it must be motivated why the classification is not accurate;
- Determine the baseline environmental condition and sensitivity of the study area in terms of avifaunal features such as habitat use, roosting, feeding and nesting/breeding;
- Assessment of the project alternatives and identification of a preferred alternative with motivation for this selection;
- Discuss gaps in baseline data and other limitations and describe the expected impacts associated with the proposed solar facility and associated infrastructure;
- A description of the assumptions made, any uncertainties or gaps in knowledge or data, and limitations in the report;
- Identify potential sensitive environments and receptors that may be impacted on by the proposed solar facility;
- Specify development setbacks or buffers required, and provide clear motivations for these recommendations, including a description of the location of areas not suitable for development and to be avoided during construction and operation i.e. identify 'No-Go' areas, where applicable;
- Provide review input on the preferred infrastructure layout following the sensitivity analysis and layout identification;
- Determine the nature and extent of potential impacts i.e. potential direct, indirect and cumulative impacts of the proposed development on birds;
- Provide an impact statement / reasoned opinion, based on the findings of the specialist assessment, with regard to the acceptability of the project from an avifaunal impact perspective and a recommendation if the development should receive approval or not; and any conditions to which the opinion is subjected if relevant; and
- Recommend mitigation measures to reduce the impact of the expected impacts and recommend potential monitoring programmes. Also, identify best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts. This will be included in the EMPr. Also confirm if there are any specific environmental sensitivities or attributes present on the project site and any resultant site-specific impact management outcomes and actions that are not included in the pre-approved Generic Substation EMPr (GN 435).
- Identification of any additional protocols, licensing and/or permitting requirements that are relevant to the project and the implications thereof;
- Determine mitigation, impact management actions and outcomes, which could be implemented to as far as possible, reduce the effect of negative impacts and enhance the effect of positive impacts.

9.2 Approach and Methodology

The following methods were used to compile this report:

- Bird distribution data of the South African Bird Atlas 2 (SABAP2) was obtained from the University of Cape Town, as a means to ascertain which species occurs within the Broader Area i.e. within a block consisting of 9 pentad grid cells each within which the proposed projects are situated (see Figure 9-1). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. From 2007 to date, a total of 3 full protocol lists (i.e. surveys lasting a minimum of two hours each) have been completed for this area. In addition, 4 ad hoc protocol lists (i.e. surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the (2022.2) International Union for Conservation of Nature (IUCN) Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the habitat in the Study Area was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison *et al.* 1997) and the National Vegetation Map (2012 beta2) from the South African National Biodiversity Institute (SANBI) website (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org). Study Area is the area covered by the land parcels where the PV projects will be located.
- The Important Bird Areas of Southern Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth ©2023) was used in order to view the Study Area on a landscape level and to help identify sensitive bird habitat.
- Priority species were defined as follows:
  - South African Red Data species: High conservation significance
  - South African endemics and near-endemics: High conservation significance
  - Raptors: High conservation significance. Raptors are at the top of the food chain and play a key role in their ecosystems. When populations of birds of prey go down, then the numbers of their prey species go up, creating an imbalance in the ecosystem.
  - Waterbirds: Evidence indicate that waterbirds may be particularly susceptible to collisions with solar arrays due to the so-called lake effect, caused by the reflection of the sun of the smooth surface of solar panels.
- The SANBI BGIS map viewer was used to determine the locality of the proposed site relative to National Protected Areas and National Protected Areas Expansion Strategy (NPAES) focus areas.
- The Department of Forestry, Fisheries and the Environment (DFFE) National Screening Tool was used to determine the assigned avian sensitivity of the proposed Study Areas.
- Data collected during previous site visits to the Broader Area was also considered as far as habitat classes and the occurrence of priority species are concerned.
- The habitat suitability model developed by BLSA was used to determine where suitable breeding habitat is available for Verreaux's Eagles.
- The study was undertaken based on a combination of the following documents:
  - Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes (i.e. Terrestrial Animal Species) in terms of sections 24(5)(a) and

(h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted in Government Notice 1150 in October 2020);

- Guidelines for the Implementation of the Terrestrial Flora & Terrestrial Fauna Species Protocols for EIAs in South Africa produced by the SANBI and BirdLife South Africa (BLSA) on behalf of the DFFE (2022); and
- The BLSA Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa. BirdLife South Africa by Jenkins, A.R., Ralston-Patton, Smit-Robinson, A.H. 2017 (hereafter referred to as the Solar Guidelines) were consulted to determine the level of survey effort that is required.

- The main source of information on the avifaunal diversity and abundance at the Study Area is an integrated pre-construction monitoring programme which was implemented between March and May 2022, covering the proposed 12 Kudu PV projects. The pre-construction avifaunal monitoring programme followed an adapted Regime 2 protocol as defined in the Birds and Solar Energy best practice guidelines (Jenkins *et al.* 2017) which require a minimum of two surveys over a six-month period (see **Appendix 9.F of this chapter for more details**).
- The potential impacts have been assessed according to the Impact Assessment Methodology contained in Chapter 4 of the EIA Report and Appendix 9.D of this chapter. The methodology includes the degree to which impacts and risks can be mitigated; reversed; and can cause loss of irreplaceable resources. Impact significance is rated both without and with mitigation, and covers the construction, operational and decommissioning phases of the project.

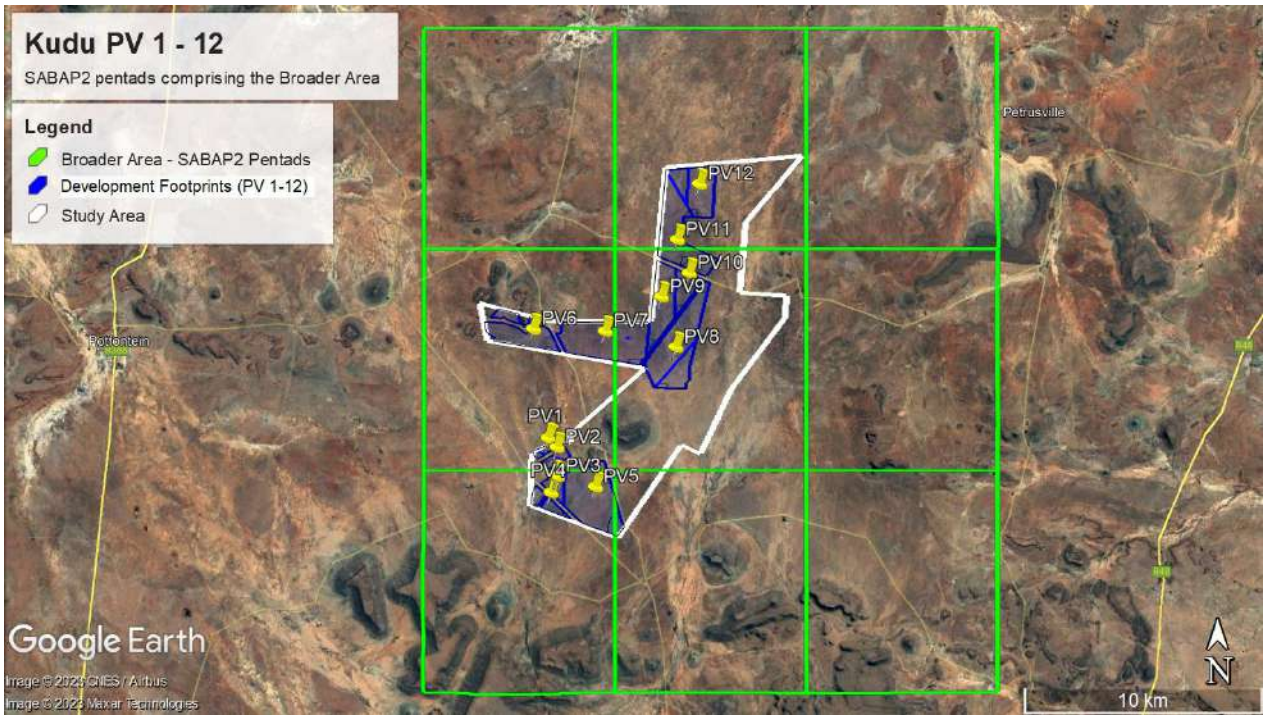


Figure 9-1: The 9 SABAP2 pentads comprising the Broader Area where the Study Area is located.

9.2.1 Information Sources

The following data sources were used to compile this report:

Data / Information	Source	Date	Type	Description
South African Protected Areas Database (SAPAD)	Department of Forestry, Fisheries and the Environment (DFFE)	2022, Q3	Spatial	• Spatial delineation of protected areas in South Africa. Updated quarterly
Atlas of Southern African Birds 1 (SABAP1)	University of Cape Town	1987-1991	Spatial, reference	• SABAP1, which took place from 1987-1991.
South African Bird Atlas Project 2 (SABAP2)	University of Cape Town	May 2022	Spatial, database	• SABAP2 is the follow-up project to the SABAP1. The second bird atlas project started on 1 July 2007 and is still growing. The project aims to map the distribution and relative abundance of birds in southern Africa.
National Vegetation Map	South African National Biodiversity Institute (SANBI) (BGIS)	2018	Spatial	• The National Vegetation Map Project (VEGMAP) is a large collaborative project established to classify, map and sample the vegetation of South Africa, Lesotho and Swaziland.
Red Data Book of Birds of South Africa, Lesotho and Swaziland	BirdLife South Africa	2015	Reference	• The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland is an updated and peer-reviewed conservation status assessment of the 854 bird species occurring in South Africa undertaken in collaboration between BirdLife South Africa, the Animal Demography Unit of the University of Cape Town, and the SANBI.
International Union for Conservation of Nature (IUCN) Red List of Threatened Species (2022.2)	IUCN	2022.2	Online reference source	• Established in 1964, the IUCN's Red List of Threatened Species is the world's most comprehensive information source on the global extinction risk status of animal, fungus and plant species.

Data / Information	Source	Date	Type	Description
Important Bird and Biodiversity Areas of South Africa	BirdLife South Africa	2015	Reference work	• Important Bird and Biodiversity Areas (IBAs), as defined by BirdLife International, constitute a global network of over 13 500 sites, of which 112 sites are found in South Africa. IBAs are sites of global significance for bird conservation, identified nationally through multi-stakeholder processes using globally standardised, quantitative and scientifically agreed criteria.
Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa	Department of Environmental Affairs, 2015. Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa. CSIR Report Number: CSIR/CAS/EMS/ER/2015/0001/B. Stellenbosch.	2015	SEA	• The SEA identifies areas where large scale wind and solar PV energy facilities can be developed in terms of Strategic Infrastructure Project (SIP) 8 and in a manner that limits significant negative impacts on the natural environment, while yielding the highest possible socio-economic benefits to the country. These areas are referred to as Renewable Energy Development Zones (REDZs).
Phase 2 Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa	Department of Environment, Forestry and Fisheries, 2019. Phase 2 Strategic Environmental Assessment for wind and solar PV energy in South Africa. CSIR Report Number: CSIR/SPLA/SECO/ER/2019/0085 Stellenbosch, Western Cape.	2019	SEA	• The SEA identifies additional areas where large scale wind and solar PV energy facilities can be developed in terms of SIP 8 and in a manner that limits significant negative impacts on the natural environment, while yielding the highest possible socio-economic benefits to the country. These areas are referred to as Renewable Energy Development Zones (REDZs). These are referred to as REDZ 9 eMalahleni (solar PV), REDZ 10 Klerksdorp (solar PV) and REDZ 11 Beaufort West (wind and solar PV). The numbers are a continuation from the already gazetted eight REDZs from the Phase 1 wind and solar PV SEA.
The National Screening Tool	DFFE	2023	Spatial	• The National Web based Environmental Screening Tool is a geographically based web-enabled application which allows a proponent

Data / Information	Source	Date	Type	Description
				intending to submit an application for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended to screen their proposed site for any environmental sensitivity.
National Protected Areas and National Protected Areas Expansion Strategy (NPAES)	DFFE	2016	Spatial	• The goal of NPAES is to achieve cost effective protected area expansion for ecological sustainability and adaptation to climate change. The NPAES sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion.
Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020)	NEMA	2020	Regulations	• Prescribe protocols in respect of specific environmental themes (i.e. Terrestrial Animal Species and Terrestrial Plant Species) for the assessment of, as well as the minimum report content requirements on, the environmental impacts for activities requiring environmental authorisation.
Guidelines for the Implementation of the Terrestrial Flora & Terrestrial Fauna Species Protocols for EIAs in South Africa produced by the South African National Biodiversity Institute on behalf of the Department of Environment, Forestry and Fisheries (2022)	South African National Biodiversity Institute (SANBI) (BGIS)	2022.V3.1	Guidelines	• The purpose of the Species Environmental Assessment Guideline is to provide background and context to the assessment and minimum reporting criteria contained within the Terrestrial Animal and Plant Species Protocols; as well as to provide guidance on sampling and data collection methodologies for the different taxonomic groups that are represented in the respective protocols. This guideline is intended for specialist studies undertaken for activities that have triggered a listed and specified activity in terms of the National Environmental Management Act, 1998 (No. 107 of 1998)

Data / Information	Source	Date	Type	Description
				(NEMA), as identified by the EIA Regulations, 2014 (as amended) and Listing Notices 1-3.
The BirdLife South Africa (BLSA) Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa. BirdLife South Africa by Jenkins, A.R., Ralston-Patton, Smit- Robinson, A.H. 2017	BirdLife South Africa	2017	Guidelines	• These guidelines were developed to ensure that any negative impacts on threatened or potentially threatened bird species are identified and effectively mitigated using structured, methodical and scientific methods. The guidelines prescribe the best practice approach to gathering bird data at proposed utility-scale solar energy plants, primarily for the purposes of accurate and effective impact assessment.
The BirdLife South Africa habitat suitability model for Verreaux's Eagle to establish if there is suitable habitat for the species in the Study Area.	BirdLife South Africa	2023	Spatial	• This is a GIS layer developed by BirdLife South Africa that indicates the suitability of the habitat in a graded manner from a potential breeding perspective.
The results of the avifaunal pre-construction monitoring implemented at the Study Area between March and May 2022.	Chris van Rooyen Consulting	2022	Spatial and quantitative	• The data consist of the results of the transect and incidental counts and nest searches which were implemented at the 12 proposed Kudu solar facilities.

9.2.2 Assumptions, Knowledge Gaps and Limitations

This study assumed that the sources of information used in this report are reliable. In this respect, the following must be noted:

- The SABAP2 data is not regarded as an adequate indicator of the avifauna which could occur at the Study Area, and it was therefore further supplemented by data collected during the on-site surveys to date.
- The focus of the study was on the potential impacts of the proposed solar PV facility on priority species.
- Only one published scientific study on the impact of PV facilities on avifauna in South Africa (Visser *et al.* 2018) currently exists. Some reliance was therefore placed on expert opinion and data from existing monitoring programmes at solar facilities in the USA, where monitoring has been ongoing since 2013. The pre-cautionary principle was applied throughout, as the full extent of impacts on avifauna at solar facilities is not presently known.
- The assessment of impacts is based on the baseline environment as it currently exists at the Study Area.
- Cumulative impacts include all renewable energy projects (i.e. Wind and Solar PV Facilities) within a 30km radius that have received an authorisation or is in process. Refer to Chapter 4 of the EIA Report for a complete list of projects that have been considered for the cumulative impact assessment.
- Conclusions drawn in this study are based on experience of the specialist on the species found on site and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.
- The **Broader Area** is defined as the area encompassed by the 9 pentads where the project is located (see Figure 9-1 above). The **Study Area** is defined as the area covered by the land parcels where the proposed PV projects will be located (i.e. the full extent of the eight affected farm properties totalling approximately 8150 hectares (ha)). The full extent of these properties has been assessed in this study in order to identify environmental sensitivities and no-go areas. At the commencement of this Scoping and EIA Process, Original Scoping Buildable Areas were identified by the Project Developer following the completion of high-level environmental screening based on the Screening Tool. Following the identification of sensitivities during the Scoping Phase, the Project Developer took the sensitivities into account and formulated the **Revised Scoping Buildable Areas**. The Revised Scoping Buildable Areas were used to inform the design of the layout and were further assessed during this EIA Phase in order to identify the preferred development footprint of the proposed project on the approved site as contemplated in the accepted Scoping Report. The **development footprint** is where the actual development will be located, i.e. the footprint containing the PV solar arrays and associated infrastructure.

9.3 Description of Project Aspects relevant to the Avifaunal Specialist Assessment

The details of the Kudu Solar Facility 4 project are provided below. However, all the Solar Energy Facilities (SEFs) have the following relevant project components from an avifaunal perspective:

Kudu Solar Facility 4		
Component	**Description / dimensions**	
Area of PV Array	Proposed area occupied by PV Modules: Refer to the Chapter 2 of the EIA Report for feedback in this regard.	
Total developable area that includes all associated infrastructure within the fenced off area of the PV facility (excluding Access Roads)	Refer to the Chapter 2 of the EIA Report for feedback in this regard.	
Area occupied by inverter-transformer stations and height	Inverter-Transformer stations: 0.5 ha for the PV site (on average). The inverter stations will have a height of ± 3m each.	
On-site substation complex	The On-Site Substation Complex could include the following: • On-site Independent Power Producer (IPP) or Facility Substation (+-1 ha). • Battery Energy Storage System (BESS) (+-1 ha). • Switching Station and Collector Station (+-2 ha). This forms part of a separate Environmental Assessment or Registration process. The substation complex will approximately to 8 ha in area and will have a height of up to 10 m	
Temporary laydown area	This will extend up to 7 ha.	
Internal roads	New internal service roads will need to be established and these would either comprise farm (compacted dirt/gravel) roads or be paved.	
Upgrading of existing access road/s	Existing roads will be used as far as practically achievable and widened where required.	
Auxiliary buildings (e.g. Warehouses, Workshop, Site office, Operational and Maintenance building / centre, Guard houses, staff lockers, and Ablution facilities)	Maximum height (m):	Up to 10 m
	Footprint (m^2):	All Auxiliary buildings i.e. cumulative footprint up to 0.5 ha (i.e., 5000 m^2)
Battery storage	Battery technology type:	Lithium-ion or redox flow technology were assessed.
	Approximate footprint (ha):	A BESS would be developed within the on-site substation complex footprint (Covering approximately 8 ha)
	Maximum height (m):	Up to 10 m
	Capacity:	500MW/ 500MWh
Underground low voltage cables or cable trays	Maximum depth (m):	Up to 1.5 m
On-site medium voltage internal cables	Placement: Capacity: Depth:	Underground or above ground in certain sections 22 or 33 kV Maximum depth of 1.5 m
Fencing	The type of fencing will either be of palisade, mesh type or a fully electrified option (up to 3 m high). A single perimeter fence is proposed around the PV Facility.	

Refer to Chapter 2 of the EIA Report for a detailed description of the project components.

9.4 Baseline Environmental Description

9.4.1 Study Area Definition

The study area for the proposed Kudu Solar Facilities 1 to 12 is the full extent of the eight affected farm properties on which the proposed PV Facilities will be constructed. The full extent of these properties has been assessed in this study in order to identify environmental sensitivities and no-go areas. The total **study area** for the Kudu Solar Facilities 1 to 12 is approximately 8 150 hectares (ha).

At the commencement of this Scoping and EIA Process, the **Original Scoping Buildable Areas** were identified by the Project Developer following the completion of high-level environmental screening based on the Screening Tool.

Following the identification of sensitivities during the Scoping Phase, the Project Developer considered such sensitivities and formulated the **Revised Scoping Buildable Areas**. The **Revised Scoping Buildable Areas** were used to inform the design of the layout and further assessed during this EIA Phase in order to identify the preferred development footprint of the proposed project on the approved site as contemplated in the accepted Scoping Report. The **development footprint** is where the actual development will be located, i.e. the footprint containing the PV solar arrays and associated infrastructure and that also constitute the Project Area of Influence (PAOI).

9.4.2 General Description

9.4.2.1 Biomes and vegetation types

The Study Area is situated on a wide flat plain, with its centre approximately 32km southwest of the small town of Petrusville, and 23km from Potfontein railway stop in the Northern Cape Province, in the Nama Karoo biome, in the Upper Karoo Bioregion (Mucina & Rutherford 2006). The habitat in the Study Area is highly homogenous and consists of extensive plains with low shrub and a very prominent grass component. Mucina & Rutherford (2006) classify the vegetation in the Study Area as a mixture of Northern and Eastern Upper Karoo on the plains, with Besemkaree Koppies Shrubland on the ridges. Northern and Eastern Upper Karoo consist of shrubland dominated by dwarf microphyllous shrubs, with 'white' grasses of the genera *Aristida* and *Eragrostis* (these become prominent especially in the early autumn months after good summer rains, as is the case currently in the Study Area). Besemkaree Koppies Shrubland consist of two-layered karroid shrubland. The lower (closed-canopy) layer is dominated by dwarf small-leaved shrubs and, especially in precipitation-rich years, also by abundant grasses, while the upper (loose canopy) layer is dominated by tall shrubs (Mucina & Rutherford). There are no prominent rivers or drainage lines in the Study Area, however additional information is provided in the separate Aquatic Biodiversity Assessment (Chapter 8 of the EIA Report).

SABAP1 recognises six primary vegetation divisions (biomes) within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison *et al.* 1997). The criteria used by the authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations. It is important to note that no new vegetation unit boundaries were created, with use being made only of

previously published data. Using this classification system, the natural vegetation in the Study Area is classified as Grassy Karoo, a sub-category of the Nama Karoo biome. Grassy Karoo can be viewed as a transitional zone between the Nama Karoo and grassland biomes, although also primarily a dwarf shrub habitat, it shows a higher proportion of grass cover (Harrison *et al*. 1997).

The Potfontein area is semi - arid with extreme temperature variation. Mean annual precipitation averages around 204mm. The least amount of rainfall occurs in July with an average of 7mm. In February, the precipitation reaches its peak, with an average of 30mm. The temperatures are highest on average in January, with a mean daily maximum of 32 °C. With a mean daily maximum of 16 °C, July is the coldest month of the year, with temperatures dropping at night to - 4°C on cold nights (meteoblue.com 2022).

9.4.2.2 Important Bird Areas (IBAs)

The Study Area is located in the Platberg-Karoo Conservancy IBA (Marnewick *et al.* 2015).

The Platberg–Karoo Conservancy IBA covers the entire districts of De Aar, Philipstown and Hanover, including suburban towns. The landscape consists of extensive flat to gently undulating plains that are broken by dolerite hills and flat-topped inselbergs. The ephemeral Brak River flows in an arc from south-east to north-west, eventually feeding into the Orange River basin. Other ephemeral rivers include the Hondeblaf, Seekoei, Elandsfontein and Ongers rivers with a network of tributaries. Vanderkloof Dam is on the north-eastern boundary (Marnewick *et al.* 2015). This IBA is in the Nama Karoo and Grassland Biomes. The eastern Nama Karoo has the highest rainfall of all the Nama Karoo vegetation types and is thus ecotonal to grassland, with a complex mix of grass- and shrub-dominated vegetation types (Marnewick et al. 2015).

The land is used primarily for grazing and agriculture. Commercial livestock farming is mostly extensive wool and mutton production, with some cattle and game farming. Less than 5% of this IBA is cultivated under dry-land or irrigated conditions, and includes lucerne and prickly pear *Opuntia ficus-indica* orchards (Marnewick et al. 2015).

This IBA contributes significantly to the conservation of large terrestrial birds and raptors. These include Blue Crane *Anthropoides paradiseus*, Ludwig's Bustard *Neotis ludwigii*, Kori Bustard *Ardeotis kori*, Blue Korhaan *Eupodotis caerulescens*, Black Stork *Ciconia nigra*, Secretarybird *Sagittarius serpentarius*, Martial Eagle *Polemaetus bellicosus*, Verreauxs' Eagle *Aquila verreauxii* and Tawny Eagle *Aquila rapax*.

A total of 289 bird species are known to occur here. IBA trigger species that are expected to occur in the Study Area are the following:

- Blue Crane (Globally Vulnerable, Regionally Near-threatened)
- Blue Korhaan (Globally Near-threatened)
- Martial Eagle (Globally and regionally Endangered)
- Verreaux's Eagle (Regionally Vulnerable)
- Ludwig's Bustard (Globally and Regionally Endangered)
- Secretarybird (Globally Endangered, Regionally Vulnerable)

9.4.2.3 National Protected Areas and National Protected Areas Expansion Strategy (NPAES) focus areas

The Study Area does not fall within a protected area or an NPAES focus area.

9.4.2.4 The Renewable Energy Development Zones (REDZ)

The Study Area is not located in a REDZ.

9.4.2.5 The Strategic Transmission Corridors

The Study Area is located within the Central Strategic Transmission Corridor that was gazetted in GN 113 in 2018.

9.4.2.6 Verreaux's Eagle Habitat Suitability Model

The habitat suitability model developed by BLSA was overlayed on the Study Area to establish if the development footprint contains suitable breeding habitat. None of the development footprints for all 12 Solar PV Facilities contain highly suitable breeding habitat for the species. There is only one nest in the Study Area which is located on the Hydra-Perseus 1 765kV powerline, and this nest has been buffered appropriately (see Section 9.4.4.2).

9.4.2.7 Avifauna

A total of 85 species could potentially occur within the Broader Area where the project is located (**Appendix 9.E**). Of these, 21 are classified as priority species for solar developments. Of the 21 priority species, 17 were recorded during the monitoring, and 15 priority species have a medium to high probability of occurring regularly in the Study Area. Five SCC were recorded during the site surveys, namely Blue Crane, Martial Eagle, Verreaux's Eagle, Cape Vulture and White-backed Vulture.

See **Appendix 9.E** for a list of species potentially occurring in the Broader Area and **Appendix 9.F** for the species recorded during the pre-construction monitoring. The possibility of priority species. Including SCC, occurring in the Study Area and potential impacts on them by the proposed PV facilities and associated infrastructure, are listed in Table 9-1 below.

Table 9-1: Priority species potentially occurring in the Study Area.

CR = Critically Endangered EN = Endangered VU = Vulnerable NT = Near-threatened LC = Least concern

Species name	Scientific name	SABAP2 reporting rate		Status					Recorded during monitoring	Likelihood of regular occurrence	Habitat					Impacts				
		Full protocol	Ad hoc protocol	Red List Global	Red List Regional	Endemic (SA)	Endemic (SA) - detail	IBA trigger species			Grassy Karoo	Alien trees	Surface water	Ridges (koppies)	High voltage lines	Collisions with solar panels	Displacement: Disturbance	Displacement: Habitat transformation	Entrapment in fences	Electrocution in substations and 33kV overhead lines
Black-headed Canary	*Serinus alario*	0.00	33.33	-	-	x	Near endemic			L	x		x			x	x	x		
Blue Crane	*Grus paradisea*	33.33	16.67	VU	NT			x	x	H	x		x				x	x	x	
Blue Korhaan	*Eupodotis caerulescens*	0.00	8.33	NT	LC	x	Endemic (SA, Lesotho, Swaziland)	x		L	x					x	x	x	x	
Cloud Cisticola	*Cisticola textrix*	0.00	0.00	-	-	x	Near endemic		x	L	x					x	x	x		
Egyptian Goose	*Alopochen aegyptiaca*	33.33	16.67	-	-				x	M		x	x		x	x				x
Fairy Flycatcher	*Stenostira scita*	0.00	0.00	-	-	x	Near endemic		x	L	x					x	x	x		
Greater Kestrel	*Falco rupicoloides*	33.33	16.67	-	-				x	H	x	x			x		x	x		x
Jackal Buzzard	*Buteo rufofuscus*	0.00	8.33	-	-	x	Near endemic		x	M	x	x	x	x	x		x	x		x
Karoo Prinia	*Prinia maculosa*	0.00	0.00	-	-	x	Near endemic		x	L	x					x	x	x		
Large-billed Lark	*Galerida magnirostris*	33.33	8.33	-	-	x	Near endemic		x	H	x					x	x	x		

Species name	Scientific name	SABAP2 reporting rate		Status					Recorded during monitoring	Likelihood of regular occurrence	Habitat					Impacts				
		Full protocol	Ad hoc protocol	Red List Global	Red List Regional	Endemic (SA)	Endemic (SA) - detail	IBA trigger species			Grassy Karoo	Alien trees	Surface water	Ridges (koppies)	High voltage lines	Collisions with solar panels	Displacement: Disturbance	Displacement: Habitat transformation	Entrapment in fences	Electrocution in substations and 33kV overhead lines
Martial Eagle	*Polemaetus bellicosus*	0.00	0.00	EN	EN			x	x	M	x	x	x	x	x		x	x		x
Pale Chanting Goshawk	*Melierax canorus*	100.00	41.67	-	-				x	H	x	x	x		x		x	x		x
Pied Starling	*Lamprotornis bicolor*	33.33	8.33	-	-	x	Endemic (SA, Lesotho, Swaziland)		x	H	x	x	x			x	x	x		
Rock Kestrel	*Falco rupicolus*	0.00	0.00	-	-				x	M	x	x		x				x		x
South African Cliff Swallow	*Petrochelidon spilodera*	33.33	0.00	-	-	x	Endemic (SA, Lesotho, Swaziland) Breeding		x	M	x					x		x		
Three-banded Plover	*Charadrius tricollaris*	0.00	0.00	-	-				x	L			x			x				
Verreaux's Eagle	*Aquila verreauxii*	66.67	0.00	-	VU			x	x	H		x	x	x	x	x	x	x		x
Cape Vulture	*Gyps coprotheres*	0.00	0.00	VU	EN	x	Near endemic		x	M	x	x	x	x	x			x		x
White-backed Vulture	*Gyps africanus*	0.00	0.00	CR	CR				x	M	x	x	x		x			x		x
Ludwig's Bustard	*Neotis ludwigii*	0.00	0	EN	EN			x		H	x						x	x	x	
Secretarybird	*Sagittarius serpentarius*	0.00	0	EN	VU			x		M	x	x	x				x	x	x	

9.4.3 Project Specific Description

The habitat in the development footprints for Kudu Solar Facility 1 - 12 is similar in that all the footprints contain the following avifaunal habitat features:

- Grassy Karoo;
- Boreholes with reservoirs;
- Alien trees;
- Proximity to high voltage lines (<2km); and
- Proximity to surface water (<1km).

None of the development footprints has a specific significant habitat feature that distinguishes it from any of the other development footprints.

9.4.3.1 Bird Habitat

Please refer to Section 9.4.2.1 for a detailed description of the Biome and main Vegetation Type of the Study Area and Development Footprints. Below follows a discussion of the bird specific habitats identified in the Study Area:

- **Grassy Karoo**

This habitat feature is described above under Section 9.4.2.1. See Table 9-1 for a list of priority avifauna that could utilise this habitat feature.

See Figures 9-2 and 9-3 for examples of the Grassy Karoo habitat.



Figure 9-2: Typical Grassy Karoo on the plains in the Study Area.



Figure 9-3: A patch of dwarf shrubs in the Study Area

- **Surface water**

Surface water is of specific importance to avifauna in this semi-arid Study Area. The Study Area contains many boreholes with water reservoirs and a few small ground dams (Figure 9-4). Boreholes with open water troughs are important sources of surface water for priority avifauna for drinking and bathing. See Table 9-1 for a list of priority avifauna that could utlise this habitat feature.



Figure 9-4: A typical borehole and water trough in the Study Area.

- **Trees**

The Study Area is generally devoid of trees, except for isolated clumps of trees at homesteads and boreholes, where a mixture of alien and indigenous trees is growing (Figure 9-5). The trees could attract a variety of bird species for purposes of nesting and roosting. See Table 9-1 for a list of priority avifauna that could utlise this habitat feature.



Figure 9-5: Trees are typically found at localities in the Study Area with surface water.

- **High voltage lines**

High voltage lines are an important potential roosting and breeding substrate for large raptors in the Karoo (Jenkins *et al*. 2013). The Hydra – Perseus 1 765kV high voltage line bisects the Study Area from south to north, the Gamma – Perseus 1 765kV high voltage line runs just west of the Study Area, and the Hydra – Perseus 400kV high voltage line runs approximately 4km east of the closest border of the Study Area. A suspected Verreaux's Eagle nest is present at -30.227660° 24.329773° on the Hydra – Perseus 1 765kV high voltage line. Five White-backed Vultures and a Cape Vulture were also observed perching on the high voltage lines in the Study Area during the first survey. There is increasing evidence that vultures are using high voltage lines in the Karoo (personal observation), mostly in the non-breeding season (January to March), and that they could be encountered anywhere in the Broader Area. See Table 9-1 for a list of priority avifauna that could utlise this habitat feature.

See Figure 9.6 for an image of the suspected Verreaux's Eagle nest in the Study Area.



Figure 9-6: Suspected Verreaux's Eagle nest in the Study Area.

- **Ridges (koppies)**

The Study Area contains one prominent ridge (koppie) known as Basberg in the south of the Study Area, which rises to a height of 1 465m/asl. There are also a cluster of lower ridges on the extreme western side of the Study Area, just north of PV 6. There are a number of ridges in the Broader Area, starting approximately 4km to the south of the Study Area and continuing further south, with names like Perdekop and Tierberg, rising to a height of 1 615m/asl. See Table 9-1 for a list of priority avifauna that could utlise this habitat feature.

9.4.3.2 Results of the pre-construction monitoring

Pre-construction surveys were conducted at the Study Area in the following periods:

- Autumn: 29 March to 01 April 2022
- Winter: 10 – 13 May 2022

See Appendix 9.F for details and the results of the pre-construction monitoring.

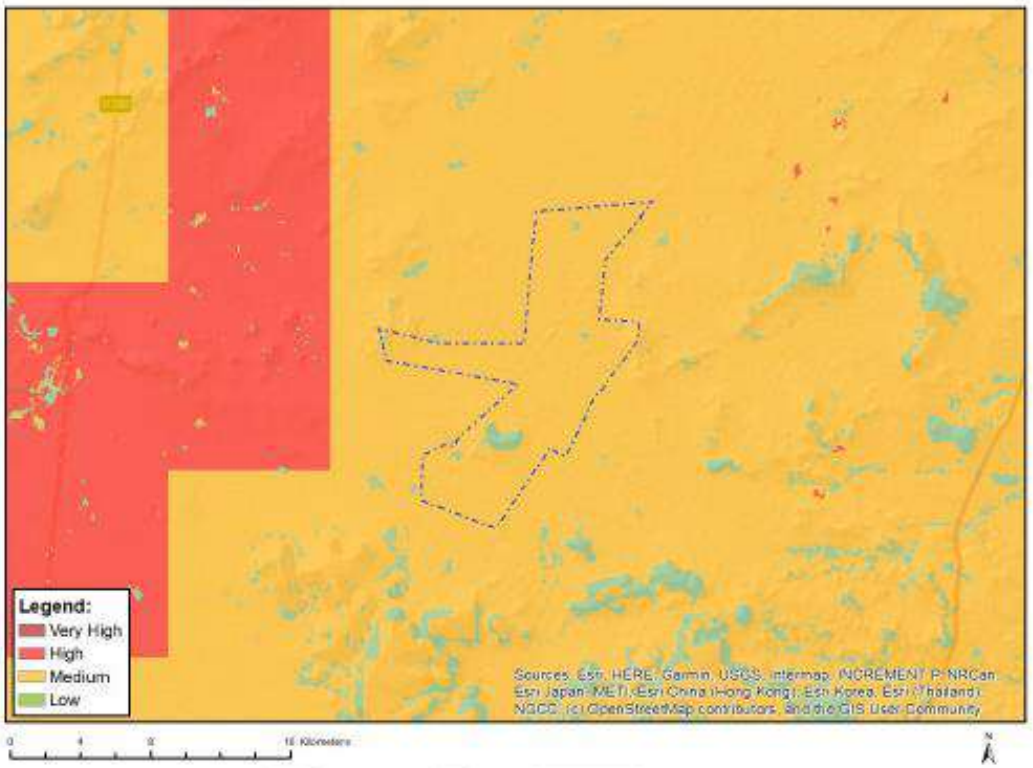
9.4.4 Identification of Environmental Sensitivities

9.4.4.1 Sensitivities identified by the National Web-Based Environmental Screening Tool

The Study Area and immediate environment is classified as **Medium** and **Low** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme. The development footprints for the 12 Solar Facilities specifically are all classified as **Medium**. The Medium classification is linked to the potential occurrence of Ludwig's Bustard (Globally and Regionally Endangered), Verreaux's Eagle (Regionally Vulnerable) and Tawny Eagle (Regionally Endangered). The Study Area contains confirmed habitat for SCC as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, Government Notice 1150, 30 October 2020). The occurrence of SCC was confirmed during the on-site surveys i.e. Martial Eagle (Globally and Regionally Endangered), Verreaux's Eagle (Regionally Vulnerable), Blue Crane (Globally Vulnerable and Regionally Near-threatened), Cape Vulture (Globally Vulnerable and Regionally Endangered) and White-backed Vulture (Globally and Regionally Endangered) were recorded in the Study Area, and habitat for Secretarybird (Globally and Regionally Endangered) and Ludwig's Bustard.

Based on the Site Sensitivity Verification survey (**Appendix 9.C**) conducted on 28 March - 1 April 2022, and the on-site surveys during the pre-construction monitoring (**Appendix 9.F**), the classification of **Medium** sensitivity for avifauna in the screening tool is therefore disputed **for all 12** development footprints, and it is suggested that a **High** rating would be more appropriate due to the presence of the above SCC. **None of the development footprints has a specific habitat feature that distinguishes it from the other development footprints which would justify a lesser rating (7). Therefore, Kudu Solar Facility 4 is rated with a High sensitivity.**

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		x	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Subject to confirmation
Medium	Aves-Aquila rapax
Medium	Aves-Aquila verreauxii
Medium	Aves-Neotis ludwigii

Figure 9-7: The National Web-Based Environmental Screening Tool map of the Study Area, indicating sensitivities for the Terrestrial Animal Species theme. The Medium sensitivity classification is linked to Ludwig's Bustard (*Neotis ludwigii*), Tawny Eagle (*Aquila rapax*) and Verreaux's Eagle (*Aquila verreauxii*).

9.4.4.2 Specialist Sensitivity Analysis and Verification

9.4.4.2.1 All infrastructure exclusion zones

Verreaux's Eagle nest: A 1km all infrastructure exclusion zone is recommended to prevent the displacement of the breeding pair during the construction phase due to disturbance (Figure 9-8). In addition, the buffer area will reduce the risk of injury to the juvenile bird due to collision with the solar panels, when it starts flying and practicing its hunting technique around the nest. None of the development footprints fall within this zone. The 1km no disturbance buffer is based on personal observations, and is also the recommended no disturbance buffer in the latest best practice guidelines for Verreaux's Eagles and wind farm developments. (Ralston – Patton, S & Murgatroyd M. 2021. Verreaux's Eagles and Wind Farms. Guidelines for impact assessment, monitoring, and mitigation. Second edition. Birdlife South Africa). In any event, the closest development area is located 2km away from the Verreaux's Eagle nest which is more than adequate to prevent any disturbance of the breeding birds.

9.4.4.2.2 Solar panel exclusion zones (other infrastructure allowed)

Waterpoints: Surface water in this semi-arid habitat is crucially important for priority avifauna and many non-priority species. The development footprints and the immediate surrounding area contain several boreholes which are sources of surface water. It is preferable to leave some open space where possible with no solar panels, for birds to access and leave the surface water area unhindered[2]. Surface water is also important area for raptors to hunt birds which congregate around water troughs, and they should have enough space for fast aerial pursuit. This will also benefit Blue Cranes which prefer to breed close to water bodies. It is noted that the area surrounding the development footprints contain several boreholes that will not be affected by the proposed development, and these boreholes will ensure that the local avifauna will still have access to adequate sources of surface water.

9.4.4.2.3 High sensitivity zones

The entire Study Area is a high sensitivity zone due to the potential presence of several SCC (see 4.4.1) including Ludwig's Bustard, Secretarybird, Martial Eagle, Cape Vulture and White-backed Vulture which could utilise the whole Study Area for foraging. However, these species do not require specific avoidance measures because there is still adequate habitat available outside the Study Area.

Figures 9-8 and 9-9 below are avifaunal sensitivity maps, indicating sensitivity areas identified for PV developments for the Study Area and Kudu PV 4, respectively. Figure 9-10[3] contains the final layout of Kudu PV 4, which has taken the avifaunal sensitivities into account.

[2] While some of the waterpoints in the development footprint will be removed, the applicant has agreed to retain some water points which will be buffered by a minimum circular solar panel exclusion zone of 50m. The removal of some of the waterpoints will therefore not be a significant impact.

[3] From a mapping aesthetic perspective, the laydown areas and larger on-site substation complex are not displayed on the map in Figure 9.10, however they have been considered in this assessment, along with all project components discussed in the project description. Refer to Chapter 2 of the EIA Report for additional layout maps.

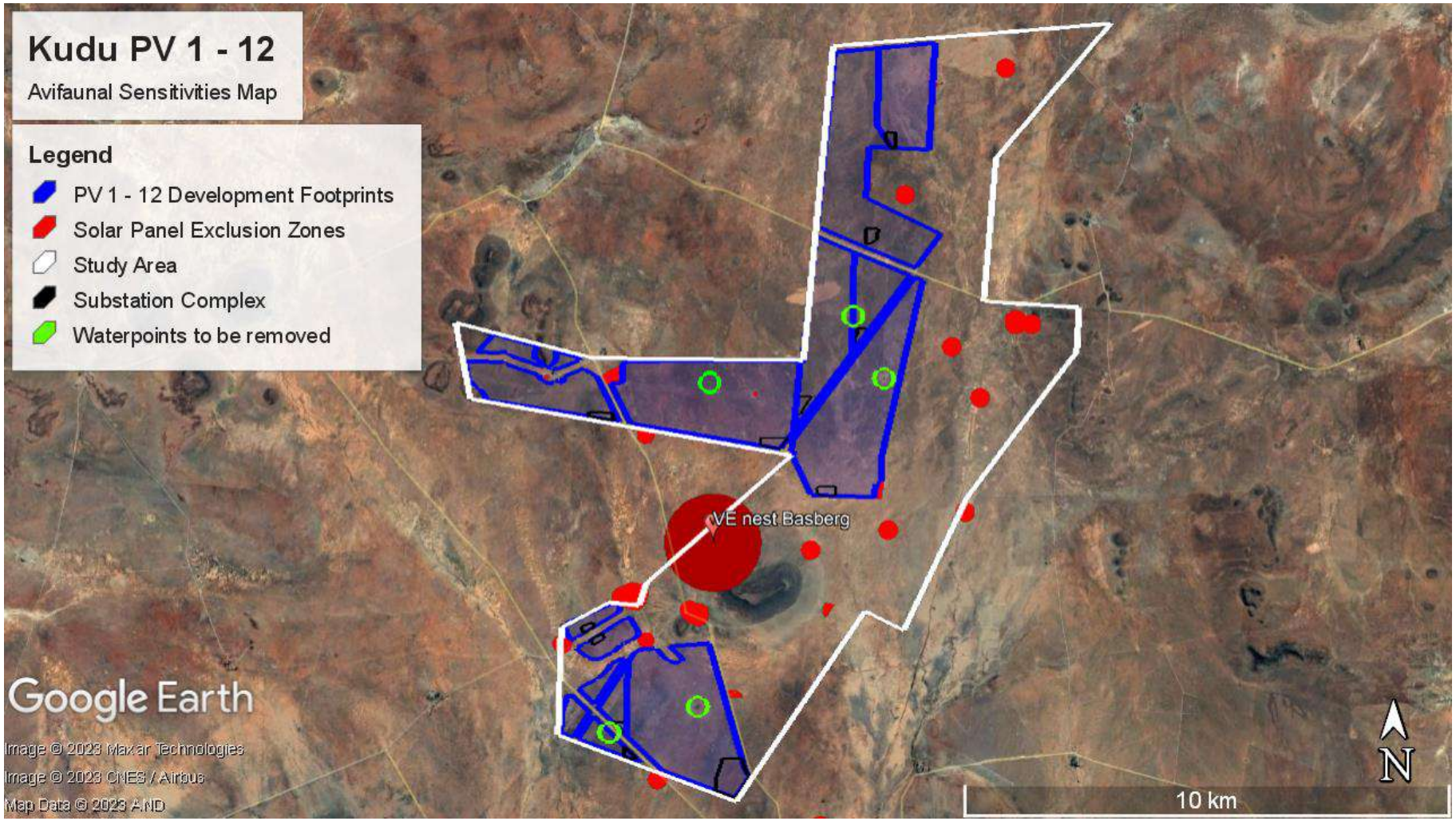


Figure 9-8: Avifaunal sensitivity zones identified for the Study Area and Kudu PV 1 – 12.

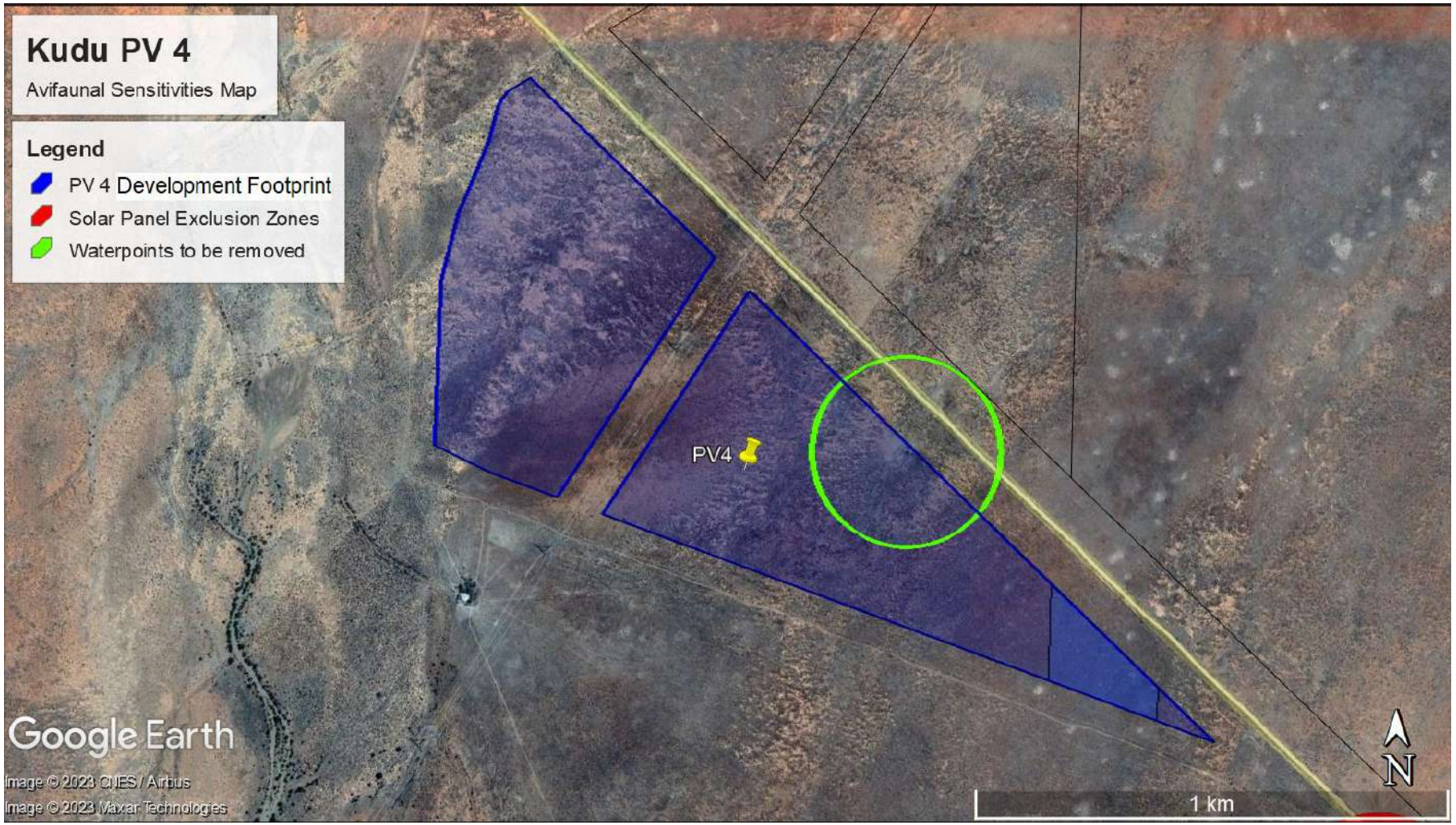


Figure 9-9: Avifaunal sensitivity zones identified for Kudu PV 4.



Figure 9-10: Final layout of Kudu PV 4, which has taken the avifaunal sensitivities into account.

9.4.4.2.4 Kudu Solar Facility 4 and associated infrastructure

The entire development footprint is High Sensitivity. The development footprint does not overlap with any waterpoint solar panel exclusion zones, it overlaps with a waterpoint which will be removed, as discussed above, and this does not present a significant risk to avifauna (**Figure 9-9** above).

9.4.4.3 Sensitivity Analysis Summary Statement

Based on the field surveys, the reclassification to High sensitivity for avifauna in the screening tool is suggested for all 12 proposed projects, including Kudu Solar Facility 4, which is the subject of this report. The presence of and suitable habitat for SCC in the whole Study Area was confirmed during the surveys i.e. Martial Eagle (Globally and Regionally Endangered), Verreaux's Eagle (Regionally Vulnerable), Blue Crane (Globally Vulnerable and Regionally Near-threatened), Cape Vulture (Globally Vulnerable and Regionally Endangered) and White-backed Vulture (Globally and Regionally Endangered). The Study Area also contain habitat for Secretarybird (Globally and Regionally Endangered) and Ludwig's Bustard (Globally and Regionally Endangered).

9.5 Alternative Development Footprints

The Animal Species Protocol (GN 1150) states that the study must identify any alternative development footprints within the preferred site which would be of "low" or "medium" sensitivity as identified by the screening tool and verified through the site sensitivity verification. The protocol further states that a motivation must be provided if there were any development footprints identified as per the latter that were identified as having "low" or "medium" terrestrial animal species sensitivity and were not considered appropriate. Note that the entire study area was assessed in this Scoping and EIA Process, and it was confirmed that the entire study area is High sensitivity. Furthermore, as indicated in Chapter 5 of the EIA Report, no other site alternatives were considered as the site was deemed feasible based on various site suitability factors. Therefore, no other alternative development footprints of low or medium sensitivity were identified and not considered appropriate for this study.

As indicated above, following the identification of sensitivities during the Scoping Phase, the Project Developer considered such sensitivities and formulated the Revised Scoping Buildable Areas. The Revised Scoping Buildable Areas led to the identification of the development footprints and detailed layouts in the EIA Phase. The development footprint and detailed layout are considered suitable from an avifaunal perspective, as the sensitivities identified above have been taken into consideration. The development footprint and detailed layout are shown in Figure 9-10. Changes to the detailed layouts are deemed acceptable if the changes remain within the approved buildable areas / development footprints and area assessed during the Scoping and EIA Process with no-go sensitive areas avoided.

9.6 Issues, Risks and Impacts

9.6.1 Identification of Potential Impacts/ Risks

A literature review reveals a scarcity of published, scientifically examined information regarding large-scale PV plants and birds. The reason for this is mainly that large-scale PV plants is a relatively recent phenomenon. The main source of information for these types of impacts are from compliance reports and a few government-sponsored studies relating to recently constructed solar plants in the south-western United States. In South Africa, only two published scientific studies have been conducted on the environmental impacts of PV plants in a South African context (Rudman et al., 2017; Visser et al., 2018). A related scientific study has also been conducted upon the effects of concentrated solar power facilities on wildlife in South Africa (Jeal et al., 2019).

The potential impacts that have been identified are listed and discussed below.

9.6.1.1 Construction Phase

- Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure.

9.6.1.2 Operational Phase

- Displacement due to habitat transformation associated with the presence of the solar PV plant and associated infrastructure.
- Collisions with the solar panels.
- Entrapment in perimeter fences.
- Electrocutions in the onsite substation complex.
- Electrocution of priority species on the internal 33kV powerlines.

9.6.1.3 Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning of the solar PV plant and associated infrastructure.

9.6.1.4 Cumulative Impacts

- Displacement due to disturbance associated with the construction and decommissioning of the solar PV plants and associated infrastructure.
- Displacement due to habitat transformation associated with the presence of the solar PV plants and associated infrastructure.
- Collisions with the solar panels.
- Entrapment in perimeter fences.
- Electrocutions in the onsite substation complexes.
- Electrocution of priority species on the internal 33kV powerlines.

- **Impact Trauma (Collisions)**

This impact refers to collision-related fatality i.e., fatality resulting from the direct contact of the bird with a project structure(s). This type of fatality has been occasionally documented at solar projects of all technology types (McCrary *et al.* 1986; Hernandez *et al.* 2014; Kagan *et al.* 2014). In some instances, the bird is not killed outright by the collision impact, but succumbs to predation later, as it cannot avoid predators due to its injured state.

Sheet glass used in commercial and residential buildings has been well established as a hazard for birds. When the sky is reflected in the sheet glass, birds fail to see the building as an obstacle and attempt to fly through the glass, mistaking it for empty space (Loss *et al.* 2014). Although very few cases have been reported it is possible that the reflective surfaces of solar panels could constitute a similar risk to avifauna.

An extremely rare but potentially related problem is the so-called “lake effect” i.e. it seems possible that reflections from solar facilities' infrastructure, particularly large sheets of dark blue PV panels, may attract birds in flight across the open desert, who mistake the broad reflective surfaces for water (Kagan *et al.* 2014)[4]. The unusually high percentage of waterbird mortalities at the Desert Sunlight PV facility (44%) may support the “lake effect” hypothesis (West 2014). Although in the case of Desert Sunlight, the proximity of evaporation ponds may act as an additional risk increasing factor, in that birds are both attracted to the water feature and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of diffusely reflected sky or horizontal polarised light source as a body of water. However, due to limited data it would be premature to make any general conclusions about the influence of the lake effect or other factors that contribute to fatality of water-dependent birds. None of the proposed Kudu PV developments are situated near a large waterbody. The activity and abundance of water-dependent species near solar facilities may depend on other site-specific or regional factors, such as the surrounding landscape (Walston *et al.* 2015). Koskiuch *et al.* (2020) found that water-obligate birds, which rely on water for take-off and landing, occurred at 90% (9/10) of site-years at 7 sites in the Sonoran and Mojave Deserts Bird Conservation Region in the USA from January 2013 to September 2018. However, they stressed that their statements should not be interpreted as evidence that there will be water-obligate bird mortality at PV facilities developed in areas with concentrations of migrating or overwintering water obligates because the causal mechanism for fatality risk is unknown. Although scientific evidence is limited, the potential impact was considered.

Weekly mortality searches at 20% coverage were conducted at the 250MW, 1300ha California Valley Solar Ranch PV site (Harvey & Associates 2014a and 2014b). According to the information that could be sourced from the internet (two quarterly reports), 152 avian mortalities were reported for the period 16 November 2013 – 15 February 2014, and 54 for the period 16 February 2014 – 15 May 2014, of which approximately 90% were based on feather spots which precluded a finding on the cause of death. These figures give an estimated unadjusted 1 030 mortalities per year, which is obviously an underestimate as it does not include adjustments for carcasses removed by scavengers and missed by searchers. The authors stated clearly that these quarterly reports do not include the results of

[4] This could either result in birds colliding directly with the solar panels or getting stranded and unable to take off again because many aquatic bird species find it very difficult and sometimes impossible to take off from dry land e.g. grebes and cormorants. This exposes them to predation, even if they do not get injured through direct collisions with the panels.

searcher efficiency trials, carcass removal trials, or data analyses, nor does it include detailed discussions.

In a report by the National Fish and Wildlife Forensic Laboratory (Kagan *et al.* 2014), the cause of avian mortalities was estimated based on opportunistic avian carcass collections at several solar facilities, including the 550MW, 1 600ha Desert Sunlight PV plant. Impact trauma emerged as the highest identifiable cause of avian mortality, but most mortality could not be traced to an identifiable cause.

Walston *et al.* (2015) conducted a comprehensive review of avian fatality data from large scale solar facilities (all technology types) in the USA. Collision as cause of death (19 birds) ranked second at Desert Sunlight PV plant and California Valley Solar Ranch (CVSR) PV plant, after unknown causes. Cause of death could not be determined for over 50% of the fatality observations and many carcasses included in these analyses consisted only of feather spots (feathers concentrated together in a small area) or partial carcasses, thus making determination of cause of death difficult. It is anticipated that some unknown fatalities were caused by predation or some other factor unrelated to the solar project. However, they found that the lack of systematic data collection and standardization was a major impediment in establishing the actual extent and causes of fatalities across all projects.

The only scientific investigation of potential avifaunal impacts that has been performed at a South African PV facility was completed in 2016 at the 96MW Jasper PV solar facility (28°17′53″S, 23°21′56″E) which is located on the Humansrus Farm, approximately 4 km south-east of Groenwater and 30km east of Postmasburg in the Northern Cape Province (Visser *et al.* 2018). The Jasper PV facility contains 325 360 solar panels over a footprint of 180 hectares with the capacity to deliver 180 000 MWh of renewable electricity annually. The solar panels face north at a fixed 20° angle, reaching a height of approximately 1.86 m relative to ground level with a distance of 3.11 m between successive rows of panels. Mortality surveys were conducted from the 14th of September 2015 until the 6th of December 2015, with a total of seven mortalities recorded among the solar panels which gives an average rate of 0.003 birds per hectare surveyed per month. All fatalities were inferred from feather spots. Extrapolated bird mortality within the solar field at the Jasper PV facility was 435 birds/yr (95% CI 133 - 805). The broad confidence intervals result from the small number of birds detected. The mortality estimate is likely conservative because detection probabilities were based on intact birds, and probably decrease for older carcasses and feather spots. The study concluded inter alia that the short study period, and lack of comparable results from other sources made it difficult to provide a meaningful assessment of avian mortality at PV facilities. It further stated that despite these limitations, the few bird fatalities that were recorded might suggest that there is no significant collision-related mortality at the study site. The conclusion was that to fully understand the risk of solar energy development on birds, further collation and analysis of data from solar energy facilities across spatial and temporal scales, based on scientifically rigorous research designs, is required (Visser *et al.* 2018).

The results of the available literature lack compelling evidence of collisions as a cause of large-scale mortality among birds at PV facilities. Kosciuch *et al*. (2020) synthesized results from fatality monitoring studies at 10 PV solar facilities across 13 site years in California and Nevada in the USA. Annual fatality rates never exceeded 2.99 fatalities/MW/year (1.03 fatalities/hectare/year), and three of the four top species detected were ground-dwelling species.

It is clear from this limited literature survey that the lack of systematic and standardised data collection is a major problem in the assessment of the causes and extent of avian mortality at all types of solar facilities, regardless of the technology employed. Until statistically tested results emerge from existing compliance programmes and more dedicated scientific research, conclusions will inevitably be largely speculative and based on professional opinion.

Based on the lack of evidence to the contrary, it is not foreseen that collisions with the solar panels at the PV facility will be a significant impact. The priority species which would most likely be potentially affected by this impact are mostly small, ground-dwelling birds which forage between the solar panels, and possibly raptors which prey on them.

See Table 9.1 for list of species which could potentially be affected by this impact.

- **Entrapment in Perimeter Fences**

Visser et al. (2018) recorded a fence-line fatality of an Orange River Francolin *Scleroptila gutturalis* resulting being trapped between the inner and outer perimeter fence of the facility; additionally, three Red-crested Korhaans were claimed to be unable to escape between these two fences without intervention from facility personnel. Considering that one would expect the birds to be able to take off in the lengthwise direction (parallel to the fences), it seems possible that the birds panicked when they were approached by observers and thus flew into the fence. Potentially, too-close a parallel configuration of double-fenced perimeters can cause fatalities, particularly of larger terrestrial birds, by way of entrapment, and especially if disturbed by people. This risk remains low, however, with Visser et al. (2018) tentatively presenting a fatality rate of 0.002 birds per km per month from this risk factor, although qualifying that the single documented fatality was inadequate for robust extrapolations. Owls are also prone to getting entangled in barbed wire fences (personal observation).

See Table 9.1 for list of species which could potentially be affected by this impact.

- **Displacement due to habitat transformation associated with the operation of the solar PV facility and associated infrastructure**

Ground-disturbing activities affect a variety of processes in arid areas, including soil density, water infiltration rate, vulnerability to erosion, secondary plant succession, invasion by exotic plant species, and stability of cryptobiotic soil crusts. These processes have the ability – individually and together – to alter habitat quality, often to the detriment of wildlife, including avifauna. Any disturbance and alteration to the desert landscape, including the construction and decommissioning of utility-scale solar energy facilities, has the potential to increase soil erosion. Erosion can physically and physiologically affect plant species and can thus adversely influence primary production and food availability for wildlife (Lovich & Ennen 2011).

Solar energy facilities require substantial site preparation (including the removal of vegetation) that alters topography and, thus, drainage patterns to divert the surface flow associated with rainfall away from facility infrastructure. Channelling runoff away from plant communities can have dramatic negative effects on water availability and habitat quality in arid areas. Areas deprived of runoff from sheet flow support less biomass of perennial and annual plants relative to adjacent areas with uninterrupted water-flow patterns (Lovich & Ennen 2011).

The activities listed below are typically associated with the **construction and operation** of solar facilities and could have direct impacts on avifauna through the transformation of habitat (County of Merced 2014):

- Preparation of solar panel areas for installation, including vegetation clearing, grading, cut and fill;
- Excavation/trenching for water pipelines, cables, fibre-optic lines, and the septic system;
- Construction of piers and building foundations;
- Construction of new dirt or gravel roads and improvement of existing roads;
- Temporary stockpiling and side-casting of soil, construction materials, or other construction wastes;
- Soil compaction, dust, and water runoff from construction sites;
- Degradation of water quality in drainages and other water bodies resulting from project runoff;
- Maintenance of fire breaks and roads; and
- Weed removal, brush clearing, and similar land management activities related to the ongoing operation of the project.

These activities could have an impact on birds breeding, foraging and roosting in or in close proximity through transformation of habitat, which could result in temporary or permanent displacement.

In a study comparing the avifaunal habitat use in PV arrays with adjoining managed grassland at airports in the USA, DeVault *et al.* (2014) found that species diversity in PV arrays was reduced compared to the grasslands (37 vs 46), supporting the view that solar development is generally detrimental to wildlife on a local scale.

In order to identify functional and structural changes in bird communities in and around the development footprint, Visser *et al.* (2018) gathered bird transect data at the 180 hectares, 96MW Jasper PV solar facility in the Northern Cape, representing the solar development, boundary, and untransformed landscape. The study found both bird density and diversity per unit area was higher in the boundary and untransformed landscape, however, the extent therefore was not considered to be statistically significant. This indicates that the PV facility matrix is permeable to most species. However, key environmental features, including available habitat and vegetation quality are most likely the overriding factors influencing species' occurrence and their relative density within the development footprint. The most significant finding was that the distribution of birds in the landscape changed, from a shrubland to open country and grassland bird community, in response to changes in the distribution and abundance of habitat resources such as food, water and nesting sites. These changes in resource availability patterns were detrimental to some bird species and beneficial to others. Shrubland specialists appeared to be negatively affected by the presence of the PV facility. In contrast, open country/grassland and generalist species, were favoured by its development (Visser *et al.* 2018).

See Table 9.1 for list of species which could potentially be affected by this impact.

- **Displacement due to disturbance associated with the construction of the solar PV facility and associated infrastructure**

As far as disturbance is concerned, it is likely that all the avifauna, including all the priority species, will be temporarily displaced in the footprint area, either completely or more likely partially (reduced

densities) during the construction phase, due to the disturbance associated with the construction activities e.g., increased vehicle traffic, and short-term construction-related noise (from equipment) and visual disturbance.

- **Electrocution in the onsite substation and the 33kV overhead lines**

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). The electrocution risk is largely determined by the design of the electrical hardware. There could be an electrocution risk to certain species, mostly raptors, but also some waterbirds, on the internal 33kV powerlines within the footprint of the PV facilities, should the decision be to not go underground with the reticulation network. This is especially a major problem for the larger Red Listed species, e.g. Martial Eagle, as it is envisaged that they will frequently perch on the power poles. Electrocution of priority avifauna in the onsite substations could also potentially happen, but this is likely to be a rare event and unlikely to affect SCC.

9.6.2 Summary of Issues identified during the Public Consultation Phase

This section discusses the comments received from stakeholders and Interested and Affected Parties (I&APs) relating to avifauna during the Scoping Phase. Responses have been provided below to indicate how such comments have been addressed or considered during the EIA Phase. Note that the comments below were made by the Northern Cape Department of Agriculture, Environmental Affairs, Rural Development and Land Reform: Environmental Research and Development.

Comment 1: *The 1km around the Verreaux eagle nests are questioned in light of the associated power lines that will be constructed for the each of these PV developments. It is recommended that habitat fragmentation must be looked at during the assessment for this species. Verreaux eagle habitat mapping is also recommended. Please liaise with Birdlife South Africa in this regard, contact person Samantha Ralston-Paton, energy@birdlife.org.za.*

Response 1: As indicated above, in Section 9.4.4.2, a Very High sensitivity, no go area (i.e. all infrastructure exclusion zone), has been demarcated around the Verreaux's Eagle nest. Specifically, a 1 km all infrastructure exclusion zone is recommended to prevent the displacement of the breeding pair during the construction phase due to disturbance. The buffer area will also reduce the risk of injury to the juvenile bird due to collision with the solar panels, when it starts flying and practicing its hunting technique around the nest. The development footprint for the proposed project does not encroach onto this area.

Note that the power lines from the PV Facilities will be subjected to separate Environmental Assessment processes. However, this 1 km exclusion zone will be abided by for the placement of the power lines also. The exclusion zone recommended by the specialists is in line with exclusion zones for both Solar PV and associated EGI, such as power lines. Wind energy developments usually have larger exclusion zones for such species. Habitat fragmentation is not a factor as the habitat in the PV development footprints is not suitable for Verreaux's Eagle. As noted in Section 9.4.2.6 of this chapter, mapping of Verreaux's Eagle habitat has been considered during the EIA Phase for this species. The

habitat suitability model developed by BLSA was overlayed on the Study Area, and none of the development footprints contain highly suitable breeding habitat for this species. There is only one nest in the Study Area, which has been buffered appropriately (see Section 9.4.4.2).

Comment 2: *Lake effect on birds (mortalities and injuries on birds) as the site is located in an Important Bird Area.*

Response 2: This has been discussed in detail in Section 9.6.2 of this chapter (Impact Trauma (Collisions)). The lake effect has so far proven not to be a major cause of avifaunal impact mortality and seems to be associated with large permanent waterbodies in close proximity to the proposed development. As noted above, the unusually high percentage of waterbird mortalities at the Desert Sunlight PV facility (44%) in California in the USA may support the "lake effect" hypothesis (West 2014). Although in the case of Desert Sunlight, the proximity of evaporation ponds may act as an additional risk increasing factor, in that birds are both attracted to the water feature and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of diffusely reflected sky or horizontal polarised light source as a body of water. However, due to limited data it would be premature to make any general conclusions about the influence of the lake effect or other factors that contribute to fatality of water-dependent birds. None of the proposed Kudu PV developments are situated near a large waterbody.

9.7 Impact Assessment

9.7.1 Potential Impacts during the Construction Phase

9.7.1.1 Impact 1: Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure

The noise and movement associated with the construction activities at the proposed PV plant will be a source of disturbance which would lead to the displacement of avifauna from the area. This impact is rated as negative, with a site-specific spatial extent and a short-term duration due to the temporary nature of the construction phase. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a substantial consequence and very likely probability, which will render the impact significance as moderate, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is reduced to low. The recommended mitigation measures are detailed **Section 9.7.1.2** below.

9.7.1.2 Impact Summary Tables: Construction Phase

The rating of the impacts identified for the construction phase is discussed in this section.

Impact 1	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Impact 1: Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure	*Status*	*Negative*	*Moderate (3)*	• Activity should as far as possible be restricted to the footprint of the infrastructure. • Measures to control noise and dust should be applied according to best practice in the industry at the time. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical. • Access to the rest of the property must be restricted. • The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned. • A 1km all infrastructure exclusion zone around the Verreaux's Eagle nest at -30.227660° 24.329773° must be implemented to provide unhindered access to the nest (see sensitivity map in Figure 9. 8 and Figure 9.9). The development footprint assessed in this report does not infringe on this buffer (Figures 9.8, 9.9 and 9.10).	*Low (4)*	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				

9.7.2 Potential Impacts during the Operational Phase

9.7.2.1 Impact 1: Total or partial displacement of avifauna due to habitat transformation associated with the presence of the solar PV plant and associated infrastructure.

This impact relates to the total or partial displacement of avifauna due to habitat transformation associated with the presence of the solar PV plant and associated infrastructure. This impact is rated as negative, with a site-specific spatial extent and a long-term duration due to the extended timeframe of the operational phase (lifetime estimated at 20 years). The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence and very likely probability, which will render the impact significance as high, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is reduced to moderate. The recommended mitigation measures are detailed **Section 9.7.2.5** below.

9.7.2.2 Impact 2: Bird mortality and injury as a result of collisions with the solar panels.

This impact relates to the bird mortalities as a result of potential collisions with the solar panels, including the so-called lake effect. This impact is rated as negative, with a site-specific spatial extent and a long-term duration due to the extended timeframe of the operational phase (lifetime estimated at 20 years). The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a slight consequence and unlikely probability, which will render the impact significance as very low. As detailed in **Section 9.7.2.5** below, no mitigation is required due to the very low impact significance.

9.7.2.3 Impact 3: Entrapment of medium and large terrestrial birds between the perimeter fences, leading to mortality.

This impact pertains to the entrapment of medium and large terrestrial birds between the perimeter fences, leading to mortality. This impact is rated as negative, with a site-specific spatial extent and a long-term duration due to the long timeframe of the operational phase (lifetime estimated at 20 years). The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is rated with a moderate consequence and likely probability, which will result in a low impact significance, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is reduced to very low. The recommended mitigation measure is to use a single perimeter fence around the PV Facilities.

9.7.2.4 Impact 4: Electrocution of priority species in the onsite substation complex.

This impact deals with the potential electrocution of priority species in the onsite substation complex. This impact is rated as negative, with a local spatial extent and a long-term duration due to the extended timeframe of the operational phase (lifetime estimated at 20 years). The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence but unlikely probability, which will result in an impact significance of moderate, without the implementation of mitigation measures. With the implementation of mitigation measures (i.e. reactive insulation of electrical hardware), the significance of the impact is reduced to very low.

9.7.2.5 Impact 5: Electrocution of priority species on the internal 33kV powerlines.

This impact deals with the potential electrocution of priority species on the internal 33kV powerlines in those instances where underground cabling cannot be utilised. This impact is rated as negative, with a local spatial extent and a long-term duration due to the extended timeframe of the operational phase (lifetime estimated at 20 years). The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence and likely probability, which will result in an impact significance of high, without the implementation of mitigation measures. With the implementation of mitigation measures (i.e. use underground cabling as far as possible, and where the use of overhead lines are unavoidable due to technical constraints, a bird-friendly pole design must be used and the avifaunal specialist must sign off on the pole design), the significance of the impact is reduced to very low.

9.7.2.6 Impact Summary Tables: Operational Phase

The rating of the impacts identified for the operational phase is discussed in this section.

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
OPERATIONAL PHASE						
Impact 1: Total or partial displacement of avifauna due to habitat transformation associated with the presence of the solar PV plant and associated infrastructure.	*Status*	*Negative*	*High (2)*	• The recommendations of the botanical specialist must be strictly implemented, especially as far as limiting the vegetation clearance to what is absolutely necessary, and rehabilitation of transformed areas are concerned. • Where possible, surface water (pans, dams and water troughs) must be buffered by a minimum of 50m to ensure unhindered access of priority species to the water. No PV panels should be constructed in this zone (**see sensitivity map Figure 9.8 and Figure 9.9**). Note that some of the waterpoints in the development footprint will be removed, however, since the minimum circular solar panel exclusion zone of 50m will be applied, the removal of some of the waterpoints will therefore not be a significant impact.	*Moderate (3)*	*Medium*
	Spatial Extent	*Site specific*				
	Duration	*Long term*				
	Consequence	*Severe*				
	Probability	*Very likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				
Impact 2: Bird mortality and injury as a result of collisions with the solar panels.	*Status*	*Negative*	*Very low (5)*	• No mitigation is required due to the very low significance	*Very low (5)*	*Medium*
	Spatial Extent	*Site specific*				
	Duration	*Long term*				
	Consequence	*Slight*				
	Probability	*Unlikely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				
	Status	*Negative*	*Low (4)*	• A single perimeter fence should be used.	*Very low (5)*	*High*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
Impact 3: Entrapment of medium and large terrestrial birds between the perimeter fences, leading to mortality.	*Spatial Extent*	*Site specific*				
	Duration	*Long term*				
	Consequence	*Moderate*				
	Probability	*Likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				
Impact 4: Electrocution of priority species in the onsite substation complex.	*Status*	*Negative*	*Moderate (3)*	• The hardware within the proposed substation yard is too complex to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded once operational, site-specific mitigation (insulation) be applied reactively. This is an acceptable approach because Red List priority species are unlikely to frequent the substation and be electrocuted.	*Very low (5)*	*High*
	Spatial Extent	*Local*				
	Duration	*Long term*				
	Consequence	*Severe*				
	Probability	*Unlikely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				
Impact 5: Electrocution of priority species on the internal 33kV powerlines.	*Status*	*Negative*	*High (2)*	• Use underground cabling as far as possible. • Where the use overhead lines are unavoidable due to technical constraints, a bird-friendly pole design must be used. The avifaunal specialist must sign off on the pole design.	*Very Low (5)*	*High*
	Spatial Extent	*Local*				
	Duration	*Long term*				
	Consequence	*Severe*				
	Probability	*Likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				

9.7.3 Potential Impacts during the Decommissioning Phase

9.7.3.1 Impact 1: Displacement due to disturbance associated with the decommissioning of the solar PV plant and associated infrastructure.

The noise and movement associated with the potential decommissioning activities will be a source of disturbance which would lead to the displacement of avifauna from the area. This impact is rated as negative, with a site-specific spatial extent and a short term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a substantial consequence and very likely probability, which will render the impact significance as moderate, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is reduced to low. The recommended mitigation measures are detailed in Section 9.7.3.2 below.

9.7.3.2 Impact Summary Tables: Decommissioning Phase

The rating of the impacts identified for the operational phase is discussed in this section.

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
DECOMMISSIONING PHASE						
The noise and movement associated with the activities at the Study Area will be a source of disturbance which would lead to the displacement of avifauna from the area.	*Status*	*Negative*	*Moderate (3)*	• Activity should as far as possible be restricted to the footprint of the infrastructure. • Measures to control noise and dust should be applied according to best practice in the industry at the time. • Maximum use should be made of existing access roads during the decommissioning phase and the construction of new roads should be kept to a minimum as far as practical. • The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned.	*Low (4)*	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				

9.7.4 Cumulative Impacts

Cumulative effects are commonly understood to be impacts from different projects that combine to result in significant change, which could be larger than the sum of all the individual impacts. The assessment of cumulative effects therefore needs to consider all renewable energy developments that have received an Environmental Authorisation or in process within at least a 30km radius of the proposed site, as well as the 12 proposed Kudu Solar PV developments. Currently, there are 12 other renewable energy cluster projects (either approved or in process) within a 30km radius of the Kudu PV Cluster (**Figure 9-11**).

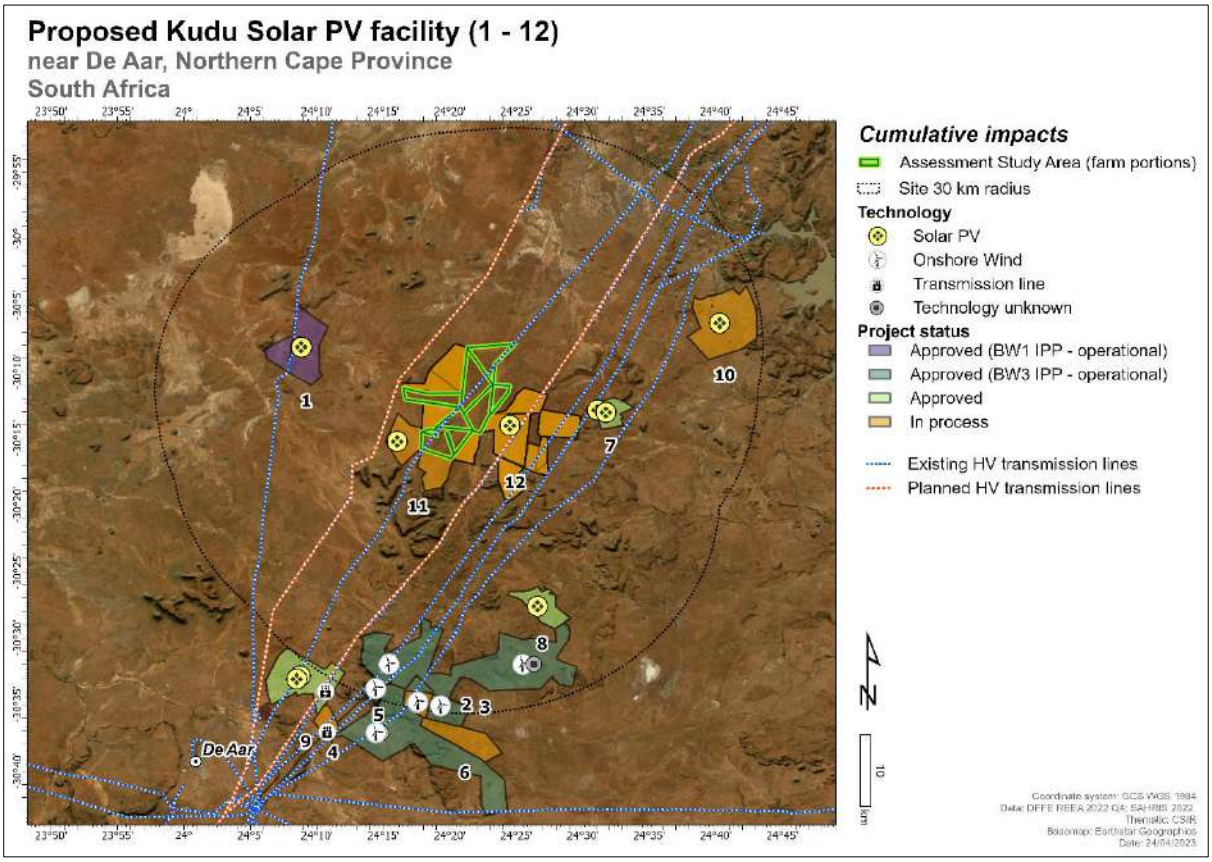


Figure 9-11: Renewable Energy and EGI Projects with 30km radius of the Kudu PV Solar Cluster Study Area.

The table below provides a list and details of all the renewable energy and EGI projects (as displayed in **Figure 9-11** above) within a 30km radius of the Kudu PV Solar Cluster.

Table 9-2: Proposed renewable energy projects, located within 30 km of the proposed Kudu Solar Facilities, that will be considered in the Cumulative Impact Assessment (in addition to the Kudu Solar Facilities and EGI Projects) (Source: DFFE REEA, Quarter 4, 2022; and SAHRIS)

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
1	• 12/12/20/2258 • 12/12/20/2258/1	Solar PV	75	Approved and Preferred Bidder (Operational)	• The Proposed Establishment of Photovoltaic (Solar Power) Farms in the Northern Cape Province - Kalkbult	2010	Scoping and EIA	Scatec Solar SA Pty Ltd	Sustainable Development Projects cc
2	• 12/12/20/2463/1 • 12/12/20/2463/1/2 • 12/12/20/2463/1/A2 • 12/12/20/2463/1/AM3 • 12/12/20/2463/1/AM4 • 12/12/20/2463/1/AM5	Onshore Wind	140	Approved and Preferred Bidder (Operational)	• Longyuan Mulilo De Aar 2 North Wind Energy Facility • Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility • The Wind Energy Facility (North and South) situated on the Plateau Near De Aar, Northern Cape Province	2010 and 2014	Scoping and EIA and Amendment	Longyuan Mulilo De Aar 2 South (Pty)	Aurecon South Africa (Pty) Ltd and Holland and Associates Environmental Consultants
3	• 12/12/20/2463/2 • 12/12/20/2463/2/AM2	Onshore Wind	100	Approved and Preferred Bidder (Operational)	• Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility • The Wind Energy Facility (North and South) Situated On The Plateau Near De Aar, Northern Cape Province	2010 and 2014	Scoping and EIA and Amendment	Mulilo Renewable Energy (Pty) Ltd	Aurecon South Africa (Pty) Ltd
4	• 14/12/16/3/3/1/1166 14/12/16/3/3/1/1166/AM3 14/12/16/3/3/1/1166/AM4	Transmission line	132	Approved	• Basic Assessment for the proposed construction of a 132 kV transmission line corridor adjacent to the existing Eskom transmission line from Longyuan Mulilo De Aar 2 North Wind Energy Facility (WEF) to the Hydra Substation in De Aar, Northern Cape	2010 and 2014	Basic Assessment	Longyuan Mulilo De Aar 2 North (Pty) Ltd	Aurecon South Africa (Pty) Ltd
5	• 14/12/16/3/3/1/785	Transmission line	132	Approved	• Proposed construction of two 132kV transmission lines from the South & North Wind Energy Facilities on the Eastern Plateau (De Aar 2) near De Aar, Northern Cape.	2010	Basic Assessment	Mulilo Renewable Energy (Pty) Ltd	Aurecon South Africa (Pty) Ltd
6	• 14/12/16/3/3/2/278 • 14/12/16/3/3/2/278/1 • 14/12/16/3/3/2/278/2	Onshore Wind	118	Approved	• Proposed Castle Wind Energy Facility Project, located near De Aar, Northern Cape	2010 and 2014	Scoping and EIA	Castle Wind Farm (Pty) Ltd	Aurecon South Africa (Pty) Ltd; and Savannah Environmental Consultants (Pty) Ltd
7	• 14/12/16/3/3/2/564 • 14/12/16/3/3/2/564/AM1 • 14/12/16/3/3/2/564/AM2	Solar PV	75	To be confirmed	• Proposed Swartwater 75MW solar PV power facility in Petrusville within Renosterburg Local Municipality, Northern Cape	2010 and 2014	Scoping and EIA and Amendment	AE-AMD Renewable Energy (Pty) Ltd	USK Environmental and Waste Engineering (Pty) Ltd
8	• 14/12/16/3/3/2/740	Solar PV	300	Approved	• Proposed 300MW Solar Power Plant in Phillipstown area in Renosterberg Local Municipality	2010	Scoping and EIA	To be confirmed	Tshikovha Environmental and Communication Consultants
9	• 14/12/16/3/3/2/744	Solar PV	Unknown	Approved	• Proposed PV facility on farm Jakhalsfontein near De Aar	2010	Scoping and EIA	Solar Capital (Pty) Ltd	Eco Compliance (Pty) Ltd
10	• 14/12/16/3/3/2/739	Solar PV	70 - 100	To be confirmed	• Proposed 70 - 100 MW Solar Power Plant in Petrusville	2010	Scoping and EIA	To be confirmed	Tshikovha Environmental and Communication Consultants
11	• Not issued yet (it is understood that the project is still within the pre-application stage)	Solar PV	800 (Maximum)	Pre-Application	• The Proposed Keren Energy Odyssey Solar PV Facilities (Odyssey Solar 1, Odyssey Solar 2, Odyssey Solar 3, Odyssey Solar 4, Odyssey Solar 5, Odyssey Solar 6, Odyssey Solar 7 And Odyssey Solar 8)	2014	Scoping and EIA	Keren Energy Group Holdings	EnviroAfrica cc
12	• To be confirmed	Solar PV	3050	Scoping	• The Proposed Development of the Crossroads (formally referred to as the Hydra B) Green Energy Cluster of Renewable Energy Facilities and Grid Connection Infrastructure, Pixley Ka Seme District Municipality, Northern Cape Province. The Cluster entails the development of up to 21 solar energy facilities, with the Scoping and EIA Processes consisting of three phases. Phases 1, 2 and 3 consist of 9, 6 and 6 solar facilities, respectively. The Phase 1 Scoping and EIA Processes were launched in January 2023.	2014	Scoping and EIA	Akuo Energy Afrique	Savannah Environmental Consultants (Pty) Ltd

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
Study area shown on map	• 14/12/16/3/3/2/2244 • 14/12/16/3/3/2/2245 • 14/12/16/3/3/2/2246 • 14/12/16/3/3/2/2247 • 14/12/16/3/3/2/2248 • 14/12/16/3/3/2/2249 • 14/12/16/3/3/2/2250 • 14/12/16/3/3/2/2251 • 14/12/16/3/3/2/2252 • 14/12/16/3/3/2/2253 • 14/12/16/3/3/2/2254 • 14/12/16/3/3/2/2255	Solar PV	2180	Scoping and EIA Process underway	• Proposed Development of 12 Solar Photovoltaic (PV) Facilities (Kudu Solar Facility 1 to 12) and associated infrastructure, near De Aar, Northern Cape Province	2014	Scoping and EIA	Kudu Solar Facility 1 (Pty) Ltd to Kudu Solar Facility 12 (Pty) Ltd	CSIR
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• HYDRA ROODEKUIL 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• HYDRA ROODEKUIL 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	765	Existing Power Line	• BETA HYDRA 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• HYDRA PERSEUS 3	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• VAN DER KLOOF ROODEKUIL 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• VAN DER KLOOF ROODEKUIL 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• BETA HYDRA 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• HYDRA PERSEUS 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• KALKBULT/KAREEBOSCHPAN 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• ROODEKUIL/ORANIA 1	-	-	-	-

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Perseus to Gamma 2nd 765 kV line • Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line	-	-	-	-
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Relocate Beta-Hydra 765kV line to form Perseus-Hydra 1st 765kV line • Cape Corridor Phase 2: Zeus - Hydra 765kV Integration	-	-	-	-
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Perseus to Gamma 2nd 765 kV line • Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line	-	-	-	-

Note that in addition to the above, all 12 Kudu Solar Facilities have been considered in this cumulative assessment. The Kudu EGI projects (i.e. Projects 13 to 26) will be the subject of separate assessments, which have not commenced with yet. Refer to Chapter 4 of the EIA Report for additional information on the cumulative impact assessment.

The total affected land parcel area taken up by other authorised renewable energy projects and the grid connection projects within the 30km radius is approximately 43 973 ha. The total affected land parcel area of the 12 Kudu Solar PV projects comprises approximately 8150 ha. If one assumes that all 12 Kudu Solar PV projects will be authorised, the combined land parcel area affected by renewable energy developments within the 30km radius around and including the Kudu Solar PV projects will equal 52 123 ha. The total area within the 30km radius around the proposed projects equates to about 282 743 ha of similar habitat. The total combined size of the land parcels affected by renewable energy projects and grid connections will thus equate to 18.4 % of the available habitat in the 30km radius. However, the actual physical footprint of the renewable energy facilities will be much smaller than the land parcel areas themselves, for example in the case of wind energy, the physical footprint comprises less than 5% of the project area. Furthermore, eight of the renewable energy cluster projects must still be subject to a competitive bidding process where only the most competitive projects will win a power purchase agreement required for the project to proceed to construction; or they must enter into private offtake agreements.

The following cumulative impacts have been identified:

9.7.4.1 Impact 1: Construction Phase - Displacement due to disturbance associated with the construction of the solar PV plants and associated infrastructure

The noise and movement associated with the construction activities of similar projects within the 30 km radius will be a source of disturbance which would lead to the displacement of avifauna from the area. This impact is rated as negative, with a site-specific spatial extent and a short-term duration due to the temporary nature of the construction phase. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a substantial consequence and very likely probability, which will render the impact significance as moderate, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is reduced to low. The recommended mitigation measures are detailed Section 9.7.4.4 below.

9.7.4.2 Impact 2: Operational Phase - Habitat transformation, collisions with the solar panels, entrapment in fences, and electrocution in onsite substation complexes and 33kV overhead lines

This impact deals with the following during the operational phase with regards to other similar projects in the 30 km radius:

- Total or partial displacement of avifauna due to habitat transformation associated with the presence of the solar PV plants and associated infrastructure.
- Bird mortality and injury as a result of collisions with the solar panels.
- Entrapment of medium and large terrestrial birds between the perimeter fences, leading to mortality; and

- Electrocution of priority species in the onsite substation complexes.
- Electrocution of priority species on the 33kV overhead powerlines.

This impact is rated as negative, with a regional spatial extent and a long-term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence and likely probability, which will render the impact significance as high, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is reduced to moderate. The recommended mitigation measures are detailed Section 9.7.4.4 below.

9.7.4.3 Impact 3: Decommissioning Phase - Displacement due to disturbance associated with the decommissioning of the solar PV plants and associated infrastructure

The noise and movement associated with the potential decommissioning activities (in terms of other similar projects in the 30 km radius) will be a source of disturbance which would lead to the displacement of avifauna from the area. This impact is rated as negative, with a site-specific spatial extent and a short-term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a substantial consequence and very likely probability, which will render the impact significance as moderate, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is reduced to low. The recommended mitigation measures are detailed Section 9.7.4.4 below.

9.7.4.4 Impact Summary Tables: Cumulative Impacts

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure	*Status* *Spatial Extent* *Duration* *Consequence* *Probability* *Reversibility* *Irreplaceability*	*Negative* *Site specific* *Short term* *Substantial* *Very likely* *High* *Low*	*Moderate (3)*	• Activity should as far as possible be restricted to the footprint of the infrastructure. • Measures to control noise and dust should be applied according to best practice in the industry at the time. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical. • Access to the rest of the property must be restricted. • The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned. • Appropriate buffer zones must be implemented around Species of Conservation Concern (SCC) nests.	*Low (4)*	*High*
OPERATIONAL PHASE						
Habitat transformation, collisions with the solar panels, entrapment in fences, and electrocution in onsite substation	*Status* *Spatial Extent* *Duration* *Consequence* *Probability* *Reversibility*	*Negative* *Regional* *Long term* *Severe* *Likely* *High*	*High (2)*	• The recommendations of the botanical specialist must be strictly implemented, especially as far as limiting the vegetation clearance to what is absolutely necessary, and rehabilitation of transformed areas are concerned.	*Moderate (3)*	*High*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
complexes and 33kV overhead powerlines.	*Irreplaceability*	*Low*		• Where possible, solar panel-free buffers must be maintained around the pans, dams and water troughs. • A single perimeter fence should be used. • The hardware within the proposed substation yards is too complex to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded once operational, site-specific mitigation (insulation) be applied reactively. This is an acceptable approach because Red List priority species are unlikely to frequent the substation and be electrocuted. • Use underground cabling as far as possible. • Where the use overhead lines are unavoidable due to technical constraints, a bird-friendly pole design must be used. The avifaunal specialist must sign off on the pole design.		
DECOMMISSIONING PHASE						
The noise and movement associated with the activities at the Study Area will be a source of disturbance which would	*Status*	*Negative*	*Moderate (3)*	• Activity should as far as possible be restricted to the footprint of the infrastructure. • Measures to control noise and dust should be applied according to best practice in the industry at the time.	*Low (4)*	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*High*				

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
lead to the displacement of avifauna from the area	*Irreplaceability*	*Low*		• Maximum use should be made of existing access roads and the construction of new roads during the decommissioning phase should be kept to a minimum as far as practical. • The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned		

9.7.5 Battery Energy Storage System

As indicated above, a Lithium-Ion Battery Energy Storage System (BESS) and Redox Flow BESS were both considered for the proposed project. For Redox Flow BESS, various chemical compositions are likely, such as Vanadium. Refer to Chapter 15 of this EIA Report for a High-Level Safety, Health and Environment Risk Assessment, which provides high level information on the safety, health and environmental risks of the BESS technologies.

Both BESS technologies have been considered in this assessment. The type of technology will have no influence on avifauna; therefore both are considered viable from an avifaunal perspective. The impacts of habitat transformation and disturbance associated with the BESS are covered in Sections 9.7.1 and 9.7.2.

9.7.6 No-Go Option

The no-go option will result in no additional impacts on avifauna and will result in the ecological status quo being maintained, which will be to the advantage of the avifauna. However, with that being said, no fatal flaws were discovered in the course of the investigations for the proposed Kudu Solar Facilities, and with mitigation the potential impact significance is rated as mainly low.

9.7.7 Impact Assessment Summary

The overall impact significance is provided in this section, in terms of pre- and post-mitigation.

Table 9-3: Avifauna - Overall Impact Significance (Pre- and Post-Mitigation)

Phase	**Overall Impact Significance (Pre-Mitigation)**	**Overall Impact Significance (Post Mitigation)**
Construction	Moderate (3)	Low (4)
Operational	Low (4) to Moderate (3)	Very Low (5) to Low (4)
Decommissioning	Moderate (3)	Low (4)
Nature of Impact	**Overall Impact Significance**	**Overall Impact Significance**
Cumulative - Construction	Moderate (3)	Low (4)
Cumulative - Operational	High (2)	Moderate (3)
Cumulative - Decommissioning	Moderate (3)	Low (4)

9.8 Legislative and Permit Requirements

There is no legislation pertaining specifically to the impact of solar facilities and associated electrical infrastructure on avifauna. Agreements, conventions, and legislation pertaining to the conservation of avifauna are discussed below.

9.8.1 Agreements and conventions

Table 9-4 below lists agreements and conventions which South Africa is party to, and which is relevant to the conservation of avifauna[5].

Table 9-4: Agreements and conventions which South Africa is party to, and which is relevant to the conservation of avifauna.

Convention name	Description	Geographic scope
African-Eurasian Waterbird Agreement (AEWA)	The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: • The conservation of biological diversity • The sustainable use of the components of biological diversity • The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global
Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global

[5] (BirdLife International (2022) Country profile: South Africa. Available from: http://www.birdlife.org/datazone/country/south_africa.

Convention name	Description	Geographic scope
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Global
Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia	The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate.	Regional

9.8.2 National legislation

9.8.2.1 Constitution of the Republic of South Africa, 1996

The Constitution of the Republic of South Africa provides in the Bill of Rights that: Everyone has the right –

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –

  (i) prevent pollution and ecological degradation;

  (ii) promote conservation; and

  (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

9.8.2.2 The National Environmental Management Act 107 of 1998, as amended (NEMA)

The National Environmental Management Act 107 of 1998, as amended, (NEMA) creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out a number of guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated. NEMA also provides that a wide variety of listed developmental activities, which may significantly affect the environment, may be performed only after an environmental impact assessment or basic assessment has been done and authorization has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

NEMA makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. The Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette Number 43855, Government Notice 1150, 30 October 2020) is applicable in the case of solar PV developments. Refer to Appendix 9.G of this chapter for a table of compliance with this protocol.

9.8.2.3 The National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA) and the Threatened or Protected Species Regulations (TOPS Regulations)

The most prominent statute containing provisions directly aimed at the conservation of birds is the National Environmental Management: Biodiversity Act (Act 10 of 2004 (as amended)) (NEMBA) read with the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations). Note that updated TOPS Regulations were published in Government Gazette 47984, Government Notice 3009 on 3 February 2023, and takes effect on 1 April 2023. Chapter 1 sets out the objectives of the Act, and they are aligned with the objectives of the Convention on Biological Diversity, which are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits of the use of genetic resources. The Act also gives effect to CITES, the Ramsar Convention, and the Bonn Convention on Migratory Species of Wild Animals. The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

9.8.2.4 Provincial Legislation

The current legislation applicable to the conservation of fauna and flora in the Northern Cape is the Northern Cape Nature Conservation Act (Act No 9 of 2009). It provides for the sustainable utilisation of wild animals, aquatic biota and plants; the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; describes offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; provides for the issuing of permits and other authorisations; and provides for matters connected therewith.

9.9 Environmental Management Programme Inputs

Please see a description of the key mitigation and monitoring recommendations for each applicable mitigation measure identified for all phases of the project below.

Management Plan for the Planning and Design Phase

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
Avifauna: Entrapment					
Entrapment of medium and large terrestrial birds between the perimeter fences, leading to mortality.	Prevent mortality of avifauna	• A single perimeter fence should be used[6].	Design the facility with a single perimeter fence.	Once-off during the planning phase.	Project Developer
Avifauna: Displacement					
Displacement of avifauna due to disturbance during construction activities.	Prevent displacement of avifauna	• A 1km all infrastructure exclusion zone around the Verreaux's Eagle nest at -30.227660° 24.329773° must be implemented to provide unhindered access to the nest (see sensitivity map in Figure 9.8 and Figure 9.9). **The development footprint assessed in**	• Design the facility with a 1km all infrastructure exclusion zone around the Verreaux's Eagle nest at -30.227660° 24.329773° to provide	Once-off during the planning phase.	Project Developer

[6] If a fence is used consisting of an outer diamond mesh fence and inner electric fence with a separation distance of approximately 100 mm or less, it should not pose any risk of entrapment for large terrestrial species and can be considered a single fence.

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		this report does not infringe on this buffer (Figure 9.8 and Figure 9.9). • Where possible, surface water (pans, dams and water troughs) must be buffered by a minimum of 50m to ensure unhindered access of priority species to the water. No PV panels should be constructed in this zone (see sensitivity map Figure 9.8 and Figure 9.9). Note that some of the waterpoints in the development footprint will be removed, however, since the minimum circular solar panel exclusion zone of 50m will be applied, the removal of some of the waterpoints will therefore not be a significant impact.	unhindered access to the nest (see sensitivity map in Figure 9.8 and Figure 9.9). • Design a facility with minimum 50m buffer zones around pans, dams and selected water troughs as delineated by the avifauna specialist.		
Avifauna: Electrocution					
Electrocution of priority species on the internal 33kV network.	Prevention of electrocution mortality	• Design the facility with underground cables as much as possible. • A raptor -friendly pole design must be used, and the pole design must	• Design the facility with underground cabling and where impractical, use a bird	Once-off during the planning phase.	Project Developer

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		be approved by the avifaunal specialist.	friendly pole design approved by the avifaunal specialist..		

Management Plan for the Construction Phase

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
Avifauna: Disturbance					
The noise and movement associated with the construction activities at the development footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management Programme (CEMPr.)	A site-specific CEMPr must be implemented, which gives an appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following: • No off-road driving; • Maximum use of existing roads, where possible and the construction of new roads should be kept to a minimum as far as practical; • Measures to control noise and dust according to latest best practice;	• Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. • Ensure that construction personnel are made aware of the impacts relating to off-road driving. • Construction access roads must be demarcated clearly. Undertake	• On a daily basis • Monthly • Monthly • Monthly • Monthly	• Contractor and ECO • Contractor and ECO • Contractor and ECO • Contractor and ECO • Contractor and ECO

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		• Restricted access to the rest of the property, the activity should as far as possible be restricted to the development footprint; • Strict application of all recommendations in the ecological and botanical specialist studies, especially pertaining to the limitation of the footprint.	site inspections to verify. • Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. • Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.		

Management Plan for the Operational Phase

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
Avifauna: Displacement due to habitat transformation					
Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance and the presence of the solar PV plants and associated infrastructure.	Prevent unnecessary displacement of avifauna by ensuring that the rehabilitation of transformed areas is implemented by an appropriately qualified rehabilitation specialist, according to the recommendations of the botanical specialist study.	• The recommendations of the botanical specialist must be strictly implemented, especially as far as limiting the vegetation clearance to what is absolutely necessary, and rehabilitation of transformed areas are concerned. • Develop a Habitat Restoration Plan (HRP). • Monitor rehabilitation via site audits and site inspections to ensure compliance. • Record and report any non-compliance.	• Appointment of rehabilitation specialist to develop HRP. • Site inspections to monitor progress of HRP. • Adaptive management to ensure HRP goals are met.	• Once-off • Once a year • As and when required	• Project Developer • Facility Environmental Manager • Project Developer and Facility Operational Manager
Avifauna: Electrocution of priority species in the onsite substation complex					
Electrocution of priority species in the onsite substation complex.	Prevention of electrocution mortality	It is recommended that if on-going impacts are recorded as part of routine inspections once operational, site-specific mitigation (insulation) be applied reactively. This is an acceptable approach because Red List priority species are unlikely to frequent the substation and be electrocuted.	Site-specific mitigation (insulation) be applied reactively	As and when required.	Project Developer and Facility Operational Manager

Management Plan for the Decommissioning Phase

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
Avifauna: Displacement due to disturbance					
The noise and movement associated with the activities at the Study Area will be a source of disturbance which would lead to the displacement of avifauna from the area.	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Decommissioning EMPr.	A site-specific Decommissioning EMPr (DEMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the DEMPr and should apply good environmental practice during decommissioning. The DEMPr must specifically include the following: • No off-road driving; • Maximum use of existing roads during the decommissioning phase and the construction of new roads should be kept to a minimum as far as practical; • Measures to control noise and dust according to latest best practice; • Restricted access to the rest of the property, the activity should as far as possible be restricted to the development footprint; • Strict application of all recommendations in the ecological and botanical	• Implementation of the DEMPr. Oversee activities to ensure that the DEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. • Ensure that decommissioning personnel are made aware of the impacts relating to off-road driving. • Access roads must be demarcated clearly. Undertake site inspections to verify. • Monitor the implementation of noise control mechanisms via	• On a daily basis • Weekly • Weekly • Weekly • Weekly	• Contractor and ECO

Impact	Mitigation/Management Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		specialist studies, especially as far as limitation of the activity footprint is concerned.	site inspections and record and report non-compliance. • Ensure that the decommissioning area is demarcated clearly and that personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.		

9.10 Final Specialist Statement and Authorisation Recommendation

9.10.1 Statement and Reasoned Opinion

The proposed Kudu Solar Facility 4 will have a range of potential pre-mitigation impacts on priority avifauna ranging from low to high significance, which is expected to be reduced to medium and low significance with the appropriate mitigation. No fatal flaws were discovered during the investigations. The Project is supported and it is therefore recommended that the activity is authorised, with the understanding that all mitigation measures recommended in this report will be strictly implemented.

9.10.2 EA Condition Recommendations

The proposed mitigation measures are detailed in Section 9.7 above.

9.11 References

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APPENDICES

Appendix 9.A: Specialist Expertise
Appendix 9.B: Specialist Statement of Independence
Appendix 9.C: Site Sensitivity Verification
Appendix 9.D: Impact Assessment Methodology
Appendix 9.E: Species list for the Broader Area
Appendix 9.F: Pre-Construction Monitoring Protocol and Results
Appendix 9.G: Compliance with the Animal Species Protocol (GN 1150)

Appendix 9.A: Specialist Expertise

Curriculum vitae: Chris van Rooyen

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	BA LLB
Nationality	:	South African
Years of experience	:	26 years

Key Experience

Chris van Rooyen has several years' experience in the assessment of avifaunal interactions with industrial infrastructure. He was employed by the Endangered Wildlife Trust as head of the Eskom-EWT Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has consulted in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. He also has extensive project management experience and he has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author and/or co-author of 17 conference papers, co-author of two book chapters, several research reports and the current best practice guidelines for avifaunal monitoring at wind farm sites. He has completed around 130 power line assessments; and has to date been employed as specialist avifaunal consultant on more than 50 renewable energy generation projects. He has also conducted numerous risk assessments on existing power lines infrastructure. He also works outside the electricity industry and he has done a wide range of bird impact assessment studies associated with various residential and industrial developments. He serves on the Birds and Wind Energy Specialist Group which was formed in 2011 to serve as a liaison body between the ornithological community and the wind industry.

Key Project Experience

Bird Impact Assessment Studies and avifaunal monitoring for wind-powered generation facilities:

1. Eskom Klipheuwel Experimental Wind Power Facility, Western Cape
2. Mainstream Wind Facility Jeffreys Bay, Eastern Cape (EIA and monitoring)
3. Biotherm, Swellendam, (Excelsior), Western Cape (EIA and monitoring)
4. Biotherm, Napier, (Matjieskloof), Western Cape (pre-feasibility)
5. Windcurrent SA, Jeffreys Bay, Eastern Cape (2 sites) (EIA and monitoring)
6. Caledon Wind, Caledon, Western Cape (EIA)
7. Innowind (4 sites), Western Cape (EIA)
8. Renewable Energy Systems (RES) Oyster Bay, Eastern Cape (EIA and monitoring)
9. Oelsner Group (Kerriefontein), Western Cape (EIA)
10. Oelsner Group (Langefontein), Western Cape (EIA)
11. InCa Energy, Vredendal Wind Energy Facility Western Cape (EIA)
12. Mainstream Loeriesfontein Wind Energy Facility (EIA and monitoring)
13. Mainstream Noupoort Wind Energy Facility (EIA and monitoring)

14. Biotherm Port Nolloth Wind Energy Facility (Monitoring)
15. Biotherm Laingsburg Wind Energy Facility (EIA and monitoring)
16. Langhoogte Wind Energy Facility (EIA)
17. Vleesbaai Wind Energy Facility (EIA and monitoring)
18. St. Helena Bay Wind Energy Facility (EIA and monitoring)
19. Electrawind, St Helena Bay Wind Energy Facility (EIA and monitoring)
20. Electrawind, Vredendal Wind Energy Facility (EIA)
21. SAGIT, Langhoogte and Wolseley Wind Energy facilities
22. Renosterberg Wind Energy Project – 12-month preconstruction avifaunal monitoring project
23. De Aar – North (Mulilo) Wind Energy Project – 12-month preconstruction avifaunal monitoring project
24. De Aar – South (Mulilo) Wind Energy Project – 12-month bird monitoring
25. Namies – Aggenys Wind Energy Project – 12-month bird monitoring
26. Pofadder - Wind Energy Project – 12-month bird monitoring
27. Dwarsrug Loeriesfontein - Wind Energy Project – 12-month bird monitoring
28. Waaihoek – Utrecht Wind Energy Project – 12-month bird monitoring
29. Amathole – Butterworth Utrecht Wind Energy Project – 12-month bird monitoring & EIA specialist
30. Phezukomoya and San Kraal Wind Energy Projects 12-month bird monitoring & EIA specialist study (Innowind)
31. Beaufort West Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
32. Leeuwdraai Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
33. Sutherland Wind Energy Facility 12-month bird monitoring (Mainstream)
34. Maralla Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
35. Esizayo Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
36. Humansdorp Wind Energy Facility 12-month bird monitoring & EIA specialist study (Cennergi)
37. Aletta Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
38. Eureka Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
39. Makambako Wind Energy Faclity (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
40. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
41. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
42. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
43. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
44. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
45. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
46. Dassieklip Wind Energy Facility 3 years post-construction monitoring (Biotherm)
47. Loeriesfontein 2 Wind Energy Facility 2 years post-construction monitoring (Mainstream)
48. Khobab Wind Energy Facility 2 years post-construction monitoring (Mainstream)
49. Excelsior Wind Energy Facility 18 months construction phase monitoring (Biotherm)

50. Boesmansberg Wind Energy Facility 12-months pre-construction bird monitoring (juwi)
51. Mañhica Wind Energy Facility, Mozambique, 12-months pre-construction monitoring (Windlab)
52. Kwagga Wind Energy Facility, Beaufort West, 12-months pre-construction monitoring (ABO)
53. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO).
54. Koup 1 and 2 Wind Energy Facilities, Beaufort West, Western Cape, 12 months pre-construction monitoring (Genesis Eco-energy)
55. Duiker Wind Energy Facility, Vredendal, Western Cape 12 months pre-construction monitoring (ABO)
56. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 18 months construction phase monitoring (Mainstream).
57. Swellendam Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Veld Renewables)
58. Lombardskraal Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Enertrag SA)
59. Mainstream Kolkies & Heuweltjies Wind Energy Facilities, Western Cape, 12-month pre-construction monitoring (Mainstream)
60. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
61. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)
62. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
63. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
64. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
65. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
66. Pofadder Wind Energy Facility, Northren Cape, Screening Report (Atlantic Energy)
67. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
68. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
69. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).

Bird Impact Assessment Studies for Solar Energy Plants:

1. Concentrated Solar Power Plant, Upington, Northern Cape.
2. Globeleq De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
3. JUWI Kronos PV project, Copperton, Northern Cape
4. Sand Draai CSP project, Groblershoop, Northern Cape
5. Biotherm Helena PV Project, Copperton, Northern Cape
6. Biotherm Letsiao CSP Project, Aggeneys, Northern Cape
7. Biotherm Enamandla PV Project, Aggeneys, Northern Cape
8. Biotherm Sendawo PV Project, Vryburg, North-West
9. Biotherm Tlisitseng PV Project, Lichtenburg, North-West

10. JUWI Hotazel Solar Park Project, Hotazel, Northern Cape
11. Namakwa Solar Project, Aggeneys, Northern Cape
12. Brypaal Solar Power Project, Kakamas, Northern Cape
13. ABO Vryburg 1,2,3 Solar PV Project, Vryburg, North-West
14. NamPower CSP Facility near Arandis, Namibia
15. Dayson Klip PV Facility near Upington, Northern Cape
16. Geelkop PV Facility near Upington, Northern Cape
17. Oya PV Facility, Ceres, Western Cape
18. Vrede and Rondawel PV Facilities, Free State
19. Kolkies & Sadawa PV Facilities, Western Cape
20. Leeuwbosch PV1 and 2 and Wildebeeskuil PV1 and 2 Facilities, North-West
21. Kenhardt PV 3,4 and 5, Northern Cape
22. Wittewal PV, Grootfontein PV and Hoekdoornen PV Facilities, Touws River, Western Cape

Bird Impact Assessment Studies for the following overhead line projects:

1. Chobe 33kV Distribution line
2. Athene - Umfolozi 400kV
3. Beta-Delphi 400kV
4. Cape Strengthening Scheme 765kV
5. Flurian-Louis-Trichardt 132kV
6. Ghanzi 132kV (Botswana)
7. Ikaros 400kV
8. Matimba-Witkop 400kV
9. Naboomspruit 132kV
10. Tabor-Flurian 132kV
11. Windhoek - Walvisbaai 220 kV (Namibia)
12. Witkop-Overyssel 132kV
13. Breyten 88kV
14. Adis-Phoebus 400kV
15. Dhuva-Janus 400kV
16. Perseus-Mercury 400kV
17. Gravelotte 132kV
18. Ikaros 400 kV
19. Khanye 132kV (Botswana)
20. Moropule – Thamaga 220 kV (Botswana)
21. Parys 132kV
22. Simplon –Everest 132kV
23. Tutuka-Alpha 400kV
24. Simplon-Der Brochen 132kV
25. Big Tree 132kV
26. Mercury-Ferrum-Garona 400kV
27. Zeus-Perseus 765kV
28. Matimba B Integration Project
29. Caprivi 350kV DC (Namibia)

30. Gerus-Mururani Gate 350kV DC (Namibia)
31. Mmamabula 220kV (Botswana)
32. Steenberg-Der Brochen 132kV
33. Venetia-Paradise T 132kV
34. Burgersfort 132kV
35. Majuba-Umfolozi 765kV
36. Delta 765kV Substation
37. Braamhoek 22kV
38. Steelpoort Merensky 400kV
39. Mmamabula Delta 400kV
40. Delta Epsilon 765kV
41. Gerus-Zambezi 350kV DC Interconnector: Review of proposed avian mitigation measures for the Okavango and Kwando River crossings
42. Giyani 22kV Distribution line
43. Liqhobong-Kao 132/11kV distribution power line, Lesotho
44. 132kV Leslie – Wildebeest distribution line
45. A proposed new 50 kV Spoornet feeder line between Sishen and Saldanha
46. Cairns 132kv substation extension and associated power lines
47. Pimlico 132kv substation extension and associated power lines
48. Gyani 22kV
49. Matafin 132kV
50. Nkomazi_Fig Tree 132kV
51. Pebble Rock 132kV
52. Reddersburg 132kV
53. Thaba Combine 132kV
54. Nkomati 132kV
55. Louis Trichardt – Musina 132kV
56. Endicot 44kV
57. Apollo Lepini 400kV
58. Tarlton-Spring Farms 132kV
59. Kuschke 132kV substation
60. Bendstore 66kV Substation and associated lines
61. Kuiseb 400kV (Namibia)
62. Gyani-Malamulele 132kV
63. Watershed 132kV
64. Bakone 132kV substation
65. Eerstegoud 132kV LILO lines
66. Kumba Iron Ore: SWEP - Relocation of Infrastructure
67. Kudu Gas Power Station: Associated power lines
68. Steenberg Booysendal 132kV
69. Toulon Pumps 33kV
70. Thabatshipi 132kV
71. Witkop-Silica 132kV
72. Bakubung 132kV
73. Nelsriver 132kV
74. Rethabiseng 132kV
75. Tilburg 132kV

76. GaKgapane 66kV
77. Knobel Gilead 132kV
78. Bochum Knobel 132kV
79. Madibeng 132kV
80. Witbank Railway Line and associated infrastructure
81. Spencer NDP phase 2 (5 lines)
82. Akanani 132kV
83. Hermes-Dominion Reefs 132kV
84. Cape Pensinsula Strengthening Project 400kV
85. Magalakwena 132kV
86. Benficosa 132kV
87. Dithabaneng 132kV
88. Taunus Diepkloof 132kV
89. Taunus Doornkop 132kV
90. Tweedracht 132kV
91. Jane Furse 132kV
92. Majeje Sub 132kV
93. Tabor Louis Trichardt 132kV
94. Riversong 88kV
95. Mamatsekele 132kV
96. Kabokweni 132kV
97. MDPP 400kV Botswana
98. Marble Hall NDP 132kV
99. Bokmakiere 132kV Substation and LILO lines
100. Styldrift 132kV
101. Taunus – Diepkloof 132kV
102. Bighorn NDP 132kV
103. Waterkloof 88kV
104. Camden – Theta 765kV
105. Dhuva – Minerva 400kV Diversion
106. Lesedi –Grootpan 132kV
107. Waterberg NDP
108. Bulgerivier – Dorset 132kV
109. Bulgerivier – Toulon 132kV
110. Nokeng-Fluorspar 132kV
111. Mantsole 132kV
112. Tshilamba 132kV
113. Thabamoopo - Tshebela – Nhlovuko 132kV
114. Arthurseat 132kV
115. Borutho 132kV MTS
116. Volspruit - Potgietersrus 132kV
117. Neotel Optic Fibre Cable Installation Project: Western Cape
118. Matla-Glockner 400kV
119. Delmas North 44kV
120. Houwhoek 11kV Refurbishment
121. Clau-Clau 132kV
122. Ngwedi-Silwerkrans 134kV

123. Nieuwehoop 400kV walk-through
124. Booysendal 132kV Switching Station
125. Tarlton 132kV
126. Medupi - Witkop 400kV walk-through
127. Germiston Industries Substation
128. Sekgame 132kV
129. Botswana – South Africa 400kV Transfrontier Interconnector
130. Syferkuil – Rampheri 132kV
131. Queens Substation and associated 132kV powerlines
132. Oranjemond 400kV Transmission line
133. Aries – Helios – Juno walk-down
134. Kuruman Phase 1 and 2 Wind Energy facilities 132kV Grid connection
135. Transnet Thaba 132kV

Bird Impact Assessment Studies for the following residential and industrial developments:

1. Lizard Point Golf Estate
2. Lever Creek Estates
3. Leloko Lifestyle Estates
4. Vaaloewers Residential Development
5. Clearwater Estates Grass Owl Impact Study
6. Somerset Ext. Grass Owl Study
7. Proposed Three Diamonds Trading Mining Project (Portion 9 and 15 of the Farm Blesbokfontein)
8. N17 Section: Springs To Leandra –"Borrow Pit 12 And Access Road On (Section 9, 6 And 28 Of The Farm Winterhoek 314 Ir)
9. South African Police Services Gauteng Radio Communication System: Portion 136 Of The Farm 528 Jq, Lindley.
10. Report for the proposed upgrade and extension of the Zeekoegat Wastewater Treatment Works, Gauteng.
11. Bird Impact Assessment for Portion 265 (a portion of Portion 163) of the farm Rietfontein 189-JR, Gauteng.
12. Bird Impact Assessment Study for Portions 54 and 55 of the Farm Zwartkop 525 JQ, Gauteng.
13. Bird Impact Assessment Study Portions 8 and 36 of the Farm Nooitgedacht 534 JQ, Gauteng.
14. Shumba's Rest Bird Impact Assessment Study
15. Randfontein Golf Estate Bird Impact Assessment Study
16. Zilkaatsnek Wildlife Estate
17. Regenstein Communications Tower (Namibia)
18. Avifaunal Input into Richards Bay Comparative Risk Assessment Study
19. Maquasa West Open Cast Coal Mine
20. Glen Erasmia Residential Development, Kempton Park, Gauteng
21. Bird Impact Assessment Study, Weltevreden Mine, Mpumalanga
22. Bird Impact Assessment Study, Olifantsvlei Cemetery, Johannesburg
23. Camden Ash Disposal Facility, Mpumalanga
24. Lindley Estate, Lanseria, Gauteng

25. Proposed open cast iron ore mine on the farm Lylyveld 545, Northern Cape
26. Avifaunal monitoring for the Sishen Mine in the Northern Cape as part of the EMPr requirements
27. Steelpoort CNC Bird Impact Assessment Study

Professional affiliations

I work under the supervision of and in association with Albert Froneman (MSc Conservation Biology) (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003.

Appendix 9.B: Specialist Statement of Independence

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 - 12), near De Aar, Northern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

Details of Specialist, Declaration and Undertaking Under Oath

Page 1 of 3

1. SPECIALIST INFORMATION

Specialist Company Name:				
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	Level 2	Percentage Procurement recognition	
Specialist name:	Chris van Rooyen			
Specialist Qualifications:	BA LLB			
Professional affiliation/registration:	I work under the supervision and in association with Albert Froneman (MSc Conservation Biology) (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003			
Physical address:	6 Pladda Drive, Plettenberg Bay			
Postal address:	PO Box 2676, Fourways, 2122			
Postal code:	2055	Cell:	0824549570	
Telephone:	0824549570	Fax:		
E-mail:	Vanrooyen.chris@gmail.com			

2. DECLARATION BY THE SPECIALIST

I, Christiaan Stephanus van Rooyen, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Name of Company: Afrimage Photography t/a Chris van Rooyen Consulting

25 November 2022

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. **UNDERTAKING UNDER OATH/ AFFIRMATION**

I, Christiaan Stephanus van Rooyen, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Afrimage Photography (Pty) Ltd t/a Chris van Rooyen Consulting

Name of Company

25 November 2022

Date

SOUTH AFRICAN POLICE SERVICE
PLETTENBERG BAY
2022 -11- 25
PLETTENBERGBAAI
SOUTH AFRICAN POLICE SERVICE

Signature of the Commissioner of Oaths

2022/11/25

Date

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 - 12), near De Aar, Northern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
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Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Afrimage Photography Pty Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)		Percentage Procurement recognition	
Specialist name:	Albert Froneman			
Specialist Qualifications:	M.Sc. Conservation Biology			
Professional affiliation/registration:	SACNASP Pr.Sci.Nat Zoological Science 400177/09			
Physical address:	Unit 28 San Henrique Estate, 2 Rosewood Road, Broadacres, 2055			
Postal address:	Box 2676, Fourways			
Postal code:	2055	Cell:	082 901 4016	
Telephone:		Fax:		
E-mail:	albert.froneman@gmail.com			

2. DECLARATION BY THE SPECIALIST

I, Albert Froneman, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

Afrimage Photography Pty Ltd

Name of Company:

2023 / 07 / 10

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Albert Froneman, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Afrimage Photography Pty Ltd
Name of Company

2023 / 07 / 10
Date

Signature of the Commissioner of Oaths

10 July 2023
Date

KERRY AUGUST
Commissioner of Oaths
Master HR Professional (MHRP)
Member Number: 53544596
25 Bordeaux Close
Stellenbosch
7600

SABPP
SA BOARD FOR PEOPLE PRACTICES

Details of Specialist, Declaration and Undertaking Under Oath

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Appendix 9.C: Site Sensitivity Verification: Kudu Solar Photovoltaic (PV) cluster

Prior to commencing with the specialist assessment, a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool). The National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. The Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, Government Notice 1150, 30 October 2020) is applicable in the case of solar PV developments.

This site sensitivity verification report is applicable and relevant to all 12 Kudu Solar Facilities, based on the homogenous habitat.

The details of the site sensitivity verification (SSV) are noted below:

Date of Site Visits	28 March – 01 April
Supervising Specialist Name	Albert Froneman
Professional Registration Number	MSc Conservation Biology (SACNASP Zoological Science Registration number 400177/09)
Specialist Affiliation / Company	Chris van Rooyen Consulting

1 Methodology

The following methods were used to compile the SSV report:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the University of Cape Town, as a means to ascertain which species occurs within the Broader Area i.e. within a block consisting of 9 pentad grid cells each within which the proposed projects are situated (see Figure 9.1 of the main report). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. From 2007 to date, a total of 3 full protocol lists (i.e. surveys lasting a minimum of two hours each) have been completed for this area. In addition, 4 ad hoc protocol lists (i.e. surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the (2022.2) International Union for Conservation of Nature (IUCN) Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the habitat in the Study Area was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison *et al.* 1997) and the National Vegetation Map (2012 beta2) from the South African National Biodiversity Institute (SANBI) website (Mucina & Rutherford 2006 & http://bgisviewer.sanbi.org). Study Area is the area covered by the land parcels where the PV projects will be located.

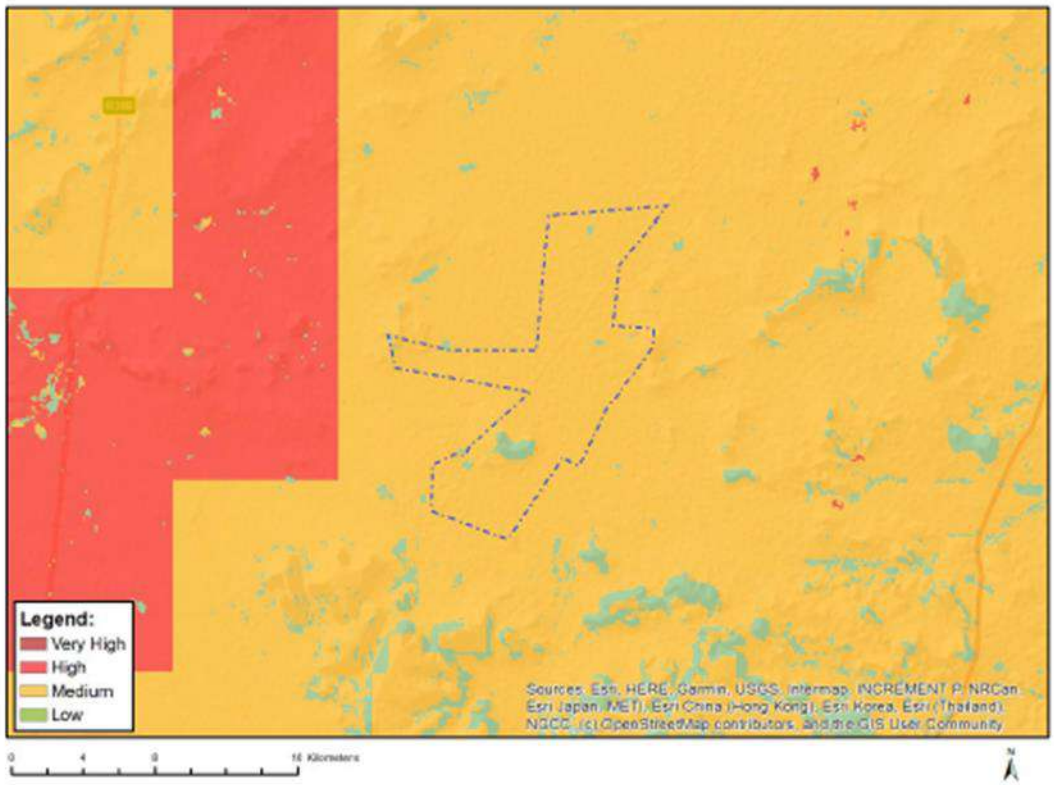
- The Important Bird Areas of Southern Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth ©2022) was used in order to view the Study Area on a landscape level and to help identify sensitive bird habitat.
- Priority species were defined as follows:
    - South African Red Data species: High conservation significance
    - South African endemics and near-endemics: High conservation significance
    - Raptors: High conservation significance. Raptors are at the top of the food chain and play a key role in their ecosystems. When populations of birds of prey go down, then the numbers of their prey species go up, creating an imbalance in the ecosystem.
    - Waterbirds: Evidence indicate that waterbirds may be particularly susceptible to collisions with solar arrays due to the so-called lake effect, caused by the reflection of the sun of the smooth surface of solar panels.
- The SANBI BGIS map viewer was used to determine the locality of the Study Area relative to National Protected Areas and National Protected Areas Expansion Strategy (NPAES) focus areas.
- The Department of Forestry, Fisheries and the Environment (DFFE) National Screening Tool was used to determine the assigned avian sensitivity of the Study Area.
- Data collected during previous site visits to the Broader Area was also considered as far as habitat classes and the occurrence of priority species are concerned.
- A SSV site visit to the Study Area was conducted on 28 March – 01 April 2022 during which time the habitat was classified, and all birds were recorded.

2 Results of site assessment

The Study Area and immediate environment is classified as **Medium** and **Low** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme on the Screening Tool (Figure C.1). The 12 development footprints specifically are all classified as **Medium**. The Medium classification is linked to the potential occurrence of Ludwig's Bustard (Globally and Regionally Endangered) and Verreaux's Eagle (Regionally Vulnerable). The Study Area contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, Government Notice 1150, 30 October 2020). The occurrence of SCC was confirmed during the surveys so far i.e. Martial Eagle (Globally and Regionally Endangered), Verreaux's Eagle (Regionally Vulnerable), Blue Crane (Globally Vulnerable and Regionally Near-threatened), Cape Vulture (Globally Vulnerable and Regionally Endangered) and White-backed Vulture (Globally and Regionally Endangered) was recorded in the Study Area, as well as habitat for Secretarybird (Globally and Regionally Endangered) and Ludwig's Bustard.

Based on the SSV survey conducted on 28 March - 1 April 2022, the classification of **Medium** sensitivity for avifauna in the screening tool is therefore disputed **for all 12** development footprints, and it is suggested that a **High** rating would be more appropriate. None of the development footprints has a specific habitat feature that distinguishes it from the other development footprints which would justify a lesser rating.

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		x	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Subject to confirmation
Medium	Aves-Aquila rapax
Medium	Aves-Aquila verreauxii
Medium	Aves-Neotis ludwigii

Figure C.1: The National Web-Based Environmental Screening Tool map of the Study Area, indicating sensitivities for the Terrestrial Animal Species theme. The Medium sensitivity classification is linked to Ludwig's Bustard (*Neotis ludwigii*), Tawny Eagle (*Aquila rapax*) and Verreaux's Eagle (*Aquila verreauxii*).

3 Avifauna

A total of 85 species could potentially occur within the Broader Area where the project is located (see Appendix 9.E). Of these, 21 are classified as priority species for solar developments. Of the 21 priority species, 17 were recorded during the monitoring, and 15 priority species have a medium to high probability of occurring regularly in the Study Area. Five SCC were recorded during the site surveys, namely Blue Crane, Martial Eagle, Verreaux's Eagle, Cape Vultures and White-backed Vulture.

The species recorded during the SSV visit is listed in Table 1.

Table 1: Priority species recorded during the SSV site visit.

Species	Taxonomic name	Species of Conservation Concern
Blue Crane	*Grus paradisea*	Yes
Cloud Cisticola	*Cisticola textrix*	
Egyptian Goose	*Alopochen aegyptiaca*	
Fairy Flycatcher	*Stenostira scita*	
Greater Kestrel	*Falco rupicoloides*	
Jackal Buzzard	*Buteo rufofuscus*	
Karoo Prinia	*Prinia maculosa*	
Large-billed Lark	*Galerida magnirostris*	
Martial Eagle	*Polemaetus bellicosus*	Yes
Pale Chanting Goshawk	*Melierax canorus*	
Pied Starling	*Lamprotornis bicolor*	
Rock Kestrel	*Falco rupicolus*	
South African Cliff Swallow	*Petrochelidon spilodera*	
Three-banded Plover	*Charadrius tricollaris*	
Verreaux's Eagle	*Aquila verreauxii*	Yes
Cape Vulture	*Gyps coprotheres*	Yes
White-backed Vulture	*Gyps africanus*	Yes

4 Bird Habitat

The following bird habitat features were recorded at and near the Study Area:

5 Biomes and Vegetation Types

The Study Area is situated on a wide flat plain, with its centre approximately 32km southwest of the small town of Petrusville, and 23km from Potfontein railway stop in the Northern Cape Province, in the Nama Karoo biome, in the Upper Karoo Bioregion (Mucina & Rutherford 2006). The habitat in the Study Area is highly homogenous and consists of extensive plains with low shrub and a very prominent grass component (see Figures C.2 and C.3). Mucina & Rutherford (2006) classify the vegetation in the Study Area as a mixture of Northern and Eastern Upper Karoo on the plains, with Besemkaree Koppies Shrubland on the ridges. Northern and Eastern Upper Karoo consist of shrubland dominated by dwarf microphyllous shrubs, with 'white' grasses of the genera Aristida and Eragrostis (these become prominent especially in the early autumn months after good summer rains,

as is the case currently in the Study Area). Besemkaree Koppies Shrubland consist of two-layered karroid shrubland. The lower (closed-canopy) layer is dominated by dwarf small-leaved shrubs and, especially in precipitation-rich years, also by abundant grasses, while the upper (loose canopy) layer is dominated by tall shrubs (Mucina & Rutherford). There are no prominent rivers or drainage lines in the Study Area, however additional information is provided in the separate Aquatic Biodiversity Assessment (Chapter 8 of the EIA Report).

SABAP1 recognises six primary vegetation divisions (biomes) within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison *et al.* 1997). The criteria used by the authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations. Using this classification system, the natural vegetation in the Study Area is classified as Grassy Karoo, a sub-category of the Nama Karoo biome. Grassy Karoo can be viewed as a transitional zone between the Nama Karoo and grassland biomes, although also primarily a dwarf shrub habitat, it shows a higher proportion of grass cover (Harrison et al. 1997).

The Potfontein area is semi – arid with extreme temperature variation. Mean annual precipitation averages around 204mm. The least amount of rainfall occurs in July with an average of 7mm. In February, the precipitation reaches its peak, with an average of 30mm. The temperatures are highest on average in January, with a mean daily maximum of 32 °C. With a mean daily maximum of 16 °C, July is the coldest month of the year, with temperatures dropping at night to - 4°C on cold nights (meteoblue.com 2022).

- **Grassy Karoo**

This habitat feature is described above under Section 5.

See Figures C.2 and C.3 for examples of the Grassy Karoo habitat.



Figure C.2: Typical Grassy Karoo on the plains in the Study Area.



Figure C.3: A patch of dwarf shrubs in the Study Area

- **Surface water**

Surface water is of specific importance to avifauna in this semi-arid Study Area. The Study Area contains many boreholes with water reservoirs and a few small ground dams (Figure C.4). Boreholes with open water troughs are important sources of surface water for priority avifauna for drinking and bathing.



Figure C.4: A typical borehole and water trough in the Study Area

- **Trees**

The Study Area is generally devoid of trees, except for isolated clumps of trees at homesteads and boreholes, where a mixture of alien and indigenous trees is growing (Figure C.5). The trees could attract a variety of bird species for purposes of nesting and roosting.



Figure C.5: Trees are typically found at localities in the Study Area with surface water.

- **High voltage lines**

High voltage lines are an important potential roosting and breeding substrate for large raptors in the Karoo (Jenkins *et al*. 2013). The Hydra – Perseus 1 765kV high voltage line bisects the Study Area from south to north, the Gamma – Perseus 1 765kV high voltage line runs just west of the Study Area, and the Hydra – Perseus 400kV high voltage line runs approximately 4km east of the closest border of the Study Area. A suspected Verreaux's Eagle nest is present at -30.227660° 24.329773° on the Hydra – Perseus 1 765kV high voltage line. Five White-backed Vultures and a Cape Vulture were also observed perching on the high voltage lines in the Study Area during the first survey. There is increasing evidence that vultures are using high voltage lines in the Karoo (personal observation), mostly in the non-breeding season (January to March), and that they could be encountered anywhere in the Broader Area.

See Figure C.6 for an image of the suspected Verreaux's Eagle nest in the Study Area.



Figure C.6: Suspected Verreaux's Eagle nest in the Study Area.

- **Ridges (koppies)**

The Study Area contains one prominent ridge (koppie) known as Basberg in the south of the Study Area, which rises to a height of 1 465m/asl. There are also a cluster of lower ridges on the extreme western side of the Study Area, just north of PV 6. There are a number of ridges in the Broader Area, starting approximately 4km to the south of the Study Area and continuing further south, with names like Perdekop and Tierberg, rising to a height of 1 615m/asl.

6 Conclusion

Based on the SSV site visit, the classification of **High** sensitivity for avifauna is suggested for the **Study Area**. The presence of SCC in the Study Area was confirmed i.e. Martial Eagle (Globally and Regionally Endangered), Verreaux's Eagle (Regionally Vulnerable), Blue Crane (Globally Vulnerable and Regionally Near-threatened), Cape Vulture (Globally Vulnerable and Regionally Endangered) and White-backed Vulture (Globally and Regionally Endangered). The Study Area also contain habitat for Secretarybird (Globally and Regionally Endangered) and Ludwig's Bustard (Globally and Regionally Endangered). None of the development footprints has a specific habitat feature that distinguishes it from the other development footprints which would justify a lesser rating.

Appendix 9.D: Impact Assessment Methodology

The impact assessment includes:

- *the nature, status, significance and consequences of the impact and risk;*
- *the extent and duration of the impact and risk;*
- *the probability of the impact and risk occurring;*
- *the degree to which impacts and risks can be mitigated;*
- *the degree to which the impacts and risks can be reversed; and*
- *the degree to which the impacts and risks can cause loss of irreplaceable resources.*

Terminology used in impact assessment can overlap. To avoid ambiguity, please note the following clarifications (that are based on NEMA and the EIA Regulations):

- *The term environment is understood to have a broad interpretation that includes both the natural (biophysical) environment and the socio-economic environment. The term socio-ecological system is also used to describe the natural and socio-economic environment and the interactions amongst these components.*
- *Significance = Consequence x Probability, which means that significance is equivalent to risk.*
- *The impact can have a positive or negative status. The significance of a negative impact may be called a risk, and the significance of a positive impact may be called an opportunity.*

The following principles are to underpin the application of this methodology:

- *Transparent and repeatable process - specialists are to describe the thresholds and limits they apply in their assessment, wherever possible.*
- *Adapt parameters to context (where justified) – the methodology proposes some thresholds (e.g. for spatial extent, in Step 3 below), however, if the nature of the impact requires a different definition of the categories of spatial extent, then this can be provided and described.*
- *Combination of a quantitative and qualitative assessment – where possible, specialists are to provide quantitative assessments (e.g. areas of habitat affected, decibels of noise, number of jobs), however, it is recognised that not all impacts can be quantified, and then qualitative assessments are to be provided.*

As per the DFFE Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect and cumulative:

- *Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.*
- *Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.*
- *Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.*

The impact assessment methodology includes the aspects described below.

- ***Step 1**: **Nature** of impact/risk - The type of effect that a proposed activity will have on the environment.*

- ***Step 2**: **Status** - Whether the impact/risk on the overall environment will be:*
    - *Positive - environment overall will benefit from the impact/risk;*
    - *Negative - environment overall will be adversely affected by the impact/risk; or*
    - *Neutral - environment overall not be affected.*

- ***Step 3**: **Qualitatively** determine the **consequence** of the impact/risk by identifying the **a) SPATIAL EXTENT; b) DURATION; c) REVERSIBILITY; AND d) IRREPLACEABILITY**.*

    - ***A) Spatial extent** – The size of the area that will be affected by the impact/risk:*
        - *Site specific;*
        - *Local (<10 km from site);*
        - *Regional (<100 km of site);*
        - *National; or*
        - *International (e.g. Greenhouse Gas emissions or migrant birds).*

    - ***B) Duration** – The timeframe during which the impact/risk will be experienced:*
        - *Very short term (instantaneous);*
        - *Short term (less than 1 year);*
        - *Medium term (1 to 10 years);*
        - *Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration)); or*
        - *Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).*

    - ***C) Reversibility** of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):*
        - *High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);*
        - *Moderate reversibility of impacts;*
        - *Low reversibility of impacts; or*
        - *Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).*

    - ***D) Irreplaceability** of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):*
        - *High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);*
        - *Moderate irreplaceability of resources;*
        - *Low irreplaceability of resources; or*

- *Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).*

Some of the criteria are quantitative (e.g. spatial extent and duration) and some may be described in a quantitative or qualitative manner (e.g. reversibility and irreplaceability). The specialist then combines these criteria in a qualitative manner to determine the ***consequence****.*

The consequence terms ranging from slight to extreme must be calibrated per Specialist Study so that there is transparency and consistency in the way a risk/impact is measured. For example, from a biodiversity and ecology perspective, the consequence ratings could be defined according to a reduction in population or occupied area in relation to Species of Conservation Concern (SCC) status, ranging from slight consequence for defined areas of Least Concern, to extreme consequence for defined areas that are Critically Endangered. For example, from a social perspective, a slight consequence could refer to small and manageable impacts, or impacts on small sections of the community; a moderate consequence could refer to impacts which affect the bulk of the local population negatively or may produce a net negative impact on the community; and an extreme consequence could refer to impacts which could result in social or political violence or institutional collapse.

- ***Consequence*** *– The anticipated consequence of the risk/impact is generally defined as follows:*
  - *Extreme (extreme alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they permanently cease);*
  - *Severe (severe alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease);*
  - *Substantial (substantial alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease;*
  - *Moderate (notable alteration of natural or socio-economic systems, patterns or processes, i.e. where the natural or socio-economic environment continues to function but in a modified manner; or*
  - *Slight (negligible and transient alteration of natural or socio-economic systems, patterns or processes, i.e. where natural systems/environmental or socio-economic functions, patterns, or processes are not affected in a measurable manner, or if affected, that effect is transient and the system recovers).*

- ***Step 4****: Rate the* ***probability*** *of the impact/risk using the criteria below:*

  - ***Probability*** *– The probability of the impact/risk occurring:*
    - *Extremely unlikely (little to no chance of occurring);*
    - *Very unlikely (<30% chance of occurring);*
    - *Unlikely (30-50% chance of occurring)*
    - *Likely (51 – 90% chance of occurring); or*
    - *Very Likely (>90% chance of occurring regardless of prevention measures).*

- ***Step 5**: Use both the **consequence** and **probability** to determine the **significance** of the identified impact/risk (qualitatively as shown in Figure 1). Significance definitions and rankings are provided below:*

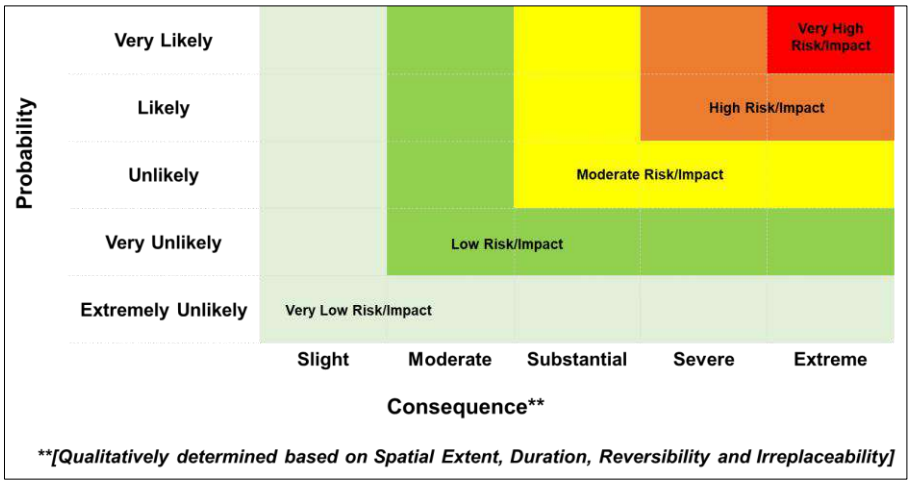


Figure 1. Guide to assessing risk/impact significance as a result of consequence and probability.

- ***Significance** – Will the impact cause a notable alteration of the environment?*
  - *Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
  - *Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
  - *Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);*
  - *High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and*
  - *Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).*

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- *Very low = 5;*
- *Low = 4;*
- *Moderate = 3;*
- *High = 2; and*
- *Very high = 1.*

The specialists must provide a written supporting motivation of the assessment ratings provided.

- ***Step 6****: Determine the* ***Confidence Level*** *– The degree of confidence in predictions based on available information and specialist knowledge:*
    - *Low;*
    - *Medium; or*
    - *High.*

Appendix 9.E: Species List for the Broader Area

Species name	Scientific name	SABAP2 Full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate
Acacia Pied Barbet	*Tricholaema leucomelas*	0.00	16.67
African Hoopoe	*Upupa africana*	0.00	0.00
African Pipit	*Anthus cinnamomeus*	100.00	33.33
African Red-eyed Bulbul	*Pycnonotus nigricans*	0.00	0.00
Ant-eating Chat	*Myrmecocichla formicivora*	100.00	50.00
Barn Swallow	*Hirundo rustica*	66.67	0.00
Black-chested Prinia	*Prinia flavicans*	0.00	8.33
Black-headed Canary	*Serinus alario*	0.00	33.33
Black-throated Canary	*Crithagra atrogularis*	33.33	8.33
Blue Crane	*Grus paradisea*	33.33	16.67
Blue Korhaan	*Eupodotis caerulescens*	0.00	8.33
Bokmakierie	*Telophorus zeylonus*	33.33	8.33
Cape Bunting	*Emberiza capensis*	0.00	0.00
Cape Sparrow	*Passer melanurus*	33.33	33.33
Cape Turtle Dove	*Streptopelia capicola*	33.33	16.67
Cape Vulture	*Gyps coprotheres*	0.00	0.00
Cape Wagtail	*Motacilla capensis*	0.00	16.67
Capped Wheatear	*Oenanthe pileata*	0.00	16.67
Chat Flycatcher	*Melaenornis infuscatus*	33.33	41.67
Cinnamon-breasted Bunting	*Emberiza tahapisi*	0.00	0.00
Cloud Cisticola	*Cisticola textrix*	0.00	0.00
Common Ostrich	*Struthio camelus*	0.00	8.33
Common Quail	*Coturnix coturnix*	0.00	0.00
Crowned Lapwing	*Vanellus coronatus*	0.00	8.33
Desert Cisticola	*Cisticola aridulus*	66.67	16.67
Eastern Clapper Lark	*Mirafra fasciolata*	100.00	16.67
Egyptian Goose	*Alopochen aegyptiaca*	33.33	16.67
European Bee-eater	*Merops apiaster*	0.00	0.00
Fairy Flycatcher	*Stenostira scita*	0.00	0.00
Familiar Chat	*Oenanthe familiaris*	33.33	8.33
Fawn-colored Lark	*Calendulauda africanoides*	0.00	16.67
Greater Kestrel	*Falco rupicoloides*	33.33	16.67
Greater Striped Swallow	*Cecropis cucullata*	33.33	0.00
Grey-backed Cisticola	*Cisticola subruficapilla*	0.00	0.00
Hadada Ibis	*Bostrychia hagedash*	0.00	0.00
Helmeted Guineafowl	*Numida meleagris*	33.33	16.67
House Sparrow	*Passer domesticus*	0.00	0.00
Jackal Buzzard	*Buteo rufofuscus*	0.00	8.33
Karoo Prinia	*Prinia maculosa*	0.00	0.00
Karoo Scrub Robin	*Cercotrichas coryphoeus*	33.33	41.67
Large-billed Lark	*Galerida magnirostris*	33.33	8.33
Lark-like Bunting	*Emberiza impetuani*	0.00	41.67

Species name	Scientific name	SABAP2 Full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate
Laughing Dove	*Spilopelia senegalensis*	0.00	8.33
Levaillant's Cisticola	*Cisticola tinniens*	0.00	0.00
Little Swift	*Apus affinis*	0.00	0.00
Long-billed Pipit	*Anthus similis*	0.00	0.00
Ludwig's Bustard	*Neotis ludwigii*	0.00	0
Martial Eagle	*Polemaetus bellicosus*	0.00	0.00
Mountain Wheatear	*Myrmecocichla monticola*	33.33	0.00
Namaqua Dove	*Oena capensis*	66.67	0.00
Neddicky	*Cisticola fulvicapilla*	0.00	0.00
Northern Black Korhaan	*Afrotis afraoides*	66.67	41.67
Pale Chanting Goshawk	*Melierax canorus*	100.00	41.67
Pied Crow	*Corvus albus*	100.00	58.33
Pied Starling	*Lamprotornis bicolor*	33.33	8.33
Plain-backed Pipit	*Anthus leucophrys*	0.00	0.00
Quailfinch	*Ortygospiza atricollis*	0.00	0.00
Red-billed Quelea	*Quelea quelea*	0.00	0.00
Red-capped Lark	*Calandrella cinerea*	33.33	8.33
Red-headed Finch	*Amadina erythrocephala*	0.00	16.67
Rock Kestrel	*Falco rupicolus*	0.00	0.00
Rock Martin	*Ptyonoprogne fuligula*	0.00	8.33
Rufous-eared Warbler	*Malcorus pectoralis*	100.00	75.00
Sabota Lark	*Calendulauda sabota*	33.33	8.33
Scaly-feathered Weaver	*Sporopipes squamifrons*	0.00	8.33
Secretarybird	*Sagittarius serpentarius*	0.00	0
South African Cliff Swallow	*Petrochelidon spilodera*	33.33	0.00
Southern Fiscal	*Lanius collaris*	33.33	25.00
Southern Grey-headed Sparrow	*Passer diffusus*	0.00	0.00
Southern Masked Weaver	*Ploceus velatus*	0.00	0.00
Southern Red Bishop	*Euplectes orix*	33.33	0.00
Speckled Pigeon	*Columba guinea*	33.33	16.67
Spike-heeled Lark	*Chersomanes albofasciata*	100.00	50.00
Spotted Thick-knee	*Burhinus capensis*	0.00	0.00
Three-banded Plover	*Charadrius tricollaris*	0.00	0.00
Verreaux's Eagle	*Aquila verreauxii*	66.67	0.00
Wattled Starling	*Creatophora cinerea*	33.33	0.00
White-backed Mousebird	*Colius colius*	33.33	0.00
White-backed Vulture	*Gyps africanus*	0.00	0.00
White-browed Sparrow-Weaver	*Plocepasser mahali*	33.33	0.00
White-necked Raven	*Corvus albicollis*	33.33	16.67
White-rumped Swift	*Apus caffer*	0.00	0.00
White-throated Canary	*Crithagra albogularis*	0.00	0.00
Yellow Canary	*Crithagra flaviventris*	0.00	0.00
Yellow-bellied Eremomela	*Eremomela icteropygialis*	0	25

Appendix 9.F: Pre-Construction Monitoring Protocol and Results

1 Methodology

Pre-construction avifaunal surveys were undertaken at the project site during the following time envelopes:

- 28 March to 01 April 2022 (Survey 1); and
- 10 to 13 May 2022 (Survey 2).

Surveys were conducted according to an adapted Regime 2 site as defined in the Solar Guidelines (Jenkins *et al.* 2017) i.e., a minimum of two surveys conducted over 6 months. Monitoring for the 12 Kudu Solar PV Project Sites were conducted in the following manner:

- Five (5) drive transects of 17.3 km, 2.8 km, 2.7 km, 5.9 km, and 1.9 km, respectively, were identified within the Study Area.
- Two monitors travelling slowly (± 10km/h) in a vehicle recorded all birds on both sides of the transects. The observers stopped at regular intervals (every 500m) to scan the environment with binoculars. Drive transects were counted three times per sampling session. All birds were recorded during the surveys.
- Three (3) walk transects of roughly 1km each were also used during the surveys. Walk transects were counted four times per sampling session.
- The following variables were recorded:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Estimated distance from transect;
    - Wind direction;
    - Wind strength (estimated Beaufort scale);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot); and
    - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground).

Figure 1 below indicates the location of the transects where monitoring was conducted.

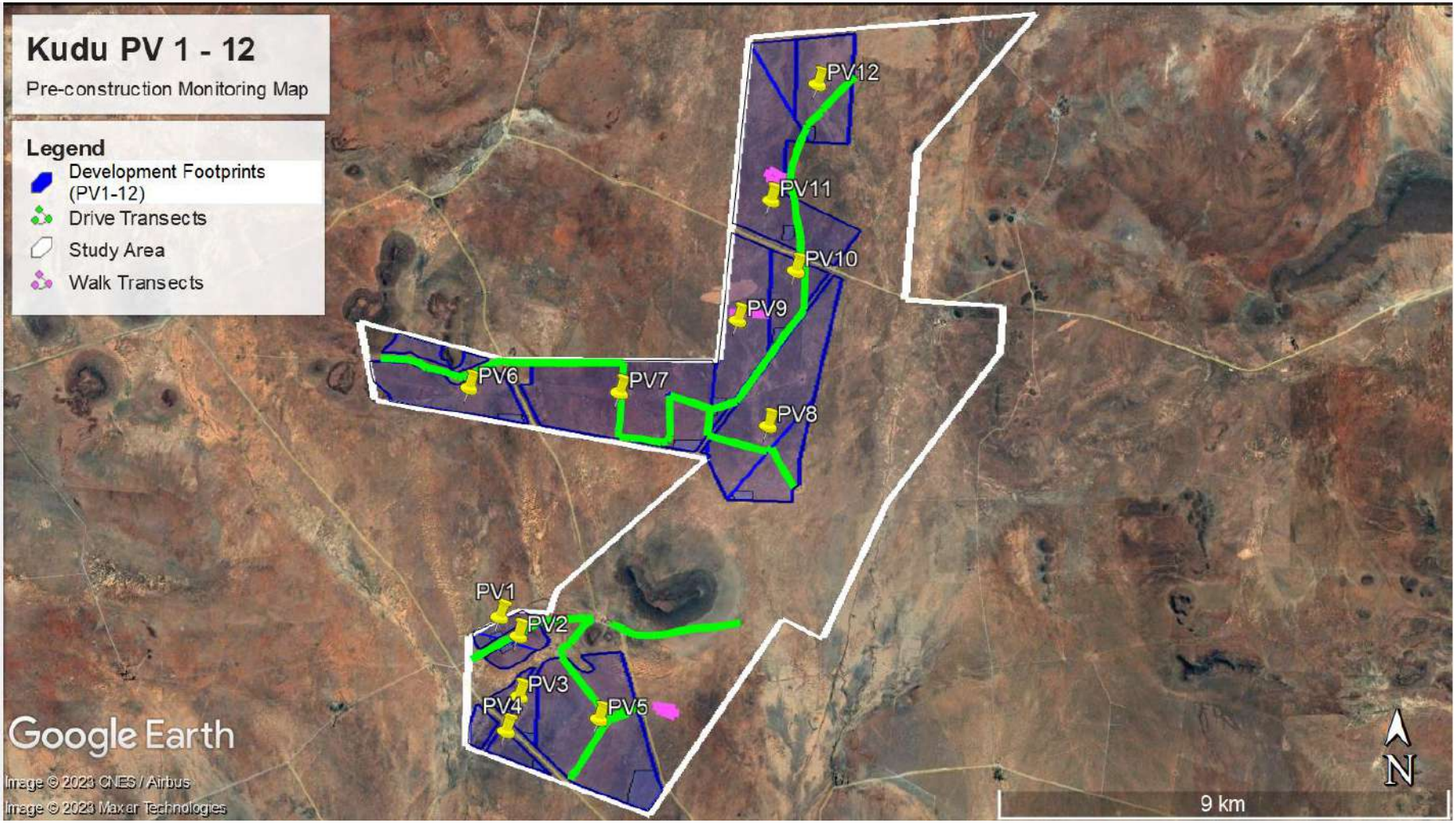


Figure 1: Map of Transect Locations of the Pre-construction Monitoring Surveys (Kudu Solar PV Study Area = white polygon).

2 Results of Pre-Construction Bird Monitoring

Table 1 and **2** and **Figures 2** and **3** below present the results of the pre-construction monitoring conducted at the Kudu PV Study Area during the two surveys. The results of the transect counts are presented in Table 1.

Table 1: Results of the transect counts

Total number of species	
All Species	76
Priority Species	18 (24%)
Non-Priority Species	58

Total number of records	
Transects	4097

An Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species recorded during transect counts for the two surveys (**Figure 2**). And **Figure 3** below shows the spatial distribution of the priority species recorded during transect counts and incidental sightings during the pre-construction monitoring surveys conducted at the Kudu Solar PV Cluster.

The results of the incidental counts are presented in Table 2.

Species names	Sci name	**Survey 1**	**Survey 2**	**Grand total**
Pale Chanting Goshawk	*Melierax canorus*	2		**2**
Large-billed Lark	*Galerida magnirostris*	1		**1**
Jackal Buzzard	*Buteo rufofuscus*		2	**2**
Greater Kestrel	*Falco rupicoloides*		1	**1**

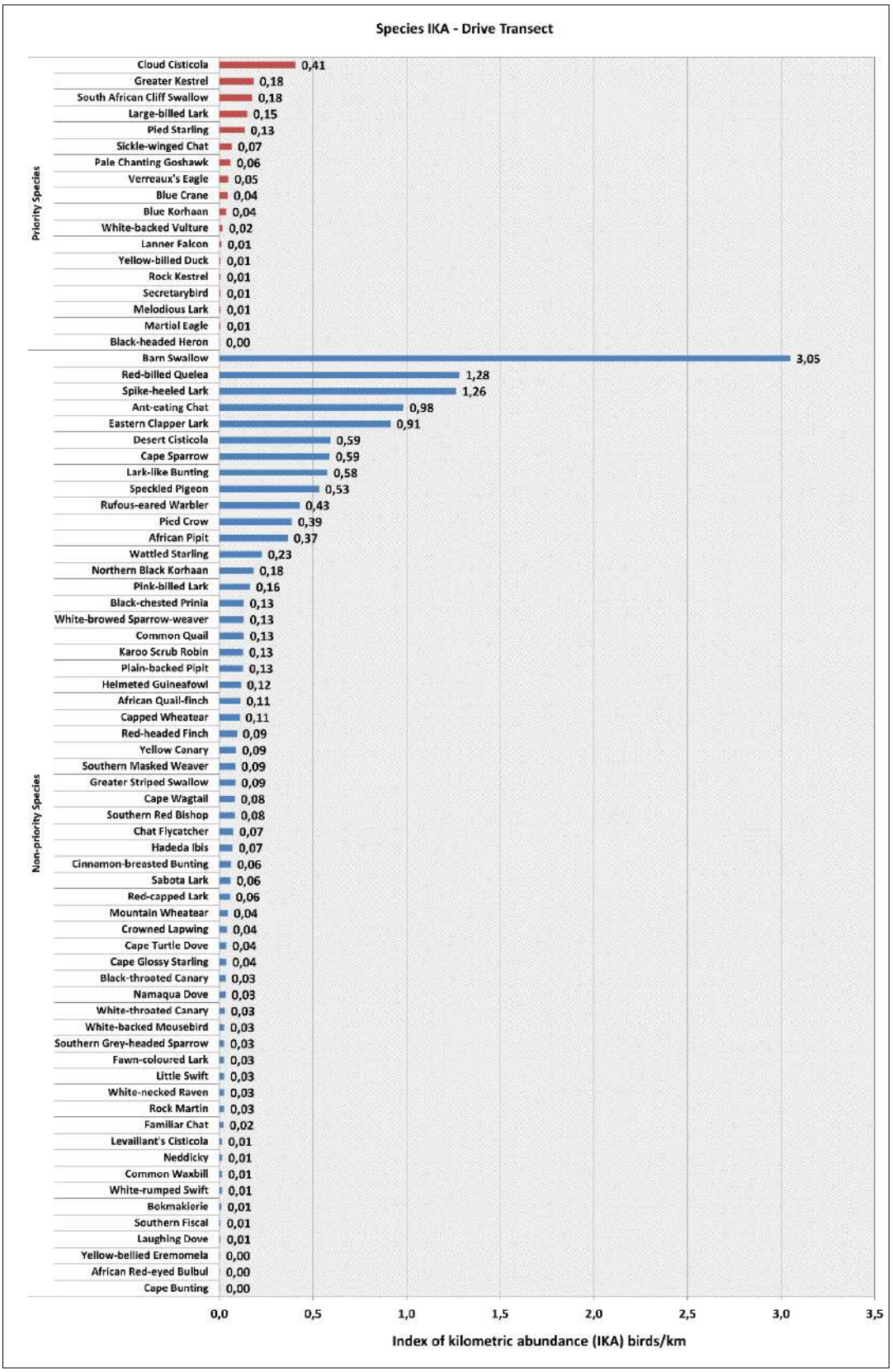


Figure 2: IKA for transect solar priority & non-priority species at the proposed Kudu Solar PV Project Cluster recorded during the two surveys.

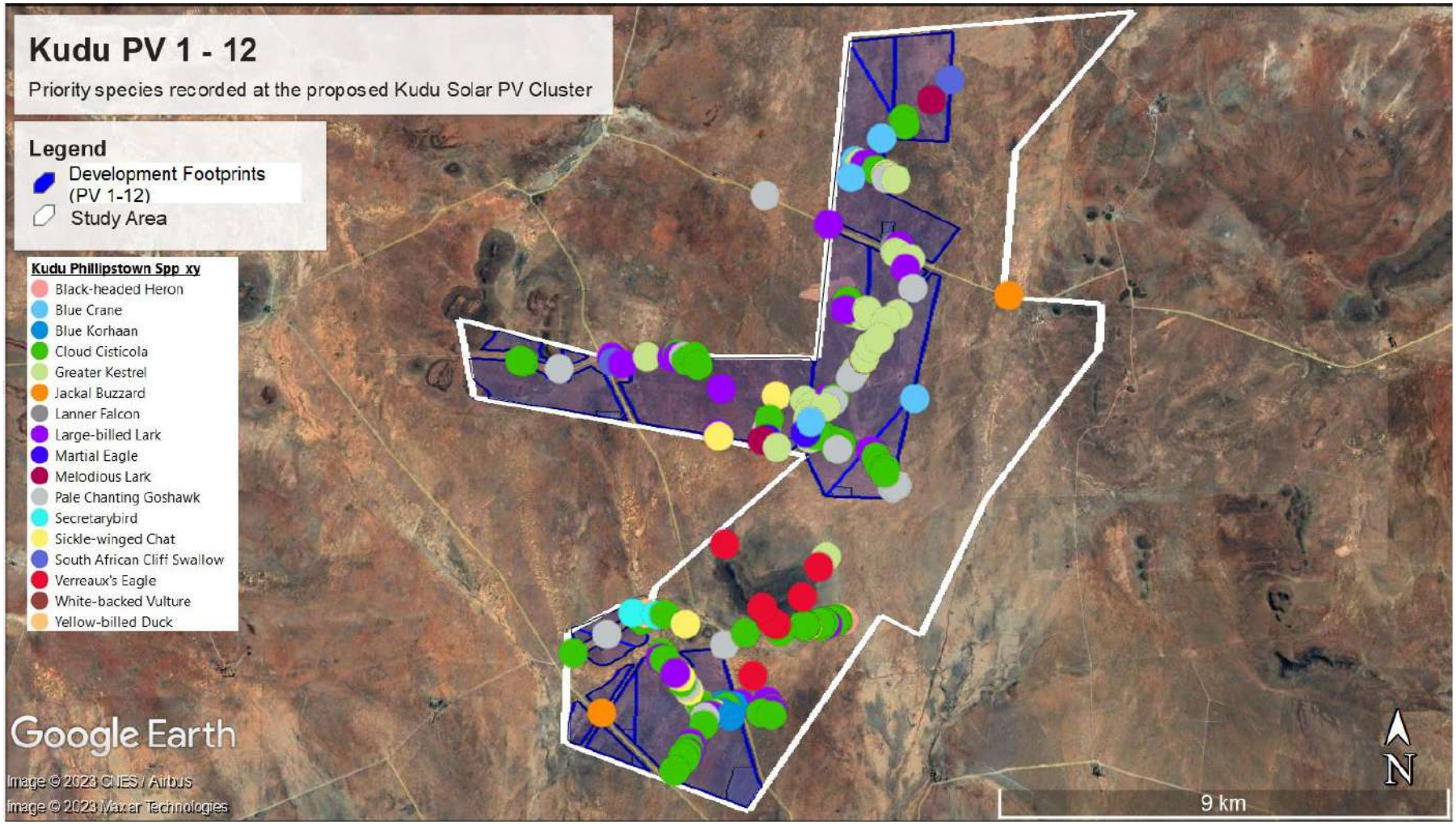


Figure 3: The location of priority species recorded at the proposed SEF study area during transect and incidental counts.

3 List of species recorded during the pre-construction monitoring

The species that were recorded during the pre-construction monitoring are listed below.

Priority Species		**Transect counts**	**Incidental counts**
Black-headed Heron	*Ardea melanocephala*	*	
Blue Crane	*Grus paradisea*	*	
Blue Korhaan	*Eupodotis caerulescens*	*	
Cloud Cisticola	*Cisticola textrix*	*	
Greater Kestrel	*Falco rupicoloides*	*	*
Jackal Buzzard	*Buteo rufofuscus*		*
Lanner Falcon	*Falco biarmicus*	*	
Large-billed Lark	*Galerida magnirostris*	*	*
Martial Eagle	*Polemaetus bellicosus*	*	
Melodious Lark	*Mirafra cheniana*	*	
Pale Chanting Goshawk	*Melierax canorus*	*	*
Pied Starling	*Lamprotornis bicolor*	*	
Rock Kestrel	*Falco rupicolus*	*	
Secretarybird	*Sagittarius serpentarius*	*	
Sickle-winged Chat	*Emarginata sinuata*	*	
South African Cliff Swallow	*Petrochelidon spilodera*	*	
Verreaux's Eagle	*Aquila verreauxii*	*	
White-backed Vulture	*Gyps africanus*	*	
Yellow-billed Duck	*Anas undulata*	*	
		18	**4**
Non-Priority Species		**Transect counts**	**Incidental counts**
African Pipit	*Anthus cinnamomeus*	*	
African Quail-finch	*Ortygospiza atricollis*	*	
African Red-eyed Bulbul	*Pycnonotus nigricans*	*	
Ant-eating Chat	*Myrmecocichla formicivora*	*	
Barn Swallow	*Hirundo rustica*	*	
Black-chested Prinia	*Prinia flavicans*	*	
Black-throated Canary	*Crithagra atrogularis*	*	
Bokmakierie	*Telophorus zeylonus*	*	
Cape Bunting	*Emberiza capensis*	*	
Cape Glossy Starling	*Lamprotornis nitens*	*	
Cape Sparrow	*Passer melanurus*	*	
Cape Turtle Dove	*Streptopelia capicola*	*	
Cape Wagtail	*Motacilla capensis*	*	
Capped Wheatear	*Oenanthe pileata*	*	
Chat Flycatcher	*Melaenornis infuscatus*	*	
Cinnamon-breasted Bunting	*Emberiza tahapisi*	*	
Common Quail	*Coturnix coturnix*	*	
Common Waxbill	*Estrilda astrild*	*	
Crowned Lapwing	*Vanellus coronatus*	*	
Desert Cisticola	*Cisticola aridulus*	*	

Eastern Clapper Lark	*Mirafra fasciolata*	*	
Familiar Chat	*Oenanthe familiaris*	*	
Fawn-coloured Lark	*Calendulauda africanoides*	*	
Greater Striped Swallow	*Cecropis cucullata*	*	
Hadeda Ibis	*Bostrychia hagedash*	*	
Helmeted Guineafowl	*Numida meleagris*	*	
Karoo Scrub Robin	*Cercotrichas coryphoeus*	*	
Lark-like Bunting	*Emberiza impetuani*	*	
Laughing Dove	*Spilopelia senegalensis*	*	
Levaillant's Cisticola	*Cisticola tinniens*	*	
Little Swift	*Apus affinis*	*	
Mountain Wheatear	*Myrmecocichla monticola*	*	
Namaqua Dove	*Oena capensis*	*	
Neddicky	*Cisticola fulvicapilla*	*	
Northern Black Korhaan	*Afrotis afraoides*	*	*
Pied Crow	*Corvus albus*	*	
Pink-billed Lark	*Spizocorys conirostris*	*	
Plain-backed Pipit	*Anthus leucophrys*	*	
Red-billed Quelea	*Quelea quelea*	*	
Red-capped Lark	*Calandrella cinerea*	*	
Red-headed Finch	*Amadina erythrocephala*	*	
Rock Martin	*Ptyonoprogne fuligula*	*	
Rufous-eared Warbler	*Malcorus pectoralis*	*	
Sabota Lark	*Calendulauda sabota*	*	
Southern Fiscal	*Lanius collaris*	*	
Southern Grey-headed Sparrow	*Passer diffusus*	*	
Southern Masked Weaver	*Ploceus velatus*	*	
Southern Red Bishop	*Euplectes orix*	*	
Speckled Pigeon	*Columba guinea*	*	
Spike-heeled Lark	*Chersomanes albofasciata*	*	
Wattled Starling	*Creatophora cinerea*	*	
White-backed Mousebird	*Colius colius*	*	
White-browed Sparrow-weaver	*Plocepasser mahali*	*	
White-necked Raven	*Corvus albicollis*	*	
White-rumped Swift	*Apus caffer*	*	
White-throated Canary	*Crithagra albogularis*	*	
Yellow Canary	*Crithagra flaviventris*	*	
Yellow-bellied Eremomela	*Eremomela icteropygialis*	*	
	Subtotal	**58**	**1**
	Grand total	**76**	**5**

Appendix 9.G: Compliance with the Animal Species Protocol (GN 1150, October 2020)

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species	***Section where this has been addressed in the Specialist Report***
2. Terrestrial Animal Species Specialist Assessment *The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects:* *2.1. The assessment must be undertaken by a specialist registered with the South African Council for Natural Scientific Professions (SACNASP), within a field of practice relevant to the taxonomic groups ("taxa") for which the assessment is being undertaken.*	*Appendix 9.A*
2.2. The assessment must be undertaken in accordance with the Species Environmental Assessment Guideline and must:	-
2.2.1. Identify the SCC which were found, observed or are likely to occur within the study area;	*Section 9.4, Appendix 9.C*
2.2.2. provide evidence (photographs or sound recordings) of each SCC found or observed within the study area, which must be disseminated by the specialist to a recognized online database facility immediately after the site inspection has been performed (prior to preparing the report contemplated in paragraph 3);	*Section 9.4, Appendix 9.C*
2.2.3. identify the distribution, location, viability and provide a detailed description of population size of the SCC identified within the study area;	*Section 9.4, Appendix 9.C, & Appendix 9.F*
2.2.4. identify the nature and the extent of the potential impact of the proposed development to the population of the SCC located within the study area;	*Sections 9.6 & 9.7*
2.2.5. determine the importance of the conservation of the population of the SCC identified within the study area, based on information available in national and international databases including the IUCN Red List of Threatened Species, South African Red List of Species, and/or other relevant databases;	*Sections 9.2 & 9.4, Appendix 9.C*
2.2.6. determine the potential impact of the proposed development on the habitat of the SCC located within the study area;	*Sections 9.6 & 9.7*
2.2.7. include a review of relevant literature on the population size of the SCC, the conservation interventions as well as any national or provincial species management plans for the SCC. This review must provide information on the need to conserve the SCC and indicate whether the development is compliant with the applicable species management plans and if not, a motivation for the deviation;	*Section 9.2*

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species	***Section where this has been addressed in the Specialist Report***
2.2.8. identify any dynamic ecological processes occurring within the broader landscape, that might be disrupted by the development and result in negative impact on the identified SCC, for example, fires in fire-prone systems;	*Section 9.7*
2.2.9. identify any potential impact on ecological connectivity within the broader landscape, and resulting impacts on the identified SCC and its long term viability	*Section 9.7*
2.2.10. determine buffer distances as per the Species Environmental Assessment Guidelines used for the population of each SCC;	*Section 9.4.4*
2.2.11. discuss the presence or likelihood of additional SCC including threatened species not identified by the screening tool, Data Deficient or Near Threatened Species, as well as any undescribed species, or roosting and breeding or foraging areas used by migratory species where these species show significant congregations, occurring in the vicinity;	*Section 9.4.2, Appendix 9.C & Appendix 9.F*
2.2.12. Identify any alternative development footprints within the preferred development site which would be of "low" sensitivity" or "medium" sensitivity as identified by the screening tool and verified through the site sensitivity verification.	*Section 9.5*
2.3. The findings of the assessment must be written up in a Terrestrial Animal Species Specialist Assessment Report.	-
3. Terrestrial Animal Species Specialist Assessment Report: *3.1. This report must include as a minimum the following information:*	-
3.1.1. contact details and relevant experience as well as the SACNASP registration number of the specialist preparing the assessment including a curriculum vitae;	*Appendix 9.A*
3.1.2. a signed statement of independence by the specialist;	*Appendix 9.B*
3.1.3. a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	*Section 9.4.4, Appendix 9.F*
3.1.4. a description of the methodology used to undertake the site sensitivity verification and impact assessment and site inspection, including equipment and modelling used where relevant;	*Section 9.2, Appendix 9.C*
3.1.5. a description of the mean density of observations/number of sample sites per unit area and the site inspection observations;	*Appendix 9.F*
3.1.6. a description of the assumptions made and any uncertainties or gaps in knowledge or data;	*Section 9.2.2*
3.1.7. details of all SCC found or suspected to occur on site, ensuring sensitive species are appropriately reported;	*Section 9.4.4*
3.1.8. the online database name, hyperlink and record accession numbers for disseminated evidence of SCC found within the study area;	*Section 9.2*

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species	***Section where this has been addressed in the Specialist Report***
3.1.9. the location of areas not suitable for development and to be avoided during construction where relevant;	*Section 9.4.4*
3.1.10. a discussion on the cumulative impacts;	*Section 9.7.4*
3.1.11. impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	*Sections 9.7, 9.9 & 9.10*
3.1.12. a reasoned opinion, based on the findings of the specialist assessment, regarding the acceptability or not of the development and if the development should receive approval or not, related to the specific theme being considered, and any conditions to which the opinion is subjected if relevant;	*Section 9.10*
3.1.13. a motivation must be provided if there were any development footprints identified as per paragraph 2.2.12 above that were identified as having "low" or "medium" terrestrial animal species sensitivity and were not considered appropriate.	*Section 9.5*
3.2. A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	*This Avifauna Report serves this purpose i.e. Chapter 9 of the EIA Report.*



CHAPTER 10:

Visual Impact Assessment



CSIR
Touching lives through innovation

VISUAL SPECIALIST ASSESSMENT:

Scoping and Environmental Impact Assessment (EIA) Processes for the Proposed Development of a Solar Photovoltaic Facility (Kudu Solar Facility 4) and associated infrastructure, near De Aar, Northern Cape Province

Report prepared for:	*Report prepared by:*
CSIR – Environmental Management Services P O Box 320 Stellenbosch 7599 South Africa	Bernard Oberholzer (bola) and Quinton Lawson (qarc) PO Box 471, Stanford, 7210

V1: 20 May 2023
V2: July 2023

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Map 10: Kudu SPV 4 Visual Sensitivity
Map 11: Kudu SPV 4 Cumulative Renewable Energy Projects
Photomontage: Kudu PV4

List of Abbreviations

BA	Basic Assessment
BESS	Battery Energy Storage System
DEM	Digital Elevation Model
DFFE	Department of Forestry, Fisheries and the Environment
EAP	Environmental assessment practitioner
EGI	Electricity Grid Infrastructure
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GN	Government Notice
GPS	Global Positioning System
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
PV	Photovoltaic
REEA	Renewable Energy EIA Application Database
SAPAD	South African Protected Areas Database
SEA	Strategic Environmental Assessment
VIA	Visual Impact Assessment

Glossary

Definitions	
Receptor	Individuals, groups or communities who are subject to the visual influence of a particular project.
Viewpoint	A selected point in the landscape from which views of the project are ascertained.
Viewshed	The outer boundary defining a view catchment area, used to determine the zone of visual influence.
View shadow	An area within the view catchment visually obscured from the project, usually by topography.
Visual absorption capacity	The ability of an area to visually absorb development by means of screening topography, vegetation or buildings.

VISUAL IMPACT ASSESSMENT

1. Introduction

1.1. Scope, Purpose and Objectives of this Specialist Input to the EIA Report

This report serves as the Visual Impact Assessment (VIA) as part of the Environmental Impact Assessment (EIA) Process for the proposed development of a Solar Photovoltaic (PV) Facility (Kudu Solar Facility 4) and associated infrastructure, near De-Aar, Northern Cape Province (**Map 1**).

The purpose of the VIA is to provide inputs to the Scoping and EIA Reports for the Kudu Solar PV project as required by the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations (2014, as amended). The intention is that the VIA used to determine layouts for the Solar PV site based on the visual sensitivities identified, as well as those by other specialists.

During the scoping phase, the specialists considered the entire study area, which included the Original Scoping Buildable Areas that included the development of up to 14 Solar PV Facilities. However, following the identification of sensitivities, discussions with landowners and other considerations such as the capacities of the upcoming Bidding Windows, the proposed projects were re-clustered and a total of up to 12 Solar PV Facilities are now being proposed.

Separate reports have been compiled for each PV facility. This report covers the Kudu Solar Facility 4 and associated infrastructure.

1.2. Details of Specialist

The visual specialist assessment has been undertaken by Bernard Oberholzer (BOLA) and Quinton Lawson (QARC). BOLA is registered with the South African Council for the Landscape Architectural Profession (SACLAP), with Registration Number 87018, and QARC with the South African Council for the Architectural Profession (SACAP), with Registration Number 3686. A curriculum vitae is included in Appendix A of this specialist input report and a signed specialist statement of independence is included in Appendix B.

1.3. Terms of Reference

The Terms of Reference for the visual scoping and EIA specialist studies include the following:

- Undertake a site inspection to identify existing scenic resources/visual characteristics on and around the proposed project sites.
- Determine visual constraints and sensitivity levels in terms of solar PV development. Verify these in terms of the National Screening Tool to confirm or dispute identified environmental sensitivities.
- Determine viewsheds, view corridors and important viewpoints in order to assess the visual influence of the proposed project.
- Review the legal framework that may have implications for visual/scenic resources.
- Identify and assess possible visual impacts that could result from the proposed project.
- Determine possible cumulative visual impacts in relation to other renewable energy projects in the region.
- Identify possible mitigation measures to reduce the significance of negative visual impacts for inclusion into the project design.

2. Approach and Methodology

The approach and methodology for the VIA specialist study includes the following:

- A 3D digital terrain model of the study area is used to determine the viewshed of the proposed project.
- Potential sensitive receptors, such as farmsteads and settlements in the surrounding area, are identified using the viewshed map and Google Earth.
- Landscape features and sensitive receptors are mapped together with recommended buffers.
- Field work is used to verify the existence and significance of landscape features and receptors.
- A photographic record is made with the emphasis on views from potential sensitive receptors of the proposed project at varying distances.
- The panoramic photographs, which include GPS positions, are then used to create the post-mitigation photomontages.

A Site visit was carried out on 15 and 16 March 2022. The track used during the fieldwork is indicated on **Map 3**. The season was not a consideration for the visual survey, but clear visibility was required.

The methodology is based on the 'Guideline for Involving Visual and Aesthetic Specialists in EIA Processes' (Oberholzer, 2005).

Potential visual impacts identified in this specialist study have been assessed based on the criteria and methodology outlined in Appendix D. Refer to Appendix E for table of compliance with Appendix 6 of the 2014 NEMA EIA Regulations (as amended).

2.1. Information Sources

A List of the main databases and information sources is given in Table 1 below. The quality of base data was considered adequate for the visual assessment.

Table 1: Sources of information

Data / Information	Source	Date	Type	Description
Project Data	ABO Wind Renewable Energies (PTY) LTD	2023	Vector Digital Spatial Data	Project Component Layout provided by proponent
South African National Protected Areas Database (SAPAD)	Department of Forestry, Fisheries and the Environment (DFFE)	2022, Q1	Vector Digital Spatial Data	Spatial delineation of protected areas in South Africa, updated quarterly
South African Renewable Energy EIA Application Database (REEA)	Department of Forestry, Fisheries and the Environment (DFFE)	2022, Q2	Vector Digital Spatial Data	Spatial delineation of Renewable Energy EIA Applications in South Africa, updated quarterly
ESKOM EGI Power Corridors	Department of Forestry, Fisheries and the Environment (DFFE)	2015	Vector Digital Spatial Data	Spatial delineation of EGI Power Corridors in South Africa
ESKOM Infrastructure Spatial Data	ESKOM: Electricity Grid Infrastructure (EGI) Database	2008	Vector Digital Spatial Data	Spatial delineation of ESKOM EGI Transmission, Distribution and Substation Data
Geological Data	Council for Geoscience	2011	Vector Digital Spatial Data	Geological Map of South Africa: Spatial Dataset

Data / Information	Source	Date	Type	Description
1:50 000 Topographic Series GIS Data	Chief Directorate National Geo-spatial Information (CDNGI)	2008	Vector Digital Spatial Data	Spatial Data of the 1:50 000 Topographic Series including elevational data (20m contours)
1:50 000 Topographic Series Maps	Chief Directorate National Geo-spatial Information (CDNGI)	2005	Georeferenced Raster Data	3024AA Potfontein, 3024AB Jakkalskuil 3024AC Houtkraal, 3024AD Philipstown
South Africa Road and Terrain Data	Google Maps (maps.google.com)	2022	Online Data	South Africa Road and Terrain Data
South Africa Satellite Imagery	Google Earth Pro	2022	Online Data	South Africa Satellite Imagery

2.1.1. Assumptions, Knowledge Gaps and Limitations

The detailed design of the solar arrays that may be used have not been determined at this stage, but a height of 3,5m was used to prepare the viewshed map.

Assumptions were made regarding the configuration and finishes of the proposed substation and battery energy storage system (BESS), as well as lighting related to the proposed project.

3. Description of Project Aspects relevant to the Visual Assessment

The Kudu project will entail the proposed development of up to 12 Solar PV Facilities ranging from up to 50 MWac to 350 MWac, as well as associated infrastructure, near De Aar, Northern Cape. This report focuses on Kudu Solar PV Facility 4.

The proposed project will make use of PV solar technology with the solar PV facility having associated infrastructure, including, but not limited to, an on-site substation complex and BESS (+-1 ha and max. height 10m). Each On-Site Substation Complex (extending up to 8 ha) could include an on-site Independent Power Producer (IPP) or Facility Substation (+-1 ha), and O&M buildings (up to 0,5 ha), as well as other infrastructure that would be subjected to the separate assessment processes. **Maps 2 and 3** indicate the affected farm portions, as well as the proposed PV areas for all 12 projects.

Various Electrical Grid Infrastructure (EGI) are being proposed to enable and facilitate connection of the proposed projects to the national grid, and that these EGI will be assessed as part of separate Basic Assessment processes or similar[1].

4. Baseline Environmental Description

4.1. Study Area Definition

The study area for all the proposed Kudu Solar Facilities is the full extent of the eight affected farm properties on which the proposed PV Facilities will be constructed. The full extent of these properties has been assessed in this study in order to identify environmental sensitivities and no-go areas. The total **study area** for all the Kudu Solar Facilities is approximately 8 150 hectares (ha).

At the commencement of this Scoping and EIA Process, the **Original Scoping Buildable Areas** were identified by the Project Developer, following the completion of high-level environmental screening based on the Screening Tool.

[1] However, for completeness, the external EGI corridor and power lines (Projects 13 to 26) are shown on some of the maps in this report. Note these are not part of this current assessment, and are still to be finalised.

Following the identification of sensitivities during the Scoping Phase, the Project Developer has considered such sensitivities and formulated the **Revised Buildable Areas**. The Revised Scoping Buildable Areas were used to inform the design of the layout, and further assessed during this EIA Phase of the project in order to identify the preferred development footprint of the proposed project on the approved site as contemplated in the accepted Scoping Report. The development footprint is where the actual development will be located, i.e. the footprint containing the PV solar arrays and associated infrastructure.

4.2. General Description

A brief description of scenic features and receptors in the surrounding area that can potentially be affected by visual impacts arising from the proposed project are described below. These are indicated on **Map 9** together with the proposed development, and in the photographs below.

The study area lies within an expansive flattish landscape, composed of Ecca Group shales, interspersed with dolerite-capped koppies, providing topographic relief, these being the main scenic features of the area (**Map 5** and Figure 1). The elevation ranges from 1000 to 1500m in the region.

The vegetation is Northern Upper Karoo type (Mucina and Rutherford, 2006), consisting of dwarf shrubland and grassland. The grassland was unusually lush after the good summer rains experienced this year in the region, (Figure 2), and the local district roads were very muddy. The dolerite koppies are covered with open shrubland along with grasses.

The main agricultural activity is open-range sheep farming with both merino and dorper sheep occurring, along with cattle farming and some horses. A main Eskom powerline (i.e. Hydra/Perseus 1 765kV) traverses several of the proposed Kudu Solar PV sites, constituting an existing visual impact.

Farmsteads nestled among tree copses in the surrounding area tend to be 2 km or more apart (Figures 4 and 5). Three of the farmsteads, Louwsvilla, Zionsheuwel and Rooidam, were derelict and not occupied (Figure 3). Two farmsteads, Wolwekuil farmstead (situated on Farm 42/RE), and Basberg, are located within the overall project area, and it was therefore assumed that these are not sensitive receptors. Furthermore, the area around the Basberg Mountain, being a scenic feature, has been excluded from the proposed PV development area.



Figure 1: Grass-covered dolerite koppies provide the main landscape relief in the area



Figure 2: The grassland plains near Louwsvilla are used for sheep grazing



Figure 3: Louwsvilla farmstead to the south of the proposed Kudu Solar PV facilities is derelict



Figure 4: Karee Kloof farmstead, surrounded by tall cypresses, would be 2,8km from the proposed Kudu project



Figure 5: View towards Middelplaas-Noord farmstead and the flat-topped Basberg in the middle distance

The only known guest farm / game farm in the area, which provides visitor facilities, is Jakkalskuil, and the nearest nature reserves are in the vicinity of the Van Der Kloof Dam more than 30km to the north-east (**Map 1**). According to the Social Impact Assessment (SIA), game occurs on most of the study area properties, several of which offer annual (winter) hunting opportunities. There are no known airfields in the local area.

The viewshed, or zone of visual influence of the proposed solar PV site potentially extends for some 5km, but is partly restricted by the Basberg to the north-east, creating a view shadow. Given the height of the solar arrays (about 3,5m), the viewshed of the proposed solar facility would be fairly localised (see **Map 6**). Estimated degrees of visibility, based on the scale and height of all the PV facilities and related infrastructure, and on the distance from various viewpoints, are indicated in Tables 2 and 3 below.

Table 2: Degrees of Visibility of Proposed PV Facilities

Very high visibility	0-500m	Prominent feature within the observer's view frame
High visibility	500m-1km	Relatively prominent within observer's view frame
Moderate visibility	1-2km	Only prominent as part of the wider landscape
Low visibility	2-4km	Visible as a minor element in the landscape
Very low visibility	>4km	Hardly visible with the naked eye in the distance

Table 3: Viewing Distances and Potential Visibility from Receptors

View-point	Receptor	Latitude	Longitude	Distance to PV arrays	Potential Visibility/ Closest PV Project
VP1	Bokkraal	30.318559 S	24.354662 E	6.79 km	Not Visible
VP2	Zionsheuwel (derelict)	30.267535 S	24.374876 E	5.81 km	Very Low visibility. Beyond 5km
VP3	Rooidam (derelict)	30.281976 S	24.362026 E	4.82 km	Very Low visibility.
VP4	Louwsvilla (derelict)	30.294538 S	24.308752 E	2.97 km	Low visibility.
VP5	Karee Kloof (Swartkoppies)	30.281137 S	24.276414 E	2.87 km	Low visibility
VP6	Vrede	30.256084 S	24.270718 E	2.59 km	Low visibility
VP7	Tafelkop	30.185034 S	24.234760 E	9.98 km	Very Low visibility. Beyond 5km
VP8	Middelplaas-Noord	30.187386 S	24.300348 E	7.56 km	Very Low visibility. Beyond 5km
VP9	Jakobsrus	30.161906 S	24.328036 E	10.74 km	Very Low visibility. Beyond 5km
VP10	Wolwekuil (Farm 42/1)	30.167089 S	24.410270 E	14.48 km	Not Visible
VP11	Grasbult	30.149474 S	24.418840 E	16.46 km	Not Visible

4.3. Project Specific Description

The description of the baseline environment for Kudu Solar Facility 4 is similar to the general description given above. Landscape and scenic features have generally been avoided in the proposed solar PV layout and features of 'very high' visual sensitivity have been avoided.

4.4. Identification of Environmental Sensitivities

4.4.1. Sensitivities identified by the National Web-Based Environmental Screening Tool

The proposed project study area has been overlaid on the landscape sensitivity map generated by the Department of Forestry, Fisheries and the Environment (DFFE) Screening Tool, and on a more detailed project-scale sensitivity map, that has been verified by the specialists, (see Appendix C).

The Screening Tool 'Landscape' Sensitivity Map indicates areas of ridges and steep slopes in the northern and southern parts of the study area (**Map 8**). These were, however, mapped at the regional scale linked to the Phase 1 Wind and Solar 2015 Strategic Environmental Assessment (SEA), and a more accurate map of landscape features with recommended buffers has been prepared at the local project scale by the specialists, (see **Map 10** and Tables 4 and 5).

4.4.2. Visual Sensitivity Analysis and Verification

Landscape features of visual or scenic value, along with potential sensitive receptors in the surroundings, are listed in Table 4 below. Visual features are indicated on **Map 9**.

Table 4: Scenic Features and Sensitive Receptors

Landscape features within or adjacent to the study area.	
Topographic features	Characteristic landforms include the dolerite *koppies* contributing to the scenic value of the area, and providing visual interest or contrast to the flat grassy plains.
Water Features	In the dry landscape, drainage features and larger dams provide scenic and amenity value.
Cultural landscapes	The area contains modest farmsteads with tree copses, grazing pasture and minimal cultivation.
Receptors adjacent to the PV project or in the local surroundings.	
Protected Areas	There are no known proclaimed nature reserves or private reserves in close proximity to the study area, the nearest being Van der Kloof Nature reserve some 30km away.
Human settlements	The nearest settlements are Philipstown and Petrusville, over 20 km away, and De Aar about 50 km away.
Scenic and arterial routes	There are no major arterial or scenic routes within the vicinity of the solar PV site.

Scenic resources and sensitive receptors within the study area have been categorised into no-go (very high), high, medium and low visual sensitivity zones, for the proposed solar PV facility, as indicated in Tables 5 and 6 below. The visual sensitivity mapping categories are spatially indicated on **Map 10**.

Substations, BESS, internal power lines and access roads would have minor buffers. The buffers in Table 5 are based on those for landscape resources in the National Wind and Solar SEA (Lawson and Oberholzer, 2014).

Table 5: Visual Sensitivity Mapping Categories for the Proposed Kudu Solar Facility 4

Scenic Resources	Very high sensitivity	High visual sensitivity	Medium visual sensitivity	Low visual sensitivity
Topographic features	Feature	Within 250m	-	-
Steep slopes	Slopes > 1:4	Slopes > 1:10	-	-
Drainage courses	Feature	Within 50m	-	-
Cultural landscapes	within 250m	within 500m	-	
Protected Landscapes / Sensitive Receptors				
Nature reserves / game farms	within 500m	within 1 km	within 2 km	-
Farmsteads outside site	within 500m	within 1 km	within 2 km	-
Farmsteads inside site	within 250m	within 500m	-	
Arterial routes n/a	within 250m	within 500m	within 1km	-
District roads	within 50m	within 100m	within 250km	-

Table 6: Visual Sensitivity Categories

Very high	Areas or features considered of such sensitivity or importance that any adverse effects upon them may be regarded as a fatal flaw.
High	Development to be limited and remain within acceptable limits of change determined by the specialist, and comply with restrictions or mitigation measures identified by the specialist.
Medium	Areas considered to be developable, but to remain within acceptable limits of change as determined by the specialist, and comply with restrictions or mitigation measures identified by the specialist.
Low	Low sensitivity areas that are considered to be developable. However, specialists may still wish to define acceptable limits of change where necessary.

4.4.3. Sensitivity Analysis Summary Statement

More accurate mapping of landscape features has been provided at the detailed project scale, being a refinement of the DFFE's Screening Tool Landscape Sensitivity Map. No significant landscape or scenic features would be affected by the currently proposed Kudu Solar facility. The sensitivities noted below are based on the identified 'Buildable Areas', (i.e. development footprints).

Table 7: Visual Sensitivity Analysis of the Proposed Solar Facility

Kudu Solar Facility	Scenic Resources / Receptors	Sensitivity
Kudu Solar Facility 4 related infrastructure	The proposed solar PV borders on a drainage feature and local road but outside the no-go buffer areas. The nearest surrounding farmstead, Vrede, is 2,59 km away, and well outside the buffer area.	Low visual sensitivity

As indicated above, following the identification of sensitivities during the Scoping Phase, the Project Developer considered such sensitivities and formulated the Revised Buildable Areas. The Revised Scoping Buildable Areas led to the identification of the development footprints and detailed layouts in the EIA Phase which are considered suitable from a visual perspective, as the sensitivities identified above have been taken into consideration as shown on **Map 10**.

Changes to the detailed layouts are deemed acceptable if the changes remain within the approved buildable areas / development footprints assessed during the Scoping and EIA Process with no-go sensitive areas avoided.

5. Issues, Risks and Impacts

5.1. Identification of Potential Impacts/Risks

Potential visual impacts arising from the proposed Kudu Solar PV Facility and associated infrastructure on landscape features and receptors identified above are listed below for each of the project phases, including cumulative impacts. No indirect impacts have been identified.

Construction Phase

- Impact 1: Potential effect of dust and noise from trucks and construction machinery during the construction period, and the effect of this on nearby farmsteads and visitors to the area.
- Impact 2: Potential visual effect of haul roads, access roads, stockpiles and construction camps in the visually exposed landscape.

Operational Phase

- Impact 1: Potential visual intrusion of solar arrays and related infrastructure on receptors including glint and glare.
- Impact 2: Potential visual impact of an industrial type activity on the pastoral / rural character and sense of place of the area.

Decommissioning Phase

- Impact 1: Potential visual effect of any remaining structures, platforms and disused roads on the landscape.

Cumulative Impacts

- Impact 1: Potential combined visual effect of the proposed 12 solar PV facilities in the study area, seen together with other existing and proposed renewable energy facilities in the area, are indicated on **Map 11** and could potentially increase the overall cumulative visual impact.

5.2. Summary of Issues identified during the Public Consultation Phase

Visual related issues were raised by Interested and Affected Parties (I&APs) and Stakeholders during the 30-day review period on the Draft Scoping Report. A summary of these issues is listed below, together with responses from the Visual Specialists.

KEY ISSUE	RESPONSE
Requests for information on the visual impact of the development on neighbouring farm portions as relating to farming and tourism activities. Specifically: • Please provide information and sketches about the visual impact that this development will have on farm Vanwyngaardspan and farming. • Please provide information and sketches about the visual impact that this development will have on farm Jakkalskuil and farming activities like the offering of hunting- and photographic safaris to clients from all over the world.	• The location of farm Vanwyngaardspan was confirmed with the landowner during the EIA Phase. Farm Vanwyngaardspan is more than 25 km away from the northern-most corner of Kudu Solar Facility 11 (and even further from the Kudu Solar Facility 4). The proposed Kudu Solar Facilities would not be visible from this area. There are also two koppies - Aasvoëlkop and Ongelukskop, which are 85m higher than the Kudu Solar Facility 11, which would block the line of sight of the proposed Kudu Solar Facilities. Refer to the VIA for Kudu Solar Facility 11 for additional information. • The Jakkalskuil farmstead is 5,84 km from the proposed project area and the Kudu Solar Facility would therefore not be visible. Refer to the VIA for Kudu Solar Facility 12 for additional information. However, the farm boundary is directly adjacent to the Kudu Solar Facility 12 and the visibility would be very high at 360m distance. The viewshed, or zone of visual influence, potentially extends for some 5 km, hence the Jakkalskuil farmstead was not included in the Visual Scoping Level Assessment. Impacts on adjacent farmsteads have therefore been identified and considered in the VIA specialist study.
Request to ensure that the visual impact on the nearest farmstead, Vrede, is adequately assessed.	Various impacts are identified and assessed in the VIA, such as the potential effect of dust and noise from trucks and construction machinery during the construction period, and the effect of this on nearby farmsteads and visitors to the area, as well as the potential visual impact of a solar energy facility on the pastoral / rural character and sense of place of the area. The Vrede farmstead is located some 2,59 km away from the proposed Kudu PV 4 project, assessed as 'low' visibility and is also outside the visual buffer area as shown on Map 10.

Minor comments related to visual impacts associated with the proposed project were raised by Interested and Affected Parties during the review period of the Draft EIA Report. These comments mainly related to clarification of high sensitivity areas being slightly encroached for Kudu Solar Facility 1, 2, 3 and 4 (which do not need to be avoided) and dust generation. Responses have been provided in Appendix H.7 of the Final EIA Report.

6. Visual Impact Assessment

This section provides an assessment of the potential visual impacts of the proposed project. Comment on the no-go alternative is also provided.

Criteria for determining visual impact included the following:

Visual Exposure: (Map 6)
The viewshed, or zone of visual influence, potentially extends for some 5km, but is partly restricted by the Basberg to the north-east where parts of the surrounding area are in a view shadow.

Visibility:
Possible degrees of visibility from a number of viewpoints are indicated in Table 3. (See also photo-montages). Visibility of lights at night would not be significant because of the localised need for lighting and the distance of receptors. Visibility for Kudu PV 4 varies from not visible to low visibility.

Landscape Integrity:
The natural landscape intactness of the area, and its pastoral sense of place, has been altered to some extent by the main Eskom powerline (i.e. Hydra/Perseus 1 765kV) that runs through the study area. The character and sense of place of the rural landscape would potentially be affected by the proposed solar PV development.

Visual Absorption Capacity:
The area around the proposed site is generally flat to gently undulating with scattered koppies, and low grass vegetation cover. It is therefore relatively visually exposed, with low to moderate visual absorption capacity, i.e. little potential to screen any proposed structures.

Visually Sensitive Resources:
Natural and cultural landscapes, or scenic resources, form part of the 'National Estate' and may have local or regional significance. The study area has few significant features, most of these being minor dolerite koppies, which have been avoided in the layout**.**

Visual Impact Intensity:
The overall potential visual impact intensity (magnitude) is determined in Table 8 below by combining the above criteria. Visual impact intensity is in turn used to assess impact consequence.

No-go Alternative

The 'no-go' alternative is the option of not constructing the Project in which case the *status quo* of the current landscape character would prevail, the disadvantage being that no solar energy would be produced for export to the national grid. The potential visual impact would be neutral where the *status quo* is maintained, with neither impacts or benefits occurring.

Table 8: Visual Impact Intensity for Kudu Solar Facility 4

Visual Criteria	Comments	Intensity
Visual exposure	Viewshed is related to the height of the solar arrays. Some areas are in a view shadow.	Medium-low
Visibility	Visible mainly from nearby farmsteads and local district roads. Distance is a mitigatory factor in most cases.	Low
Visual absorption capacity (VAC)	Visually exposed landscape with some undulations. Generally low VAC.	Medium
Landscape integrity / intactness	Effect on landscape character / sense of place.	Medium-high

Visual Criteria	Comments	Intensity
Landscape / scenic sensitivity	Landscape features generally avoided.	Low
Impact intensity	Summary	**Medium**

The quantification of overall visual impact significance for the proposed Kudu Solar Facility is based on the methodology provided by the CSIR (2022), as used in Tables 9 to 12 below. The assessment criteria are included in Appendix D of this report, and the significance rating is based on Figure 6 below.

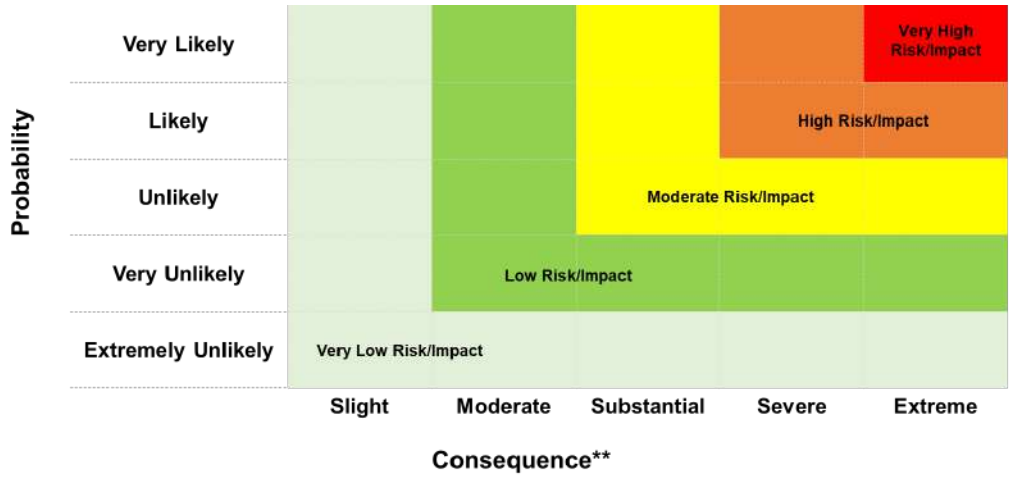


Figure 6: Visual impact risk chart

6.1. Potential Visual Impacts during the Construction Phase

This section includes a description of the potential visual impacts during the Construction Phase.

- ***Impact 1: Potential effect of dust and noise from trucks and construction machinery during the construction period, and the effect of this on nearby farmsteads and visitors to the area.***

The above impact is rated as a negative, direct impact that extends locally and is of a short-term duration. The consequence is rated as moderate, and the probability identified as very likely, resulting in an impact significance of low, without the implementation of mitigation measures. With mitigation, the significance would remain low significance. Mitigation measures include ensuring that the Environmental Management Programme (EMPr) is implemented during the construction phase via the appointment of an Environmental Control Officer (ECO); and ensuring that construction camp and other facilities are located in visually unobtrusive areas, away from public roads. The impact summary is given in Table 9.

- ***Impact 2: Potential visual effect of haul roads, access roads, stockpiles and construction camps in the visually exposed landscape.***

This impact is rated as a negative, direct impact with a short-term duration and local spatial extent. The consequence and probability are respectively rated as moderate and very likely, rendering a low impact significance, without the implementation of mitigation measures. With mitigation, the significance of this

impact would remain low significance. The same mitigation measures identified for Impact 1 above apply to Impact 2.

Table 9: Construction Phase: Visual Impact Assessment

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Potential visual effect of construction activities, haul roads, construction camps (Impacts 1 and 2)	*Status*	**Negative**	**Low risk (Level 4)**	Locate construction camps, batching plants and stockpiles in visually unobtrusive areas, away from public roads. Implement EMPr with ECO during construction.	**Low risk (Level 4)**	**High**
	Spatial Extent	**Local**				
	Duration	**Short Term**				
	Consequence	**Moderate**				
	Probability	**Very Likely**				
	Reversibility	**High**				
	Irreplaceability	**Low**				

6.2. Potential Impacts during the Operational Phase

This section includes a description of the potential visual impacts during the Operational Phase.

- ***Impact 1 for the above facility: Potential visual intrusion of solar arrays and related infrastructure on receptors including glint and glare***

This impact is rated as a negative, direct impact that extends locally and is of a long term duration. The consequence is rated as moderate, and the probability identified as very likely, resulting in an impact significance of low risk, without the implementation of mitigation measures. With mitigation, the significance of this impact remains low risk significance. Mitigation measures include:

- Locate the substations and BESS in unobtrusive low-lying areas, away from public roads.
- Use muted natural colours and non-reflective finishes for structures generally.
- Keep internal access roads as narrow as possible, and use existing roads or tracks as far as possible.
- Fit outdoor/ security lighting with reflectors to obscure the light source, and minimise light spillage.
- Locate internal powerlines (i.e. 22 kV or 33 kV) underground where possible. (In some cases, such as stream crossings, internal powerlines may need to be above ground).
- Use discrete outdoor signage and avoid commercial / billboard signage.

- ***Impact 2 for the above solar facility: Potential visual impact of an industrial type activity on the pastoral / rural character and sense of place of the area***

This impact is rated as a negative, direct impact with a long-term duration and local spatial extent. The consequence and probability are respectively rated as moderate and very likely, rendering a low risk impact significance, without the implementation of mitigation measures. With mitigation, the significance of this impact remains low risk significance. The same mitigation measures identified for Impact 1 above apply to Impact 2. The impact summary is given in Table 10.

Table 10: Operational Phase: Visual Impact Assessment

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
OPERATIONAL PHASE						
Impact 1: Potential visual intrusion of solar arrays and related infrastructure on receptors, including glint and glare. Impact 2: Effect of an industrial type activity on the pastoral/rural character and sense of place.	*Status*	**Negative**	**Low risk (Level 4)**	Substation and BESS to be located in an unobtrusive low-lying area, away from public roads. Muted natural colours and non-reflective finishes to be used for structures generally. Internal access roads to be as narrow as possible, and existing roads or tracks used as far as possible. Outdoor/ security lighting to be fitted with reflectors to obscure the light source, and to minimise light spillage. Internal powerlines (i.e. 22 kV or 33 kV) to be located underground where possible. (In some cases, such as stream crossings, internal powerlines may need to be above ground). Outdoor signage to be discrete and commercial / billboard signage avoided.	**Low risk (Level 4)**	**High**
	Spatial Extent	**Local**				
	Duration	**Long Term**				
	Consequence	**Moderate**				
	Probability	**Very Likely**				
	Reversibility	**High**				
	Irreplaceability	**Low**				

6.3. Potential Impacts during the Decommissioning Phase

This section includes a description of the potential visual impacts during the Decommissioning Phase.

- ***Impact 1: Potential visual effect of any remaining structures, platforms and disused roads on the landscape.***

This impact is rated as a negative, direct impact that extends locally and is of a short-term duration. The consequence is rated as moderate, and the probability identified as very likely, resulting in an impact significance of low, without the implementation of mitigation measures. With mitigation, the significance of this impact is rated as very low significance. Mitigation measures include ensuring that the solar arrays and infrastructure are removed and recycled; and access roads that are no longer required are ripped and regraded, and that exposed or disturbed areas are revegetated to blend with the surroundings. The impact summary is given in Table 11.

Table 11: Decommissioning Phase: Visual Impact Assessment

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
DECOMMISSIONING PHASE						
Potential visual effect of any remaining structures, platforms and disused roads on the landscape.	*Status*	**Negative**	**Low risk (Level 4)**	Solar arrays and infra-structure to be removed and recycled. Access roads no longer required to be ripped and regraded. Exposed or disturbed areas to be revegetated to blend with the surroundings.	**Very low risk (Level 5)**	**High**
	Spatial Extent	**Local**				
	Duration	**Short Term**				
	Consequence	**Moderate**				
	Probability	**Very Likely**				
	Reversibility	**High**				
	Irreplaceability	**Low**				

6.4. Cumulative Impacts

This section includes a description of the potential cumulative visual impacts during the Construction, Operational and Decommissioning Phases.

There are a number of other renewable energy and EGI projects within 30km of the site, (see **Map 11**), not all of which will be within the same viewshed as the proposed Kudu Solar PV 4 facility. The projects numbered on Map 11 are as follows:

- Project 1: Kalkbult Solar PV (Operational)
- Project 2: Longyuan Mulilo De Aar 2 North Wind Energy Facility (WEF) (Operational)
- Project 3: Longyuan Mulilo De Aar Maanhaarberg WEF (Operational)
- Project 4: EGI for the Longyuan Mulilo De Aar 2 North WEF
- Project 5: EGI for the De Aar 2 WEF
- Project 6: Proposed Castle WEF
- Project 7: Proposed Swartwater PV
- Project 8: Proposed Solar Power Plant in Phillipstown area
- Project 9: Proposed PV facility on farm Jakhalsfontein near De Aar
- Project 10: Proposed Solar Power Plant in Petrusville
- Project 11: Proposed Keren Energy Odyssey Solar PV Facilities (Eight PV Facilities)
- Project 12: Proposed Crossroads Green Energy Cluster of Renewable Energy Facilities and Grid Connection Infrastructure. The Cluster entails the development of up to 21 solar energy facilities, with the Scoping and EIA Processes consisting of three phases. Phases 1, 2 and 3 consist of 9, 6 and 6 solar facilities, respectively. The Phase 1 Scoping and EIA Processes were launched in January 2023.

Cumulative visual impacts would mainly be the combined visual effect of the 12 Kudu Solar PV facilities, as well as those solar projects within about 5 km of the Kudu PV 4 site, as well as the existing and proposed Eskom powerlines shown on **Map 11**.

The potential combined visual effect of the proposed 12 solar PV facilities and adjacent proposed solar facilities, seen together, is rated as a negative, cumulative impact for the construction, operational and decommissioning phases. The duration for the impact is rated as short term for the construction and decommissioning phases; and long term for the operational phase. The impacts have been rated with a local spatial extent. The consequence of the impact has been rated as substantial for the operational phase; and moderate for the construction and decommissioning phases; and the probability has been rated as very likely for the three phases. Without the implementation of mitigation measures, the impact

is rated as low significance for the construction and decommissioning phases, and moderate significance for the operational phase. With mitigation, the significance of this impact is rated as low, moderate and very low significance for the construction, operational, and decommissioning phases, respectively.

Table 12: Cumulative Visual Impact Assessment

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Potential combined visual effect of proposed 12 solar PV facilities seen together during construction phase.	*Status*	**Negative**	**Low risk (Level 4)**	Mitigation measures as for construction phase, Table 9.	**Low risk (Level 4)**	**High**
	Spatial Extent	**Local**				
	Duration	**Short Term**				
	Consequence	**Moderate**				
	Probability	**Very Likely**				
	Reversibility	**High**				
	Irreplaceability	**Low**				
OPERATIONAL PHASE						
Potential combined visual effect of proposed 12 solar PV facilities seen together during operational phase.	*Status*	**Negative**	**Moderate risk (Level 3)**	Mitigation measures as for operational phase, Table 10.	**Moderate risk (Level 3)**	**High**
	Spatial Extent	**Local**				
	Duration	**Long Term**				
	Consequence	**Substantial**				
	Probability	**Very Likely**				
	Reversibility	**High**				
	Irreplaceability	**Low**				
DECOMMISSIONING PHASE						
Potential combined visual effect of proposed 12 solar PV facilities seen together during decommissioning phase.	*Status*	**Negative**	**Low risk (Level 4)**	Mitigation measures as for decommissioning phase, Table 11.	**Very low risk (Level 5)**	**High**
	Spatial Extent	**Local**				
	Duration	**Short Term**				
	Consequence	**Moderate**				
	Probability	**Very Likely**				
	Reversibility	**High**				
	Irreplaceability	**Low**				

6.5. Substation and BESS

Lithium-Ion BESS and Redox Flow BESS were both considered for the proposed project. For Redox Flow BESS, various chemical compositions are likely, such as Vanadium. Refer to Chapter 15 of this EIA Report for a High-Level Safety, Health and Environment Risk Assessment, which provides high level information on the safety, health and environmental risks of the BESS technologies.

The substation and BESS have been considered as an integral part of the solar facility and mitigations for these have been included in the assessment tables above. Both BESS technologies are considered viable from a visual perspective.

7. Impact Assessment Summary

The overall visual impact significance findings, post-mitigation, are indicated in the Table 13 below:

Table 13: Overall Visual Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	**Low risk (level 4)**
Operational:	**Low risk (level 4)**
Decommissioning	**Very low risk (level 5)**
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	**Low risk (level 4)**
Cumulative - Operational	**Moderate risk (level 3)**
Cumulative - Decommissioning	**Very low risk (level 5)**

8. Legislative and Permit Requirements

No permits, licenses or other authorizations are specifically required in terms of landscape or visual issues. Visual assessments are sometimes required in terms of the National Heritage Act, being part of the 'national estate', and would be included with the heritage assessment in those cases.

Although the proposed Kudu Solar PV project is located in the Northern Cape, the Western Cape guideline for involving visual and aesthetic specialists in EIA processes has been used.

National Heritage Resources Act (Act 25 of 1999 NHRA)	The Act includes protection of national and provincial heritage sites, as well as areas of environmental or cultural value, and proclaimed scenic routes. Natural heritage, including scenic resources, form part of the 'national estate'.
Provincial Government of the Western Cape 2005: Guideline for Involving Visual and Aesthetic Specialists in EIA Processes. B. Oberholzer.	A guideline document for specialist visual input with respect to determining potential visual impacts, along with criteria for rating the significance of impacts.

9. Environmental Management Programme Inputs

Mitigation measures have been recommended for the solar facility and related infrastructure in the tables above, in order to minimise visual impacts on scenic resources and sensitive receptors.

Visual input into the Environmental Management Programme (EMPr) is discussed below. This should be included in the Environmental Authorisation for the project.

Design Phase Monitoring:

Review signed off designs to ensure that the substation and BESS are located in an unobtrusive low-lying area, away from public roads; muted natural colours and non-reflective finishes are used for structures; internal access roads are designed to be as narrow as possible, and existing roads or tracks used as far as possible; outdoor/security lighting to be fitted with reflectors; internal powerlines (i.e. 22 kV or 33 kV) to be located underground where possible (in certain cases, such as stream crossings, internal powerlines may need to be aboveground); and outdoor signage to be discrete and commercial / billboard signage avoided.

Responsibility: Project Developer and ECO.

Timeframe: During the planning and design phase.

Construction Phase Monitoring:

Ensure that visual management measures are included as part of the EMPr, monitored by an Environmental Control Officer (ECO), including siting of any construction camps, stockpiles, temporary laydown areas and batching plants outside of identified no-go areas unless otherwise approved by the visual specialists, as well as the implementation of dust suppression and litter control measures. Rehabilitation efforts to commence immediately after construction activities are completed.

Responsibility: ECO / Contractor.

Timeframe: Preparation of EMPr during the planning phase. Monitoring during the construction phase.

Operation Phase Monitoring:

Ensure that visual mitigation measures are monitored by management on an on-going basis, including the maintenance of rehabilitated areas, as well as control of any signage, lighting and waste at the proposed solar project, with interim inspections by the responsible environmental officer.

Responsibility: Solar Farm Operator.

Timeframe: During the operational life of the project.

Decommissioning Phase Monitoring:

Ensure that procedures for the removal of structures and stockpiles during decommissioning are implemented, including recycling of materials and rehabilitation of the site to a visually acceptable standard, and signed off by the delegated authority.

It is assumed that some access roads and concrete pads would remain. Those that are not required should be ripped and regraded, and vegetation or cropland reinstated to match the surroundings.

Exposed or disturbed areas to be revegetated to blend with the surroundings. The revegetation measures are not described here as they would fall under the auspices of the vegetation/ biodiversity specialist.

Responsibility: ECO / Contractor / qualified rehabilitation ecologist or horticulturist.

Timeframe: During the decommissioning contract phase, as well as a prescribed maintenance period thereafter (usually one year).

10. Visual Specialist Statement and Authorisation Recommendation

The VIA is based on the currently provided layout for the proposed Kudu PV 4 facility. Mitigation measures have been recommended in Tables 9 to 12 above. These have been included where possible in the project layout. A photomontage has been attached to depict the current layout.

The visual assessment findings are the following:

- The viewshed is fairly localised given the modest height of the solar facilities.
- There are a number of visual receptors in the surroundings these being mainly small farmsteads. However, these are fairly distant, the Vrede farmstead being the closest at 2,59 km.
- The overall visual impact significance for the Kudu PV 4 facility has been rated as low during the operational and construction phases, both before and after mitigation. The main visual impact is that there would be some change in character to the rural area.

- The cumulative visual impact significance of the proposed 12 Kudu solar energy facilities, seen in combination with other renewable energy projects in the adjacent area, as well as existing and proposed Eskom powerlines, could be substantial and has been rated as moderate using the rating methodology provided by the CSIR.

The fact that there will be similar proposed solar facilities adjacent to the site tends to reduce the visual sensitivity of the Kudu PV 4 site as the area would be seen as a node for solar energy.

Conclusion, Reasoned Opinion, and Impact Statement

The layout of the Kudu PV 4 facility has been subject to revisions, based on the various specialist findings, including the mapping of scenic resources and sensitive receptors. The currently proposed layout succeeds in avoiding visually sensitive areas as indicated on the visual sensitivity map (**Map 10**).

The cumulative visual impact of the solar facilities and related infrastructure, such as the substations, battery facilities and grid connection powerlines, together with other existing and proposed renewable energy facilities in the area, could affect the rural quality of the area (**Map 11**).

Specialist Recommendations for Inclusion in the EA

It is the opinion of the Visual Specialists that provided the recommended mitigation measures and EMPr are implemented, the Kudu PV 4 project would not present a potential fatal flaw in visual terms and could be authorised.

11. References

CSIR, April 2022. Terms of Reference for Specialist Studies for the Environmental Impact Assessments and Basic Assessments for the proposed development of 15 Solar PV Facilities and Associated Infrastructure, near De Aar, Northern Cape.

DFFE, 2022. Screening Report for an Environmental Authorisation as Required by the 2014 EIA Regulations – Proposed Site Environmental Sensitivity: Kudu PV Project.

Lawson, Q. and Oberholzer, B. 2014. National Wind and Solar PV SEA Specialist Report: Landscape Assessment, with CSIR for Department of Environmental Affairs.

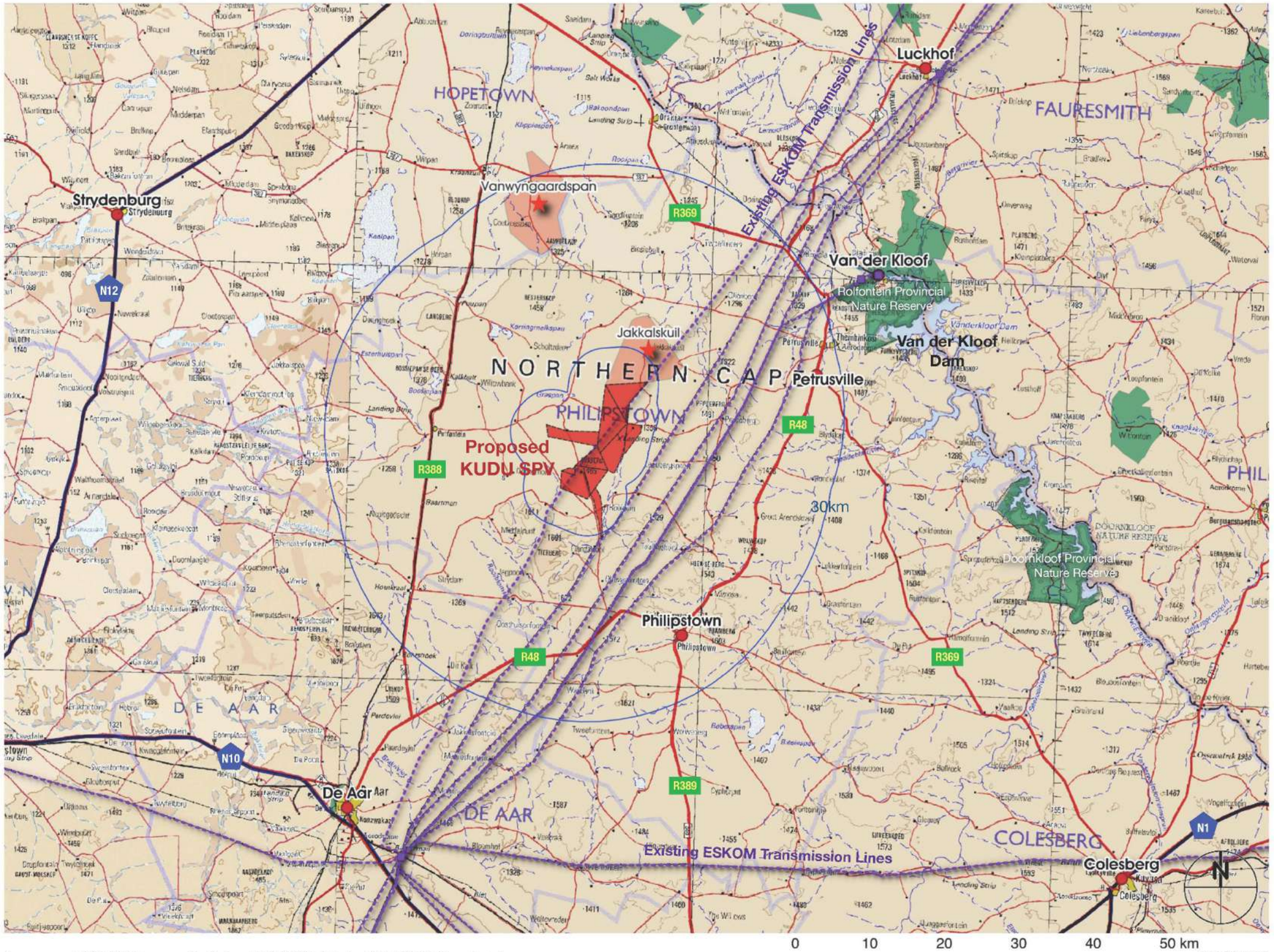
Mucina, L. and Rutherford, M.C. (eds) 2006.The Vegetation of South Africa, Lesotho and Swaziland. *Strelizia* 19. SANBI, Pretoria.

Oberholzer, B. 2005. Guideline for Involving Visual and Aesthetic Specialists in EIA Processes: Edition 1 CSIR Report No. ENV-S-C 2005 053 F. Provincial Government of the Western Cape, Department of Environmental Affairs and Development Planning.

MAPS

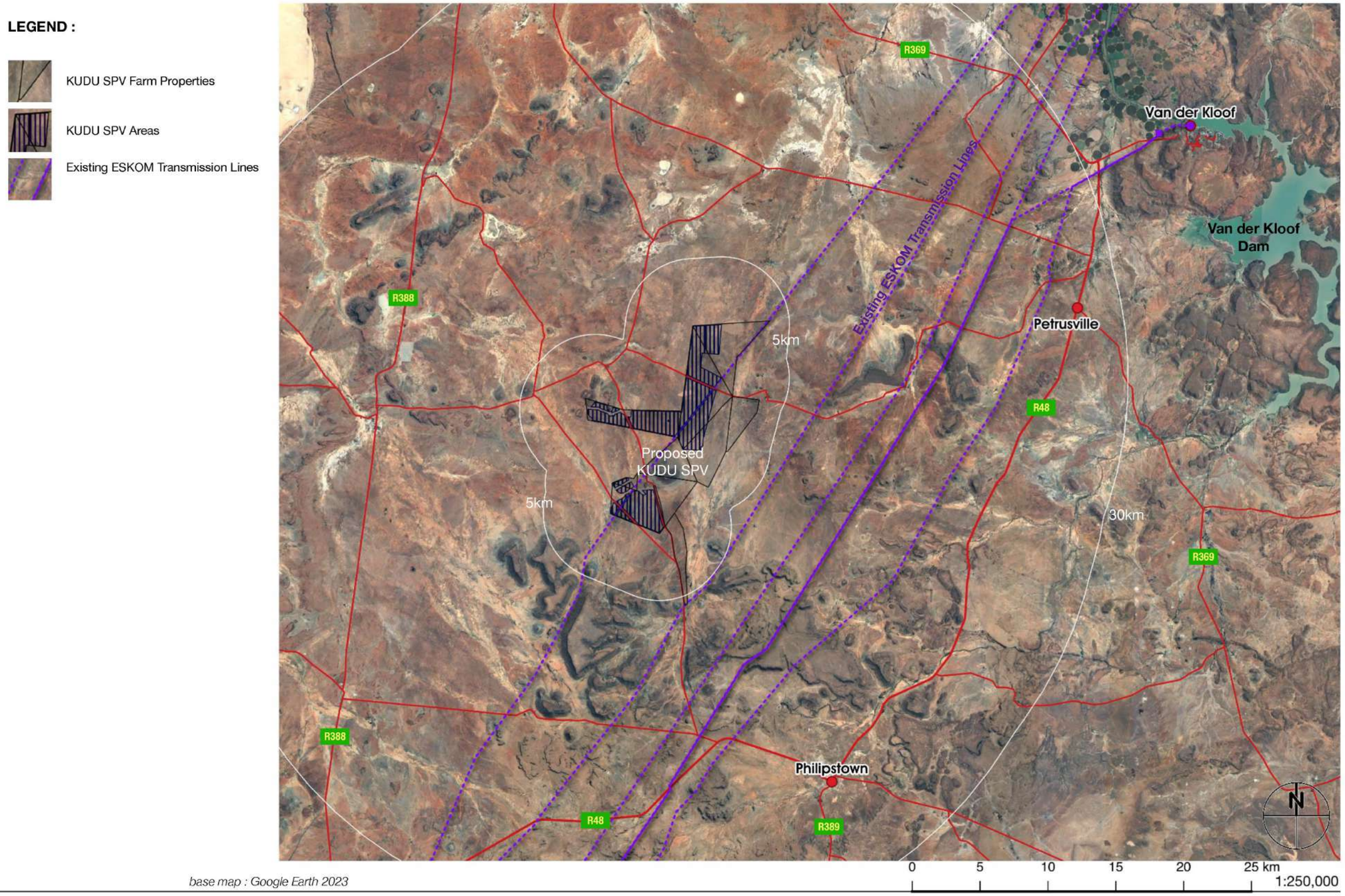
LEGEND :

- KUDU SPV Farm Properties
- SAPAD Protected Areas
- Existing ESKOM Transmission Lines

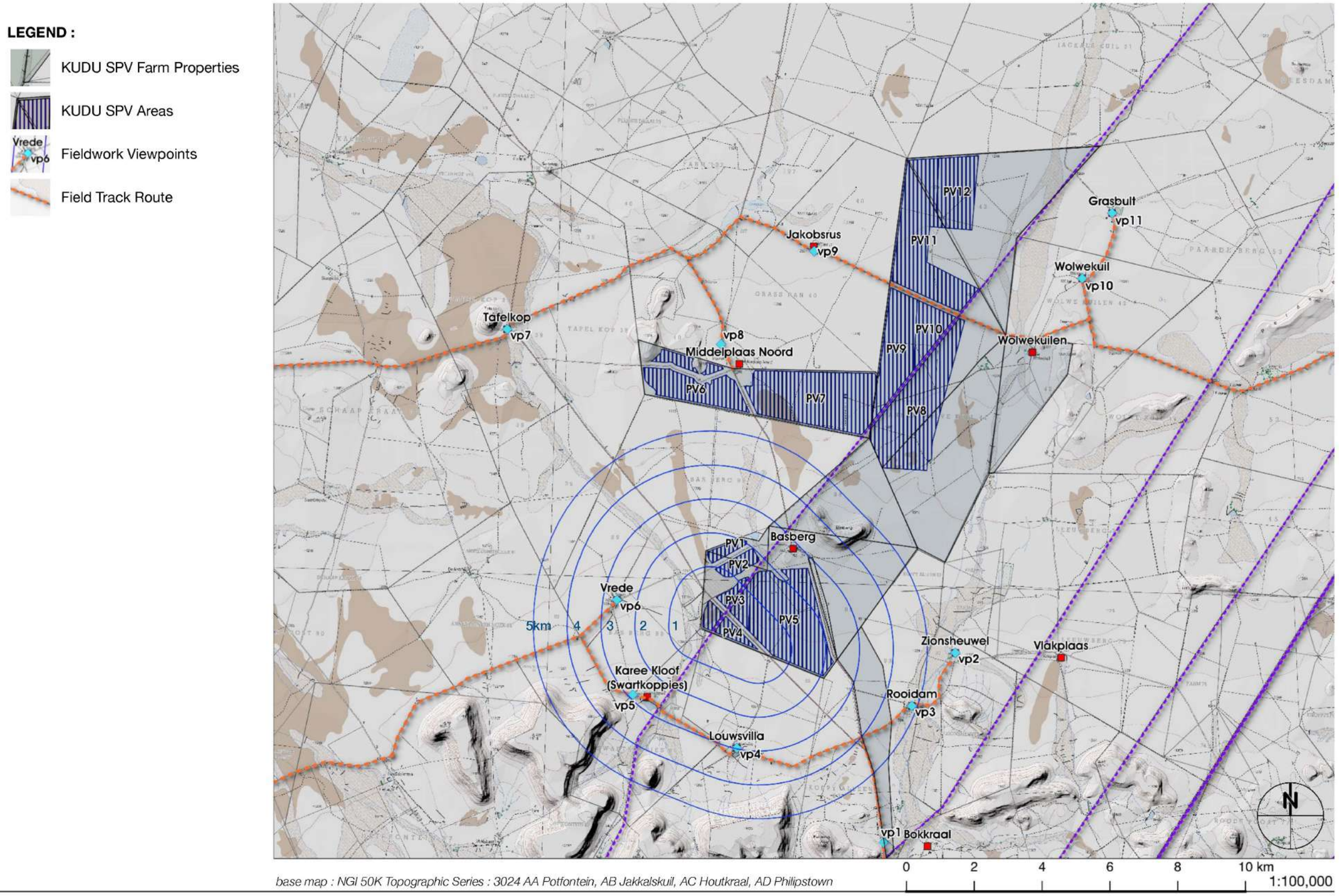


base map : NGI 500K Topographic Series : 2920-3124 Prieska, 2924-3128 Bloemfontein

map 1 : KUDU SPV 4 Regional Locality



map 2 : KUDU SPV 4 Local Context

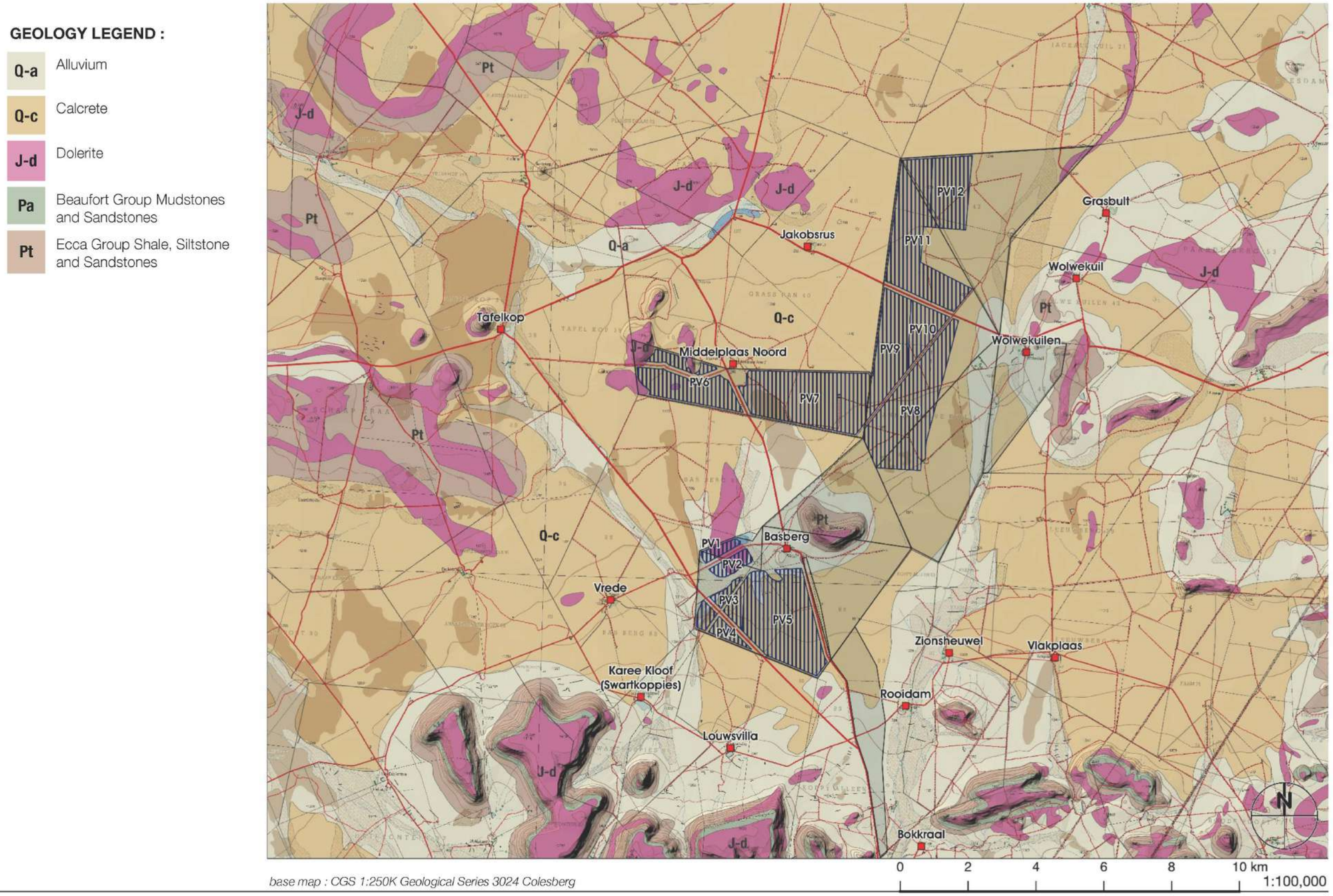


base map : NGI 50K Topographic Series : 3024 AA Potfontein, AB Jakkalskuil, AC Houtkraal, AD Philipstown

map 3 : KUDU SPV 4 • Fieldwork and Viewpoints



map 4 : KUDU SPV 4 • Facilities Layout

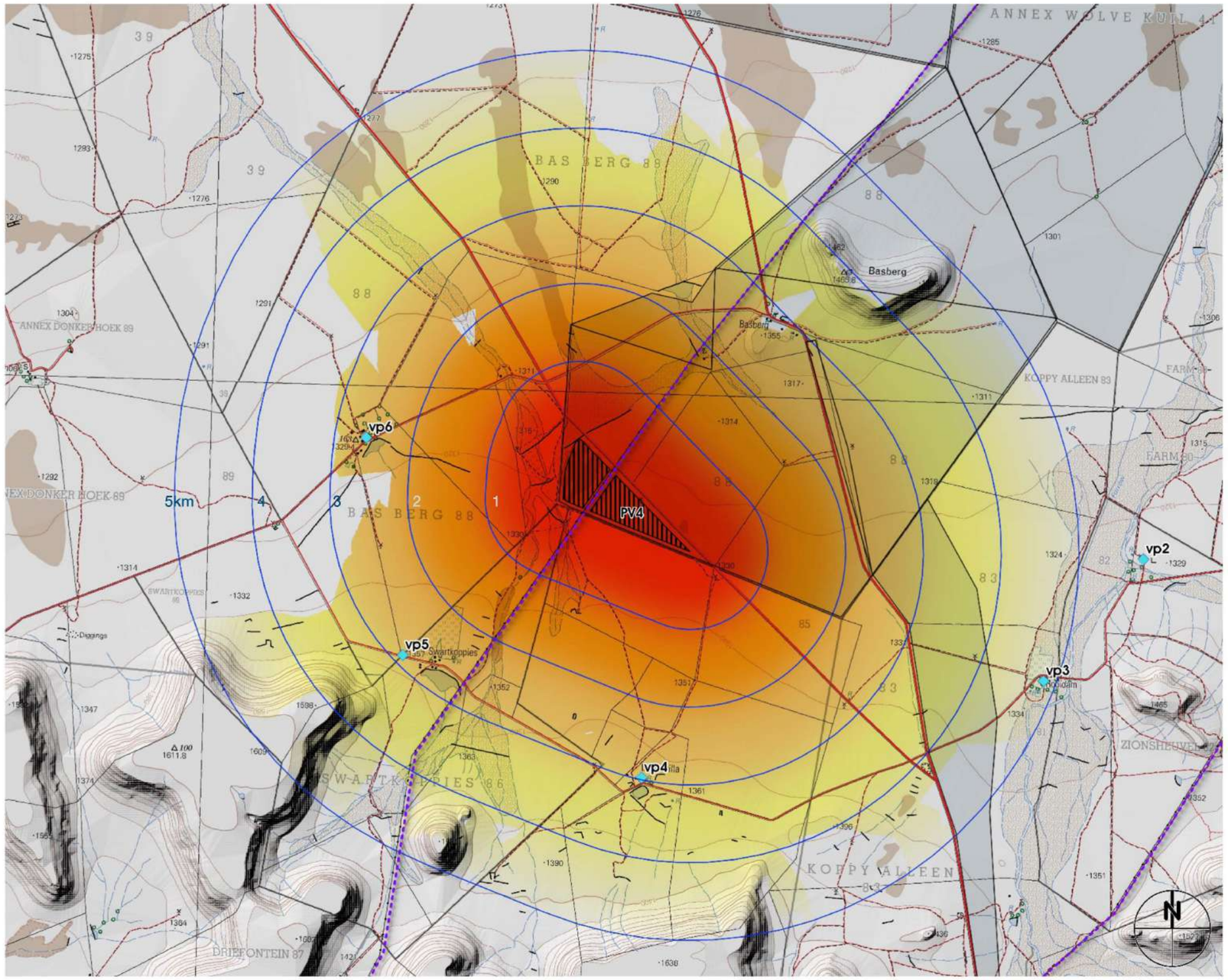


base map : CGS 1:250K Geological Series 3024 Colesberg

map 5 : KUDU SPV 4 Geology

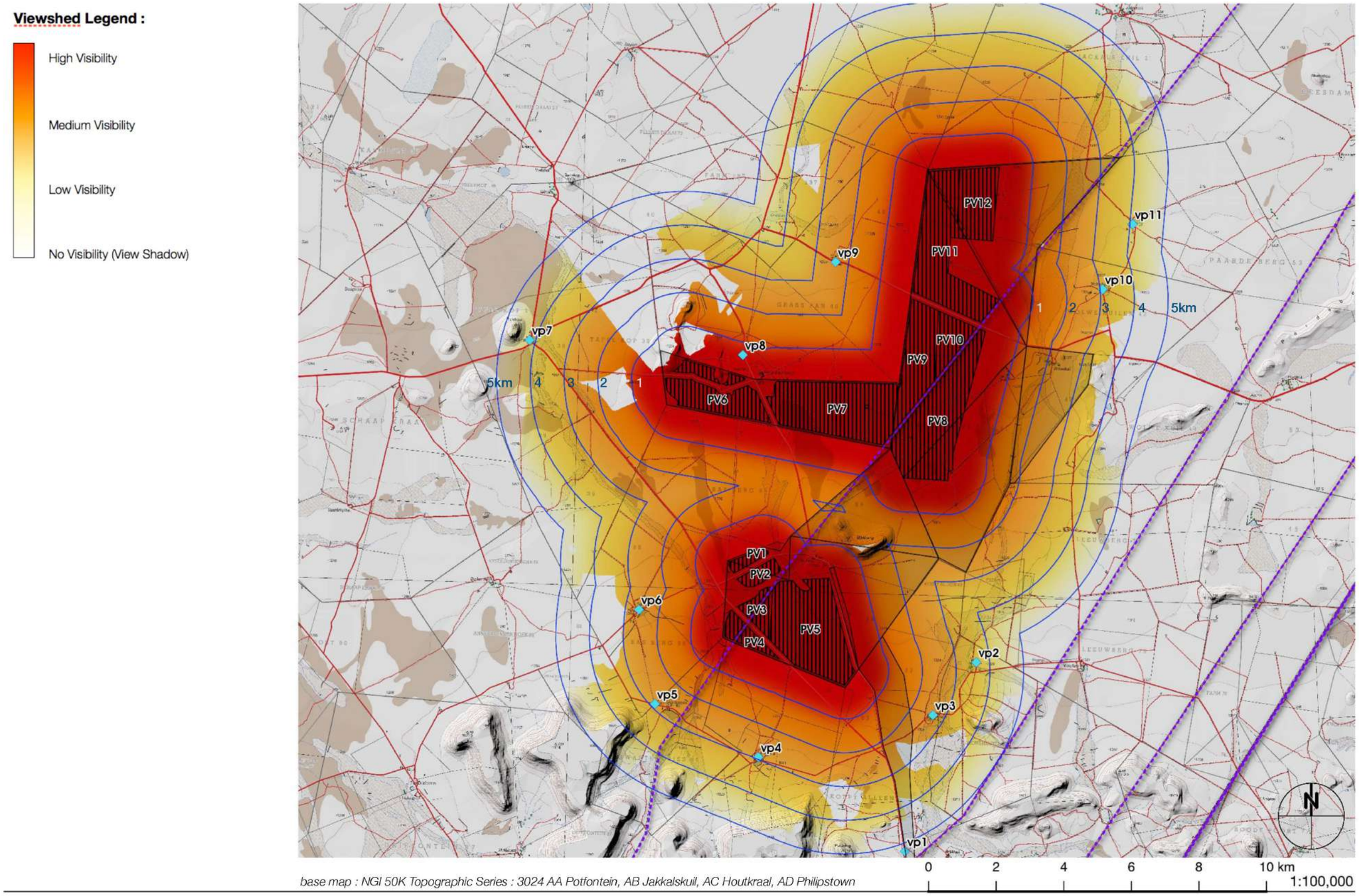
Viewshed Legend :

- High Visibility
- Medium Visibility
- Low Visibility
- No Visibility (View Shadow)



base map : NGI 50K Topographic Series : 3024 AA Potfontein, AB Jakkalskuil, AC Houtkraal, AD Philipstown

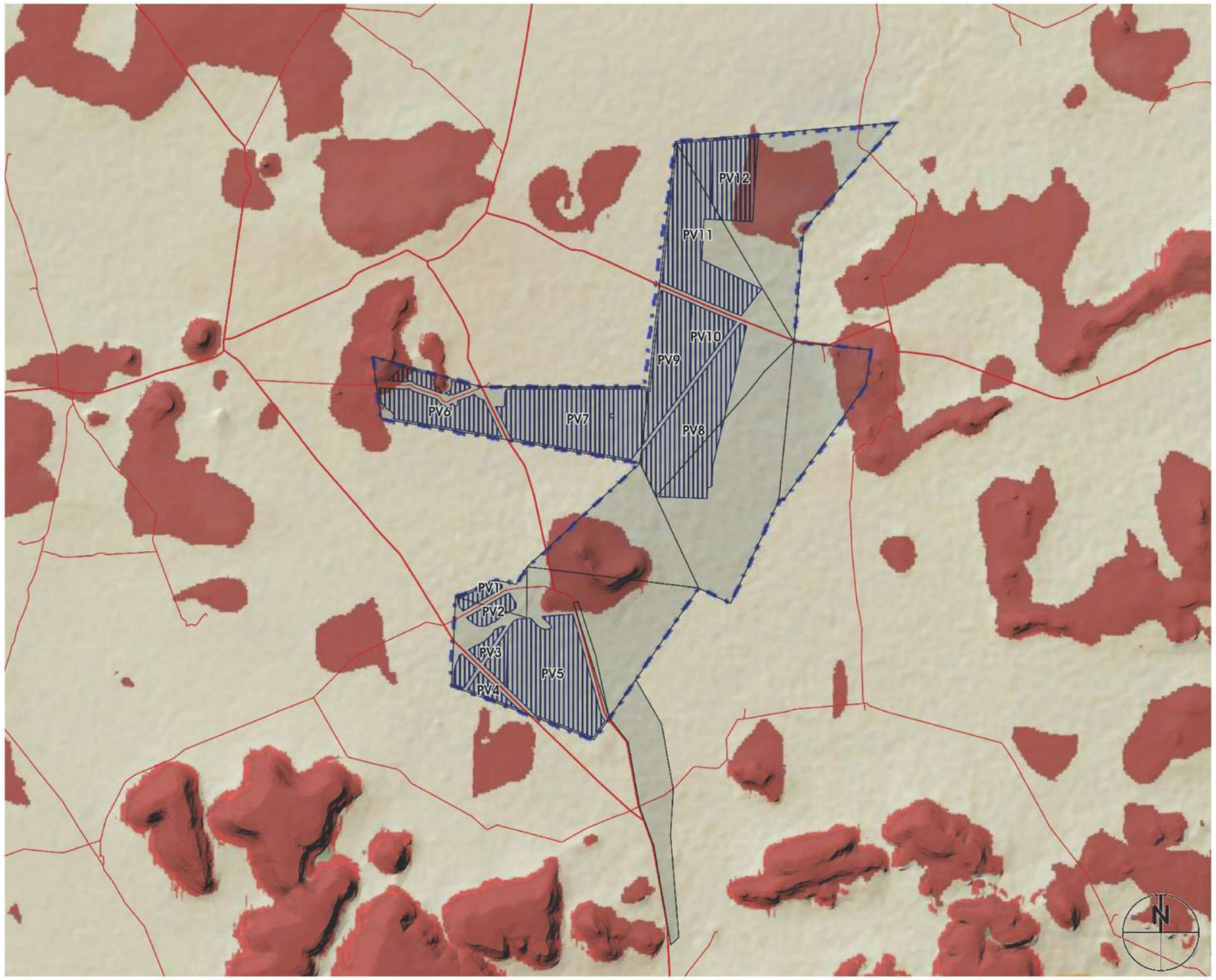
map 6 : KUDU SPV 4 • Nominal Viewshed : PV Arrays 3.5m High



map 7 : KUDU SPV • Combined Viewshed : PV Arrays 3.5m High

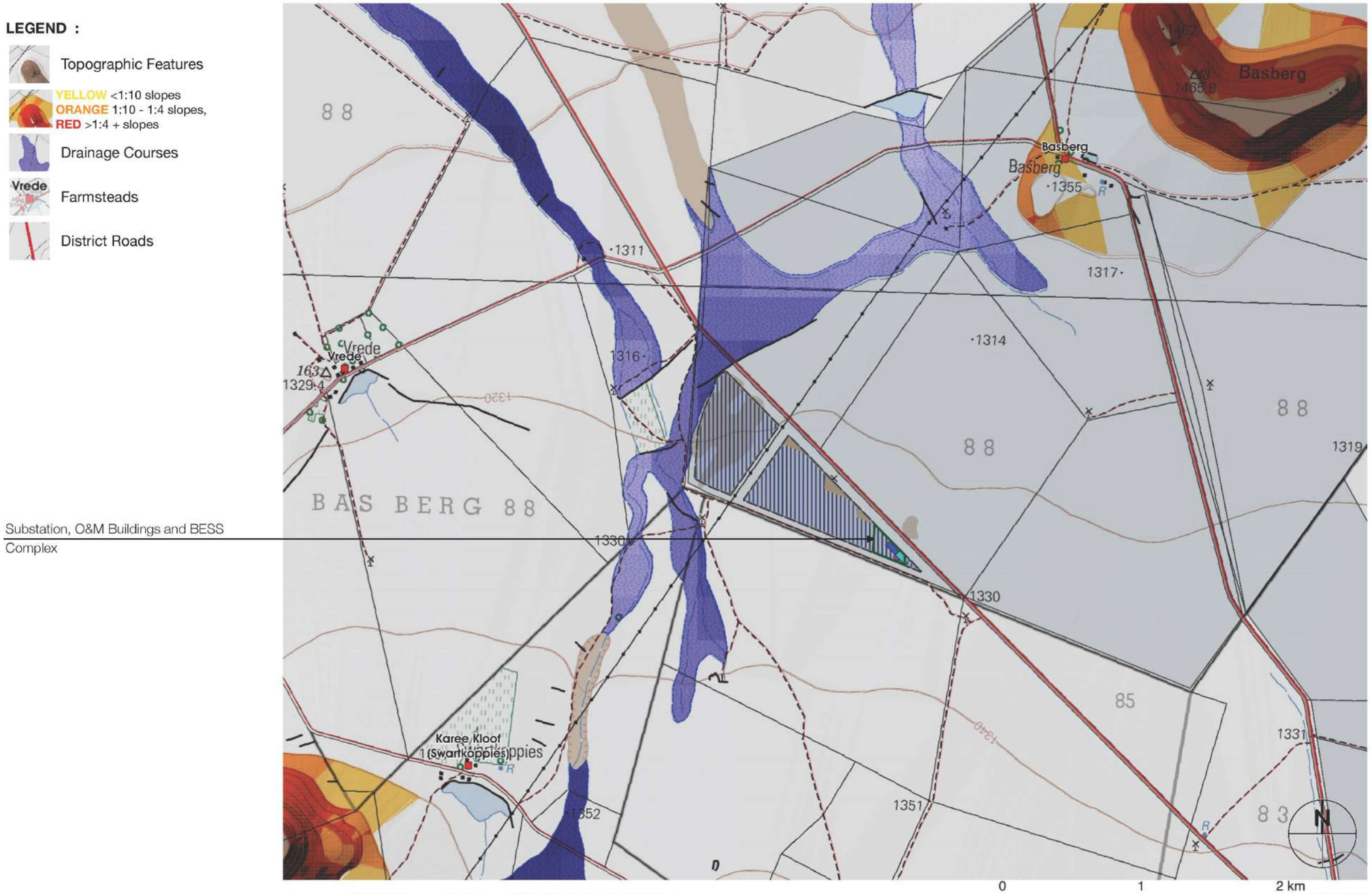
Sensitivity Features:

Sensitivity	Feature(s)
High	Slope between 1:4 and 1:10
Low	Slope less than 1:10
Very High	Mountain tops and high ridges
Very High	Slope more than 1:4



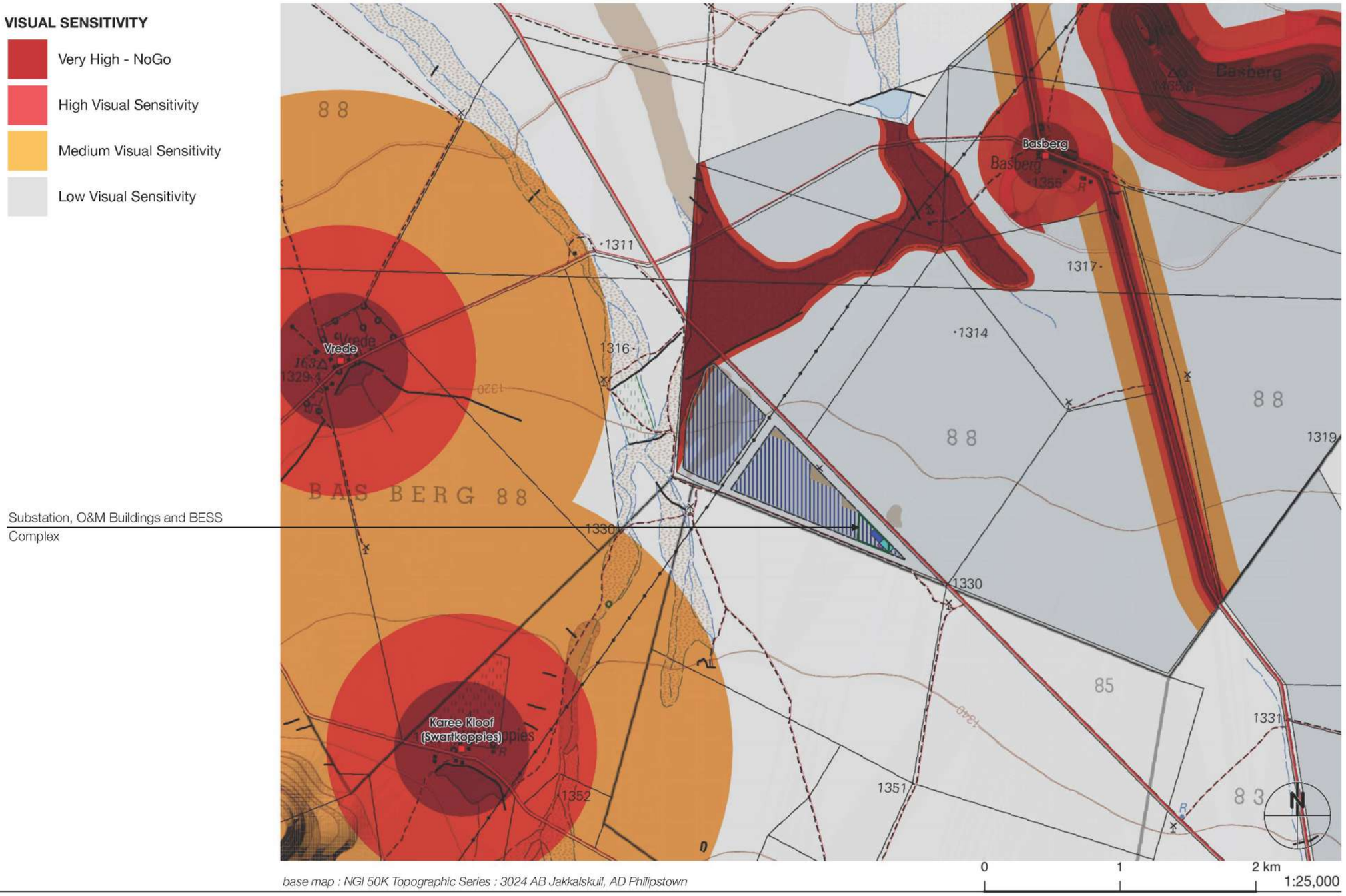
Legend:
- Very High
- High
- Medium
- Low

map 8 : KUDU SPV 4 : DFFE Screening Tool : Landscape (Solar) Theme

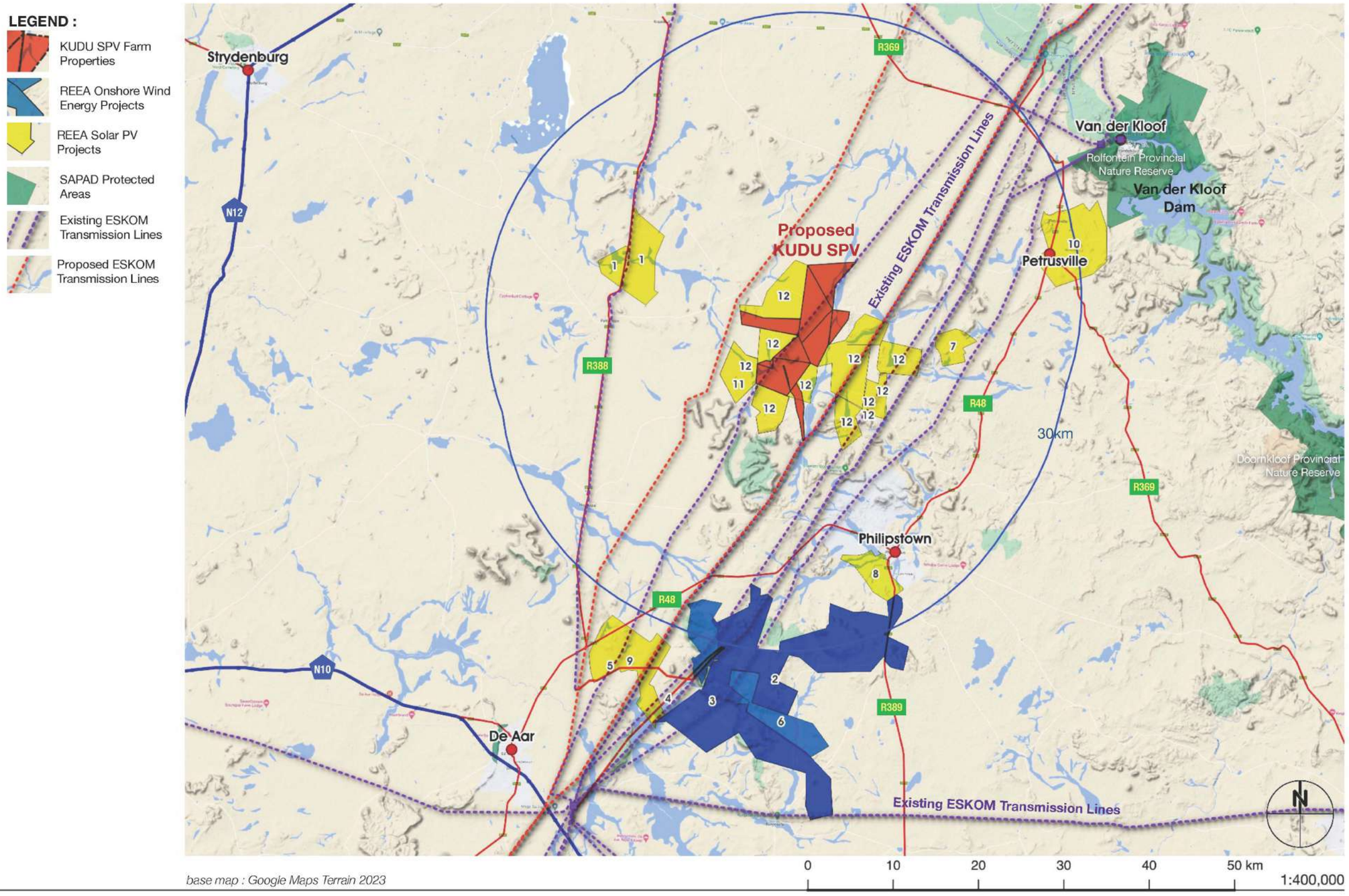


base map : NGI 50K Topographic Series : 3024 AB Jakkalskuil, AD Philipstown

map 9 : KUDU SPV 4 • Visual Features



map 10 : KUDU SPV 4 • Visual Sensitivity



map 11 : KUDU SPV Cumulative Renewable Energy Projects • REEA - SAHRIS Projects 25/04/2023



vp5 : Looking North East from Karee Kloof farm road

30.281137S 24.276414E Distance 2.87km

Photomontage : KUDU SPV 4 • Viewpoint 5 : Karee Kloof (Swartkoppies)

Appendix A: Visual Specialist Expertise

Bernard Oberholzer, Landscape Architect
PO Box 471, Stanford, Western Cape, 7210
Email: bernard.bola@gmail.com

Quinton Lawson, Architect
8 Blackwood Drive, Hout Bay 7806
Email: quinton@openmail.co.za

Expertise

Bernard Oberholzer has a Bachelor of Architecture (UCT) and Master of Landscape Architecture (U. of Pennsylvania), and has more than 25 years' experience in undertaking visual impact assessments. He has presented papers on *Visual and Aesthetic Assessment Techniques*, and is the author of *Guideline for Involving Visual and Aesthetic Specialists in EIA Processes,* prepared in association with the CSIR for the Dept. of Environmental Affairs and Development Planning, Provincial Government of the Western Cape, 2005.

Quinton Lawson has a Bachelor of Architecture Degree (Natal) and has more than 15 years' experience in visual assessments, specializing in 3D modelling and visual simulations. He has previously lectured on visual simulation techniques in the Master of Landscape Architecture Programme at UCT.

The authors have been involved in visual assessments for a wide range of residential, industrial and renewable energy projects. They prepared the 'Landscape/Visual Assessment' chapter in the report for the *National Wind and Solar PV Strategic Environmental Assessment (SEA)*, as well as the *National Electricity Grid Infrastructure SEA* in association with the CSIR, for the Department of Environmental Affairs in 2014-2015.

Appendix B: Specialist Statement of Independence

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 - 12), near De Aar, Northern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

Details of Specialist, Declaration and Undertaking Under Oath

Page 1 of 3

1. SPECIALIST INFORMATION

Specialist Company Name:	BOLA			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	Level 5	Percentage Procurement recognition	
Specialist name:	Bernard Oberholzer			
Specialist Qualifications:	B.Arch, MLA			
Professional affiliation/registration:	SACLAP			
Physical address:	16 Caledon Street			
Postal address:	PO Box 471, Stanford			
Postal code:	7210	Cell:		
Telephone:	083 513 5696	Fax:		
E-mail:	bernard.bola@gmail.com			

2. DECLARATION BY THE SPECIALIST

I, B. Oberholzer, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

BO

Signature of the Specialist

BOLA

Name of Company:

20 May 2023

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, B. Oberholzer, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

BJO

Signature of the Specialist

BOLA

Name of Company

20 May 2023

Date

Karin Sfreddo

Signature of the Commissioner of Oaths

20 May 2023

Date

COMMISSIONER OF OATHS
KARIN T. SFREDDO
9/1/8/2 PRETORIA
805 STANZA BOPAPE STR. ARCA

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
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PROJECT TITLE

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Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	qarc			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Quinton Lawson			
Specialist Qualifications:	BArch (Natal)			
Professional affiliation/ registration:	SACAP 3686			
Scientific Organisation Registration / Member Number	-			
Status of Registration / Membership	Current			
Physical address:	8 Blackwood Drive, Hout Bay, Cape Town			
Postal address:	As above			
Postal code:	7806	Cell:	083 309 3338	
Telephone:	021 790 5119	Fax:	-	
E-mail:	quinton@openmail.co.za			

2. DECLARATION BY THE SPECIALIST

I, **Quinton Lawson**, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

Signature of the Specialist

qarc

Name of Company:

14 /06/ 2023

Date

3. **UNDERTAKING UNDER OATH/ AFFIRMATION**

I, **Quinton Lawson**, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

qarc

Name of Company

14 /06/ 2023

Date

Signature of the Commissioner of Oaths

14/06/2023

Date

I certify that the DEPONENT has acknowledged that he / she knows and understands the contents of this affidavit, that he / she does not have any objection to taking the oath, and that he / she considers it to be binding on his / her conscience, and which was sworn to and signed before me and that the administering oath complied with regulations contained in Government Gazette No. R 1258 of 21 July 1972, as amended.

BRANCH MANAGER
Post Office
14 JUN 2023
HOUTBAAI 7872

SIGNATURE
Commissioner of Oaths
Designation: BRANCH MANAGER ex officio Republic of South Africa
Date: 14 JUNE 2023
Place: HOUTBAY
Business Address: MAINSTREAM CENTRE HOUTBAY

Appendix C: Site Sensitivity Verification

Part A of the Assessment Protocols published in Government Notice (GN) 320 on 20 March 2020 (i.e. Site sensitivity verification requirements where a specialist assessment is required but no specific assessment protocol has been prescribed) is applicable where the Department of Forestry, Fisheries and the Environment (DFFE) Screening Tool has the relevant themes to verify. This is applicable to the Visual Impact Assessment, as the Landscape Theme relevant to Solar PV developments is relevant.

Prior to commencing with the specialist assessment in accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the DFFE National Web-Based Environmental Screening Tool (Screening Tool).

The details of the site sensitivity verification are noted below:

Date of Site Visit	15 and 16 March 2022
Specialist Name	Bernard Oberholzer and Quinton Lawson
Professional Registration Number	South African Council for the Landscape Architectural Profession (SACLAP) 87018 South African Council for the Architectural Profession (SACAP) 3686
Specialist Affiliation / Company	BOLA and QARC

The site sensitivity verification was undertaken using the following means:

(a) desk top analysis, using 1:50 000 topographic series maps and Google Earth satellite imagery;
(b) preliminary on-site inspection; and
(c) various databases, including the South African Protected Areas Database (SAPAD).

A screening report was compiled using the DFFE Screening Tool. The Report includes a 'Map of Relative Landscape (Solar) Theme Sensitivity', based on mapping prepared for the Phase 1 Wind and Solar SEA by the CSIR for DFFE in 2015 (DEA, 2015).

The current visual sensitivity mapping included in this Visual Impact Assessment is in greater detail (at the site scale) for the proposed solar photovoltaic (PV) study area, taking into account detailed viewshed mapping and local site conditions.

Outcome of the site sensitivity verification:

(a) The DFFE screening tool findings for the Landscape Theme (Figure 1 below) was refined, based on more detailed project-scale mapping of landscape features.

(b) Evidence is provided by means of detailed feature mapping and the application of visual sensitivity buffers as contained in the Visual Impact Assessment Report. (Figure 2 below).

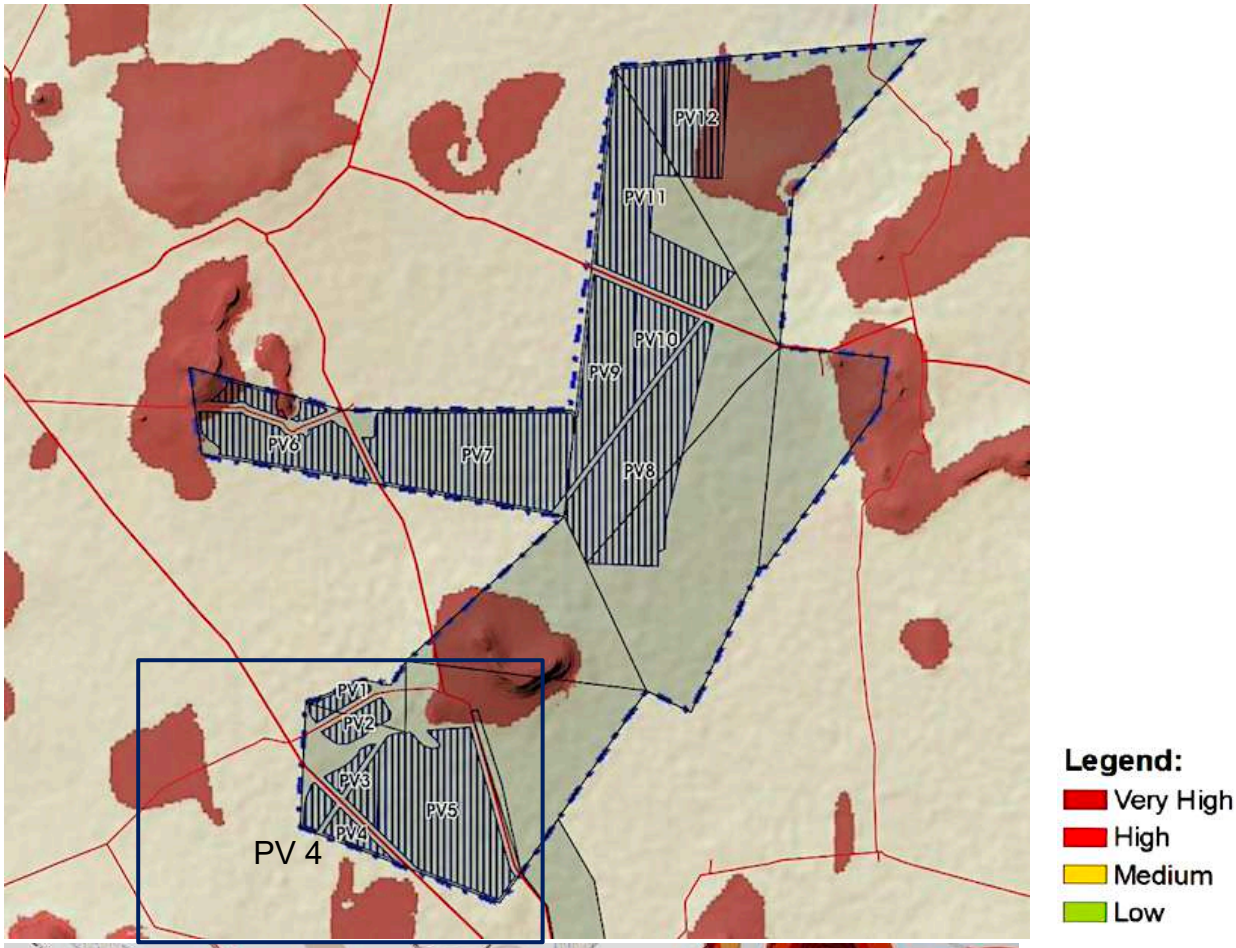


Figure 1

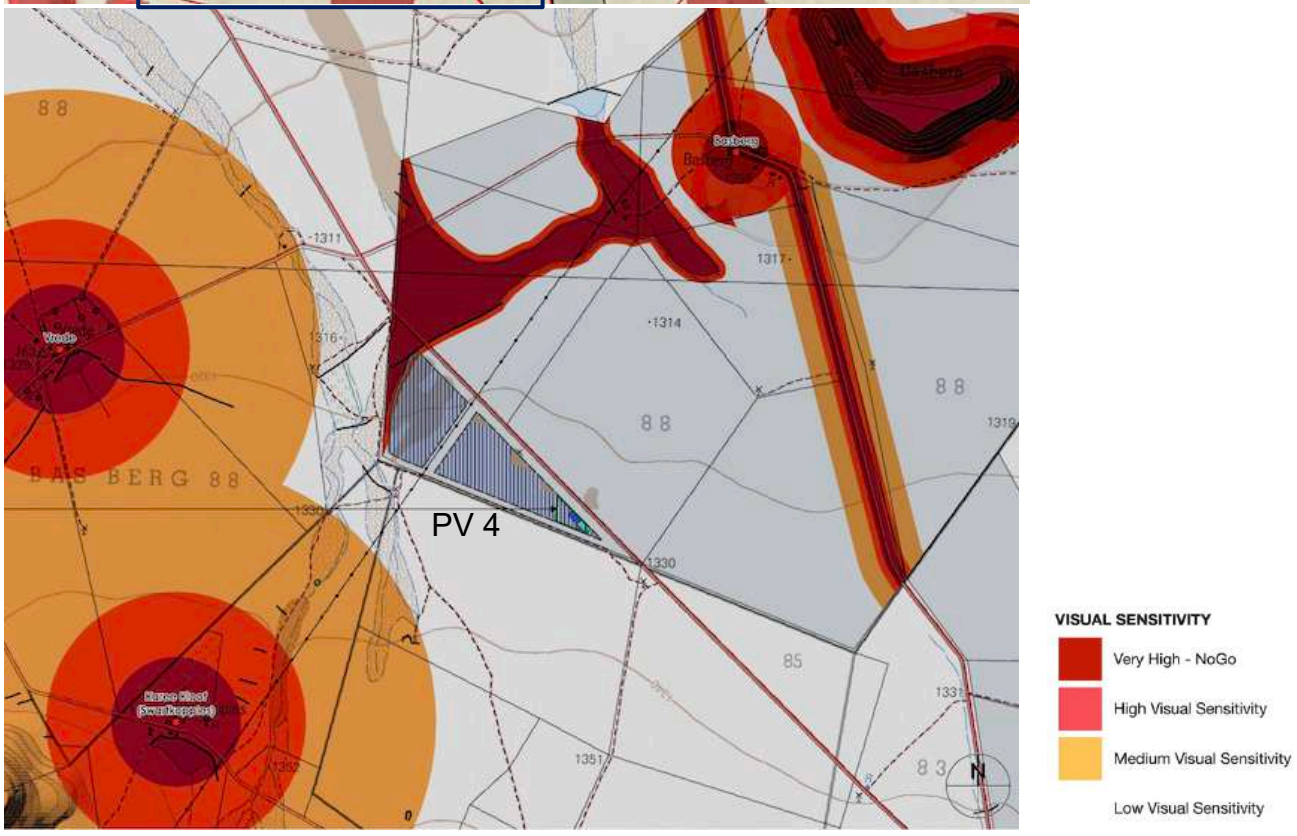


Figure 2

Appendix D: Impact Assessment Methodology

The impact assessment includes:

- *the nature, status, significance and consequences of the impact and risk;*
- *the extent and duration of the impact and risk;*
- *the probability of the impact and risk occurring;*
- *the degree to which impacts and risks can be mitigated;*
- *the degree to which the impacts and risks can be reversed; and*
- *the degree to which the impacts and risks can cause loss of irreplaceable resources.*

Terminology used in impact assessment can overlap. To avoid ambiguity, please note the following clarifications (that are based on NEMA and the EIA Regulations):

- *The term environment is understood to have a broad interpretation that includes both the natural (biophysical) environment and the socio-economic environment. The term socio-ecological system is also used to describe the natural and socio-economic environment and the interactions amongst these components.*
- *Significance = Consequence x Probability, which means that significance is equivalent to risk.*
- *The impact can have a positive or negative status. The significance of a negative impact may be called a risk, and the significance of a positive impact may be called an opportunity.*

The following principles are to underpin the application of this methodology:

- *Transparent and repeatable process - specialists are to describe the thresholds and limits they apply in their assessment, wherever possible.*
- *Adapt parameters to context (where justified) – the methodology proposes some thresholds (e.g. for spatial extent, in Step 3 below), however, if the nature of the impact requires a different definition of the categories of spatial extent, then this can be provided and described.*
- *Combination of a quantitative and qualitative assessment – where possible, specialists are to provide quantitative assessments (e.g. areas of habitat affected, decibels of noise, number of jobs), however, it is recognised that not all impacts can be quantified, and then qualitative assessments are to be provided.*

As per the DFFE Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect and cumulative:

- *Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.*
- *Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.*
- *Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.*

The impact assessment methodology includes the aspects described below.

- ***Step 1**: **Nature** of impact/risk - The type of effect that a proposed activity will have on the environment.*

- ***Step 2**: **Status** - Whether the impact/risk on the overall environment will be:*
  - *Positive - environment overall will benefit from the impact/risk;*
  - *Negative - environment overall will be adversely affected by the impact/risk; or*
  - *Neutral - environment overall not be affected.*

- ***Step 3**: **Qualitatively** determine the **consequence** of the impact/risk by identifying the **a) SPATIAL EXTENT; b) DURATION; c) REVERSIBILITY; AND d) IRREPLACEABILITY**.*

  - ***A) Spatial extent** – The size of the area that will be affected by the impact/risk:*
    - *Site specific;*
    - *Local (<10 km from site);*
    - *Regional (<100 km of site);*
    - *National; or*
    - *International (e.g. Greenhouse Gas emissions or migrant birds).*

  - ***B) Duration** – The timeframe during which the impact/risk will be experienced:*
    - *Very short term (instantaneous);*
    - *Short term (less than 1 year);*
    - *Medium term (1 to 10 years);*
    - *Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration)); or*
    - *Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).*

  - ***C) Reversibility** of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):*
    - *High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);*
    - *Moderate reversibility of impacts;*
    - *Low reversibility of impacts; or*
    - *Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).*

  - ***D) Irreplaceability** of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):*
    - *High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);*
    - *Moderate irreplaceability of resources;*
    - *Low irreplaceability of resources; or*
    - *Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).*

*Some of the criteria are quantitative (e.g. spatial extent and duration) and some may be described in a quantitative or qualitative manner (e.g. reversibility and irreplaceability). The specialist then combines these criteria in a qualitative manner to determine the **consequence**.*

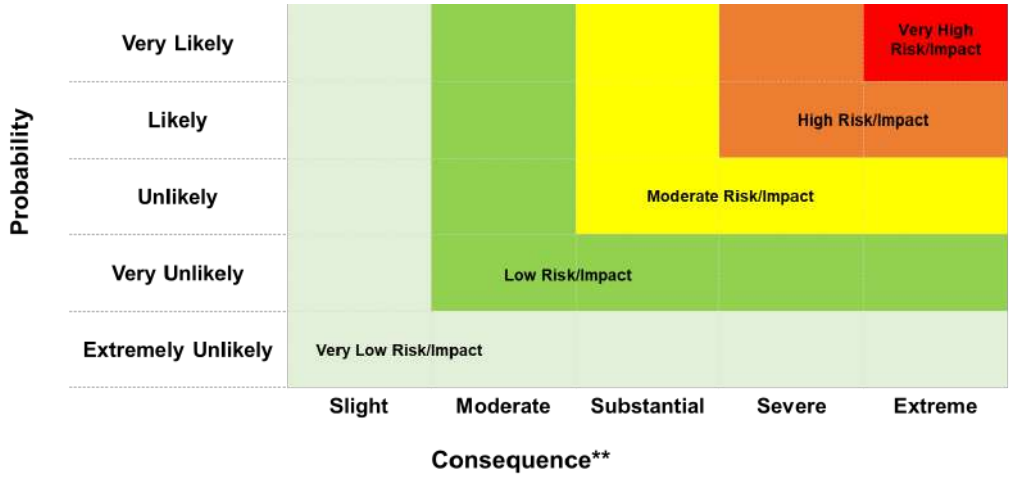
The consequence terms ranging from slight to extreme must be calibrated per Specialist Study so that there is transparency and consistency in the way a risk/impact is measured. For example, from a biodiversity and ecology perspective, the consequence ratings could be defined according to a reduction in population or occupied area in relation to Species of Conservation Concern (SCC) status, ranging from slight consequence for defined areas of Least Concern, to extreme consequence for defined areas that are Critically Endangered. For example, from a social perspective, a slight consequence could refer to small and manageable impacts, or impacts on small sections of the community; a moderate consequence could refer to impacts which affect the bulk of the local population negatively or may produce a net negative impact on the community; and an extreme consequence could refer to impacts which could result in social or political violence or institutional collapse.

- ***Consequence*** *– The anticipated consequence of the risk/impact is generally defined as follows:*
    - *Extreme (extreme alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they permanently cease);*
    - *Severe (severe alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease);*
    - *Substantial (substantial alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease;*
    - *Moderate (notable alteration of natural or socio-economic systems, patterns or processes, i.e. where the natural or socio-economic environment continues to function but in a modified manner; or*
    - *Slight (negligible and transient alteration of natural or socio-economic systems, patterns or processes, i.e. where natural systems/environmental or socio-economic functions, patterns, or processes are not affected in a measurable manner, or if affected, that effect is transient and the system recovers).*

- ***Step 4****: Rate the* ***probability*** *of the impact/risk using the criteria below:*

    - ***Probability*** *– The probability of the impact/risk occurring:*
        - *Extremely unlikely (little to no chance of occurring);*
        - *Very unlikely (<30% chance of occurring);*
        - *Unlikely (30-50% chance of occurring)*
        - *Likely (51 – 90% chance of occurring); or*
        - *Very Likely (>90% chance of occurring regardless of prevention measures).*

- ***Step 5****: Use both the* ***consequence*** *and* ***probability*** *to determine the* ***significance*** *of the identified impact/risk (qualitatively as shown in Figure 1). Significance definitions and rankings are provided below:*



[Qualitatively determined based on Spatial Extent, Duration, Reversibility and Irreplaceability]

Figure 1. Guide to assessing risk/impact significance as a result of consequence and probability.

- ***Significance*** *– Will the impact cause a notable alteration of the environment?*
    - *Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
    - *Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
    - *Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);*
    - *High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and*
    - *Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).*

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- *Very low = 5;*
- *Low = 4;*
- *Moderate = 3;*
- *High = 2; and*
- *Very high = 1.*

The specialists must provide a written supporting motivation of the assessment ratings provided.

- ***Step 6****: Determine the* ***Confidence Level*** *– The degree of confidence in predictions based on available information and specialist knowledge:*
    - *Low;*
    - *Medium; or*
    - *High.*

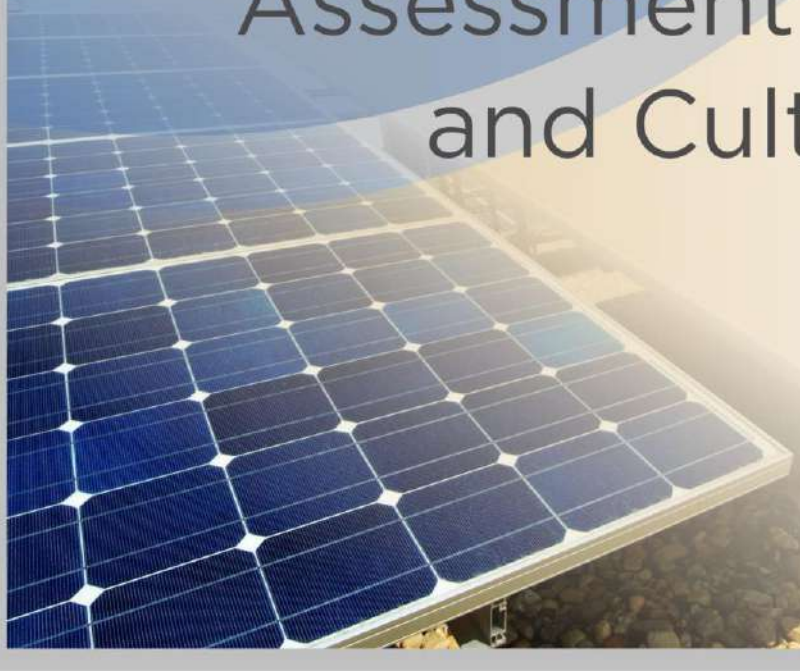
Appendix E: Appendix 6 of the 2014 NEMA EIA Regulations (as amended)

NEMA requirements for Specialist Reports		
	Specialist Report content as required by the NEMA 2014 EIA Regulations, as amended	**Section**
1 (1)(a)	(i) the specialist who prepared the report; and	Section 1 Appendix A
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix B
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA)	an indication of the quality and age of the base data used for the specialist report;	Section 2
(cB)	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6
(d)	the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 2
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process, inclusive of equipment and modelling used;	Section 2
(f)	details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 6
(g)	an identification of any areas to be avoided, including buffers;	Section 4
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Map 10
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity, or activities;	Section 7
(k)	any mitigation measures for inclusion in the EMPr;	Section 6 tables
(l)	any conditions for inclusion in the environmental authorisation;	Section 6
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 6
(n)	a reasoned opinion-	Section 10
	(i) whether the proposed activity or portions thereof should be authorised; and	
	(iA) regarding the acceptability of the proposed activity or activities; and	
	(ii) if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	n/a
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 5
(q)	any other information requested by the competent authority.	n/a
2	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Appendix C



CHAPTER II:

Heritage Impact Assessment (Archaeology and Cultural Heritage)



CSIR
Touching lives through innovation

HERITAGE SPECIALIST STUDY:

Scoping and Environmental Impact Assessment (EIA) Processes for the Proposed Development of a Solar Photovoltaic Facility (Kudu Solar Facility 4) and associated infrastructure, near De Aar, Northern Cape Province

Required under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999)

SAHRA Case ID: 20339

Report for:

CSIR – Environmental Management Services
P.O. Box 320, Stellenbosch, 7599
Email: RAbed@csir.co.za

On behalf of:

Kudu Solar Facility 4 (Pty) Ltd

Dr Jayson Orton
ASHA Consulting (Pty) Ltd
40 Brassie Street, Lakeside, 7945
Tel: (021) 788 1025 | 083 272 3225
Email: jayson@asha-consulting.co.za

1st draft: 23 March 2023
Final report: 23 May 2023

Specialist declaration

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment (EIA) Processes for the Proposed Development of 12 Solar Photovoltaic Facilities (Kudu Solar Facilities 1 to 12) and associated infrastructure, near De Aar, Northern Cape Province

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	ASHA Consulting (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	0
Specialist name:	Dr Jayson Orton			
Specialist Qualifications:	D.Phil (Archaeology, Oxford, UK) MA (Archaeology, UCT)			
Professional affiliation/registration:	ASAPA CRM member No. 233 APHP member No. 043			
Physical address:	40 Brassie Street, Lakeside, 7945			
Postal address:	40 Brassie Street, Lakeside			
Postal code:	7945	Cell:	083 272 3225	
Telephone:	021 788 1025	Fax:	n/a	
E-mail:	jayson@asha-consulting.co.za			

2. DECLARATION BY THE SPECIALIST

I, JAYSON ORTON, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

ASHA CONSULTING (PTY) LTD

Name of Company:

19-05-2023

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, JAYSON ORTON, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

ASHA CONSULTING (PTY) LTD

Name of Company

19-05-2023

Date

SGT

Signature of the Commissioner of Oaths

2023-05-19

Date

SOUTH AFRICAN POLICE SERVICE
KIRSTENHOF SAPS
19 MAY 2023
CSC
SUID-AFRIKAANSE POLISIEDIENS

EXECUTIVE SUMMARY

ASHA Consulting (Pty) Ltd was appointed by the Council for Scientific and Industrial Research (CSIR) to assess the potential impacts to heritage resources that might occur through the proposed development of a suite of twelve photovoltaic (PV) solar energy facilities (SEFs) to be located between 50 km and 66 km northeast of De Aar, Northern Cape. They will be named Kudu PV1 SEF, Kudu PV2 SEF, etc. The present report pertains to the Kudu PV4 SEF which has a centre point at S30° 15' 44.3" E24° 18' 11.4".

The wider site was assessed in the field over 4 days and found to be covered in very dense grass which made visibility extremely poor. However, several dolerite hills and outcrops were encountered and visibility was better on those. Fieldwork was thus focused on the visible dolerite with the open grasslands receiving very little attention. Desktop work and previous experience suggested that significant heritage resources were likely to be very rare in the open grasslands with most heritage focused on the rocky areas. Ephemeral scatters of Pleistocene-aged MSA artefacts were seen in the grasslands in a few denuded areas and the Basberg farm graveyard and some animal watering points of varying age were also located in the grassland. All other resources were associated with rocky outcrops and included LSA engravings, a rock gong, historical engravings, historical stone walling (related to agricultural uses and also to the Anglo-Boer War) and farmsteads. The farmsteads were not on the outcrops but close to them.

No heritage resources were found within the Kudu PV4 site but the site does form part of the wider cultural landscape which would be altered if the facility was constructed.

All impacts were found to be of low to very low significance after mitigation and no fatal flaws were found. Given the lack of significant heritage on the PV4 site, it is the opinion of the heritage specialist that the proposed project should be authorised in full.

It is recommended that the proposed Kudu PV4 SEF be authorised, but subject to the following recommendations which should be included as conditions of authorisation:

- Visually permeable fences, preferably in a dark colour, should be used;
- Buildings to be painted in earthy colours to reduce contrast;
- Night-time light spillage should be minimised, possibly through the use of motion detectors so that the area can stay dark until light is needed; and
- If any archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

Glossary

Background scatter: Artefacts whose spatial position is conditioned more by natural forces than by human agency

Early Stone Age: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.

Holocene: The geological period spanning the last approximately 10-12 000 years.

Hominid: a group consisting of all modern and extinct great apes (i.e. gorillas, chimpanzees, orangutans and humans) and their ancestors.

Later Stone Age: Period of the Stone Age extending over the last approximately 20 000 years.

Middle Stone Age: Period of the Stone Age extending approximately between 200 000 and 20 000 years ago.

Patina: The weathered surface of an artefact which has changed colour and/or texture (patinated, patination).

Pleistocene: The geological period beginning approximately 2.5 million years ago and preceding the Holocene.

Abbreviations

APHP: Association of Professional Heritage Practitioners

ASAPA: Association of Southern African Professional Archaeologists

BA: Basic Assessment

CSIR: Council for Scientific and Industrial Research

CRM: Cultural Resources Management

DFFE: Department of Forestry, Fisheries and the Environment

EA: Environmental Authorisation

ECO: Environmental Control Officer

EGI: Electricity Grid Infrastructure

EIA: Environmental Impact Assessment

EMPr: Environmental Management Program

ESA: Early Stone Age

GPS: global positioning system

GP: General Protection

HIA: Heritage Impact Assessment

LSA: Later Stone Age

MSA: Middle Stone Age

NBKB: Ngwao-Boswa Ya Kapa Bokoni

NEMA: National Environmental Management Act (No. 107 of 1998)

NHRA: National Heritage Resources Act (No. 25) of 1999

PPP: Public Participation Process

REDZ: Renewable Energy Development Zone

SAHRA: South African Heritage Resources Agency

SAHRIS: South African Heritage Resources Information System

Compliance with Appendix 6 of the 2014 EIA Regulations

Requirements of Appendix 6 – GN R326 (7 April 2017)	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 1.4 Appendix 1
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ii (Preliminary Section of this report)
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.3
(cA) an indication of the quality and age of base data used for the specialist report;	Section 3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 7.6, 7.4 & 7.8
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3.2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 3
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying alternatives;	Sections 1.1.3 & 5 Appendix 3
g) an identification of any areas to be avoided, including buffers;	Section 11
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Appendix 3
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.6
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 5 Section 11
k) any mitigation measures for inclusion in the EMPr;	Section 10
l) any conditions for inclusion in the environmental authorisation;	Section 12
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 10
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity and activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Sections 11.1 & 12
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 3.7
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 6.1
q) any other information requested by the competent authority.	Not Applicable
2. Where a government notice gazetted by the Minister provides for any protocol of minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply	Part A of the Assessment Protocols published in Government Notice No. 320 on 20 March 2020 is applicable (i.e. Site sensitivity verification requirements where a specialist assessment is required but no specific assessment protocol has been prescribed). See Appendix 3.

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1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by the Council for Scientific and Industrial Research (CSIR) to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed development of a suite of twelve photovoltaic (PV) solar energy facilities (SEFs) to be located between 50 km and 66 km northeast of De Aar, Northern Cape (Figure 1). They will be named Kudu PV1 SEF, Kudu PV2 SEF, etc. The present report pertains to the Kudu PV4 SEF which has a centre point at S30° 15' 44.3" E24° 18' 11.4" (Figure 2). The properties affected are shown in Table 1.

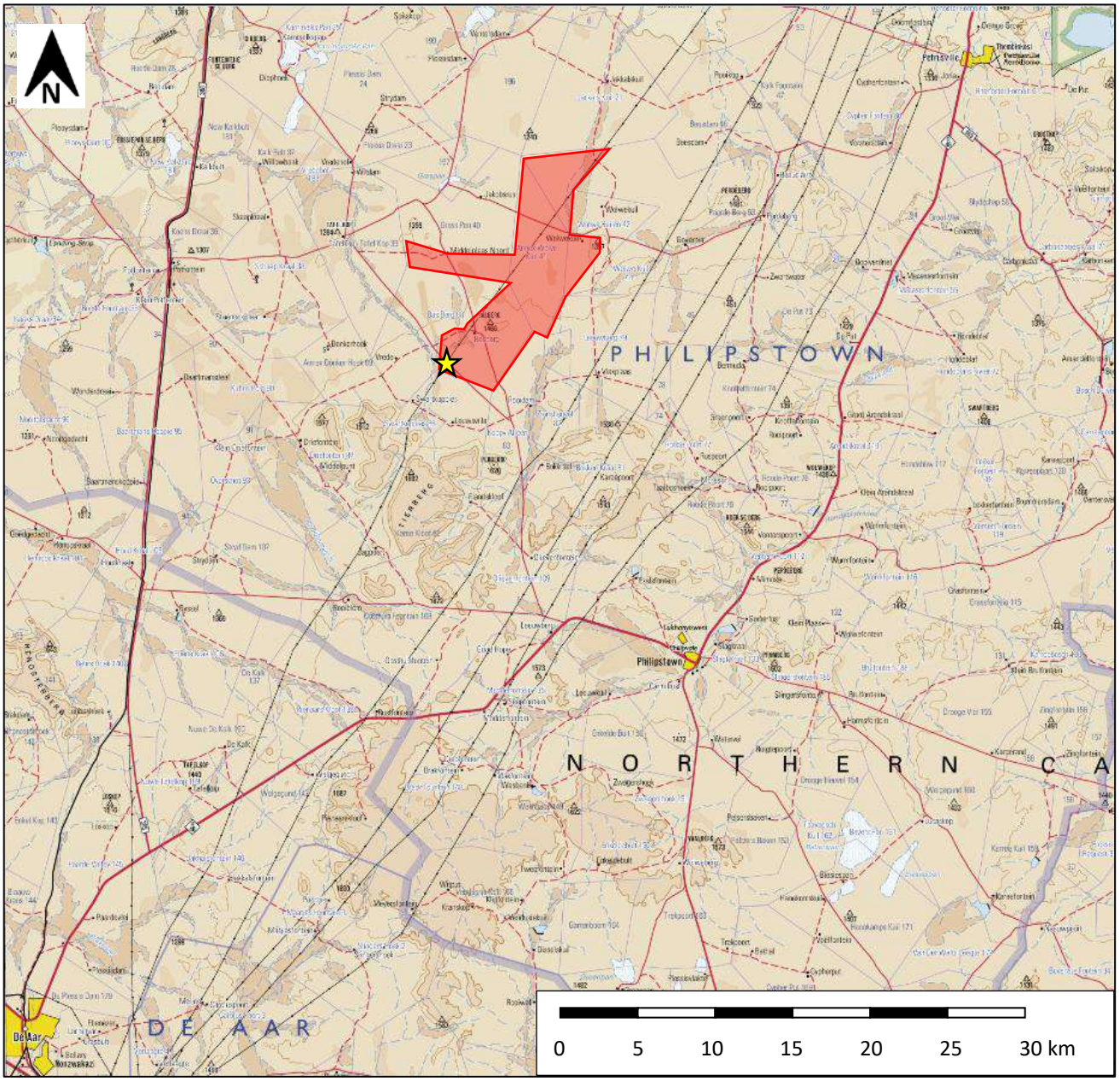


Figure 1: *Extract from 1:250 000 topographic map 3024 showing the location of the broader study area (red shaded polygon) in relation to De Aar and Philipstown. The approximate location of PV4 is starred. Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.*

Table 1: *List of farm portions included in the overall study area with an indication of which farm portions are affected by each proposed Kudu PV project.*

Farm Portions Affected	**Kudu PV facility**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Remaining Extent of the Farm Bas Berg No. 88	X	X										
Remaining Extent of Portion 3 of the Farm Bas Berg No. 88	X	X	X	X	X							
Portion 4 (Portion of Portion 3) of the Farm Bas Berg No. 88												
Remaining Extent of Portion 2 (Middel Plaats) (a Portion of Portion 1) of the Farm Grass Pan No. 40[1]						X	X					
Remaining Extent of the Farm Annex Wolve Kuil No. 41								X				
Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41								X	X	X	X	
Remaining Extent of the Farm Wolve Kuilen No. 42												
Portion 2 of the Farm Wolve Kuil No. 43												X

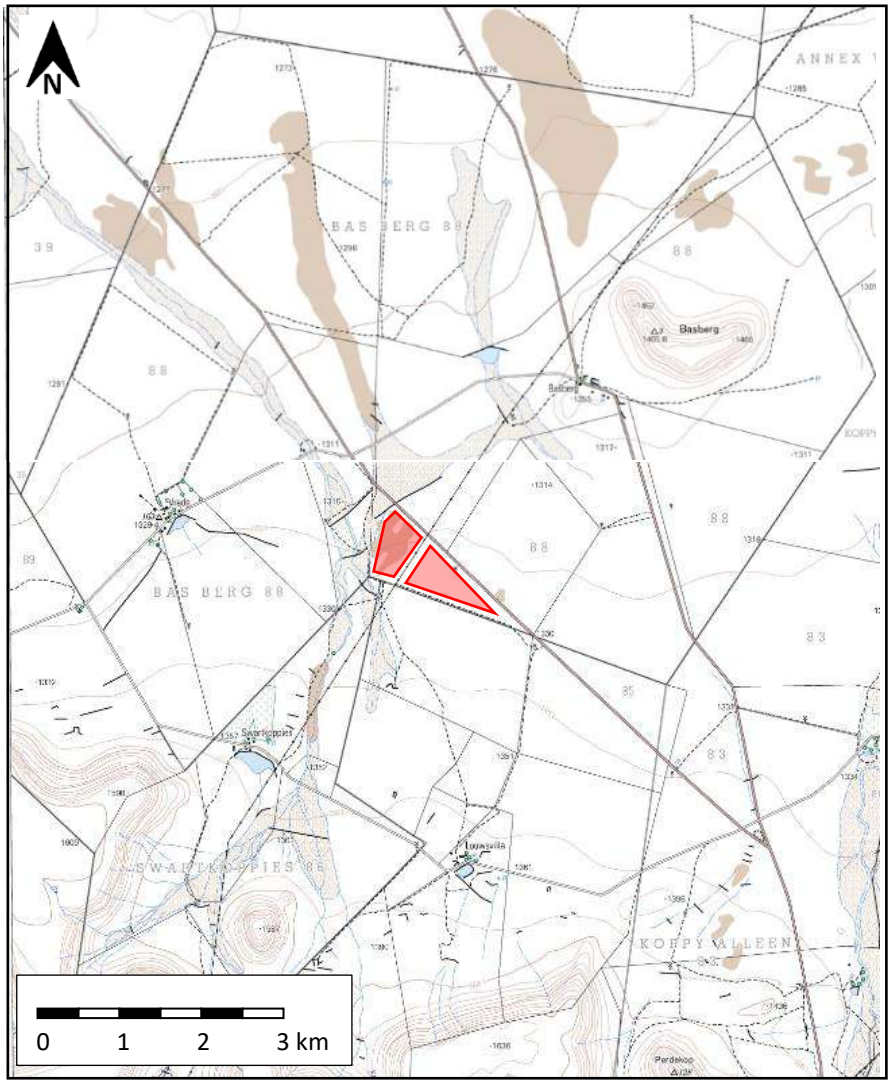


Figure 2: *Extract from 1:50 000 topographic map 3024AB & AD showing the location of the PV4 site (red polygon). Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.*

[1] Note that although the topographic map and SG Diagram uses the spelling "Grass Pan, the current Title Deed shows the property name as "Grasspan".

1.1. The proposed project

1.1.1. Project description

ABO Wind is proposing to develop twelve PV SEFs and associated Electrical Grid Infrastructure (EGI), north-east of the town of De Aar, in the Renosterberg Local Municipality and Pixley Ka Seme District Municipality, in the Northern Cape Province. The Kudu PV4 SEF will consist of the infrastructure described in Table 2 with the layout being as shown in Figure 3. Note that the Kudu EGI projects, Projects 13 to 26 are the subject of separate assessments that will be carried out at a later stage.

Table 2: *Details of the proposed Kudu PV4 SEF.*

Component	Description
Solar Field	
Type of Technology	Solar Photovoltaic (PV) Technology
Generation Capacity (Maximum Installed)	▪ 50 MWac
Total developable area that includes all associated infrastructure within the fenced off area of the PV facility	**Revised Scoping Buildable Areas:** ▪ 70 ha
PV Panel Structure (with the following possible tracking and mounting systems): ▪ Single Axis Tracking structures (aligned north-south); ▪ Dual Axis Tracking (aligned east-west and north-south); ▪ Fixed Tilt Mounting Structure; ▪ Mono-facial Solar Modules; or ▪ Bifacial Solar Modules.	▪ Height: Approximately 3.5 m (maximum)
Building Infrastructure	
Auxiliary Buildings	▪ Type: These include, but are not limited to, Operation and Maintenance (O&M) building / centre, site office, workshop, staff lockers, bathrooms/ablutions, warehouses, guard houses, etc. ▪ Cumulative Footprint: Approximately up to 5000 m^2 ▪ Height: Up to 10 m
Inverter/Transformer Stations	▪ Preliminary average number of stations: 27 ▪ Height: Approximately 3 m ▪ Footprint: Approximately 220 m^2 each
On-site Substation Complex	▪ Components of the on-site substation complex: ○ On-site Independent Power Producer (IPP) or Facility Substation (~1 ha).

	○ Lithium Ion or Redox Flow Battery Energy Storage System. Refer to the details below. ○ Switching Station and Collector Station (~2 ha). This forms part of Projects 13 – 24 and will be assessed as part of separate processes. ▪ Footprint of the on-site substation complex: Up to approximately 8 ha ▪ Height of the on-site substation complex: Up to 10 m ▪ Capacity of the on-site substation complex: This varies according to the detailed design and requirements from potential clients, however a capacity stepping up from 22 kV or 33 kV to 132 kV is estimated.
Associated Infrastructure	
Battery Energy Storage System (BESS)	▪ Technology: Lithium-Ion BESS or Redox Flow BESS (both options considered in the Scoping and EIA Process) ▪ Footprint: Approximately 1 ha ▪ Height: Up to 10 m ▪ Capacity: Up to 500 MW / 500 MWh
On-site medium voltage internal cables	▪ Placement: Underground or above ground in certain sections ▪ Capacity: 22 or 33 kV ▪ Depth: Maximum depth of 1.5 m
Underground low voltage cables or cable trays	▪ Depth: Maximum depth of 1.5 m
Access roads (including upgrading and widening of existing roads, where relevant)	▪ Details: Existing roads will be used as far as practically achievable, with some intersections potentially needing widening and some roads potentially needing upgrading.
Internal roads	▪ Details: New internal service roads will need to be established. These would either comprise farm roads (compacted dirt/gravel) or paved roads. ▪ Width: Approximately 4 – 5 m
Fencing around the PV Facility Perimeter	▪ Type: Could be palisade or mesh or fully electrified ▪ Height: Up to 3 m
Storm water channels	▪ Details to be confirmed once the Engineering, Procurement and Construction (EPC) contractor has been selected and the design is finalised. Where necessary, a detailed storm water management plan would need to be developed.
Panel cleaning and maintenance area	▪ Refer to the EIA Report for information
Work area during the construction phase (i.e. laydown area)	▪ Temporary Laydown: Up to 7 ha.
Water Requirements	▪ Approximately 9 000 m^3 of water is estimated to be required per year for the construction phase. ▪ Approximately 1 000 m^3 of water is estimated to be required per year for the operational phase.

	▪ Water requirements during the decommissioning phase are unknown at this stage. ▪ Potential sources: Local municipality, third-party water supplier, existing boreholes or drilled boreholes on site.
Construction Period	▪ 12 – 18 months
Operational Period	▪ Once the commercial operation date is achieved, the proposed facility will generate electricity for a minimum period of 20 years.

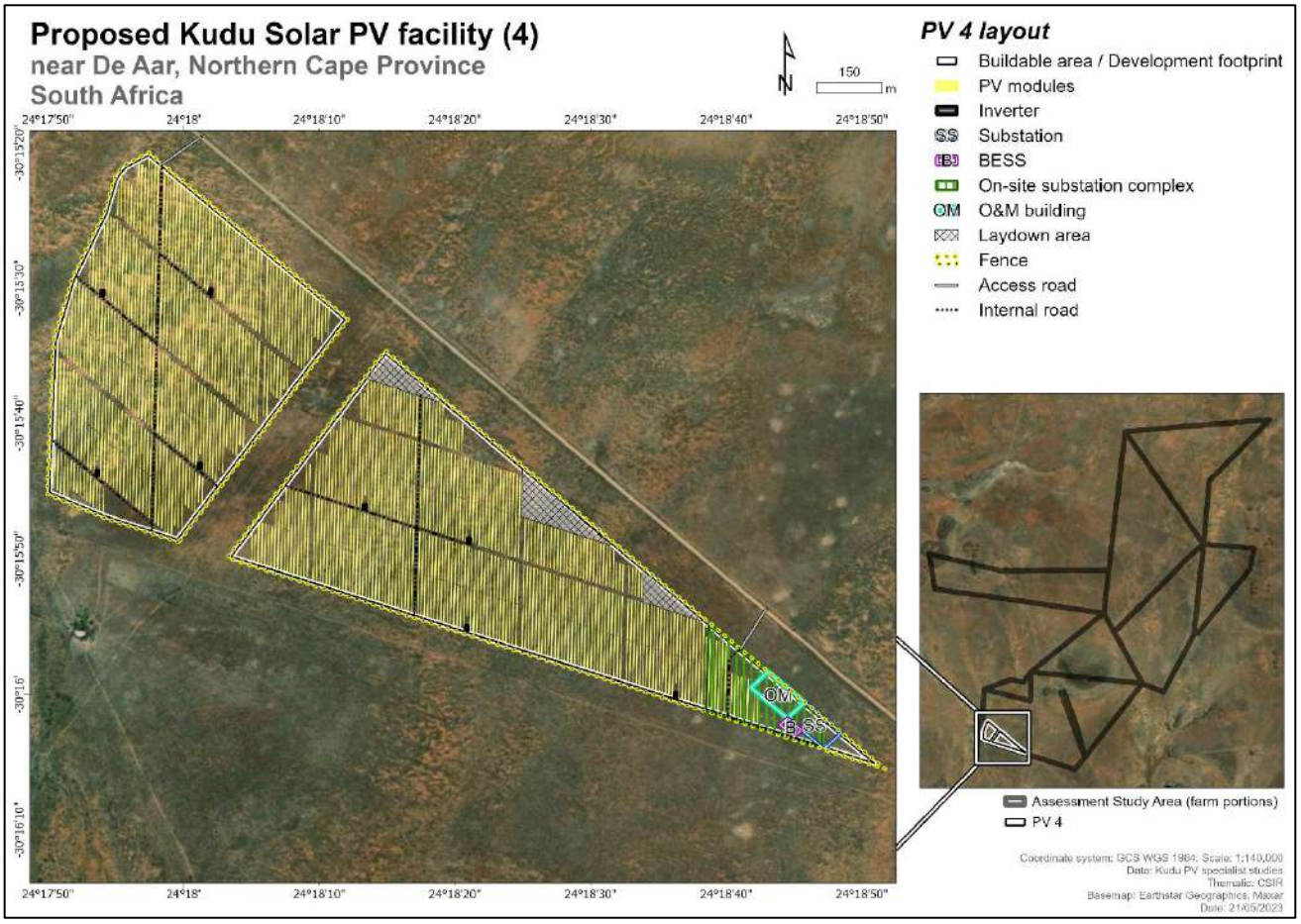


Figure 3: *Map showing the layout of the proposed project.*

1.1.2. Identification of alternatives

No alternative sites have been examined because the assessment process started with a larger site (i.e. study area consisting of eight farm portions totalling 8 150 ha) and the final footprint has been selected based on the lack of sensitive environmental features. Two different battery technologies are being considered, but this makes no difference to the heritage assessment and, being equally acceptable, they are not assessed separately in this report.

1.1.3. Description of project aspects relevant to the heritage study

All aspects of the proposed development are relevant, since excavations for foundations may impact on archaeological and/or palaeontological remains, while the above-ground aspects create potential

visual (contextual) impacts to the cultural landscape and any significant heritage sites that might be visually sensitive.

1.2. Terms of reference

ASHA Consulting was asked to:

- Conduct a field survey to search for sensitive areas and sites of heritage significance;
- Provide mapping data indicating where sensitive features lay;
- Compile separate impact assessment reports per project including the following:
    - Describe regional and local features of the receiving environment;
    - Map sensitive features;
    - Assess (identify and rate) the potential impacts on the environment;
    - Identify relevant legislation and legal requirements; and
    - Provide recommendations on possible mitigation measures, rehabilitation procedures, and management guidelines.

1.3. Scope, purpose and objectives of the report

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

1.4. Details of specialist

This specialist assessment has been undertaken by Dr Jayson Orton of ASHA Consulting (Pty) Ltd. He has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting Heritage Impact Assessments and archaeological specialist studies in South Africa (primarily in the Western Cape and Northern Cape provinces) since 2004 (please see curriculum vitae included as Appendix 1). He has also conducted research on aspects of the Later Stone Age in these provinces and published widely on the topic. He is an accredited heritage practitioner with the Association of Professional Heritage Practitioners (APHP; Member #43) and also holds archaeological accreditation with the Association of Southern African Professional Archaeologists (ASAPA) CRM section (Member #233) as follows:

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

A signed specialist statement of independence is included at the front of this specialist assessment.

2. LEGISLATIVE CONTEXT

2.1. National Heritage Resources Act (NHRA) No. 25 of 1999

The NHRA protects a variety of heritage resources as follows:

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old as well as military remains more than 75 years old;
- Section 36: graves and human remains older than 60 years and located outside of a formal cemetery administered by a local authority; and
- Section 37: public monuments and memorials.

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

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

Section 3(3) describes the types of cultural significance that a place or object might have in order to be considered part of the national estate. These are as follows:

a) its importance in the community, or pattern of South Africa’s history;
b) its possession of uncommon, rare or endangered aspects of South Africa’s natural or cultural heritage;
c) its potential to yield information that will contribute to an understanding of South Africa’s natural or cultural heritage;

d) its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
e) its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
f) its importance in demonstrating a high degree of creative or technical achievement at a particular period;
g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
h) its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
i) sites of significance relating to the history of slavery in South Africa.

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

2.2. Approvals and permits

2.2.1. Assessment Phase

Section 38(8) of the NHRA states that if an impact assessment is required under any legislation other than the NHRA then it must include a heritage component that satisfies the requirements of S.38(3). Furthermore, the comments of the relevant heritage authority must be sought and considered by the consenting authority prior to the issuing of a decision. Under the National Environmental Management Act (No. 107 of 1998; NEMA), as amended, the project is subject to an EIA. The present report provides the heritage component. Ngwao-Boswa Ya Kapa Bokoni (Heritage Northern Cape; for built environment and cultural landscapes) and the South African Heritage Resources Agency (SAHRA; for archaeology and palaeontology) are required to provide comment on the proposed project in order to facilitate final decision making by the DFFE.

2.2.2. Construction Phase

If archaeological or palaeontological mitigation is required prior to construction, then the appointed archaeologist or palaeontologist would need to obtain a permit from SAHRA. This would be issued in their name. This is so that the heritage authority can ensure that the appointed practitioner has proposed an appropriate methodology that will result in the mitigation being done properly. A built environment permit, if required, would need to be obtained from the Provincial Heritage Resources Authority (PHRA).

2.3. Guidelines

SAHRA have issued minimum standards documents for archaeological and palaeontological specialist studies. There is also a Western Cape Provincial guideline for heritage specialists working in an EIA context and which is generally useful. The reporting has been prepared in accordance with these guidelines. The relevant documents are as follows:

- Winter, S. & Baumann, N. 2005. Guideline for involving heritage specialists in EIA processes: Edition 1. CSIR Report No ENV-S-C 2005 053 E. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.
- SAHRA. 2007. Minimum Standards: archaeological and palaeontological components of impact assessment reports. Document produced by the South African Heritage Resources Agency, May 2007.

3. APPROACH AND METHODOLOGY

3.1. Literature survey and information sources

A survey of available literature was carried out to assess the general heritage context into which the development would be set. The information sources used in this report are presented in Table 3 with relevant dates of each source referenced in the text as needed. Data were also collected via a field survey. The data quality is suitable for the purpose of informing this report.

Table 3: *Information sources used in this assessment.*

Data / Information	Source	Date	Type	Description
Maps	Chief Directorate: National Geo-Spatial Information	Various	Spatial	Historical and current 1:50 000 topographic maps of the study area and immediate surrounds
Aerial photographs	Chief Directorate: National Geo-Spatial Information	Various	Spatial	Historical aerial photography of the study area and immediate surrounds
Aerial photographs	Google Earth	Various	Spatial	Recent and historical aerial photography of the study area and immediate surrounds
Cadastral data	Chief Directorate: National Geo-Spatial Information	Various	Survey diagrams	Historical and current survey diagrams, property survey and registration dates
Background data	South African Heritage Resources Information System (SAHRIS)	Various	Reports	Previous impact assessments for any developments in the vicinity of the study area
Palaeontological sensitivity	South African Heritage Resources Information System (SAHRIS)	Current	Spatial	Map showing palaeontological sensitivity and required actions based on the sensitivity.
Background data	Books, journals, websites	Various	Books, journals, websites	Historical and current literature describing the study area and any relevant aspects of cultural heritage.

3.2. Field survey

The site was subjected to a foot survey on 21, 22, 24 and 25 April 2022. This was during autumn and after good summer rains the grass was quite dense which meant that visibility of the ground and archaeological resources was very poor. Other heritage resources are not affected by seasonality. During the survey the positions of finds and survey tracks were recorded on a hand-held Garmin Global Positioning System (GPS) receiver set to the WGS84 datum (Figure 4). Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

ASHA was requested to consider the entirety of the eight properties identified for the Kudu solar projects with a view to informing the final layouts. As such, the survey ranged widely across the study area but, due to an extremely low incidence of finds in the open grasslands, these areas were covered only very sparsely. More emphasis was placed on parts of the study area most likely to be sensitive (e.g. hills, rocky outcrops and areas close to farmsteads).

It should be noted that the amount of time between the dates of the field inspection and final report do not materially affect the outcome of the report.

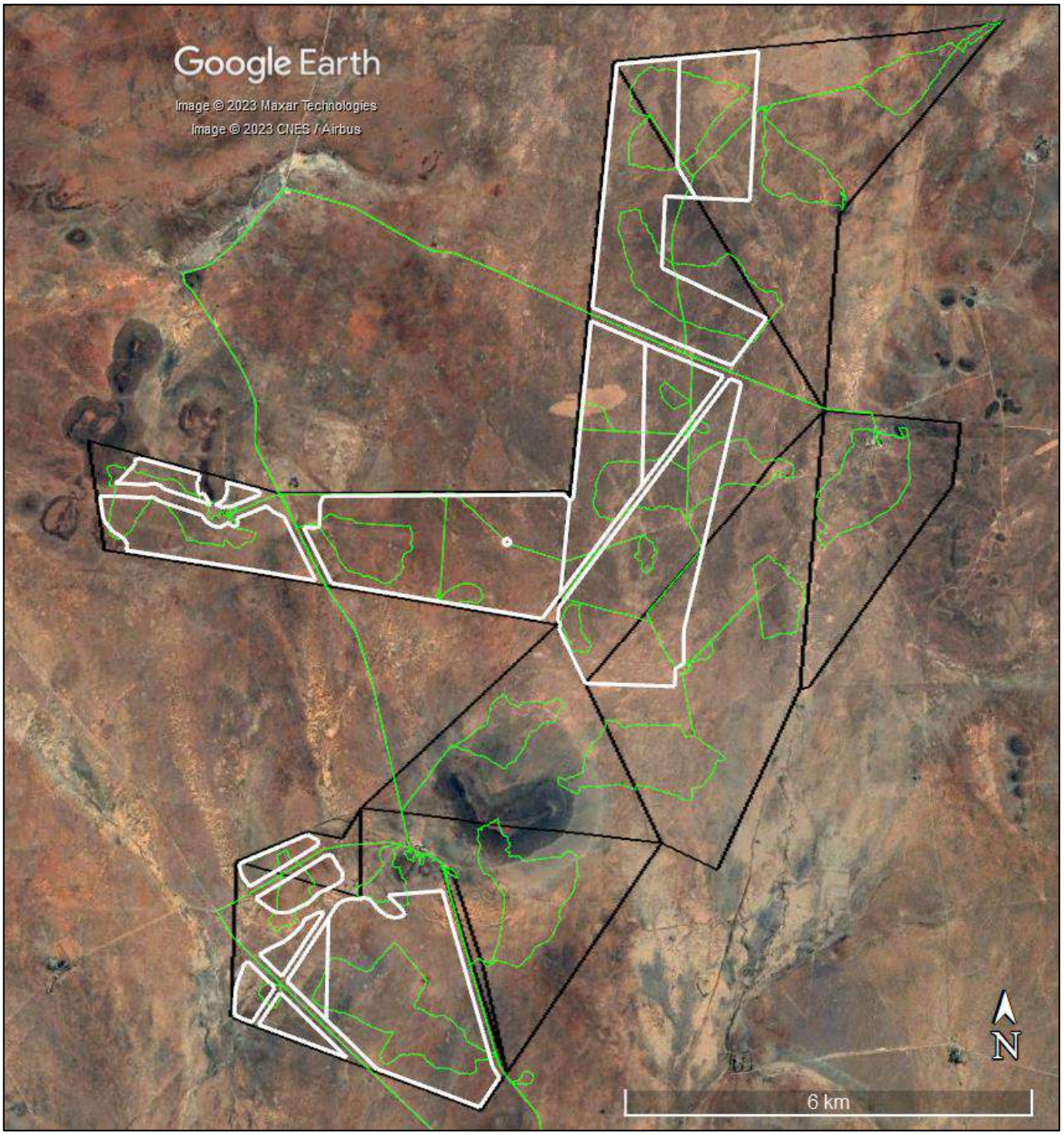


Figure 4: *Map showing the survey tracks (green lines) across the wider study area. The farm portions are in black and the PV footprints are in white.*

3.3. Specialist studies

A separate palaeontological specialist study was compiled.

3.4. Impact assessment

For consistency among specialist studies, the impact assessment was conducted through application of a scale supplied by the CSIR. Please see the EIA report for details.

3.5. Grading

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

It is intended under S.7(2) that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. SAHRA (2007) has formulated its own system[2] for use in provinces where it has commenting authority. In this system sites of high local significance are given Grade IIIA (with the implication that the site should be preserved in its entirety) and Grade IIIB (with the implication that part of the site could be mitigated and part preserved as appropriate) while sites of lesser significance are referred to as having 'General Protection' (GP) and rated as GP A (high/medium significance, requires mitigation), GP B (medium significance, requires recording) or GP C (low significance, requires no further action).

3.6. Assumptions, knowledge gaps and limitations

The study is carried out at the surface only and hence any completely buried archaeological sites will not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. On site the grass was dense which meant that ground visibility was very limited. From experience, significant resources in this type of environment tend to be spatially related to dolerite outcrops and these were generally easily located and surveyed. Surveys of the grasslands were very minimal because of both the very low visibility and the expected very low likelihood of finding significant heritage resources there. Nonetheless, transects were walked through these grassy areas to confirm the expectations. Despite the relatively low survey coverage, the expected distribution patterns are assumed to hold true.

Cumulative impacts are difficult to assess due to the variable site conditions that would have been experienced in different areas and in different seasons. Survey quality is thus likely to be variable. As such, some assumptions need to be made in terms of what and how much heritage might be impacted by other developments in the broader area. It is also notable that most of the projects shown in the cumulative impacts map (see Section 7.4) do not appear on the South African Heritage Resources Information System (SAHRIS).

[2] The system is intended for use on archaeological and palaeontological sites only.

3.7. Consultation processes undertaken

The NHRA requires consultation as part of an HIA but, since the present study falls within the context of an EIA which includes a public participation process (PPP), no dedicated consultation was undertaken as part of the HIA. Interested and affected parties would have the opportunity to provide comment on the heritage aspects of the project during the PPP.

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The broader Kudu study area is very remote and lies far from any towns. Philipstown is the nearest and lies some 27 km to the southeast. Petrusville is some 33 km east-northeast and De Aar is 57 km to the southwest. The area is used for livestock grazing. Access is all on gravel roads and the only other infrastructure present aside from farming-related features are several high voltage (HV) powerlines. One of these passes through the middle of the Kudu study area (Figure 5). The study area does not fall within a Renewable Energy Development Zone (REDZ; the nearest is Kimberley REDZ 130 km to the northeast) but is entirely contained within the Central Electricity Grid infrastructure (EGI) Corridor.



Figure 5: *Map showing the project location in relation to existing HV powerlines (green lines).*

4.2. Site description

The wider study area is a flat grassy plain with a number of dolerite hills protruding from it. The PV facilities are proposed on the flat grassland areas. The largest hill is Basberg which lies in the southern part of the study area and affords excellent views over the grasslands to the north and south (Figures 6 and 7). Another prominent but very much smaller hill, *Kaaimanskop*, lies in the north and offers views over that part of the study area (Figure 8).



Figure 6: *Panoramic view towards the south from the summit of Basberg showing the general character of the landscape.*



Figure 7: *Panoramic view towards the north from the summit of Basberg showing the general character of the landscape.*



Figure 8: *View towards the southwest from the summit of Kaaimanskop showing the character of the flat grasslands in the wider study area.*

The Kudu PV4 facility study area is flat, open grassland and lacks any features. The nearest dolerite hill is just over 2.4 km to the northeast and southeast. Figure 9 shows a view of the PV4 area.



Figure 9: *View towards the northeast from the centre of the PV4 study area towards Basberg in the distance. The powerline at left splits the PV study area into two portions.*

5. FINDINGS OF THE HERITAGE STUDY

This section describes the heritage resources recorded in the study area during the course of the project.

5.1. Palaeontology

The SAHRIS Palaeosensitivity Map shows the site to be of largely high palaeontological sensitivity but with small areas of moderate and zero sensitivity (Figure 10). The latter are the dolerite outcrops. Because of this high sensitivity, a palaeontological survey was carried out. The survey found that in fact the areas marked high sensitivity on the SAHRIS map are better considered low sensitivity in practice. Further details are contained in the relevant specialist report.

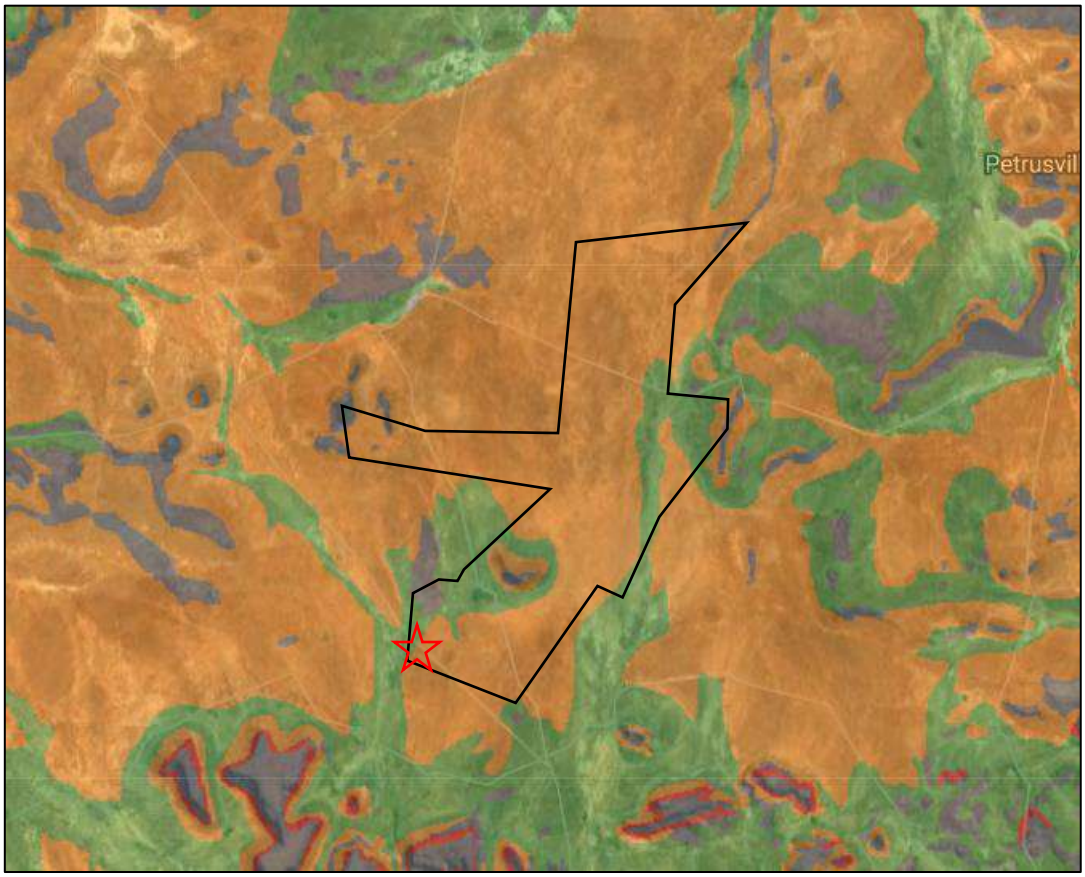


Figure 10: *Extract from the SAHRIS Palaeosensitivity Map showing the wider study area to be of largely high sensitivity (orange shading). PV4, however, is underlain by sediments of both moderate and high sensitivity (red star).*

5.2. Archaeology

5.2.1. Desktop study

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. These date to the Early (ESA), Middle (MSA) and Late Stone Ages (LSA) but the former tend to be the least common and do not appear to be on record in the relatively well-studied De Aar area. Pleistocene-aged MSA artefacts occur quite widely and are usually exposed in areas where there is erosion or deflation of the surface. These artefacts are identifiable as MSA by the fact that they are weathered and heavily patinated from very long term exposure and appear orange in colour with their edges rounded off. Much less patinated artefacts are younger with the least patinated or often entirely unpatinated ones being from the Holocene LSA. Heavily patinated artefacts were reported by Van Vollenhoven (2013) to the east of the study area, although he considered them to be from the LSA.

Most other work in the wider area has been close to De Aar and has revealed a variety of Stone Age materials. Because they are generally far better preserved, LSA sites are usually the most significant. Most impressive was a very dense LSA site on a low hill just to the northeast of the town (Orton 2022a). This site had many thousands of stone artefacts as well as pottery and contact period metal items. Other LSA sites in the area tend mostly to be focused on the dolerite outcrops and include

ephemeral stone-walled features (Orton 2012; Orton & Webley 2013a, 2013b). However, LSA materials have also been recorded along the Brak River (Orton 2022b). MSA artefacts as noted above have also been widely documented around De Aar (Morris 2011; Kruger 2012; Orton 2012).

One of the most significant aspects of Karoo archaeology is the presence of many prehistoric stone kraals. Most notably, the Seacow River valley to the south of the present study area has revealed many such kraals (Sampson 1984, 1985, 1986, 2010) and enabled a kraal typology to be constructed (Hart 1989). The kraals are typically constructed on sloping ground against dolerite ridges and overlooking water sources. Domestic debris and stone artefacts are seldom associated with them, but when they are, they are taken to represent either the pastoralists camping alongside their kraals or else later re-occupation of the kraals by hunter-gatherer people (Sampson 1985). Although pottery is often taken to signify pastoralist occupation, Sampson (2010) and others (Bollong *et al.* 1993, 1997; Rudner 1979) have shown that in the interior some pottery is tempered with fibre and was made by Bushmen hunter-gatherers rather than Khoekhoe pastoralists.

Rock engravings occur widely, but in highly variable density, on the dolerite outcrops of the Karoo. Rock paintings are also said to be known from the area (De Aar, n.d.) but further details are unknown. Orton & Webley (2013a) found a rock gong that also had a faint fine-line animal engraving on it, while some 40 km south of the Kudu study area Webley and Orton (2011) reported some rock engravings. Some historical engravings (names, initials and dates) are also sometimes found engraved on the rocks (Orton 2012; Webley & Orton 2011). Parkington *et al.* (2008) show an early 20th century map of engravings known at that time (Figure 11). While they do not provide a modern equivalent, this map does give an indication that the main distribution of engravings is to the north of the present study area in the eastern part of Northern Cape and western part of Free State.

Historical archaeological materials in the Karoo are most often associated with farmsteads, either standing, ruined or demolished (e.g. Orton 2012). These materials are often collected in a domestic dump and include items such as glass, ceramics, bones, ash and rubble. Ruined farm buildings include houses, kraals and various outbuildings. Isolated artefacts or small clusters – such as where a bottle was dropped and broke – are also regularly found in isolation but are not significant.

The Anglo-Boer War was a significant event in Karoo history and will be discussed below. However, it is noted here that artefacts and ruined/disused structures related to the war are also frequently found. Alongside the Brak River at De Aar, for example, was an extensive, but low-density scatter of historical materials that may well represent an Anglo-Boer War camp. Another ephemeral scatter of such material was found by Orton (2021) on a very low hill to the north of and overlooking De Aar. On excavation, this site turned out to have almost all glass and metal artefacts and was very likely a small lookout post (Orton 2022). Small stone-walled features and sometimes larger forts related to the war can also be found but none are known from the area by the present author. No major Anglo-Boer War battles occurred within 70 km of the Kudu study area.

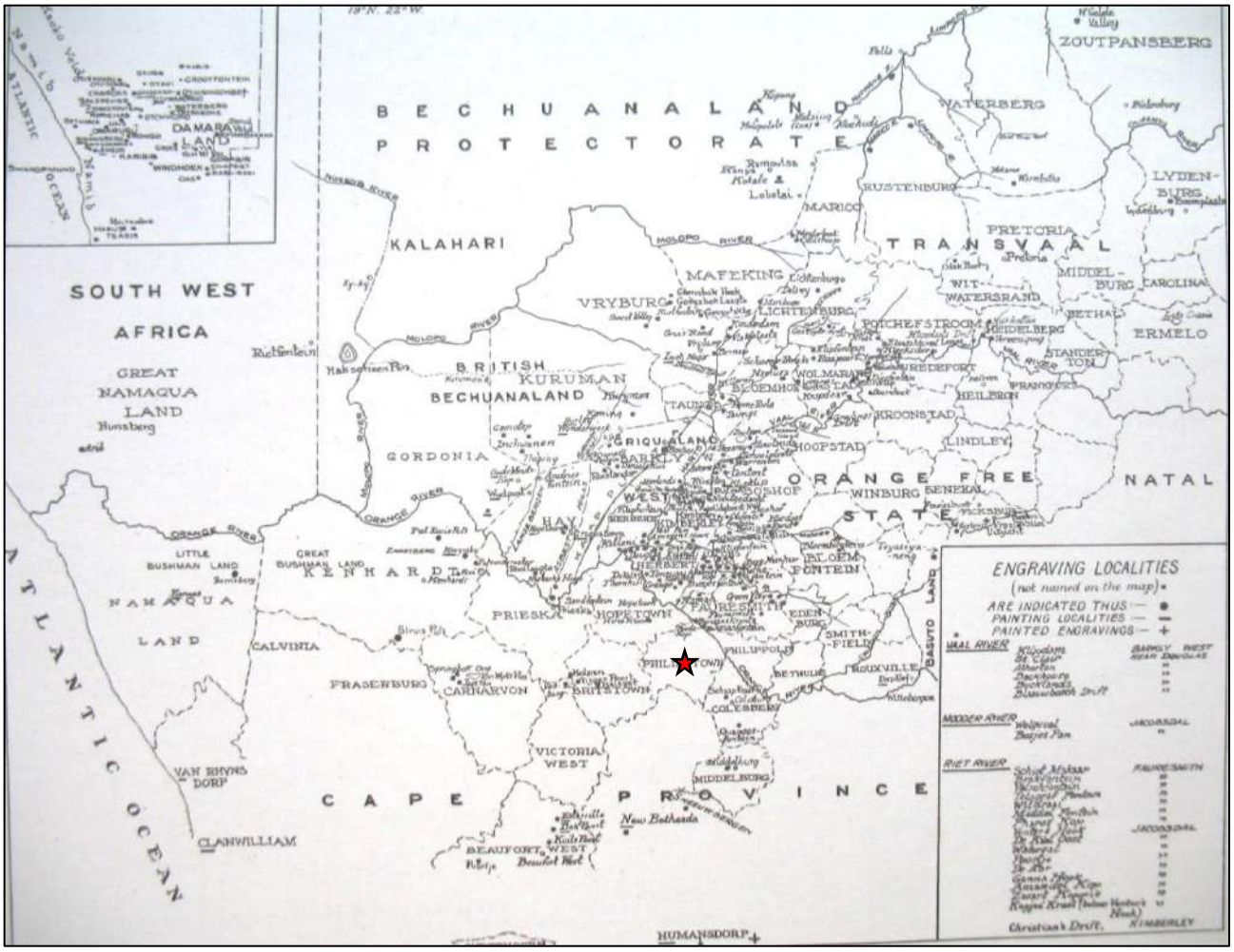


Figure 11: *Map compile by Maria Wilman in the early 20th century showing the locations of known rock engravings. Source: Parkington* et al. *(2008: 33).*

5.2.2. Site visit

Table 4 provides a full list of heritage resources recorded across the wider Kudu study area during the survey. They are mapped in Appendix 3. The full list is useful because of the extreme paucity of significant heritage in the PV4 footprint. Reporting only materials from that PV site would suggest there to be very little heritage present on the landscape. However, it was evident that significant heritage resources were associated with nearby dolerite hills and outcrops. These include historical materials related to farming and the Anglo-Boer War as well as both Stone Age and historical engravings. One site had Stone Age engravings on a rock gong. Because the facility layout was designed to avoid sensitive features (and all rocky outcrops), none occur within or close to the proposed footprint and impacts to them are not expected.

It is clear from the observations of weathered and patinated artefacts in areas where the soil is exposed that such finds will be present as background scatter artefacts throughout the study area but likely in variable densities. This includes within the PV4 site. These artefacts relate to many millennia of occupation of the landscape through the MSA and LSA and, because their distribution is conditioned more by natural factors such as erosion, these artefacts are not connected with specific, spatially definable occupation sites. All other traces of occupation have long since disappeared and these artefacts have very low cultural significance. They are therefore of no further concern.

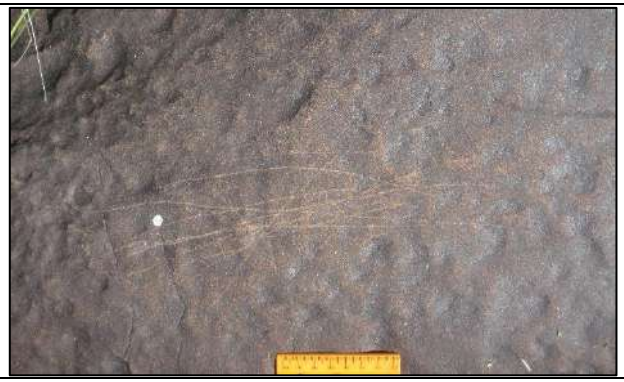
Table 4: *List of finds made during the survey. Note that all finds from the wider study area are provided for context but none were found within or close to the PV4 study area.*

Waypoint	Location	Description		Significance Grade
947	S30 11 13.0 E24 23 45.3	Farm complex on Wolwe Kuilen 42/rem. The house is early 20th century and it is in good condition (including inside). There are various outbuildings. The main house is surrounded by trees.	 	High
948	S30 09 40.1 E24 21 50.3	Gum trees, wind pump and reservoir – part of the cultural landscape		Low

949	S30 08 21.5 E24 22 20.5	Light scatter of well-patinated hornfels MSA flakes and blades and also one less patinated core located in an eroded area. 		Very low GPC
950	S30 09 01.2 E24 21 30.2	Light scatter of well-patinated hornfels MSA flakes located in an eroded area.		Very low GPC

951	S30 08 34.6 E24 22 39.0	Line of gum trees, a wind pump, an old stone-lined low reservoir (derelict), a square plastered and white-washed reservoir and a newer corrugated iron and cement reservoir – heritage resources forming part of the cultural landscape. 	 	Low
952	S30 08 22.9 E24 23 33.5	A cluster of gum trees with a corrugated iron reservoir under them – part of the cultural landscape.		Low

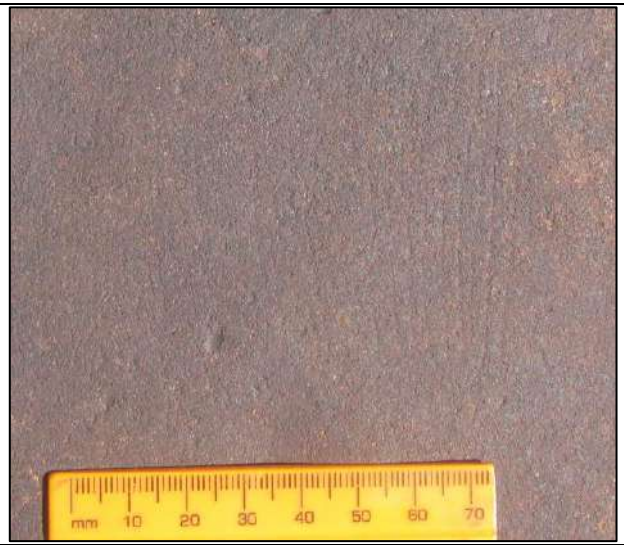
953	S30 08 03.5 E24 24 26.0	A small circular feature made of dolerite rocks and about 1.5 m in diameter. Very close by is a small cairn of dolerite rocks. Both are very overgrown with grass. Also seen here were a few fragments of dark bottle glass, the neck of a small cobalt blue bottle, two fragments of red-painted refined white earthenware and some wire. The site is presumably related to farming activity. 	  	Medium GPA
954	S30 08 06.6 E24 24 32.1	A circular stone-walled feature of dolerite rocks and located on a low dolerite hill. The feature is about 2 m in diameter. It lies very close to the kraal at waypoint 955 (visible in the background).		Medium GPA

955	S30 08 07.1 E24 24 31.9	A rectangular stone-walled measuring about 9 m by 20 m. It is heavily overgrown with grass. It is very close to the circular feature at waypoint 954. 		Medium GPA
956	S30 08 07.3 E24 24 31.7	A dolerite rock with a scratched motif on it.		Low GPB
957	S30 07 54.5 E24 24 50.2			High

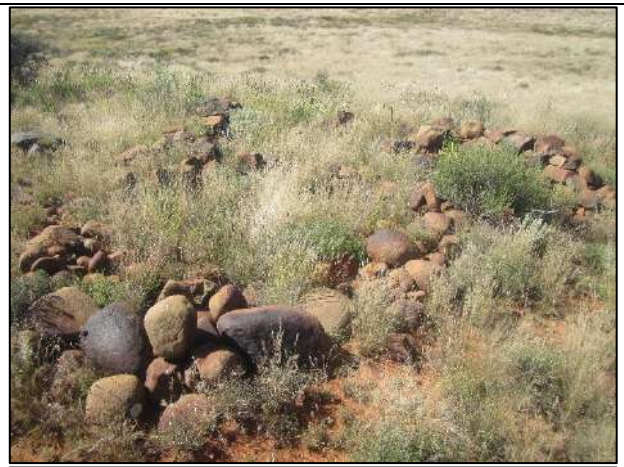
957B	S30 07 53.8 E24 24 46.2	These two points lie along the southern end of an approximately 5 km long dolerite stone wall that extends northwards along a dolerite dyke on Farm 209 ending at waypoint 959 on the farm to the north (outside the study area). The wall has been broken down to erect the current farm fence.	 	IIIB
958	S30 07 53.8 E24 24 51.8	A lightly scraped geometric engraving. It is almost certainly not part of the geometric tradition rock art but looks quite recent.		Medium GPA

959	S30 07 53.1 E24 24 52.6	This point is at the northern end of the wall recorded under waypoint 957.		High IIIB
960	S30 07 53.3 E24 24 52.0	A dolerite rock with some scratches on it.		Very low GPC

961	S30 07 53.4 E24 24 51.9	Two historical scratched horse engravings and a few other images. The horses are identical in design, but the one is far smaller (and clearer) than the other. The large one is above the scale in the photograph below, while the smaller is indicated by the yellow arrowed. There is also a patch of multiple parallel lines that is very well patinated and must be far older (red arrow). 		Medium IIIB

				
962	S30 08 23.9 E24 24 12.8	An isolated dolerite rock that looks like it has been used as a lower grindstone. The surface is lightly concave which presumably invited this use.		Very low GPC
963	S30 09 03.6 E24 23 16.6	Light scatter of well-patinated hornfels MSA flakes located in an eroded area.		Very low GPC
964A	S30 09 14.1 E24 23 25.6			Medium

964B	S30 09 14.9 E24 23 25.6	These waypoints are the four corners of a U-shaped kraal located on the northern foot of a prominent hill. The open side of the kraal faces downhill and the entire structure is 33 m by 33 m. It is heavily overgrown with grass.		GPA
964C	S30 09 15.2 E24 23 24.5			
964D	S30 09 14.2 E24 23 24.4			
965	S30 09 16.3 E24 23 25.8	These waypoints represent the corners of two adjoining rectangular stone-walled kraals. The whole feature has ends of about 21 m (north) and 26 m (south), while its sides measure 50 m (west)and 44 m (east). The shared wall in the middle is 26 m long.		Medium GPA
965B	S30 09 16.1 E24 23 26.5			
965C	S30 09 16.8 E24 23 26.9			
965D	S30 09 17.1 E24 23 26.0			
965E	S30 09 17.8 E24 23 26.4			
965F	S30 09 17.4 E24 23 27.2			

966	S30 09 15.5 E24 23 25.8	There are two stone-walled features here. One is a small, circular feature less than 2 m across (photograph below), while the other has two enclosures with the whole feature being about 5 m across (photographs at right). They are assumed to relate to farming activities and are located just north of the kraal at waypoint 965. 	 	Medium GPA

967	S30 09 17.5 E24 23 25.4	Two stone-walled enclosures of about 2 m diameter each.		Medium GPA
968	S30 09 18.2 E24 23 25.0	A small stone cairn with two fragments of dark bottle glass alongside it.		Medium GPA
969	S30 09 18.9 E24 23 25.0	A small stone cairn. Feature apparently related to the ABW.		Medium GPA

970	S30 09 19.6 E24 23 25.1	A small stone cairn. Feature apparently related to the ABW.		Medium GPA
971	S30 09 19.7 E24 23 25.1	An elongated pile of stones. Feature apparently related to the ABW.		Medium GPA
972	S30 09 20.1 E24 23 25.4	A small stone cairn on a flat dolerite outcrop. Feature apparently related to the ABW.		Medium GPA

973	S30 09 20.6 E24 23 25.2	An elongated pile of stones. Feature apparently related to the ABW.		Medium GPA
974	S30 09 21.0 E24 23 25.2	An elongated pile of stones. Feature apparently related to the ABW.		Medium GPA

975	S30 09 21.2 E24 23 25.5	A small stone cairn. Feature apparently related to the ABW.		Medium GPA
976	S30 09 21.2 E24 23 25.1	A small stone cairn. Feature apparently related to the ABW.		Medium GPA

977	S30 09 21.7 E24 23 25.1	A small stone cairn. Feature apparently related to the ABW.		Medium GPA
978 978B 978C	S30 09 19.1 E24 23 15.0 S30 09 18.5 E24 23 14.2 S30 09 19.7 E24 23 13.3	The overgrown and much degraded remains of an earthen walled dam with a few stones present on the ground at 978 and a slight earth mound present at 978B and 978C. The earth mound has no doubt eroded flat.		Very low GPC
979	S30 09 18.9 E24 23 15.0	Light scatter of moderately well-patinated MSA hornfels flaked stone artefacts.		Very low GPC

980	S30 09 48.7 E24 22 15.6	A row of gum trees with other older trees and a corrugated iron reservoir nearby. Part of the cultural landscape.		Low
981	S30 09 45.7 E24 22 17.3	Ephemeral scatter of well-patinated hornfels MSA flakes located in an eroded area.		Very low GPC
982	S30 11 08.7 E24 21 35.8	Some trees and a reservoir. Part of the cultural landscape.		Low
983	S30 11 22.8 E24 18 16.7	A large farm outbuilding and two ruined labourers' cottages that are likely more than 60 years old. They are on Portion 5 of Grass Pan 40, outside the study area. There is also one more recent cottage. These are on a neighbouring farm and were not visited.		Medium

984	S30 11 09.9 E24 23 47.8	Light scatter of well-patinated hornfels MSA flakes as well as a few less patinated ones and some quite fresh ones. The latter are LSA. The artefacts are located in an eroded area with plenty of hornfels gravel at the foot of a dolerite hill.		Very low GPC
985	S30 11 10.5 E24 23 53.6	The poorly preserved remains of a stone-walled kraal measuring about 18 m by 37 m and located on the foot of a dolerite hill. Although the site was not examined in detail, some glass, ceramics and metal fragments were seen.		Low GPB

986	S30 11 11.3 E24 23 55.5	This is the foundation of a small (presumably) house made of dolerite rocks but with a brick and cement portion built on to the southern side. It is located very closer to the kraal at waypoint 985. Although the site was not examined in detail, some glass, ceramics and metal fragments were seen.		Medium GPA
987	S30 11 08.2 E24 23 56.3	A scraped engraving on top of a dolerite hill. It looks quite recent and relatively casually done. It might be lettering but it is not possible to be sure of this.		Very low GPC

988	S30 11 07.5 E24 23 55.9	A circular enclosure of about 3.5 m by 2.5 m located on the summit of a dolerite hill. It is just a low wall of informally piled stones. No associated artefacts seen so cannot tell if this is historical or precolonial.		Low GPB
989	S30 11 07.2 E24 23 55.8	A circular enclosure of about 1 m diameter located on the summit of a dolerite hill. It looks like informally piled stones but could also be badly tumbled. The walling is far more substantial than that at waypoint 988 No associated artefacts seen so cannot tell if this is historical or precolonial.		Low GPB
990	S30 11 10.1 E24 24 00.2	Ephemeral scatter of well-patinated hornfels MSA flakes as well as some quite fresh ones. The latter are LSA. The artefacts are located in an eroded area with plenty of hornfels gravel at the foot of a dolerite hill.		Very low GPC
991	S30 12 03.3 E24 23 13.1	Some gum trees and a reservoir. Part of the cultural landscape.		Low

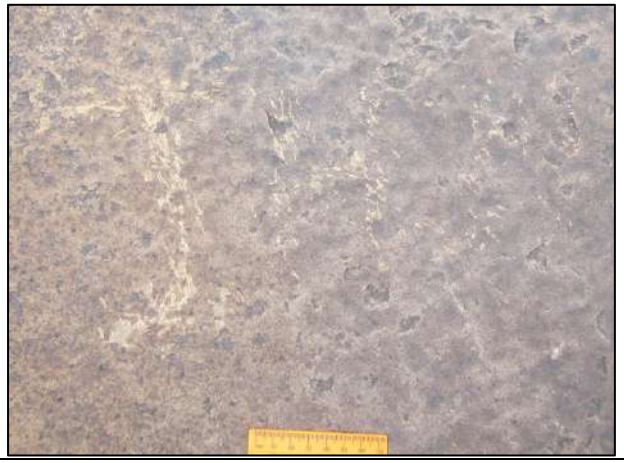
992	S30 11 15.1 E24 23 30.6	A rectangular earthen feature measuring 18 m by 24 m. It is barely visible on the ground but is clear on aerial photography. It may have been a low dam but there are no stones on the walls and no wind pump nearby.		Very low GPC
993	S30 11 10.7 E24 23 30.0	This is a scatter of patinated MSA hornfels artefacts in a disturbed area. There are heavily patinated and somewhat less patinated artefacts indicating hat not all come from the same time.		Very low GPC
994	S30 11 20.6 E24 21 49.2	An ephemeral scatter of well-patinated MSA hornfels artefacts located in the jeep track below powerlines.		Very low GPC
995	S30 11 48.6 E24 21 23.7	An ephemeral scatter of well-patinated MSA hornfels artefacts located in the jeep track below powerlines.		Very low GPC

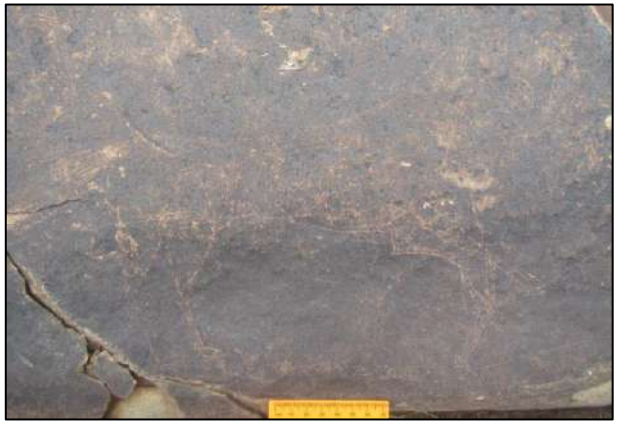
996	S30 11 49.9 E24 21 59.1	Some gum and Karee trees and a reservoir. Part of the cultural landscape.		Low
997	S30 11 47.4 E24 22 01.2	An ephemeral scatter of well-patinated MSA hornfels artefacts located in a denuded area.		Very low GPC
998	S30 11 29.7 E24 22 52.1	This is an area with windrows as well as a fruit orchard (quince, prickly pear and probably peach trees) as well as a grove of Soutbos. There is a stone-lined dam (marked as waypoint 999) and some wind pumps and a corrugated iron reservoir. Part of the cultural landscape.		Low
999	S30 11 28.2 E24 22 50.6	This is the stone-lined dam noted under waypoint 998.		
1000	S30 11 18.4 E24 22 07.5	Ephemeral scatter of well-patinated hornfels MSA flakes located in an eroded area.		Very low GPC
1001	S30 13 01.1 E24 21 55.9	Some trees, a corrugated iron reservoir and a wind pump. Part of the cultural landscape.		Low
1002	S30 13 32.8 E24 22 02.6	Some trees and a reservoir. Part of the cultural landscape.		Low

1003	S30 13 55.1 E24 21 30.5	An old prickly pear orchard located very far from any farm buildings. Part of the cultural landscape.		Low
1004	S30 13 52.7 E24 20 48.4	A light scatter of fresh hornfels flaked stone artefacts and some ostrich eggshell fragments at the northern foot of a dolerite hill (Basberg). It cannot be determined how extensive the scatter is due to the dense grass but it might stretch much further than was evident. These finds were in a pathway.		Low GPB
1005	S30 12 01.4 E24 20 19.0	Some trees, a corrugated iron reservoir and a wind pump. Part of the cultural landscape.		Low
1006	S30 11 53.4 E24 19 44.3	A cluster of gum trees. Part of the cultural landscape.		Low
1007	S30 11 33.2 E24 18 22.3	A farmstead on Portion 5 of Grass Pan 40, outside the study area. It was not visited. The house looks to be early 20th century.		High

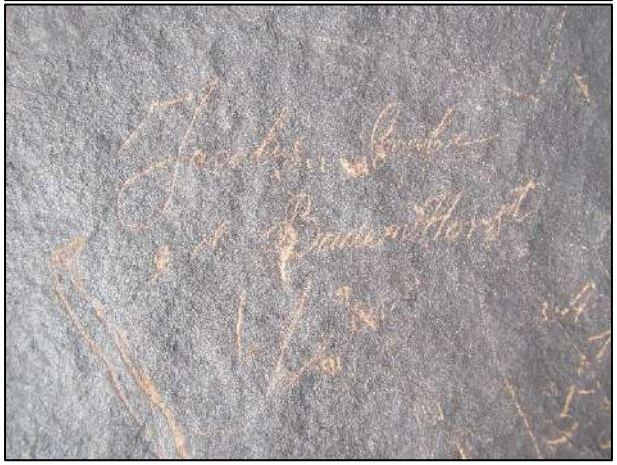
1008	S30 14 30.9 E24 19 35.9	The oldest-looking of a set of three different labourers' cottages. It is in poor condition and is probably early-mid-20th century.		Low
1009	S30 17 32.6 E24 20 50.6	Mixed age hornfels artefacts exposed along the edge of a borrow it. Some artefacts were seen to have some calcrete adhering and the patination varied from well-patinated red to only lightly patinated grey.		Very low GPC
1010	S30 16 13.1 E24 19 54.9	Ephemeral scatter of well-patinated hornfels MSA flakes located in an eroded area.		Very low GPC
1011	S30 16 10.6 E24 19 41.7	Ephemeral scatter of well-patinated hornfels MSA flakes located in an eroded area.		Very low GPC
1012	S30 16 15.8 E24 19 04.5	Some gum trees, a corrugated iron reservoir and a wind pump. Part of the cultural landscape.		Low

1013	S30 15 28.9 E24 19 35.7	Some trees, a corrugated iron reservoir and a wind pump. Part of the cultural landscape.		Low
1014	S30 15 21.0 E24 20 07.6	A large willow tree, a corrugated iron reservoir and a wind pump. Part of the cultural landscape.		Low
1015	S30 14 35.8 E24 19 46.5	An earthen-walled dam with a few stones along its crest at one point.		Very low

1016	S30 14 36.0 E24 19 49.5	An area of 25 m diameter on a low dolerite hill with many historical/recent engravings. They include indistinguishable scratches and motifs, horses, ostriches and writing. One rock has the date “5 Sep 1926” and the name “Jacobus Grabe (likely) Badenhorst” in cursive writing. It also has “E. ROBINSON” and a large stylised ostrich scratched on it. Another rock has two ostriches, one with a shaded body, while two others have stylised horses scratched on them. The site has been allocated a grade despite the date of 1926, since it is easily possible that the engravings were made over a long period of time and some may be older than 100 years. Either way, the site demonstrates a connection with intangible heritage through its continuation of the engraving tradition. The same applies to all the rock engravings recorded below. 	 	Medium-High IIIB

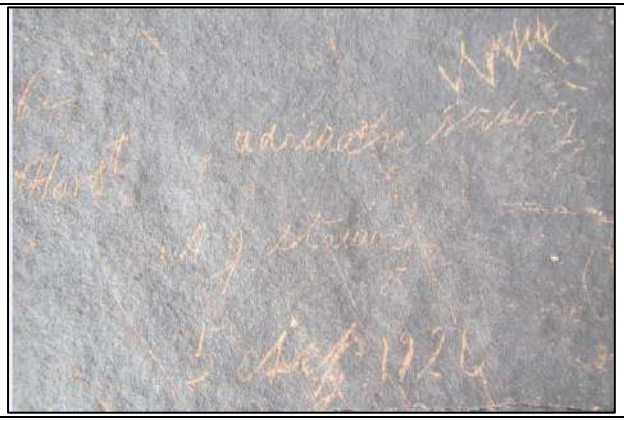
		 	 	

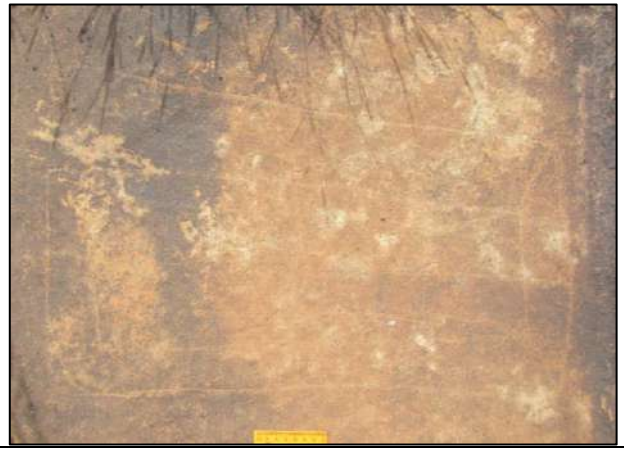








				
1017	S30 14 37.1 E24 19 50.9	This is another area on the same low hill as waypoint 1016 but it is about 10 m in diameter. It includes a checkered motif made in a cross shape with some squares having an X in them, along with several other geometric and indeterminate scratched motifs. 		Medium GPA

1018	S30 14 38.1 E24 19 51.3	This is another area on the same low hill as waypoint 1016 but it is about 5 m in diameter. The engravings here include a stylised horse which is somewhat patinated and could be older than the rest, a geometric motif similar to a Nine Men's Morris board, a set of three columns of 8, 9 and 10 short lines respectively, and some indeterminate scratches/motifs. 	 	Medium-High IIIB

1019	S30 14 38.8 E24 19 51.5	Further along the same hill as waypoint 1016, a very lightly scratched stylised horse with several other indeterminate very light scratches over and around it.		Medium GPA
1020	S30 14 39.8 E24 19 52.7	Further along the same hill as waypoint 1016, an indeterminate scratched geometric motif.		Low GPB

1021	S30 14 40.3 E24 19 52.7	Further along the same hill as waypoint 1016, an indeterminate scratched motif.		Low GPB
1022	S30 14 38.7 E24 19 48.9	Various scratched rocks with one image being an animal with the top of its body drawn far higher than it should be. 		Low GPB

1023	S30 14 27.5 E24 19 26.2	The Basberg farm complex has an assortment of structures of varying age. The main house is in very good condition and looks to be early-mid-20th century. A large barn made from clay bricks is probably a little older, as is a very small structure with two doors and an internal hearth. Right outside it is a pole with several hooks on it (possibly for hanging hunted animals). A werf wall of dolerite cobbles runs round the back of the main house.	 	Medium-High

		 		
1024	S30 14 27.7 E24 19 24.4			

1024B	S30 14 28.1 E24 19 23.5	A large ash and rubbish midden measuring about 35 m long and about 10-20 m wide. It is on sloping ground. The waypoints are near each end. There is plenty of glass and ceramics as well as various types of metal (iron, copper and a grey metal, possibly pewter) and much bone. There are also rock and brick fragments present. Among the ceramics there is some stoneware but the vast majority of pieces are refined white earthenware including hand-painted, sponge-printed, transfer printed in various colours, lined industrial). The glass includes various colours (pink, clear, dark green, brown, black) and various forms (wine, medicine). The material probably does not go back beyond the late 19th century. A large scraper on a dolerite flake was also noted. 	   	Medium-High IIIB

			 	
Waypoints 1025-1033 are all on the hill immediately behind (south of) the Basberg farm house.				
1025	S30 14 28.2 E24 19 23.3	A poorly preserved and possibly unfinished engraving that looks like a horse. Only the top of the head, neck back and tail and back legs are present.		Medium GPA

1026	S30 14 29.6 E24 19 24.2	Some historical scratched engravings on the side of the hill. One rock has a geometric form similar to the one at waypoint 1018 (Nine Men's Morris-like) with "AS 1948" or "1968" scratched over it. A second rock has what looks like a Nine Men's Morris board with another geometric scratched over it. A third rock includes a probable horse (its head is unclear) with some geometric marks over it.	 	Medium GPA

				
1027	S30 14 31.5 E24 19 25.3	A rock at the top of the hill with some indeterminate historical scratches on it.		Very low GPC
1028	S30 14 31.5 E24 19 26.4	A rock with various indeterminate motifs as well as a fair bit of writing. Among the writing can be seen a date of “25 MAY ‘30” and another with “5 1940” written below the word/name “BABS”.		Medium GPA

1029	S30 14 31.1 E24 19 26.5	This is a set of rocks at the top of the hill with various mostly scraped initials on various horizontal and vertical faces and also a scraped cross with a backdrop of vertical scratched lines. 		Medium GPA
1030	S30 14 31.6 E24 19 27.1	Another set of rocks at the top of the hill with various historical and (probably mostly) quite recent scratched names and motifs. Included are the names “ANDRE” and “IAN” as well as “A+D” and a heart.		Medium GPA
1031	S30 14 32.6 E24 19 28.2	A rock at the top of the hill with some indeterminate historical scratches on it.		Very low GPC
1032	S30 14 32.1 E24 19 28.5	A rock at the top of the hill with some indeterminate historical scratches on it.		Very low GPC

1033	S30 14 31.7 E24 19 28.5	A rock on the side of the hill with an indeterminate geometric historical motif on it.		Very low GPC
1034	S30 14 30.6 E24 19 32.3	A dolerite cobble and cement kraal with an adjoining shed. The cement is fairly modern so likely early-mid-20th century.		Medium
1035	S30 15 01.9 E24 18 22.9	Ephemeral scatter of well-patinated hornfels MSA flakes located in an eroded area.		Very low GPC
1036	S30 15 05.6 E24 18 14.1	Ephemeral scatter of well-patinated hornfels MSA flakes located in an eroded area.		Very low GPC

1037	S30 14 25.7 E24 19 20.0	A dolerite rock away from the foot of the hill with some historical scratches on it. There is also a small amount of building rubble in the grass here but no evidence of any foundation or walling.		Very low GPC
1038	S30 14 26.7 E24 19 17.1	A heavily overgrown (with grass) but fenced (with a now derelict wire fence) graveyard to the west of the Basberg fam complex. It is impossible to count the graves. There is one double grave for “HENDRIK JOHANNES CHRISTIAN HANEKOM” who lived from 1833 to 1907 and his wife “HENDRINA JOHANNA” who died in 1901 (birth date illegible) and whose maiden name was Badenhorst. These may be the parents of the Badenhorst who left his name at waypoint 1016. Another grave has a stone lying loose on top of it with much cursive writing on it. It is very difficult to read but bears dates that look like 1826 and 1891 near the base. The name “Badenhorst” also appears near the top and at the very base of the stone. There are several graves that only have dolerite cobbles packed over them.		High IIIA

				
1039	S30 14 28.5 E24 19 17.7	Occasional fresh hornfels LSA artefacts can be seen in the grass here but it is impossible to determine how extensive or dense the scatter might be.		Low GPB
1040	S30 14 32.1 E24 19 17.0	An area at the foot of the hill had many large dolerite flakes of the sort that would be expected from stone dressing. Along this area it is apparent that stones have been moved to the side to create a roadway		Very low GPC

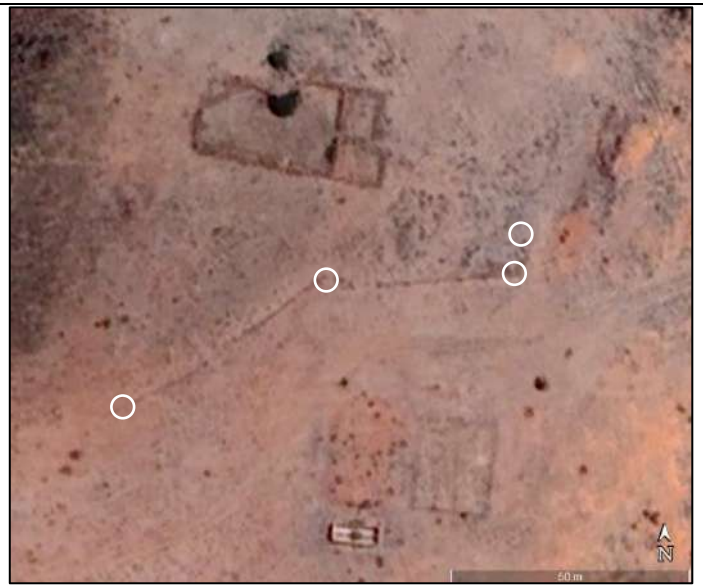
1041	S30 14 35.0 E24 19 18.5	This is an engraving of a single animal, likely an eland. It is somewhat stylised with a very small hump and a nose that ends in a point. The rump is also pointing upwards rather than being square. It is somewhat patinated and poorly preserved and lies halfway up the hill.		Medium-High IIIB
1042	S30 14 35.5 E24 19 20.2	A rock at the top of the hill with a ground patch and some scratches on it.		Very low GPC
1043	S30 14 36.2 E24 19 20.8	A rock at the top of the hill with a ground patch on it.		Very low GPC
1044	S30 14 37.8 E24 19 20.7	A boulder right on the edge of the hilltop has a number of scraped engravings on its vertical face that faces onto the hill. The engravings look quite fresh but yet are poorly preserved. There seem to be two ostriches towards the right, but the rest are difficult to tell the species of. A large flake of dolerite on top of the boulder has been used as a rock gong and makes a fairly high-pitched sound.		High IIIA

		 		
1045	S30 14 38.5 E24 19 21.9	A rock at the top of the hill with a ground patch on it.		Very low GPC
1046	S30 14 40.2 E24 19 22.1	A rock at the top of the hill with a ground patch and two pecked areas on it.		Very low GPC

1047	S30 14 42.2 E24 19 24.2	A rock at the base of the hill with a ground patch on it.		Very low GPC
1048	S30 14 49.2 E24 18 57.8	Ephemeral scatter of well-patinated hornfels MSA flakes located in an eroded area.		Very low GPC
1049	S30 14 44.6 E24 18 57.6	A sheep dip made with dolerite and grey cement and likely to date to the early-mid-20th century. There are two square enclosures with the dip in between. The enclosure from which the sheep enter the dip has a stone and cement floor, while the other enclosure has an earth floor. 		Low

1050	S30 14 26.2 E24 19 26.1	This is a pair of historical gate posts at the Basberg farm complex and which stand on either side of a public road.		Medium
Waypoints 1051 to 1056 are an historical farm complex. The grass in this area was very dense and it is likely that other features may have been missed. Notably, no graves were found and it seems likely that some must be present.				
1051	S30 11 49.0 E24 17 46.9	An early-mid-20th century ruined building with dressed stone halfway up the walls and red clay bricks above. Grey cement has been used throughout. The brick section was plastered but much of the plaster has peeled off. The joinery is metal, including the door which has fallen off. The roof is missing.		Low GPB

1052	S30 11 48.4 E24 17 47.3	Two parallel and conjoined rectangular enclosures. One measures about 8 m by 18 m and is only one stone high. The second one to the east is about 6 m by 18 m. On site only the larger enclosure was seen, such was the density of the grass, with the second identified only from aerial photography. The walls are made from stones (two skins and rubble fill). Due to the grass it was impossible to photograph the whole feature, but a detail is provided with the grass removed.		Medium GPA
1053	S30 11 48.4 E24 17 46.8	This is the remains of a house of about 11 m by 20 m. A dressed stone plinth is present, and a semi-circular cement step has been built onto the eastern side. There are many broken red frog bricks and it is evident that both grey cement and mud mortar were used in the construction. The cement may have been added at a later date.		Medium GPA
1054	S30 11 47.1 E24 17 46.8	This is a stone wall of about 100 m length running parallel to the road through the farm complex. The wall is a row of single boulders		Medium GPA
1054B	S30 11 47.1 E24 17 48.2			

1054C	S30 11 46.8 E24 17 48.1	usually in the order of 0.3 to 0.5 m in diameter. The rocks are too big to be the base of an old fence line and the shape of the entire feature (shown by white circles at right) suggests another indeterminate function. 		
1054D	S30 11 48.0 E24 17 44.9			
1055	S30 11 46.7 E24 17 48.6	A long feature of about 22 m with the southern part being about 3 m wide and made of bricks (though no in situ bricks could be seen) and the northern part being 5 m wide and of stone.		Medium GPA

1056	S30 11 46.2 E24 17 46.6	A stone kraal complex with maximum length of about 39 m by 19 m. There are three enclosures with two smaller ones to the east and one larger one to the west.		Medium GPA
1057	S30 11 46.4 E24 17 44.3	Four boulders on a dolerite hill with various inscriptions as follows: “STEPHANUS”, “CNEL”, “J.C.L. v. Vuure...” (middle initial uncertain and right hand end of rock broken) with “1898” below it and another name on a broken rock that includes “VAN VUU…”. Some other graffiti is unclear. 	 	Medium- High IIIB

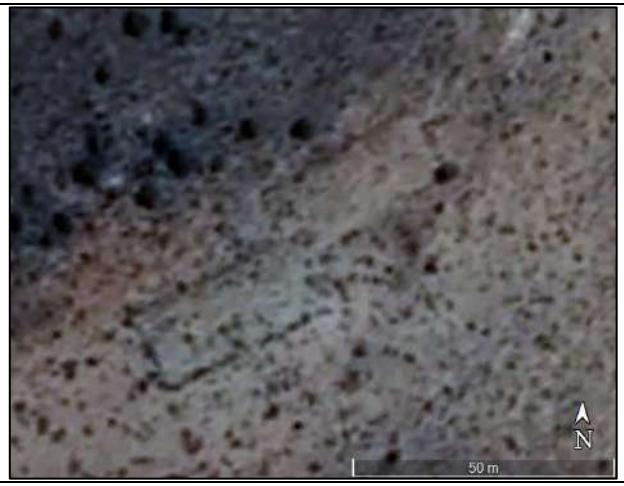
				
1058	S30 11 49.6 E24 17 40.0	A cluster of trees, a corrugated iron reservoir, a wind pump and some wire enclosures. Part of the cultural landscape, but directly associated with the historical farm complex.		Medium
1059	S30 11 41.7 E24 17 38.2	A rock with scratched writing on it. Among other things, it includes “JLVV” and “4de oet 07”. The date could be a corruption of August in French, or else could really be “oct”. Neither seem satisfactory explanations, since French is unlikely to have been spoken here and *Oktober* is spelled with a “k” in both Dutch and Afrikaans.		Medium-High IIIB

1060	S30 11 31.2 E24 17 16.8	Ephemeral scatter of well-patinated hornfels MSA flakes located in an eroded area.		Very low GPC
1061	S30 11 42.8 E24 17 03.1	Three ground rocks on a dolerite outcrop.		Very low GPC
1062	S30 11 42.0 E24 17 03.3	A Nine Men's Morris board has been lightly scratched onto a rock and there is a ground rock here too.		Very low GPC
1063	S30 11 41.4 E24 17 03.7	Two ground rocks and a set of five parallel scratched lines that are between 35 and 45 mm long and a few mm apart from each other. The scratches are likely more recent, possibly less than 100 years old.		Low GPB
1064	S30 11 40.8 E24 17 04.1	There are several ground rocks on a dolerite outcrop here.		Very low GPC
1065	S30 11 40.1 E24 17 04.5	One ground rock on a dolerite outcrop.		Very low GPC

1066	S30 11 56.8 E24 17 22.8	A small beacon of dolerite rocks on a small dolerite outcrop.		Very low GPC
1067	S30 11 54.0 E24 17 36.5	A 400 m long berm runs from northwest to southeast. Its function could not be ascertained.		Very low GPC
1067B	S30 12 02.0 E24 17 48.1			
1068	S30 11 51.8 E24 17 50.1	There are two stone-lined dams here that are built end to end and share a short side. They seem well-preserved but are very overgrown and impossible to photograph. They are directly related to the adjacent historical farmstead.		Low GPB
1069	S30 11 51.2 E24 17 47.2	This is a concrete plinth that seems like the foundation for a pump. It is likely mid-20th century in age.		Very low GPC
1070	S30 11 51.5 E24 18 35.8	A cluster of gum trees and a corrugated iron reservoir. Part of the cultural landscape.		Low
1071	S30 12 09.4 E24 19 22.5	An ephemeral scatter of hornfels stone artefacts with variable patina were found in a denuded area with exposed calcrete. Included is a large, circular scraper.		Very low GPC

				
1072	S30 14 18.1 E24 19 24.2	Several large pepper trees occur alongside the road just north of the Basberg farm complex. These are part of the cultural landscape.		Medium

1073	S30 14 33.1 E24 19 34.0	Two boulders with pecked and scraped engravings of animals. They look historical/recent. 		Low GPB
1074	S30 14 33.4 E24 19 33.8	Some stone walling running along just below the summit of a dolerite hill. Its function is indeterminate. There is also a boulder with “AS” scratched onto it as well as what looks like an incomplete Nine Men’s Morris board. 		Low GPB

1075	S30 18 07.5 E24 21 27.3	These three points are at the ends of three walls that divide two U-shaped kraal enclosures on the side of a dolerite hill. The total kraal measures about 50 m by 76 m. The lowest sides (towards the northeast) have no walls present. A few hornfels flakes (probably LSA), some glass and some transfer-printed ceramics were also seen here. 		Medium GPA
1075B	S30 18 08.0 E24 21 28.4			
1076	S30 18 08.6 E24 21 29.8			
1077	S30 18 14.2 E24 21 29.7	These six points outline a kraal with three enclosures and which was very poorly visible in the long grass. The one is about 36 m by 16 m, while the other two are each about 26 m by 14 m. The latter two share a long side, while the first one shares one of its short sides with the other two.		Medium GPA
1077B	S30 18 14.6 E24 21 28.9			
1077C	S30 18 15.4 E24 21 29.3			
1077D	S30 18 15.0 E24 21 30.2			
1077E	S30 18 15.8 E24 21 28.0			
1077F	S30 18 15.4 E24 21 27.8			

1078	S30 18 25.1 E24 21 30.0	This is a small brick cottage that lies outside the study area and was not visited. It looks from a distance to be in ruin.		Medium GPA
1079	S30 18 17.8 E24 21 22.3	This is an old road alignment that has a telephone wire strung alongside it. The road is only represented by a slight indentation in the ground.		Very low GPC
1080	S30 19 14.9 E24 21 34.6	This is an earthen-walled reservoir and wind pump just outside the study area.		Low

5.3. Graves

Graves are often present close to farm complexes, especially those that are far from towns and municipal graveyards. For this reason, it was unusual to see just one graveyard in the wider study area. This was at the Basberg farmstead and was located a short distance to the west of the complex, far from any potential impacts.

Other graves might still occur in the area, including possibly within the PV4 footprint, but these are most likely to be unmarked graves whose locations cannot be determined or predicted. The chances of such graves being present, however, are very low.

5.4. Historical aspects and the Built environment

5.4.1. Desktop study

Although the study area is remote from towns, it is worth briefly mentioning the nearest ones. Philipstown was founded in 1863 on the farm Rietfontein and contains a number of Provincial Heritage Sites (Schoeman 2008). Petrusville is slightly younger, having been founded in 1877, although the owner of the farm Rhenosterfontein had already donated a part of his farm to the Dutch Reformed Church in 1822 (Frandsen 2019). De Aar was founded as an important railway junction linking lines from all over southern Africa. Although the site for the junction was chosen in 1881, the town itself was only formally declared just after the end of the Anglo-Boer War (Schoeman 2008). The War was an important period on the region's history resulting in the creation of many heritage resources ranging from battlefields, to forts and blockhouses and many smaller stone-walled features. As already noted, battlefields are absent from the vicinity and Green (2022) does not list any blockhouses from the area.

Moving into the immediate study area, a review of historical aerial photography shows that all three currently extant farm complexes in or very close to the study area were present at least 50 years ago and in much the same state as they are now. A barn has had additions at Wolwekuil (on Remainder of Wolwe Kuilen 42) since 1968 (Figure 12), a labourer's cottage was added at Middelplaas Noord (Portion 5 of Grass Pan 40) since 1968 (Figure 13), but Basberg (on Portion 3 of Basberg 88) is no different now than it was in 1974 (Figure 14). Notable at Wolwekuil (on Remainder of Wolwe Kuilen 42) are the two enclosures made from *Agave americana* plants (Figure 12). These spiky plants were used in the past to create enclosures for livestock or vegetables (Baloyi & Klopper 2017). It is evident that small-scale agriculture was undertaken at the first two farms in 1968 but in both cases this land use has long since been discontinued. At Basberg, too, there was small scale agriculture some distance to the southwest of the farmstead but it had already been discontinued by 1974 (not illustrated). Figure 15 shows that in the far south of Annex Wolwe Kuilen 41/rem a prickly pear orchard was planted after 1968. It is in poor condition today, having clearly been abandoned for many years. It is noted that this orchard was planted very far from a homestead, but its location is in a drainage line which must have facilitated it getting enough water.

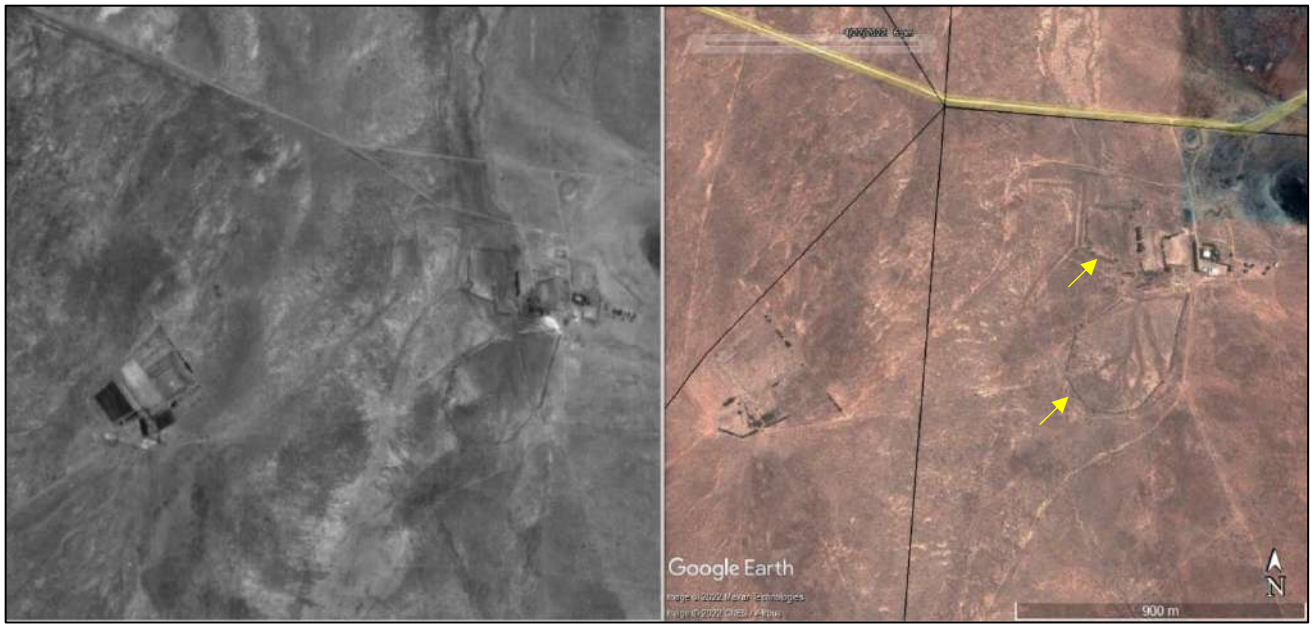


Figure 12: *1968 (611_012_00356) and modern (Google Earth) views of the Wolwekuil farm complex (on Remainder of Wolwe Kuilen 42). Three structures are visible in the main complex (waypoint 947) and the orchard and fields to the southwest (on Remainder of Annex Wolwe Kuilen 41) were in use (waypoints 998 & 999). At the farmstead there are two enclosures of Agave plants that predate 1968 (yellow arrows).*



Figure 13: *1968 (611_012_00354) and modern (Google Earth) views of the Middelplaas Noord farm complex (on Portion 5 of Grass Pan 40). Two structures are visible in the main complex (waypoint 1007) and the larger structure is visible to the north (waypoint 983).*



Figure 14: *1974 (738_025_12970) and modern (Google Earth) views of the Basberg farm complex (on Portion 3 of Basberg 88). All structures present today were present in 1974 as well (waypoint 1008).*

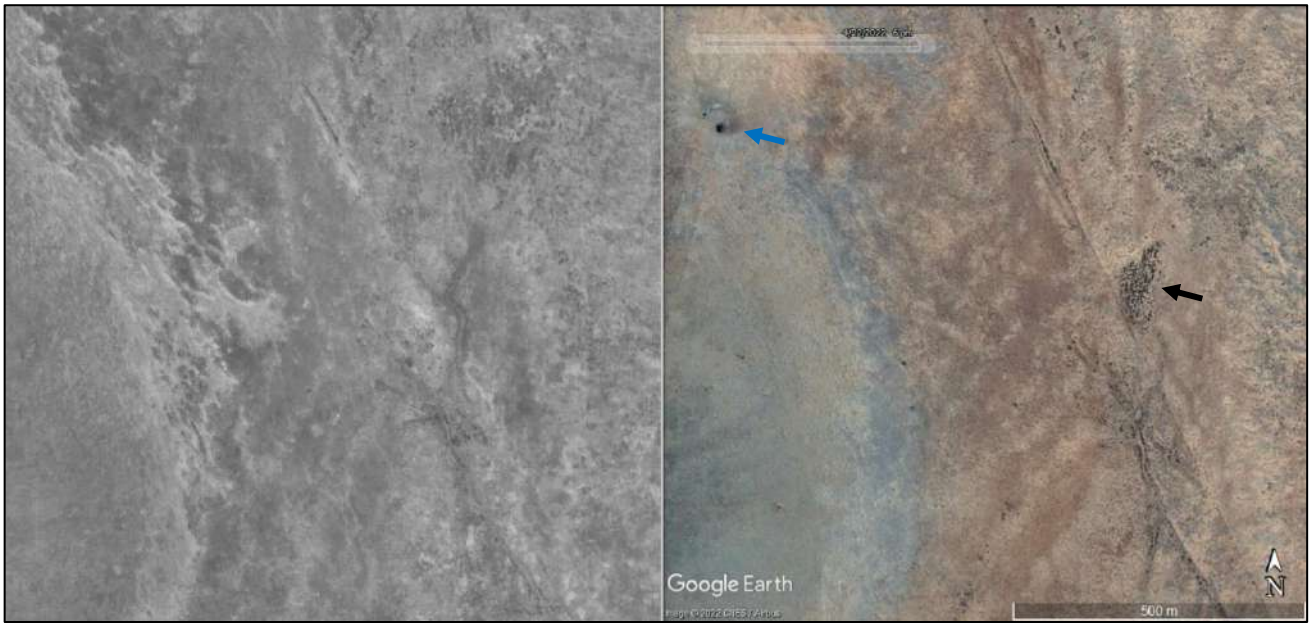


Figure 15: *1974 (738_025_12972) and modern (Google Earth) views showing the location of a prickly pear orchard (black arrow) planted since 1974 on the remainder of Annex Wolwe Kuilen 41. The water point (blue arrow) on Basberg 88/rem also post-dates 1974.*

5.4.2. Site visit

Most significant historical resources that were not archaeological were at the farmsteads and comprised of houses, outbuildings and related features as noted in the desktop study above. No buildings occur within 400 m of the PV facilities. The only other historical features were some of the livestock watering points that have reservoirs older than 60 years but none of these are considered

significant heritage resources. Although some reservoirs occur within PV footprints, none are within the PV4 study area.

5.5. Cultural landscapes and scenic routes

Cultural landscapes are the product of the interactions between humans and nature in a particular area. Sauer (1925) defined them thus: "The cultural landscape is fashioned from a natural landscape by a cultural group. Culture is the agent, the natural area is the medium, the cultural landscape the result".

Many water points were present on the landscape as noted above. Some have large karee trees associated with them and others large gum trees. Their ages are variable but it is evident that many new rows of gum trees have been planted at some of these water points in recent decades. They are variable in age with some clearly being modern additions to the landscape (e.g. Figure 16 and 17). Nonetheless, all contribute to the rural character and sense of place of the wider study area. One water point occurs within the PV4 footprint but, as noted above, it has no associated reservoir.



Figure 16: *1968 (611_012_00356) and modern (Google Earth) views of two watering points on Portion 1 of Annex Wolwe Kuilen 41. It is evident that there was more activity at the western one in 1968, while the eastern one was not yet present at that time. These are close to PV11 and are illustrated here as an example.*

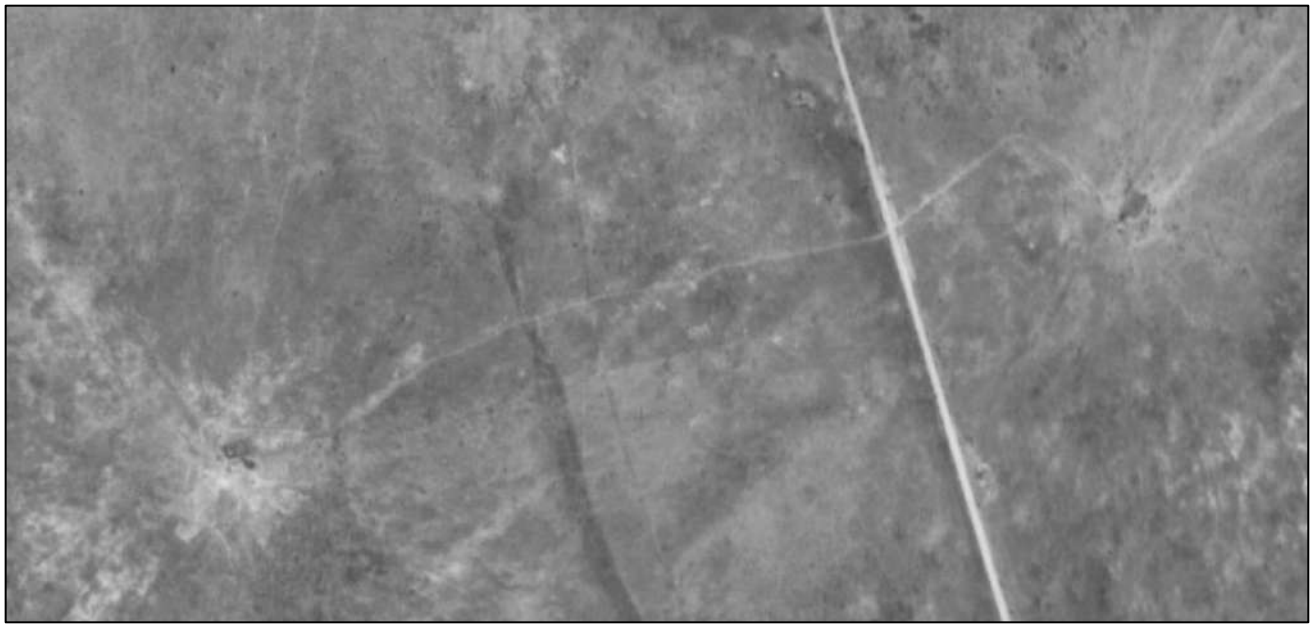


Figure 17: *1974 (738_026_13055) view of two watering points on Portion 3 of Basberg 88. The western one is within PV5 and is illustrated here as an example.*

A key feature of the cultural landscape is the quietness of the Karoo and the darkness at night. While there would be some noise during construction, the operation of the facility is quiet and this is not an issue. However, security lighting can alter the night-time qualities of a place and the large, dark star-lit sky is an important aspect of the local landscape.

The study area is well away from any major roads and there are thus no scenic route concerns.

5.6. Statement of significance and provisional grading

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ‘‘cultural significance’’ means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. The reasons that a place may have cultural significance are outlined in Section 3(3) of the NHRA (see Section 2 above).

The archaeological resources within the PV footprint are deemed to have very low cultural significance at the local level for their scientific value and can be graded GPC. Higher significance finds do occur in the wider study area with finds up to grade IIIA having been recorded.

Graves are deemed to have high cultural significance at the local level for their social value. They are allocated a grade of IIIA.

The built environment heritage resources of the area are up to medium significance for their architectural, historical and social values.

The cultural landscape is largely a natural landscape with aesthetic value and is rated as having medium cultural significance at the local level.

Heritage features are mapped in Figure 18 in relation to the proposed Kudu PV4 footprint.



Figure 18: *Map of heritage resources occurring in and around the PV4 study area. They are mapped with 50 m buffers (dark red symbols = IIIA, red = IIIB, orange = GPS, yellow = GPB), but GPC resources are not buffered (white symbols).*

5.7. Summary of heritage indicators

- Significant fossils should not be damaged or destroyed by the proposed project.
- Significant archaeological sites should not be damaged or destroyed by the proposed project.
- Graves should not be damaged or destroyed by the proposed project.
- The cultural landscape should not be dominated by the proposed project.

6. ISSUES, RISKS AND IMPACTS

6.1. Summary of issues identified during the Scoping Phase

The potential heritage issues identified during the scoping phase of this EIA process include:

- Potential impacts to archaeological resources;
- Potential impacts to graves; and
- Potential impacts to the cultural landscape.

Palaeontological impacts were also considered but it was found after a field assessment that no significant impacts would occur and this aspect was not studied further in the EIA Phase.

Consultation was carried out during the Scoping Phase but no heritage issues were raised. A comment was received from SAHRA as follows:

> The SAHRA Archaeology, Palaeontology and Meteorites (APM) Unit requests that the HIA must be revised to include a map of the track logs and must be revised to show all project components such as the access roads etc. The table of identified heritage resources i.e. Table 2, must be revised to indicate in which Kudu project each heritage resources is located within and any specific mitigation and/or management measures required.

Their comment has been taken into account in the HIA.

6.2. Identification of potential impacts/risks

Based on the fieldwork, impacts to fossils were not considered to be a significant issue and were not studied further in the EIA Phase.

The potential impacts identified during the EIA assessment are:

Construction Phase

- Potential impacts to archaeology
- Potential impacts to graves; and
- Potential impacts to the cultural landscape.

Operational Phase

- Potential impacts to the cultural landscape.

Decommissioning Phase

- Potential impacts to the cultural landscape.

Cumulative impacts

- Potential impacts to archaeology
- Potential impacts to graves; and
- Potential impacts to the cultural landscape.

7. IMPACT ASSESSMENT

7.1. Construction Phase

7.1.1. Impacts to archaeological resources

Direct impacts to archaeological resources would occur during the construction phase when equipment is brought to site and grubbing begins. However, because the archaeological materials expected to occur on the grassy plains are of such low cultural significance and likely to be very low density, the impact consequence is deemed to be slight and the probability unlikely leading to an impact significance of **very low negative** (Table 4). The only mitigation measures suggested are to report any chance finds of dense artefact clusters and contract an archaeologist to conduct any sampling that may be required. The chances of such finds being made are extremely small. After mitigation the significance is still **very low negative**.

There are no fatal flaws in terms of construction phase impacts to archaeology.

7.1.2. Impacts to graves

Direct impacts to graves would occur during the construction phase when equipment is brought to site and grubbing begins. However, because graves are extremely unlikely to be present in the PV footprint, the impact probability is deemed to be extremely unlikely. Despite the extreme consequence (because of the high cultural significance of graves), the impact significance is **very low negative** (Table 4). Mitigation measures entail reporting and protecting chance finds until they can be professionally dealt with. After mitigation the significance is still **very low negative**.

There are no fatal flaws in terms of construction phase impacts to graves.

7.1.3. Impacts to the cultural landscape

Direct impacts to the cultural landscape would occur during the construction phase when equipment is brought into the area and construction work begins. The activity associated with construction will disrupt the quiet, rural character of the area. Although the impact would be short term, its consequence is considered substantial and it would definitely occur if construction happens. The significance would be **moderate negative** (Table 4). The only mitigation measures suggested are minimising the duration of the construction period and ensuring that any areas not needed during operation are rehabilitated at the end of the construction period. With mitigation, the significance drops to **low negative**.

There are no fatal flaws in terms of construction phase impacts to the cultural landscape.

7.2. Operation Phase

7.2.1. Impacts to the cultural landscape

Direct impacts to the cultural landscape would occur during the operation phase as a result of the presence of the PV facility in the rural landscape. Although the activity will have abated, the duration of impact will be long and the consequence is considered substantial. If the facility is built the impact would definitely occur and the significance would be **moderate negative** (Table 4). Mitigation measures include ensuring that operation activities remain in designated areas, that buildings are painted in earthy colours and that night-time light pollution is minimised. With mitigation, the significance drops to **low negative**.

There are no fatal flaws in terms of operation phase impacts to the cultural landscape.

7.3. Decommissioning Phase

7.3.1. Impacts to the cultural landscape

Direct impacts to the cultural landscape would occur during the decommissioning phase when equipment is brought into the area and decommissioning of the facility begins. The activity associated with decommissioning will disrupt the quiet, rural character of the area. Although the impact would be short term, its consequence is considered substantial and it would definitely occur if the facility is built and requires decommissioning. The significance would be **moderate negative** (Table 4). The only mitigation measures suggested are minimising the duration of the decommissioning period and ensuring that the site is adequately rehabilitated. With mitigation, the significance drops to **low negative**.

There are no fatal flaws in terms of decommissioning phase impacts to the cultural landscape.

Table 4: *Assessment of impacts.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
Construction Phase						
Damage or destruction of archaeological materials	Status	Negative	Very low (5)	- Report any chance finds of dense clusters of artefacts to SAHRA and/or an archaeologist - Protect in situ and appoint archaeologist to sample as needed	Very low (5)	High
	Spatial extent	Site specific				
	Duration	Permanent				
	Consequence	Slight				
	Probability	Unlikely				
	Reversibility	Non-reversible				
	Irreplaceability	High				
Damage or destruction of graves	Status	Negative	Very low (5)	- Report any chance finds to SAHRA and/or an archaeologist - Protect in situ and appoint archaeologist to exhume	Very low (5)	High
	Spatial extent	Site specific				
	Duration	Permanent				
	Consequence	Extreme				
	Probability	Extremely unlikely				
	Reversibility	Non-reversible				
	Irreplaceability	High				
Intrusion of SEF and equipment into the landscape	Status	Negative	Moderate (3)	- Minimise duration of construction period - Ensure effective rehabilitation, at the end of the construction period, of areas not needed during operation	Low (4)	High
	Spatial extent	Local				
	Duration	Short term				
	Consequence	Substantial				
	Probability	Very likely				
	Reversibility	High				
	Irreplaceability	Moderate				
Operational Phase						
Intrusion of SEF into the landscape	Status	Negative	Moderate (3)	- Ensure that all maintenance vehicles and operational activities stay within designated areas - Paint buildings in earthy colours to reduce contrast - Make use of motion detectors and downlighting to reduce night-time light pollution	Low (4)	High
	Spatial extent	Regional				
	Duration	Long term				
	Consequence	Substantial				
	Probability	Very likely				
	Reversibility	High				
	Irreplaceability	Moderate				
Decommissioning Phase						
Intrusion of SEF and equipment into the landscape	Status	Negative	Moderate (3)	- Minimise duration of dcommissioning period - Ensure effective rehabilitation of the entire site once the infrastructure has been removed	Low (4)	High
	Spatial extent	Local				
	Duration	Short term				

	Consequence	Substantial				
	Probability	Very likely				
	Reversibility	High				
	Irreplaceability	Moderate				
Cumulative impacts – Construction phase						
Impacts to archaeology, graves	Status	Negative	Low (4)	- Follow stipulated mitigation measures as required per project (none required for this project) - Conduct mitigation if needed per project (none required for this project)	Very Low (5)	High
	Spatial extent	Regional				
	Duration	Permanent				
	Consequence	Moderate				
	Probability	Very likely				
	Reversibility	Non-reversible				
	Irreplaceability	High				
Intrusion of SEF and equipment into the landscape	Status	Negative	Moderate (3)	- Minimise duration of construction period - Minimise cut-and-fill and landscape scarring in general - Avoid construction on slopes and high ground - Ensure effective rehabilitation, at the end of the construction period, of areas not needed during operation	Low (4)	High
	Spatial extent	Regional				
	Duration	Short term				
	Consequence	Substantial				
	Probability	Very likely				
	Reversibility	High				
	Irreplaceability	Moderate				
Cumulative impacts – Operational Phase						
Intrusion of SEF into the landscape	Status	Negative	Moderate (3)	- Make use of motion detectors and downlighting to reduce night time light pollution - Place ancillary infrastructure in less prominent areas	Low (4)	High
	Spatial extent	Regional				
	Duration	Long term				
	Consequence	Substantial				
	Probability	Very likely				
	Reversibility	High				
	Irreplaceability	Moderate				
Cumulative impacts – Decommissioning Phase						
Intrusion of SEF into the landscape	Status	Negative	Moderate (3)	- Make use of motion detectors and downlighting to reduce night time light pollution - Place ancillary infrastructure in less prominent areas - Ensure rehabilitation after decommissioning	Low (4)	High
	Spatial extent	Regional				
	Duration	Short term				
	Consequence	Substantial				
	Probability	Very likely				
	Reversibility	High				
	Irreplaceability	Moderate				

7.4. Cumulative Impacts

Table 5 and Figure 19 show the other projects considered for cumulative impacts, although it must be noted that other types of development (e.g. roads, agriculture) can also result in impacts to heritage resources. These impacts are difficult to quantify because of the variable survey conditions that are likely to have pertained during the assessments of the various projects. Nonetheless, it is noted that archaeological finds in the areas typically considered for development in the grasslands tend to be minimal, while finds on hills tend to be avoided in the construction of wind energy facilities (WEFs). It is still possible that some archaeological sites and/or graves might have been overlooked during the various surveys and the potential cumulative impacts for the construction phase are thus rated **low negative** (Table 4). Incorporating the various mitigation measures that are suggested for each project (which might include pre-construction surveys or archaeological mitigation) would reduce the impact significance to **very low negative**.

Impacts to the cultural landscape relate mainly to the amount of change that one could see/experience from one place, including the night-time lighting of the facilities. It is essentially impossible that one could see all the facilities listed in Table 5 from one area due to the various dolerite hills in the landscape. As a result, the consequence is only rated as substantial and the significance as **moderate negative** for all phases (Table 4). Employing the listed mitigation measures in each phase would reduce the impacts after mitigation to **low negative**.

There are no fatal flaws in terms of cumulative impacts.

Table 5: *Proposed renewable energy projects, located within 30 km of the proposed Kudu Solar Facilities, that will be considered in the Cumulative Impact Assessment (in addition to the Kudu Solar Facilities and EGI Projects) (Source: DFFE REEA, Quarter 4, 2022; and SAHRIS).*

DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE
12/12/20/2258 12/12/20/2258/1	Solar PV	75	Approved and Preferred Bidder (Operational)	The Proposed Establishment of Photovoltaic (Solar Power) Farms in the Northern Cape Province - Kalkbult
12/12/20/2463/1 12/12/20/2463/1/2 12/12/20/2463/1/A2 12/12/20/2463/1/AM3 12/12/20/2463/1/AM4 12/12/20/2463/1/AM5	Onshore Wind	140	Approved and Preferred Bidder (Operational)	Longyuan Mulilo De Aar 2 North Wind Energy Facility Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility The Wind Energy Facility (North and South) situated on the Plateau Near De Aar, Northern Cape Province
12/12/20/2463/2 12/12/20/2463/2/AM2	Onshore Wind	100	Approved and Preferred Bidder (Operational)	Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility The Wind Energy Facility (North and South) Situated On The Plateau Near De Aar, Northern Cape Province
14/12/16/3/3/1/1166 14/12/16/3/3/1/1166/AM3 14/12/16/3/3/1/1166/AM4	Transmission line	132	Approved	Basic Assessment for the proposed construction of a 132 kV transmission line corridor adjacent to the existing Eskom transmission line from Longyuan Mulilo De Aar 2 North Wind Energy Facility (WEF) to the Hydra Substation in De Aar, Northern Cape

DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE
14/12/16/3/3/1/785	Transmission line	132	Approved	Proposed construction of two 132kV transmission lines from the South & North Wind Energy Facilities on the Eastern Plateau (De Aar 2) near De Aar, Northern Cape.
14/12/16/3/3/2/278 14/12/16/3/3/2/278/1 14/12/16/3/3/2/278/2	Onshore Wind	118	Approved	Proposed Castle Wind Energy Facility Project, located near De Aar, Northern Cape
14/12/16/3/3/2/564 14/12/16/3/3/2/564/AM1 14/12/16/3/3/2/564/AM2	Solar PV	75	To be confirmed	Proposed Swartwater 75MW solar PV power facility in Petrusville within Renosterburg Local Municipality, Northern Cape
14/12/16/3/3/2/740	Solar PV	300	Approved	Proposed 300MW Solar Power Plant in Phillipstown area in Renosterberg Local Municipality
14/12/16/3/3/2/744	Solar PV	unknown	Approved	Proposed PV facility on farm Jakhalsfontein near De Aar
14/12/16/3/3/2/739	Solar PV	70 - 100	To be confirmed	Proposed 70 - 100 MW Solar Power Plant in Petrusville
Not issued yet (it is understood that the project is still within the pre-application stage)	Solar PV	800 (Maximum)	Pre-Application	The Proposed Keren Energy Odyssey Solar PV Facilities (Odyssey Solar 1, Odyssey Solar 2, Odyssey Solar 3, Odyssey Solar 4, Odyssey Solar 5, Odyssey Solar 6, Odyssey Solar 7 And Odyssey Solar 8)
To be confirmed	Solar PV	3050	Scoping	The Proposed Development of the Crossroads (formally referred to as the Hydra B) Green Energy Cluster of Renewable Energy Facilities and Grid Connection Infrastructure, Pixley Ka Seme District Municipality, Northern Cape Province. The Cluster entails the development of up to 21 solar energy facilities, with the Scoping and EIA Processes consisting of three phases. Phases 1, 2 and 3 consist of 9, 6 and 6 solar facilities, respectively. The Phase 1 Scoping and EIA Processes were launched in January 2023.
14/12/16/3/3/2/2244 14/12/16/3/3/2/2245 14/12/16/3/3/2/2246 14/12/16/3/3/2/2247 14/12/16/3/3/2/2248 14/12/16/3/3/2/2249 14/12/16/3/3/2/2250 14/12/16/3/3/2/2251 14/12/16/3/3/2/2252 14/12/16/3/3/2/2253 14/12/16/3/3/2/2254 14/12/16/3/3/2/2255	Solar PV	2180	Scoping and EIA Process underway	Proposed Development of 12 Solar Photovoltaic (PV) Facilities (Kudu Solar Facility 1 to 12) and associated infrastructure, near De Aar, Northern Cape Province
N/A	Transmission Line	220	Existing Power Line	HYDRA ROODEKUIL 2
N/A	Transmission Line	132	Existing Power Line	HYDRA ROODEKUIL 1

DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE
N/A	Transmission Line	765	Existing Power Line	BETA HYDRA 2
N/A	Transmission Line	400	Existing Power Line	HYDRA PERSEUS 3
N/A	Transmission Line	220	Existing Power Line	VAN DER KLOOF ROODEKUIL 2
N/A	Transmission Line	220	Existing Power Line	VAN DER KLOOF ROODEKUIL 1
N/A	Transmission Line	400	Existing Power Line	BETA HYDRA 1
N/A	Transmission Line	400	Existing Power Line	HYDRA PERSEUS 2
N/A	Transmission Line	132	Existing Power Line	KALKBULT/KAREEBOSCHPAN 1
N/A	Transmission Line	132	Existing Power Line	ROODEKUIL/ORANIA 1
N/A	Transmission Line	765	Planned Power Line	Perseus to Gamma 2nd 765 kV line Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line
N/A	Transmission Line	765	Planned Power Line	Relocate Beta-Hydra 765kV line to form Perseus-Hydra 1st 765kV line Cape Corridor Phase 2: Zeus - Hydra 765kV Integration
N/A	Transmission Line	765	Planned Power Line	Perseus to Gamma 2nd 765 kV line Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line

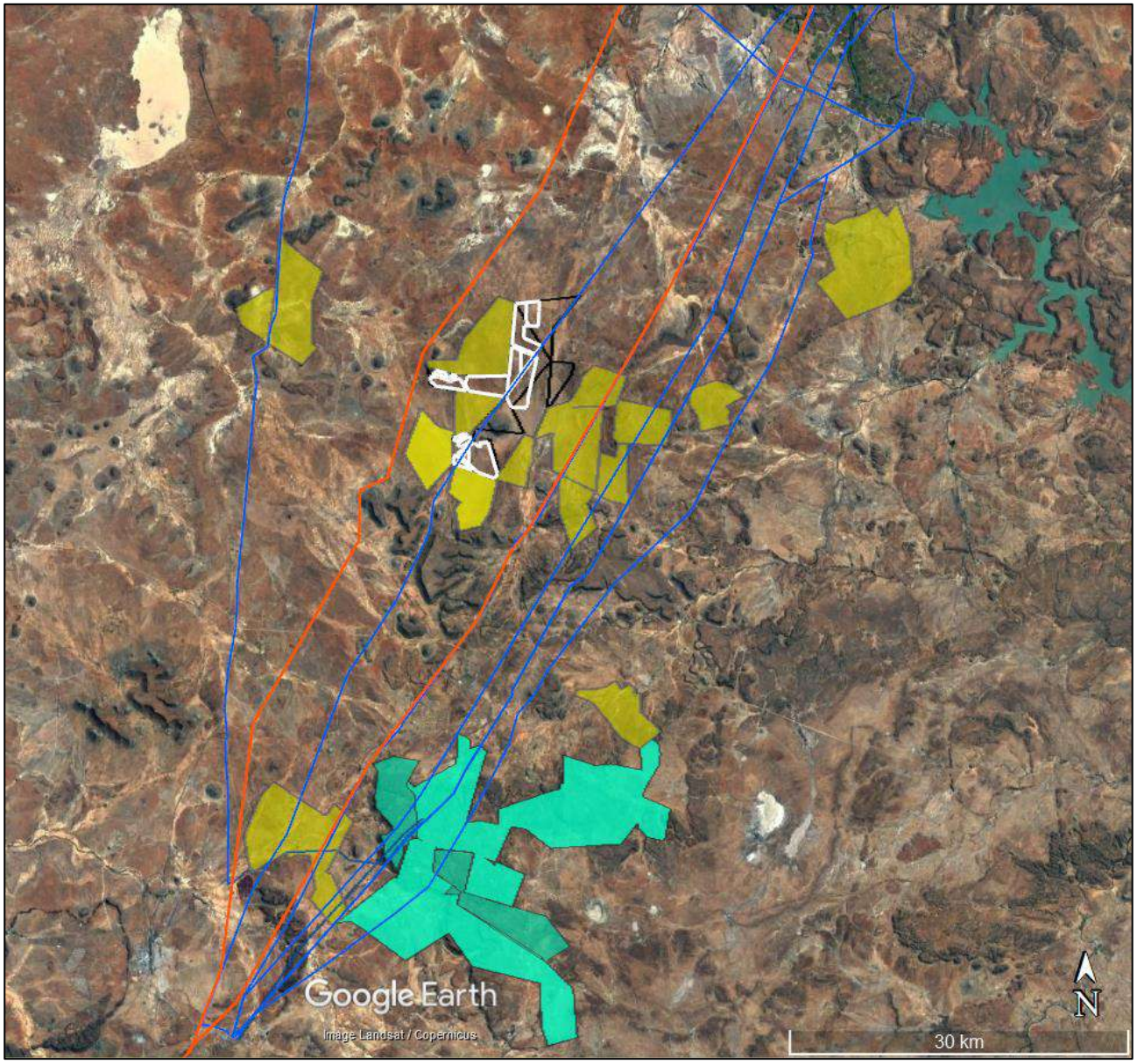


Figure 19: *Map showing renewable energy facilities (operational and proposed) in the vicinity of the Kudu study area. Kudu land parcels shown in white.*

7.5. Evaluation of impacts relative to sustainable social and economic benefits

Section 38(3)(d) of the NHRA requires an evaluation of the impacts on heritage resources relative to the sustainable social and economic benefits to be derived from the development.

The project will provide construction phase jobs but more importantly it will help alleviate the ongoing electricity supply problems which are hampering economic growth in South Africa. Stabilising the electricity supply will thus have significant socio-economic benefits as a growing economy means more jobs and better income all round. These are clear economic and social benefits and, if mitigation is applied as suggested above, then the socio-economic benefits outweigh the residual heritage impacts.

7.6. Existing impacts to heritage resources

There are currently no obvious threats to heritage resources on the site aside from the natural degradation, weathering and erosion that might affect archaeological materials. Trampling from grazing animals and/or farm/other vehicles could also occur. These impacts would be of **negligible negative** significance. The only existing impact to the rural cultural landscape relates to the presence of several HV powerlines running though the area. Their impact on the landscape is quite small and the existing impact is thus rates as **very low negative**.

7.7. The No-Go alternative

If the project were not implemented then the site would stay as it currently is (impact significance of **negligible** for archaeology and graves and **very low negative** for the landscape). Although the heritage impacts with implementation would be greater than the existing impacts, the loss of socio-economic benefits is more significant and suggests that the No-Go option is less desirable in heritage terms.

7.8. Levels of acceptable change

Any impact to an archaeological or palaeontological resource or a grave is deemed unacceptable until such time as the resource has been inspected and studied further if necessary. Impacts to the landscape are difficult to quantify but in general a development that visually dominates the landscape from many publicly accessible vantage points is undesirable. Because of the height of the majority of the proposed development and its very remote location, such an impact to the landscape is not envisaged.

8. IMPACT ASSESSMENT SUMMARY

The overall impact significance essentially follows the most significant impact in each phase following the implementation of the proposed mitigation measures. These are shown in Table 6.

Table 6: *Overall Impact Significance (Post Mitigation)*

Phase	**Overall Impact Significance**
Construction	Low negative
Operational	Low negative
Decommissioning	Low negative
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Low negative
Cumulative - Operational	Low negative
Cumulative - Decommissioning	Low negative

9. LEGISLATIVE AND PERMIT REQUIREMENTS

This report and the proposed recommendations will need to be approved by SAHRA. There are no further legislative requirements for the approval process under the NHRA but if archaeological mitigation is needed then the appointed archaeologist will need to apply for and be granted a permit from SAHRA to do the work. This must be carried out well in advance of construction to ensure that there is enough time for SAHRA to approve the mitigation work before construction commences.

10. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

The actions recorded in Table 7 should be included in the environmental management program (EMPr) for the project.

Table 7: *Heritage considerations for inclusion in the EMPr.*

Impact	**Mitigation / management objectives & outcomes**	**Mitigation / management actions**	**Monitoring**		
			Methodology	**Frequency**	**Responsibility**
Impacts to archaeology and graves					
Damage or destruction of archaeological sites or graves	Rescue information, artefacts or burials before extensive damage occurs	Construction, Operation and Decommissioning Phases: Reporting chance finds of graves and dense clusters of artefacts as early as possible to an archaeologist and/or SAHRA (https://www.sahra.org.za/contact/), protect in situ and stop work in immediate area and appoint archaeologist to exhume or sample as needed (where relevant)	Inform staff to be vigilant and carry out inspections of all new excavations	Ongoing basis	Construction Manager or Contractor
				Whenever on site (at least weekly)	ECO
Impacts to the cultural landscape					
Visible landscape scarring	Minimise landscape scarring	Construction Phase: Ensure disturbance is kept to a minimum and does not exceed project requirements. Minimise the duration of the activities. At the end of the construction period, rehabilitate areas, not needed during operation.	Monitoring of surface clearance relative to approved layout	Ongoing basis	Construction Manager or Contractor
				As required	ECO
Intrusion into cultural landscape	Minimise construction duration	Operational Phase: Ensure that all maintenance vehicles and operational activities stay within designated areas.	Undertake visual inspections and report non-compliance	As required	Environmental Manager
Intrusion into cultural landscape	Minimise contrast and light pollution	Operational Phase: Paint buildings in earthy colours to reduce contrast. Make use of motion detectors and	Monitor that this has been considered in the design	Once off	Project Developer

		downlighting to reduce night-time light pollution.	and operation of the facility		
Visible landscape scarring	Minimise landscape scarring	Decommissioning Phase: Ensure disturbance is kept to a minimum and does not exceed project requirements. Minimise the duration of the activities. Rehabilitate the entire site once the infrastructure has been removed.	Monitoring of surface clearance relative to approved layout	Ongoing basis	Construction Manager or Contractor
			Undertake visual inspections and report non-compliance	As required	Environmental Manager

11. CONCLUSIONS

There are no significant concerns for the proposed Kudu PV4 project. The heritage indicators and project responses are shown in Table 8. The facility layout has been designed to avoid all known heritage resources with the exception of the cultural landscape which will not be significantly impacted. The water point to be removed from this PV footprint is of no concern. There are no areas requiring avoidance and no protective buffers are needed. The development footprint and detailed layout (Figure 3) are considered suitable from a heritage perspective. Any further changes to the detailed layouts as might become necessary are deemed acceptable if the changes remain within the overall development footprint area assessed during the Scoping and EIA Process.

Table 8: *Heritage indicators and project responses.*

Indicator	**Project Response**
Significant fossils should not be damaged or destroyed by the proposed project.	No significant fossils expected, chance finds procedure to be implemented following guidelines in palaeontological study.
Significant archaeological sites should not be damaged or destroyed by the proposed project.	The project has been designed to avoid all significant sites. None fall within the footprint and none are close enough to be at risk of incidental damage.
Graves should not be damaged or destroyed by the proposed project.	No known graves fall within the footprint and none are close enough to be at risk of incidental damage.
The cultural landscape should not be dominated by the proposed project.	The landscape is characterised by hills in a flat landscape and because the development will be fairly low, it will not overly dominate the landscape.

11.1. Statement and reasoned opinion of the specialist

Given the lack of significant heritage resources in the proposed Kudu PV4 footprint and generally limited impacts to the cultural landscape, it is the opinion of the heritage consultant that the project may be authorised in full using either battery technology.

12. RECOMMENDATIONS

It is recommended that the proposed Kudu PV4 SEF be authorised, but subject to the following recommendations which should be included as conditions of authorisation:

- Visually permeable fences, preferably in a dark colour, should be used;
- Buildings to be painted in earthy colours to reduce contrast;
- Night-time light spillage should be minimised, possibly through the use of motion detectors so that the area can stay dark until light is needed; and
- If any archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

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APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

Address: 23 Dover Road, Muizenberg, 7945
Telephone: (021) 788 1025
Cell Phone: 083 272 3225
Email: jayson@asha-consulting.co.za

Birth date and place: 22 June 1976, Cape Town, South Africa
Citizenship: South African
ID no: 760622 522 4085
Driver's License: Code 08
Marital Status: Married to Carol Orton
Languages spoken: English and Afrikaans

Education:

SA College High School	Matric	1994
University of Cape Town	B.A. (Archaeology, Environmental & Geographical Science)	1997
University of Cape Town	B.A. (Honours) (Archaeology)*	1998
University of Cape Town	M.A. (Archaeology)	2004
University of Oxford	D.Phil. (Archaeology)	2013

*Frank Schweitzer memorial book prize for an outstanding student and the degree in the First Class.

Employment History:

Spatial Archaeology Research Unit, UCT	Research assistant	Jan 1996 – Dec 1998
Department of Archaeology, UCT	Field archaeologist	Jan 1998 – Dec 1998
UCT Archaeology Contracts Office	Field archaeologist	Jan 1999 – May 2004
UCT Archaeology Contracts Office	Heritage & archaeological consultant	Jun 2004 – May 2012
School of Archaeology, University of Oxford	Undergraduate Tutor	Oct 2008 – Dec 2008
ACO Associates cc	Associate, Heritage & archaeological consultant	Jan 2011 – Dec 2013
ASHA Consulting (Pty) Ltd	Director, Heritage & archaeological consultant	Jan 2014 –

Professional Accreditation:

Association of Southern African Professional Archaeologists (ASAPA) membership number: 233
CRM Section member with the following accreditation:

- Principal Investigator: Coastal shell middens (awarded 2007)
  Stone Age archaeology (awarded 2007)
  Grave relocation (awarded 2014)
- Field Director: Rock art (awarded 2007)
  Colonial period archaeology (awarded 2007)

Association of Professional Heritage Practitioners (APHP) membership number: 43

- Accredited Professional Heritage Practitioner

➢ ***Memberships and affiliations:***

South African Archaeological Society Council member	2004 – 2016
Assoc. Southern African Professional Archaeologists (ASAPA) member	2006 –
UCT Department of Archaeology Research Associate	2013 –
Heritage Western Cape APM Committee member	2013 –
UNISA Department of Archaeology and Anthropology Research Fellow	2014 –
Fish Hoek Valley Historical Association	2014 –
Kalk Bay Historical Association	2016 –
Association of Professional Heritage Practitioners member	2016 –

Fieldwork and project experience:

Extensive fieldwork and experience as both Field Director and Principle Investigator throughout the Western and Northern Cape, and also in the western parts of the Free State and Eastern Cape as follows:

Feasibility studies:

- Heritage feasibility studies examining all aspects of heritage from the desktop

Phase 1 surveys and impact assessments:

- Project types
  - Notification of Intent to Develop applications (for Heritage Western Cape)
  - Desktop-based Letter of Exemption (for the South African Heritage Resources Agency)
  - Heritage Impact Assessments (largely in the Environmental Impact Assessment or Basic Assessment context under NEMA and Section 38(8) of the NHRA, but also self-standing assessments under Section 38(1) of the NHRA)
  - Archaeological specialist studies
  - Phase 1 archaeological test excavations in historical and prehistoric sites
  - Archaeological research projects
- Development types
  - Mining and borrow pits
  - Roads (new and upgrades)
  - Residential, commercial and industrial development
  - Dams and pipe lines
  - Power lines and substations
  - Renewable energy facilities (wind energy, solar energy and hydro-electric facilities)

Phase 2 mitigation and research excavations:

- ESA open sites
  - Duinefontein, Gouda, Namaqualand
- MSA rock shelters
  - Fish Hoek, Yzerfontein, Cederberg, Namaqualand
- MSA open sites
  - Swartland, Bushmanland, Namaqualand
- LSA rock shelters
  - Cederberg, Namaqualand, Bushmanland
- LSA open sites (inland)
  - Swartland, Franschhoek, Namaqualand, Bushmanland
- LSA coastal shell middens
  - Melkbosstrand, Yzerfontein, Saldanha Bay, Paternoster, Dwarskersbos, Infanta, Knysna, Namaqualand
- LSA burials
  - Melkbosstrand, Saldanha Bay, Namaqualand, Knysna
- Historical sites
  - Franschhoek (farmstead and well), Waterfront (fort, dump and well), Noordhoek (cottage), variety of small excavations in central Cape Town and surrounding suburbs
- Historic burial grounds
  - Green Point (Prestwich Street), V&A Waterfront (Marina Residential), Paarl

Awards:

Western Cape Government Cultural Affairs Awards 2015/2016: Best Heritage Project.

APPENDIX 2 - Site Sensitivity Verification

As required in Part A of the Government Gazette 43110, GN 320, a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool. The details of the site sensitivity verification are noted below:

Date of Site Visit	21, 22, 24 and 25 April 2022
Specialist Name	Dr Jayson Orton
Professional Registration Number	Association of Southern African Professional Archaeologists (ASAPA): 233 Association of Professional Heritage Practitioners (APHP): 043
Specialist Affiliation / Company	ASHA Consulting (Pty) Ltd

Method of the Site Sensitivity Verification

Initial work was carried out using satellite aerial photography in combination with the author's accumulated knowledge of the local landscape. This was used to provide sensitivity data. Subsequent fieldwork served to ground truth the site, including areas identified as potentially sensitive. Desktop research was also used to inform on the heritage context of the area. This information is presented in the report (Sections 5.2.1 and 5.4.1).

Outcome

The first map below is extracted from the screening tool report and shows the archaeological and heritage sensitivity to be low throughout the wider Kudu study area. The site visit showed that in fact the majority of the site is of low sensitivity but with several pockets of higher sensitivity being present (where archaeological and other heritage resources were found). The heritage specialist thus disputes the screening tool report sensitivity mapping. The other three maps below show the areas considered to be archaeologically sensitive. Most are sites considered to be of high sensitivity, but those sites marked as low cultural significance can be seen as medium sensitivity. The remaining land in between is of low sensitivity. A photographic record and description of the relevant heritage resources are contained within the impact assessment report.

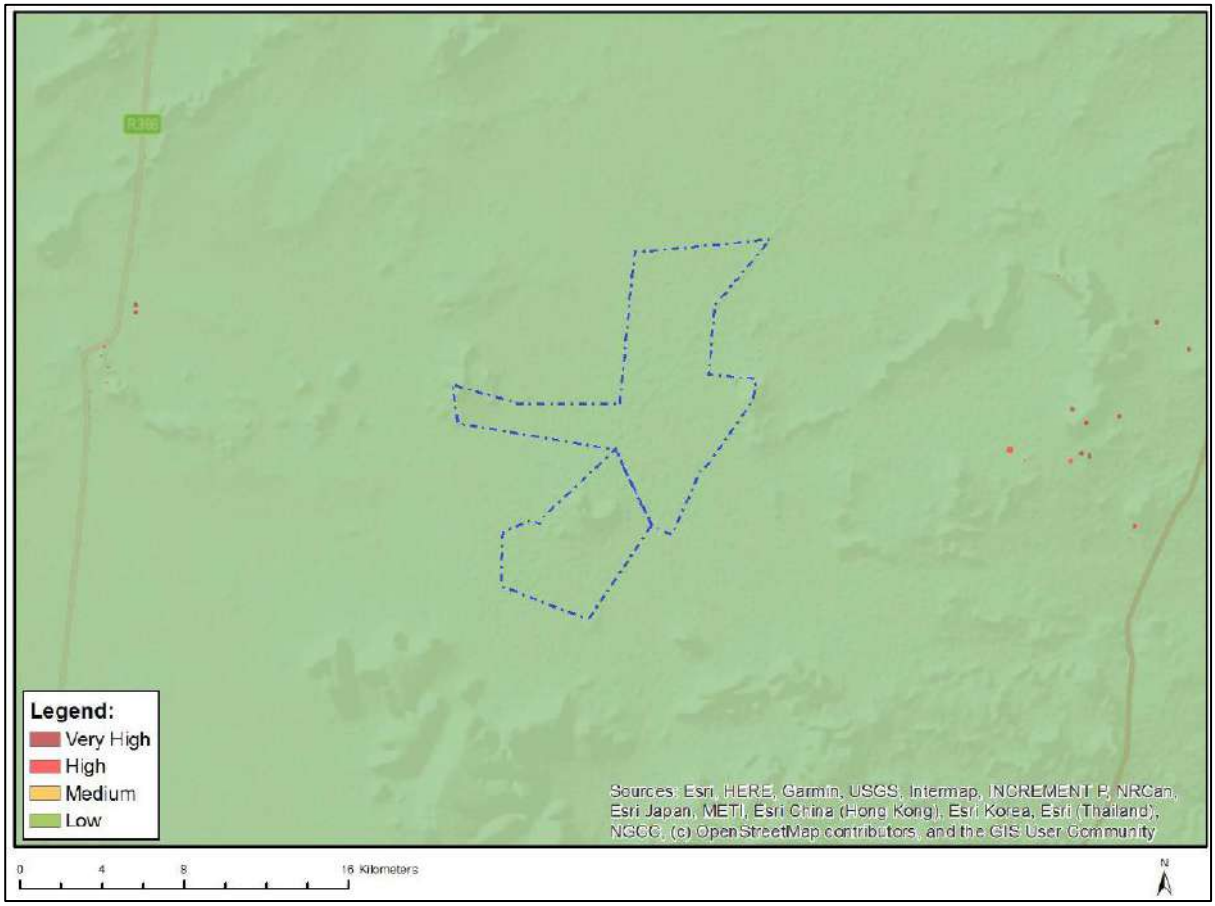
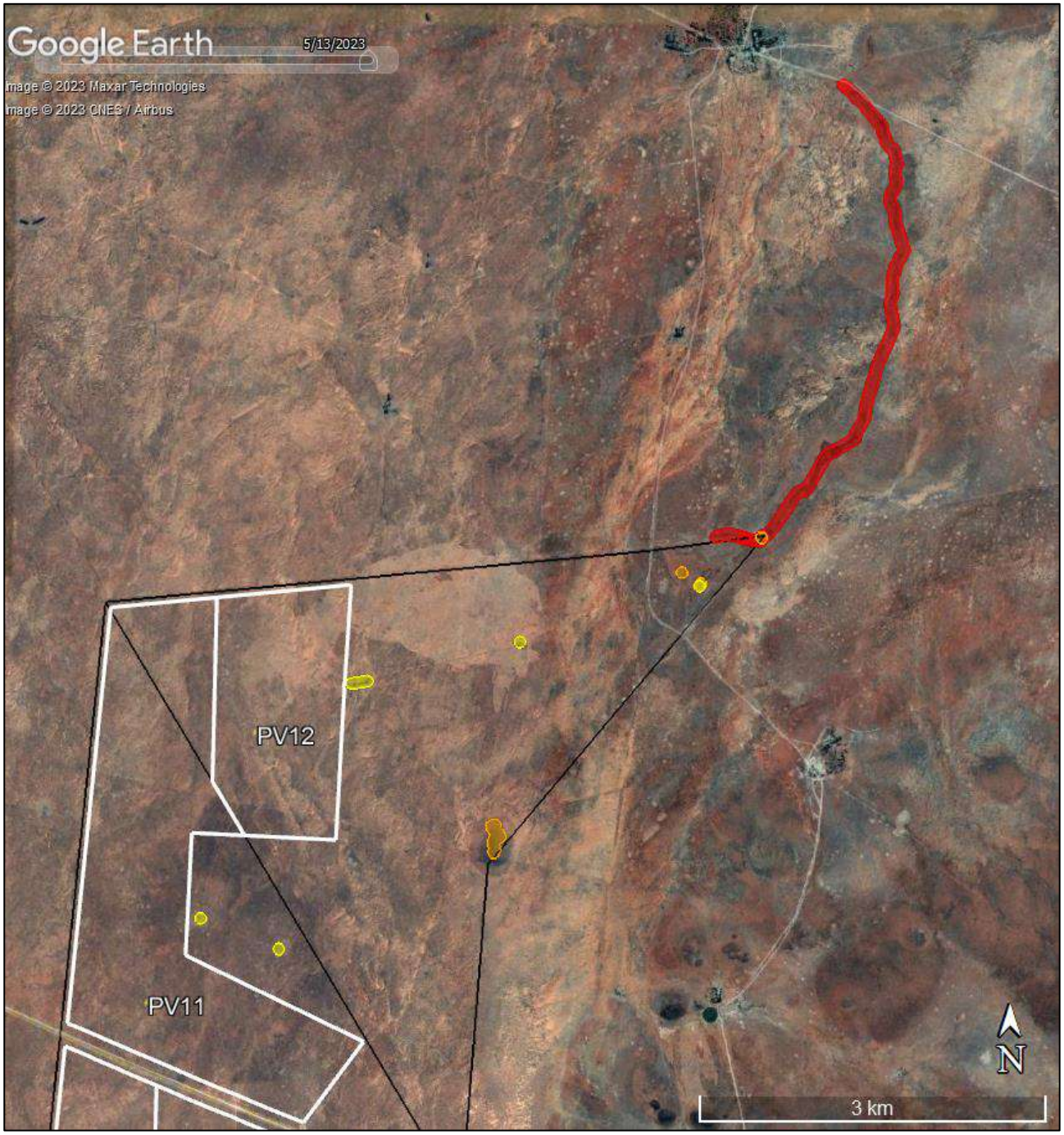
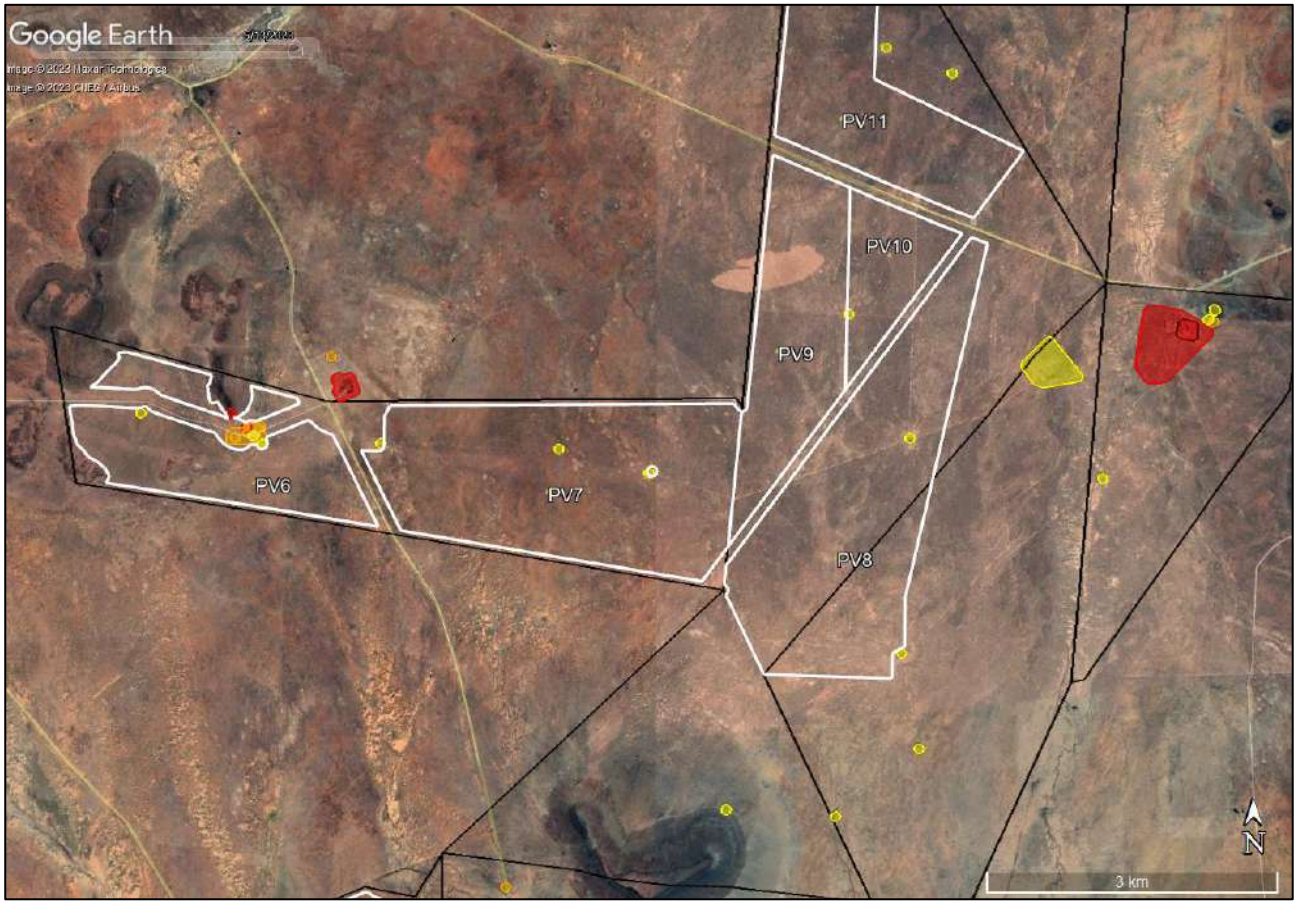
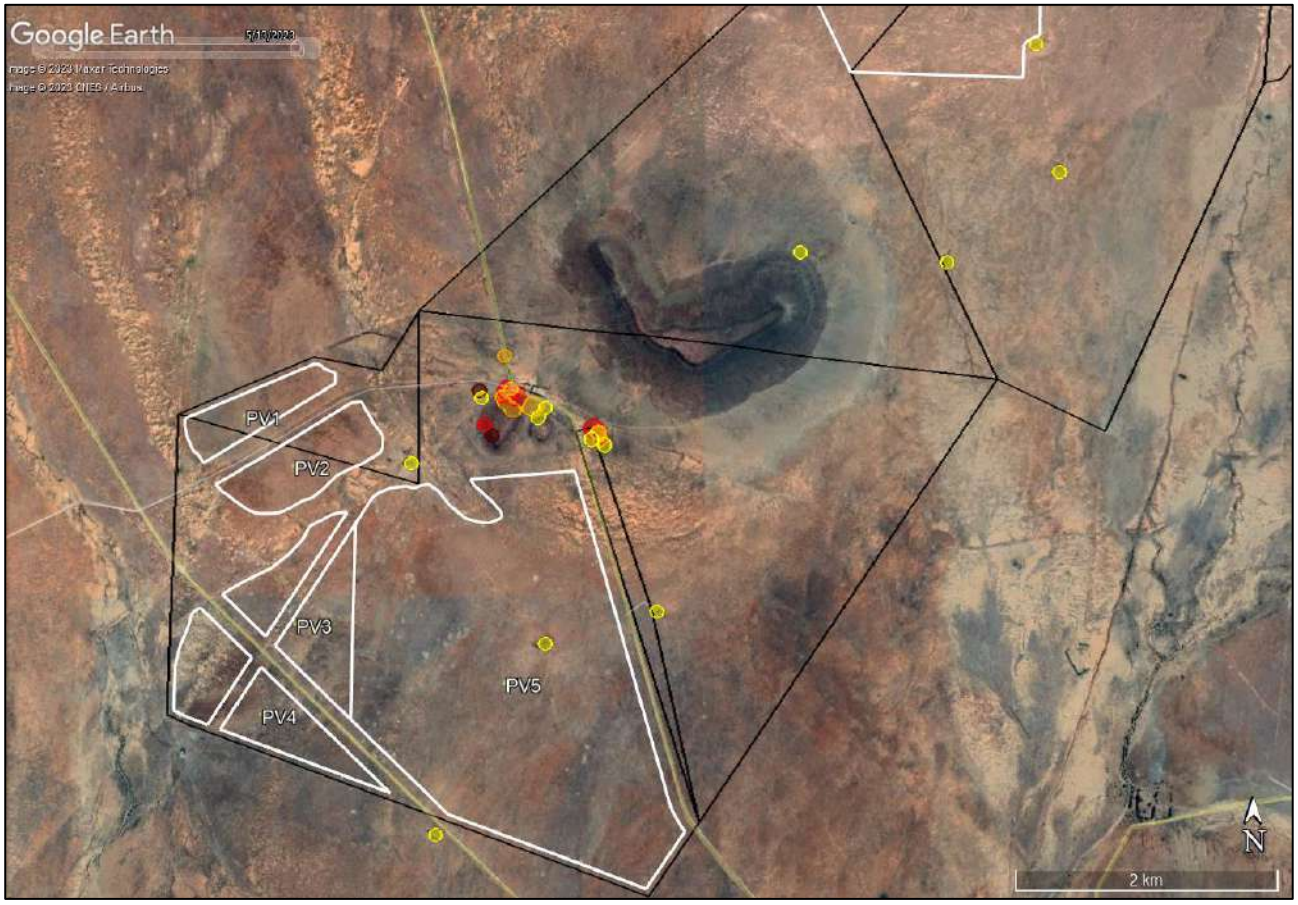


Figure A2.1: *Screening tool map of archaeological and heritage sensitivity.*


Google Earth
5/13/2023
Image © 2023 Maxar Technologies
Image © 2023 CNES / Airbus
PV12
PV11
N
3 km

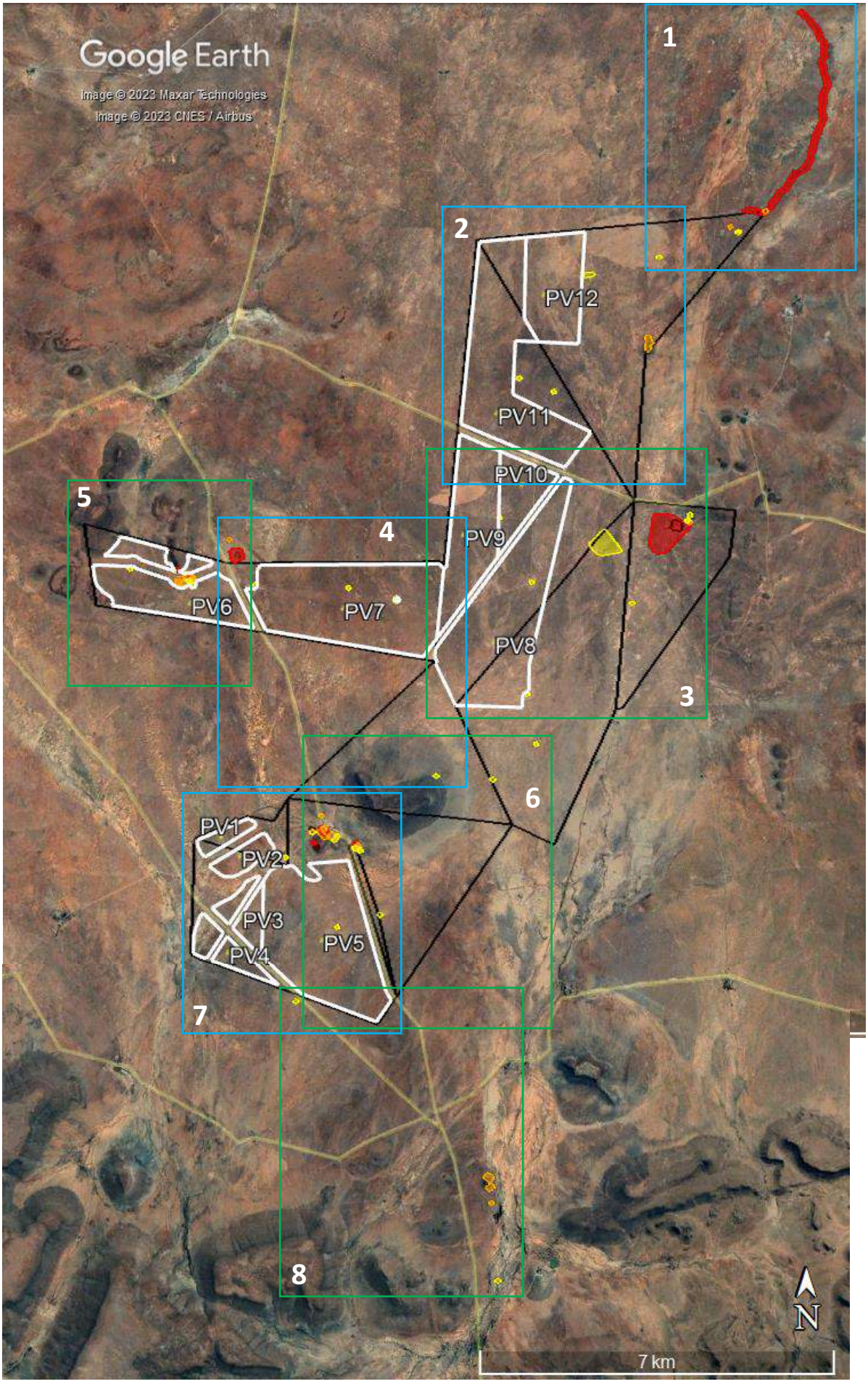

Google Earth
PV11
PV10
PV9
PV6
PV7
PV8
N
3 km



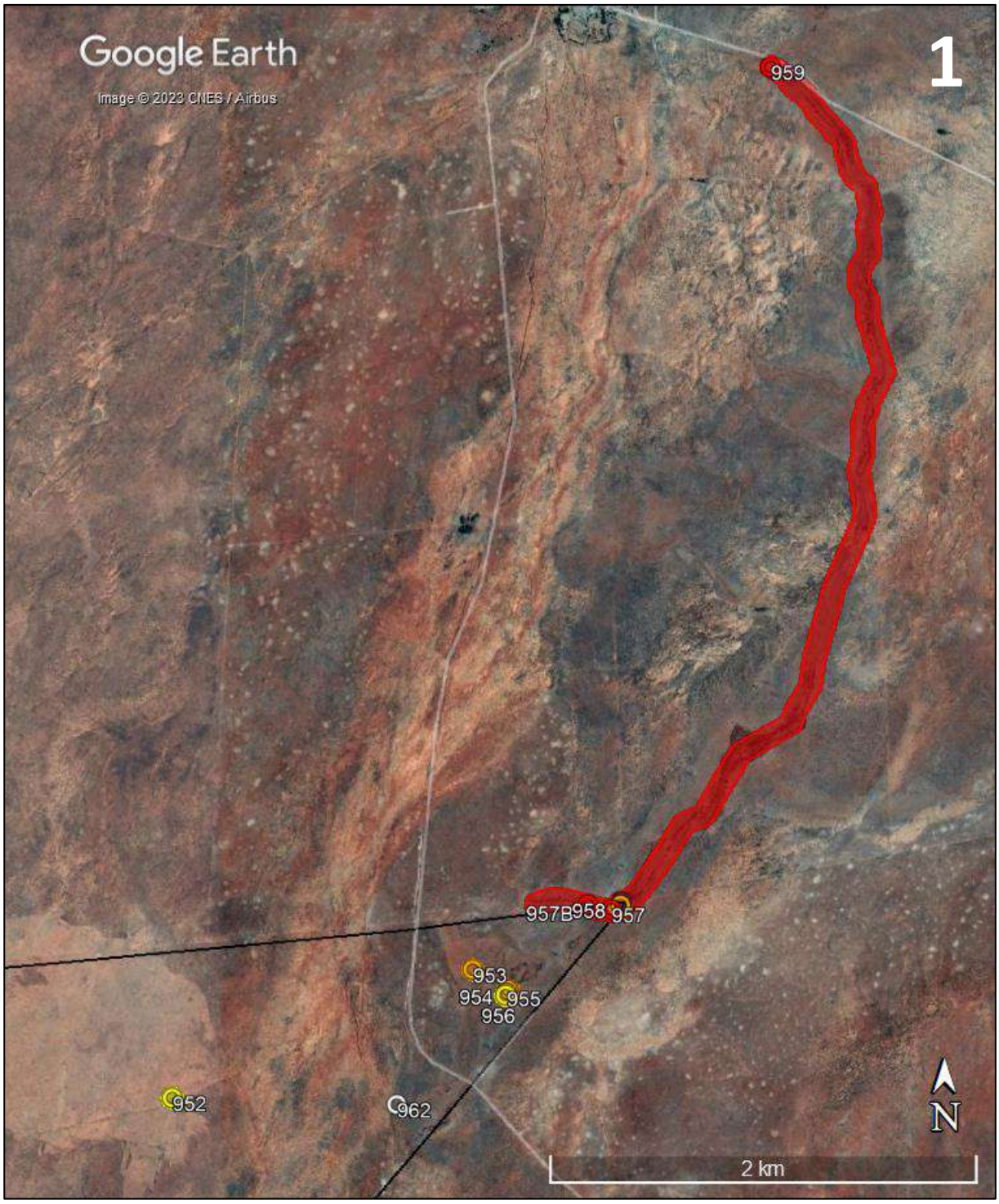
APPENDIX 3 – Mapping

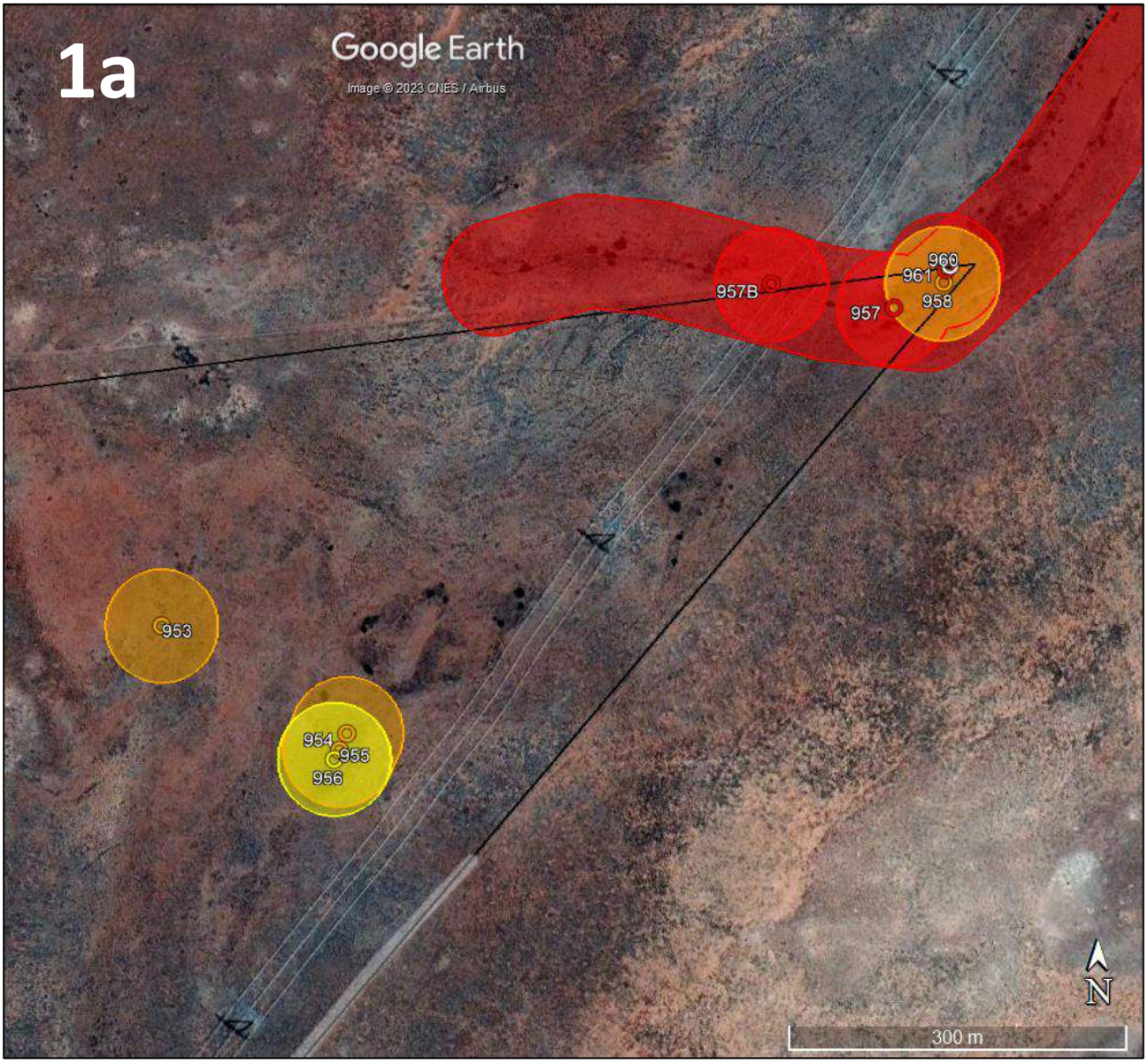
Key to mapping: Black polygons: farm boundaries
White polygons: project footprints (i.e. fence lines; labelled by yellow pins)
Dark Red: Grade IIIA
Red: Grade IIIB
Orange: Grade GPA
Yellow: Grade GPB
White: Grade GPC

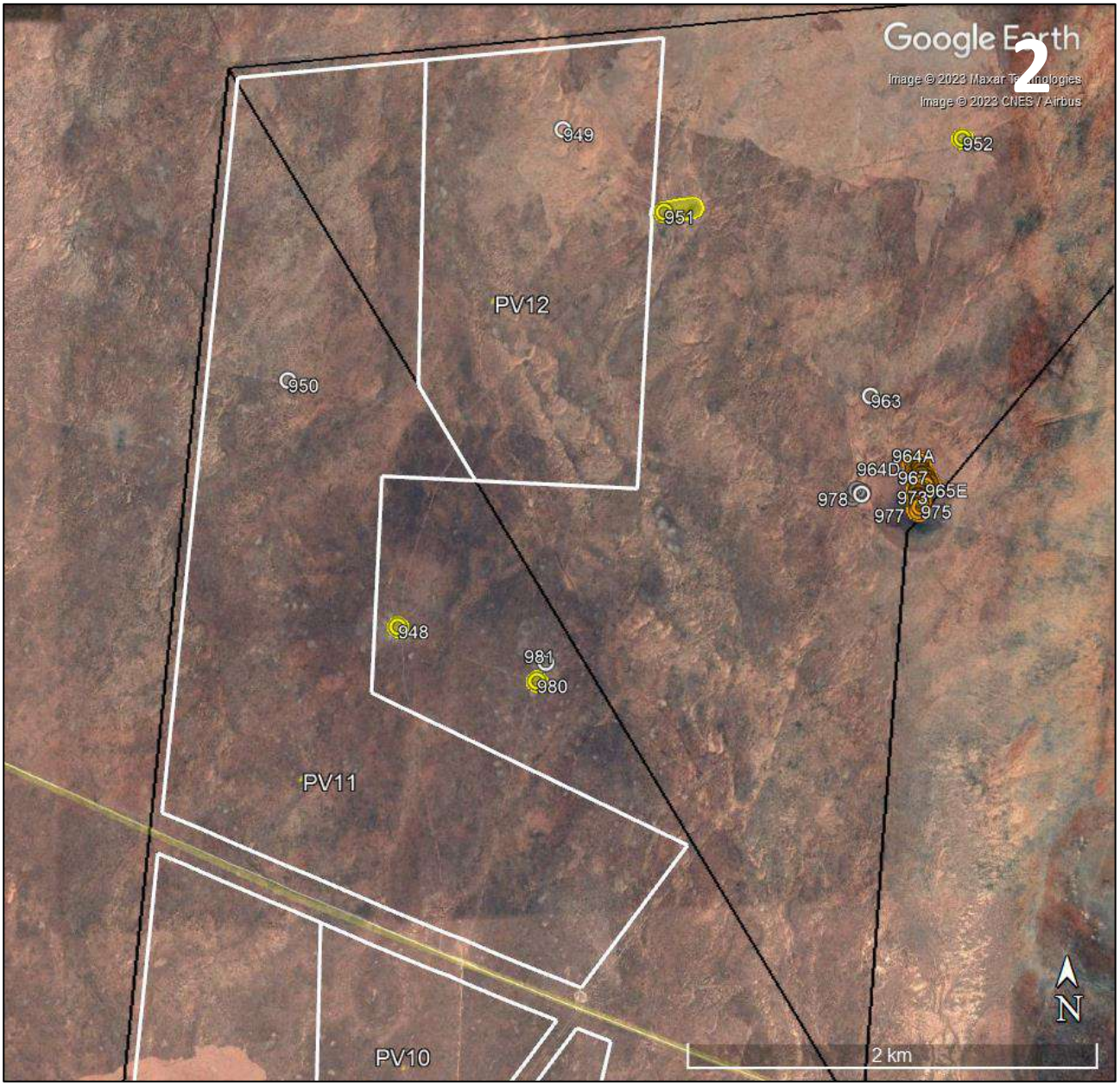
Maps shown with facility fence line only for the sake of mapping clarity. The fence line will contain all the proposed infrastructure as shown in the detailed layout in Figure 3 of the HIA report.


Google Earth
Image © 2023 Maxar Technologies
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1
2
PV12
PV11
PV10
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PV8
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PV5
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8
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7 km

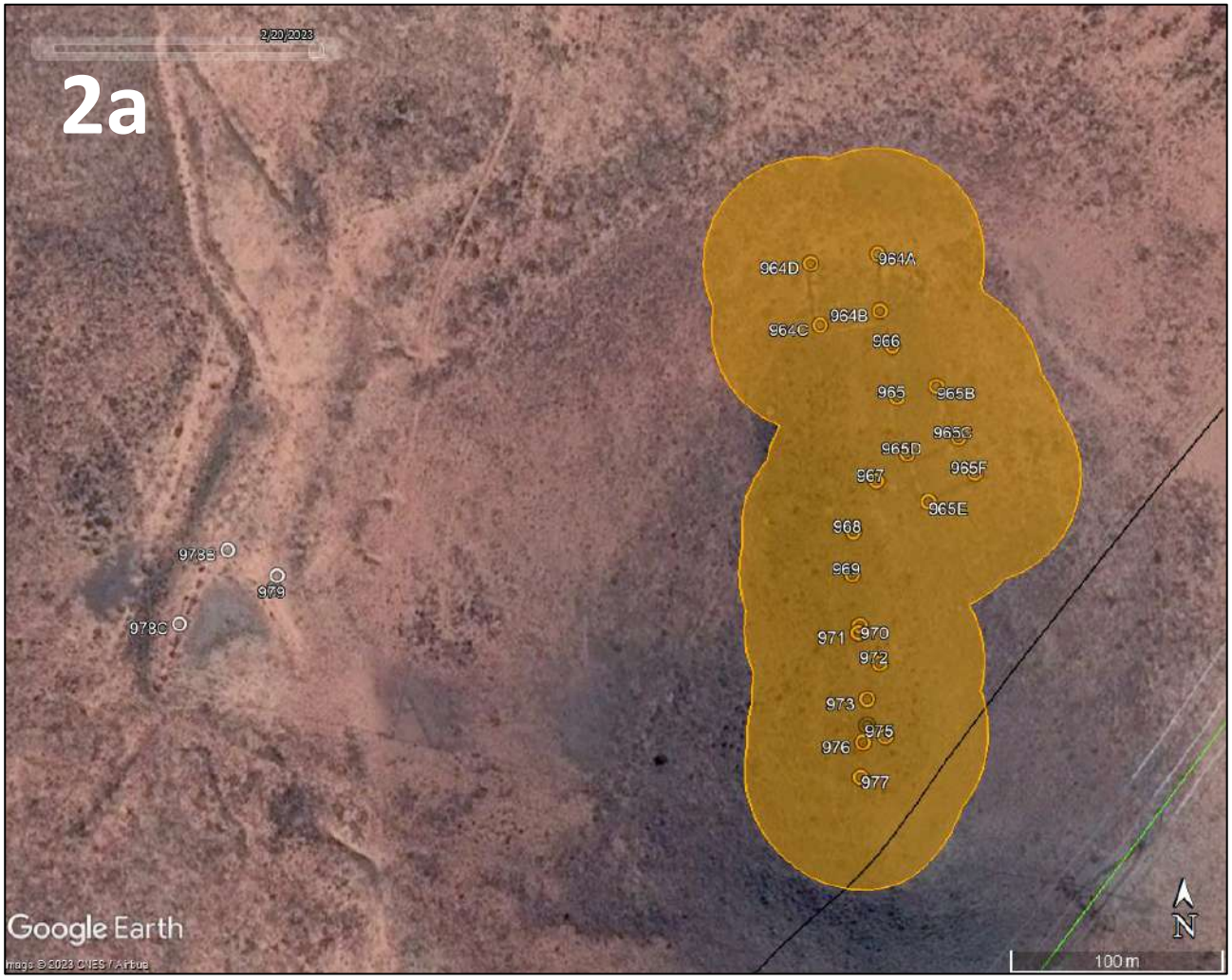
Numbered boxes indicate main enlargements below.

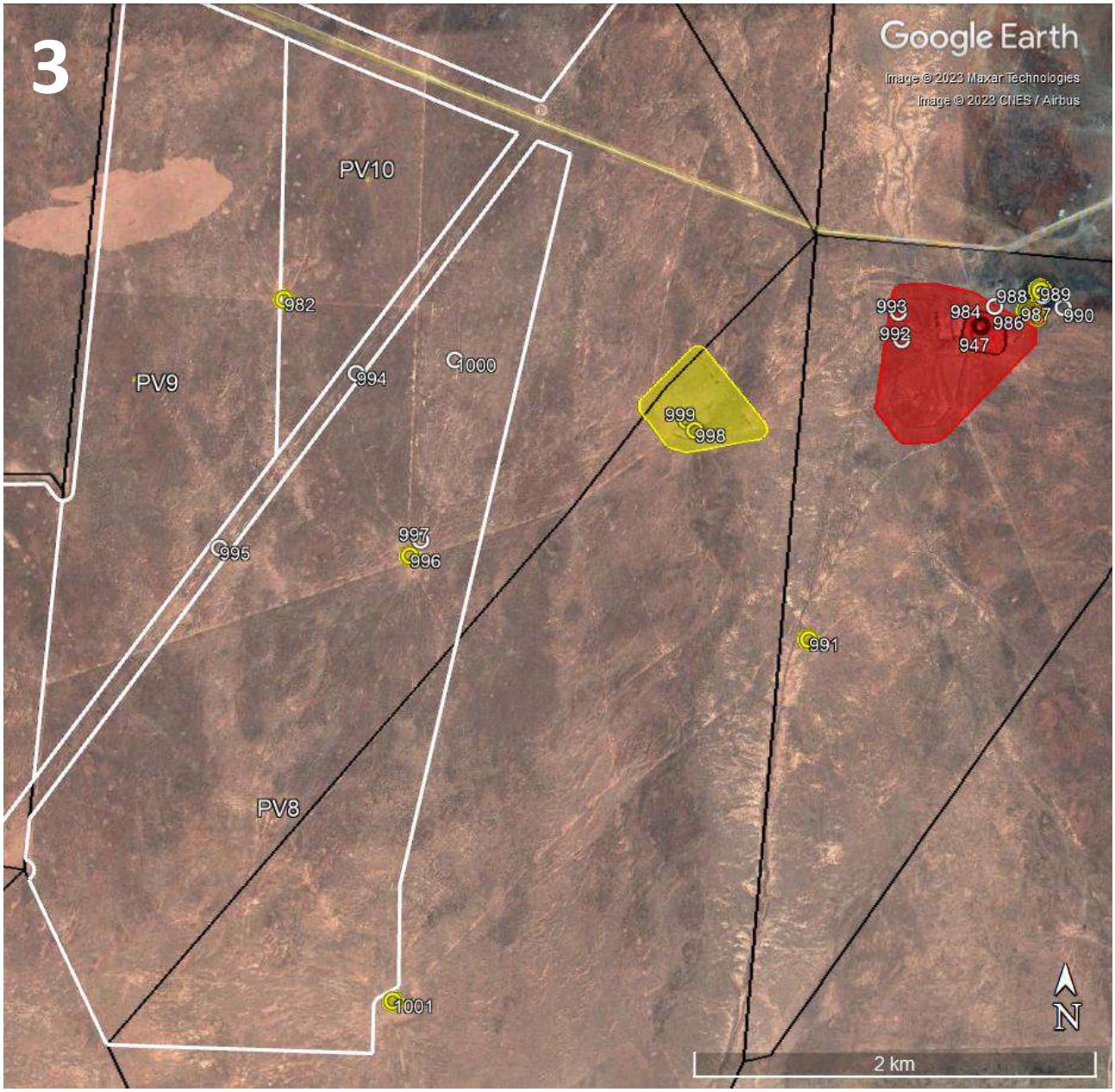


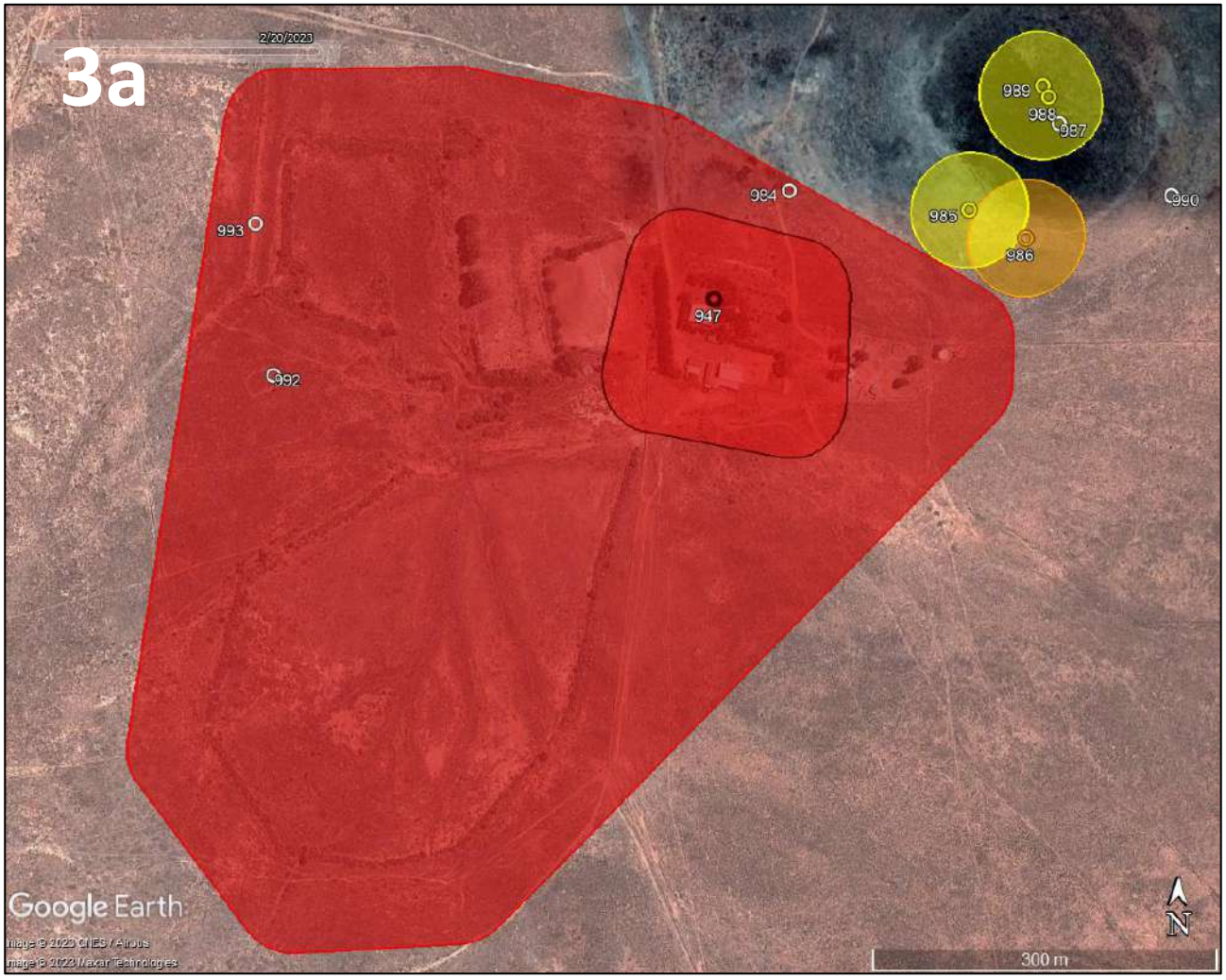

1a
Google Earth
Image © 2023 CNES / Airbus
960
961
957B
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N
300 m

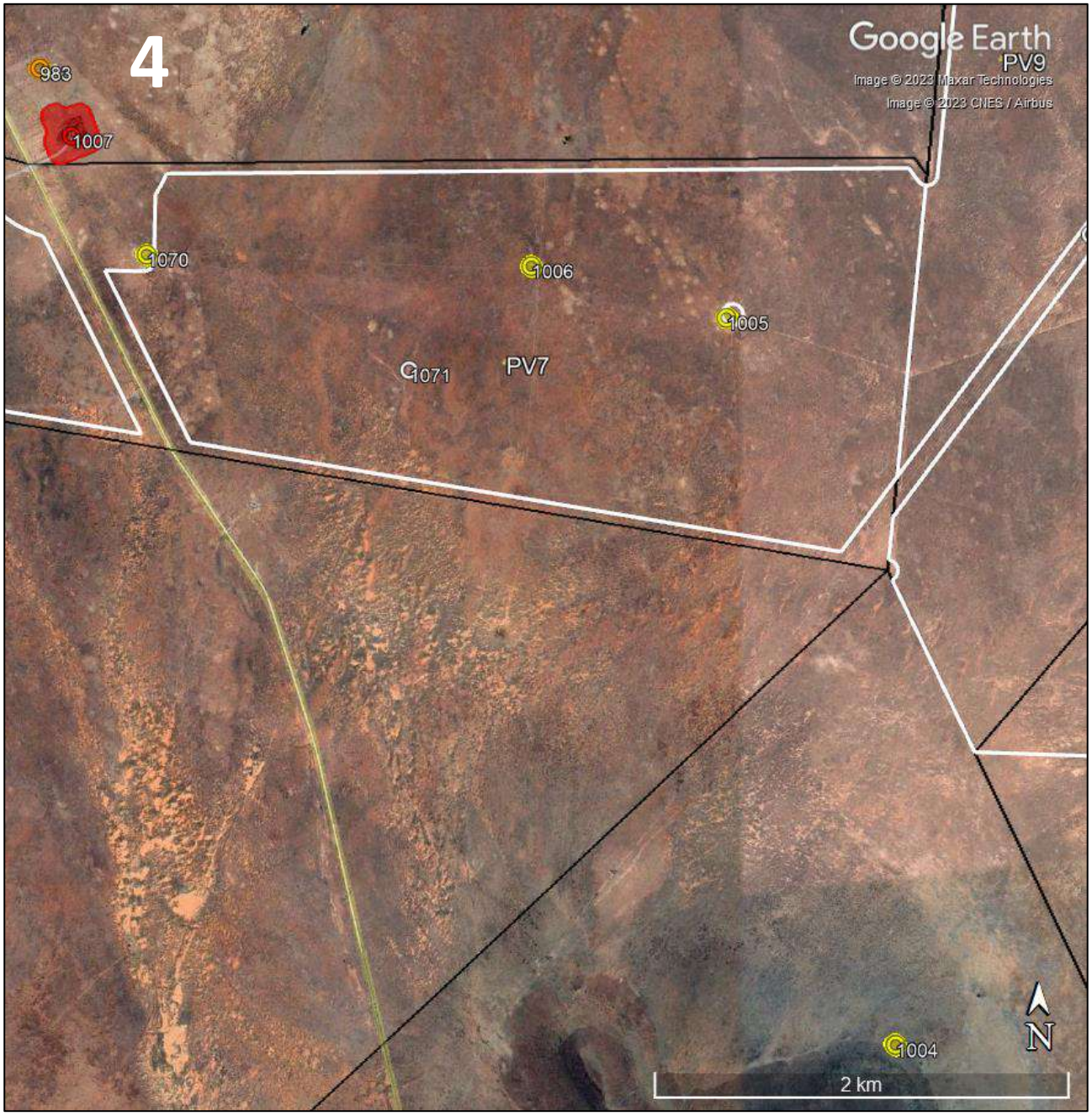

Google Earth
Image © 2023 Maxar Technologies
Image © 2023 CNES / Airbus
949
952
951
PV12
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2 km

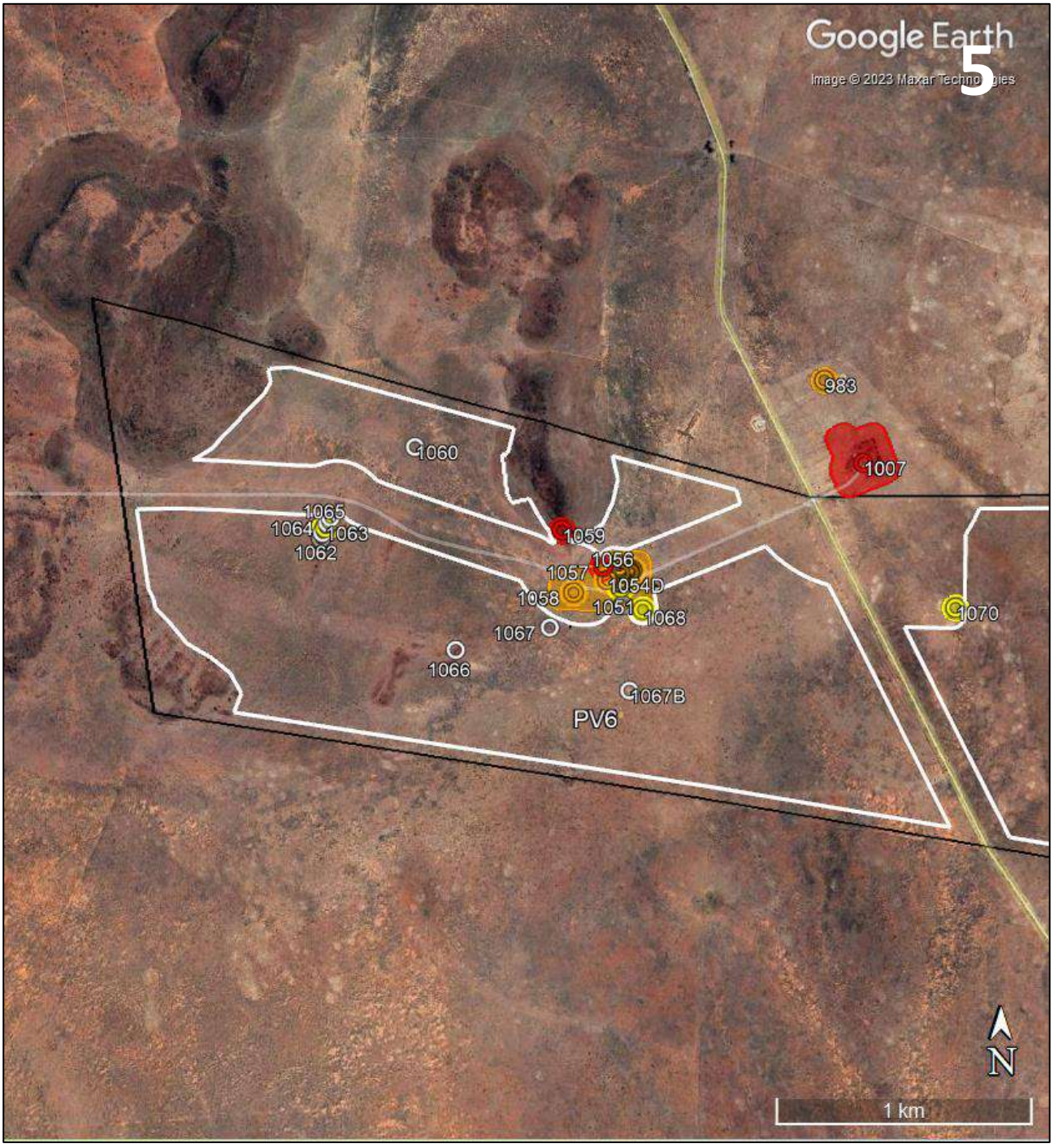
2


2a
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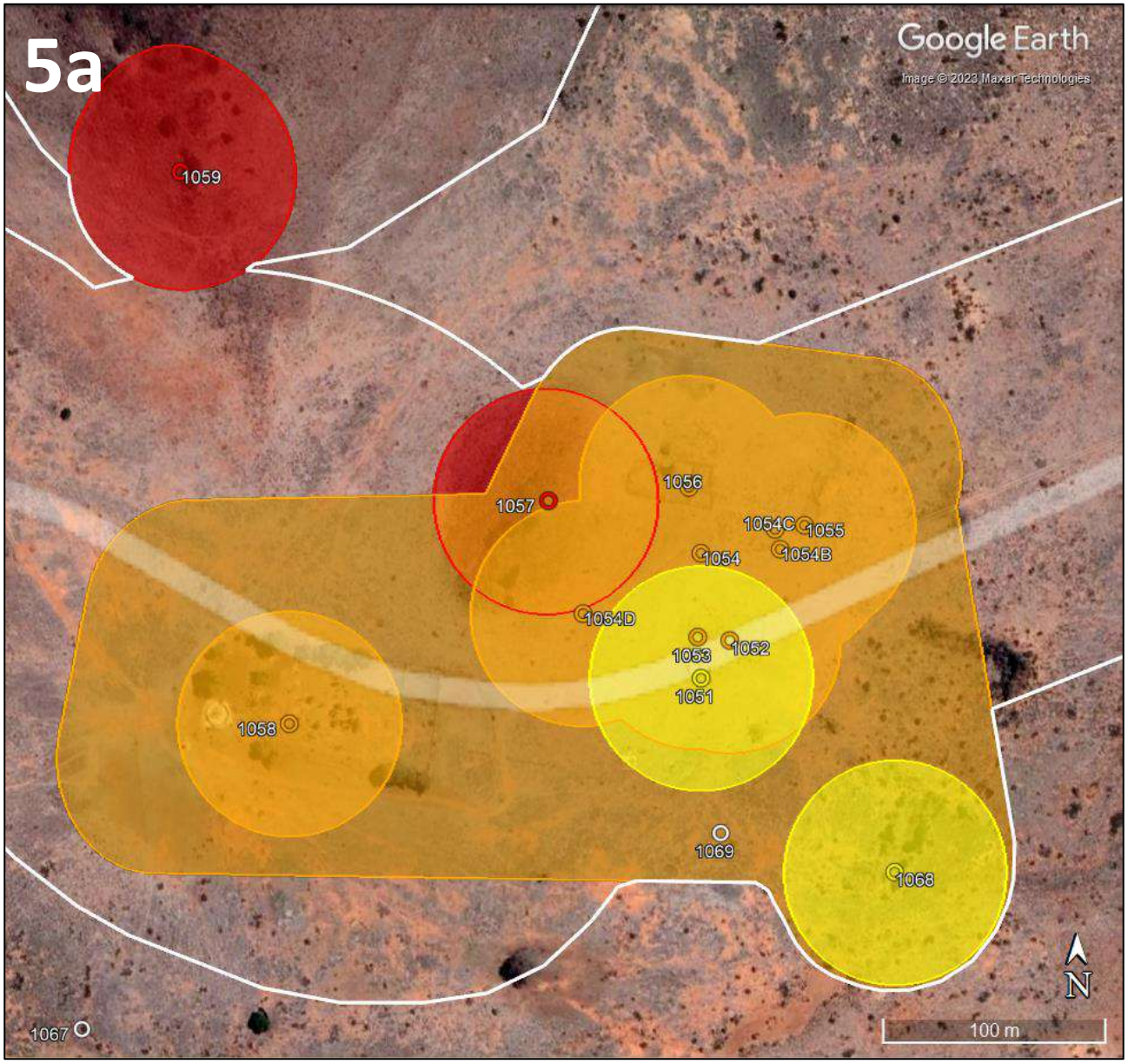

3
Google Earth
Image © 2023 Maxar Technologies
Image © 2023 CNES / Airbus
PV10
PV9
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2 km

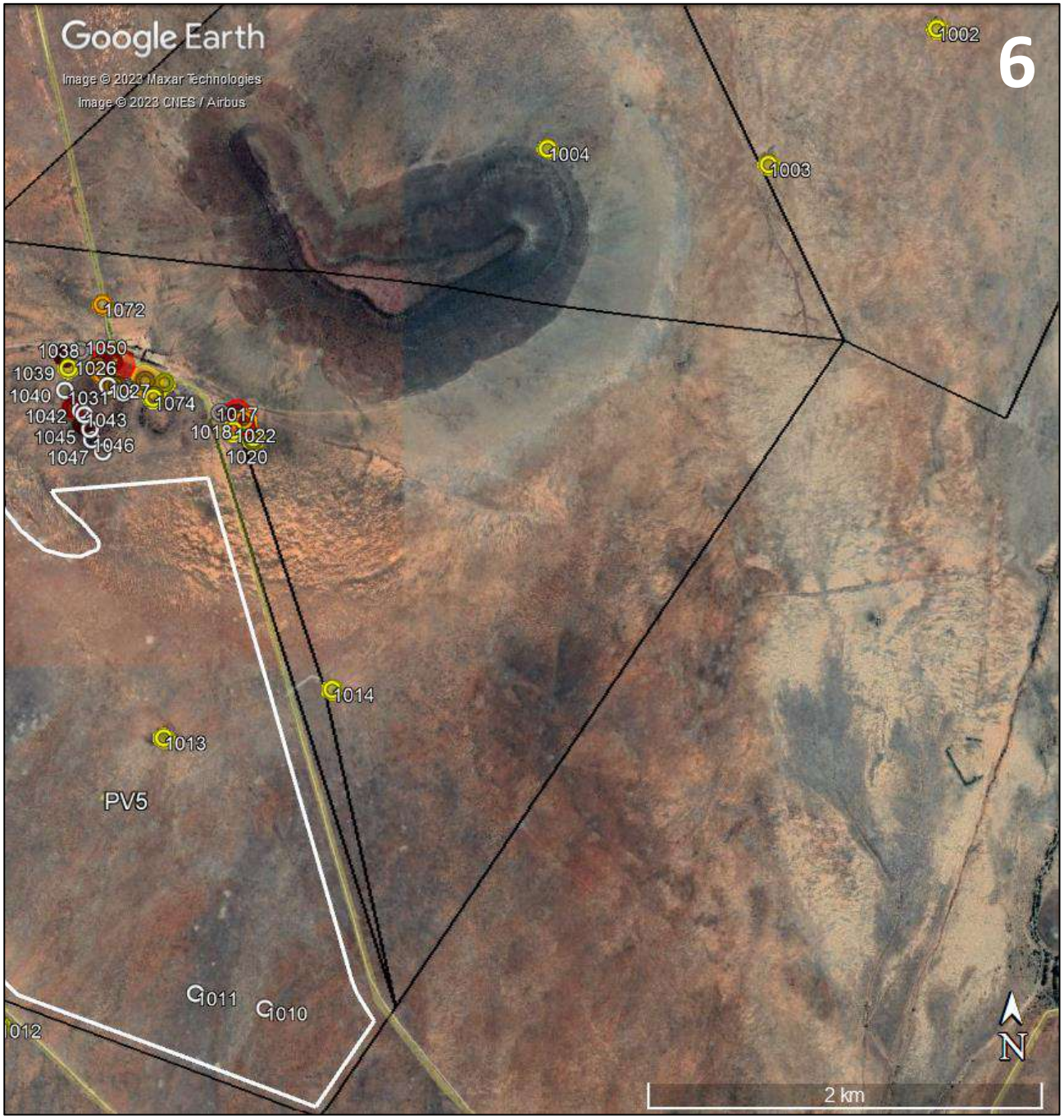

3a
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987
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Google Earth
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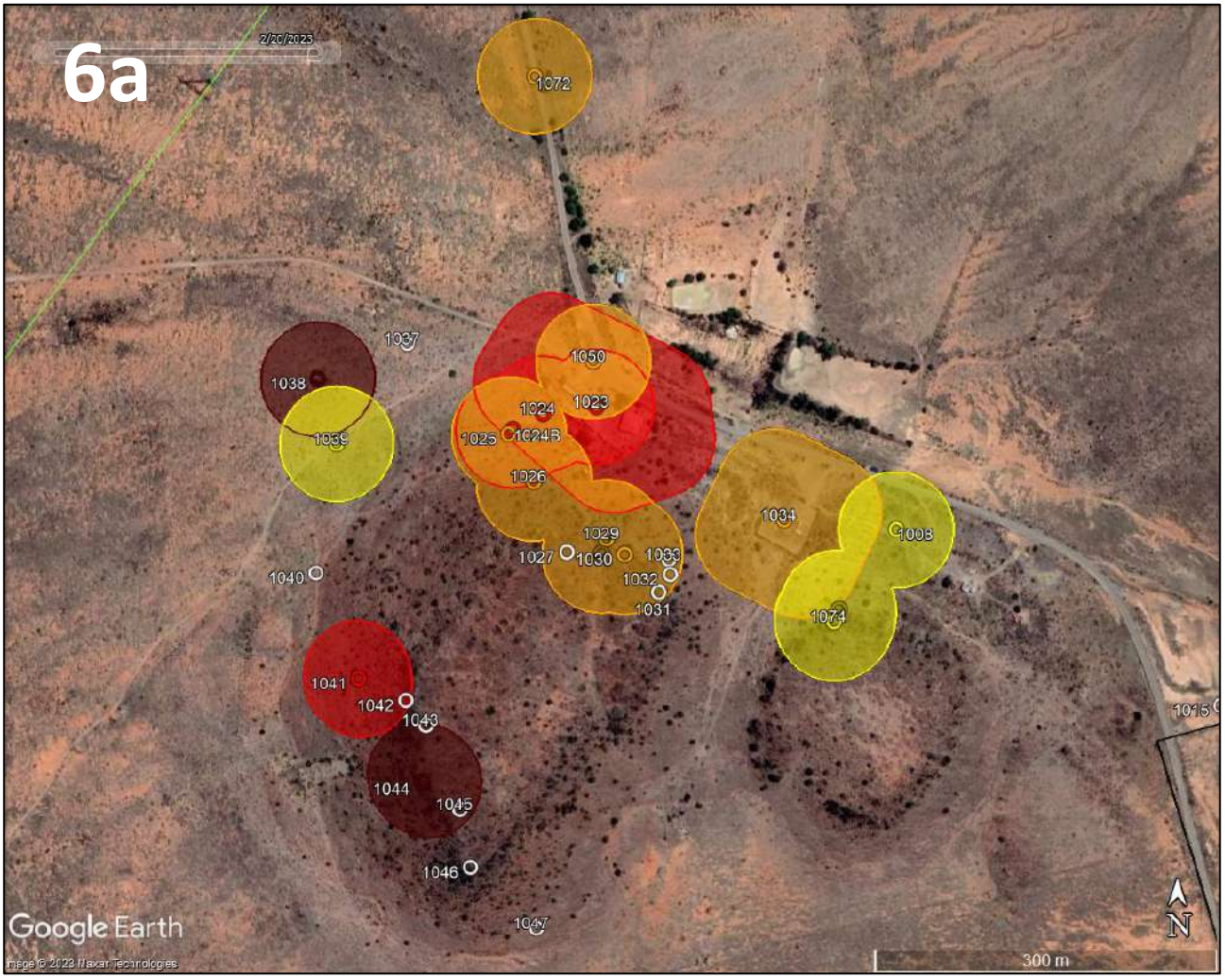

4
Google Earth
PV9
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Image © 2023 CNES / Airbus
983
1007
1070
1006
1005
1071
PV7
1004
N
2 km

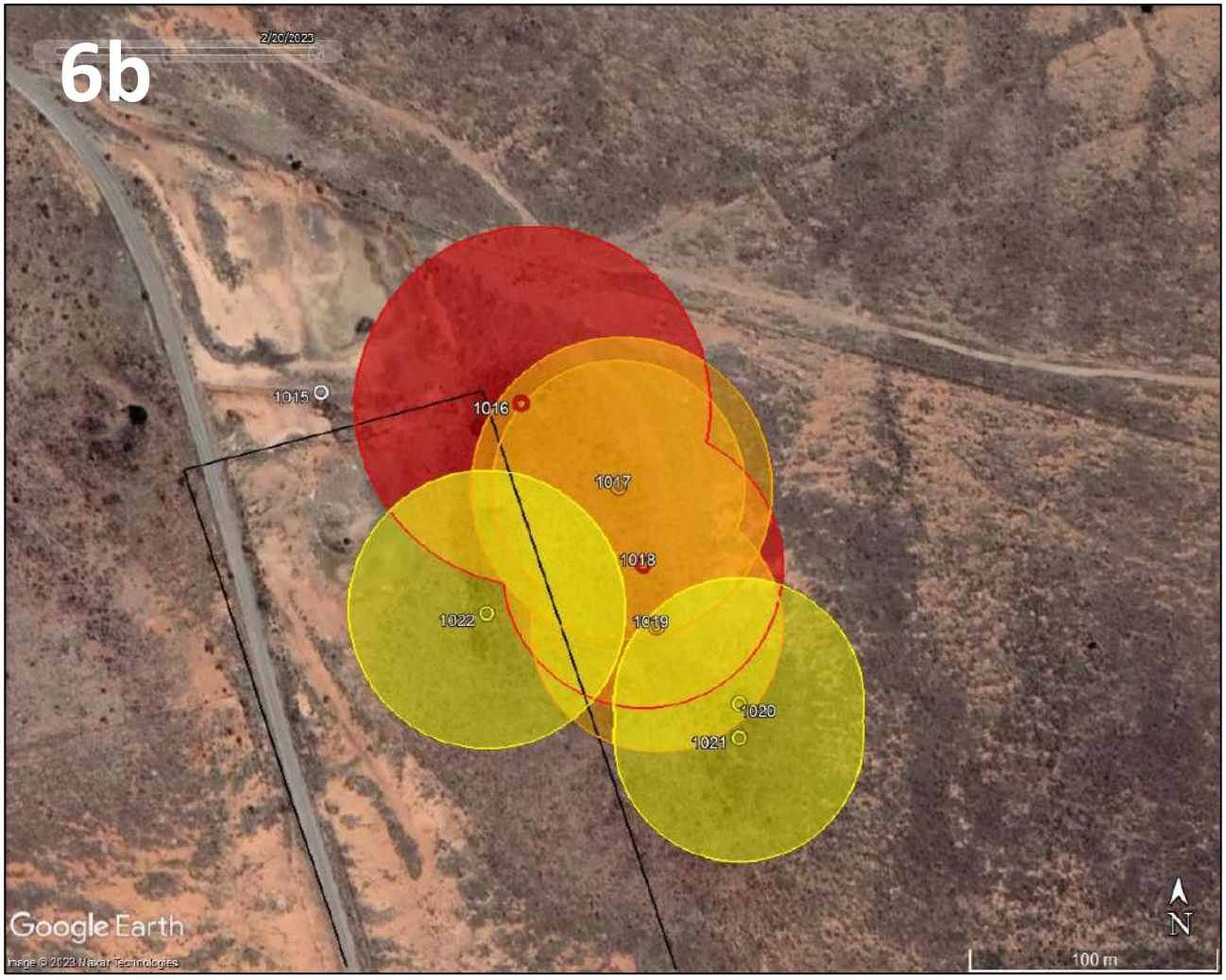

Google Earth
Image © 2023 Maxar Technologies
983
1007
1060
1065
1064
1063
1062
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1054D
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1068
1070
1067
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1067B
PV6
N
1 km

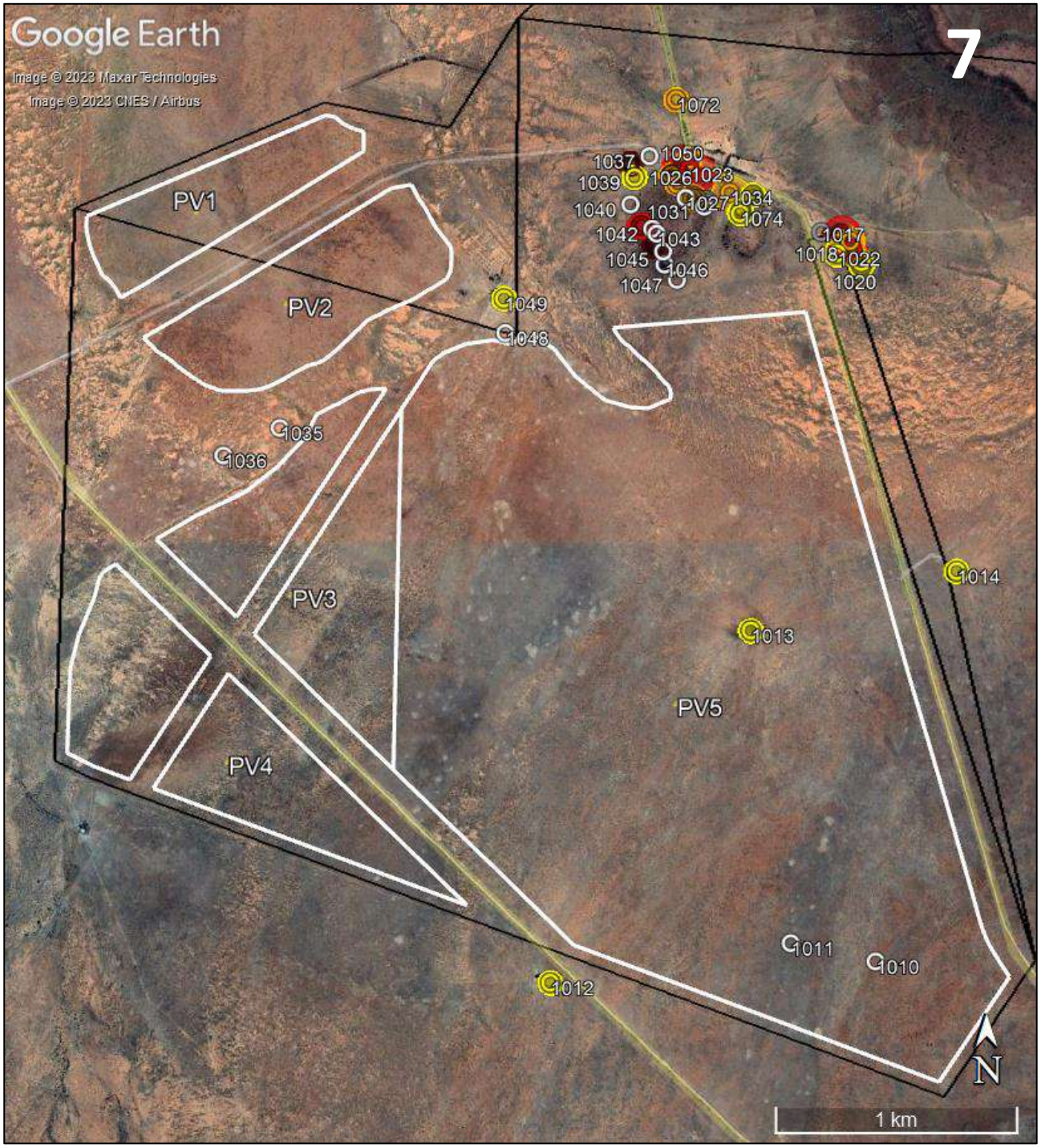
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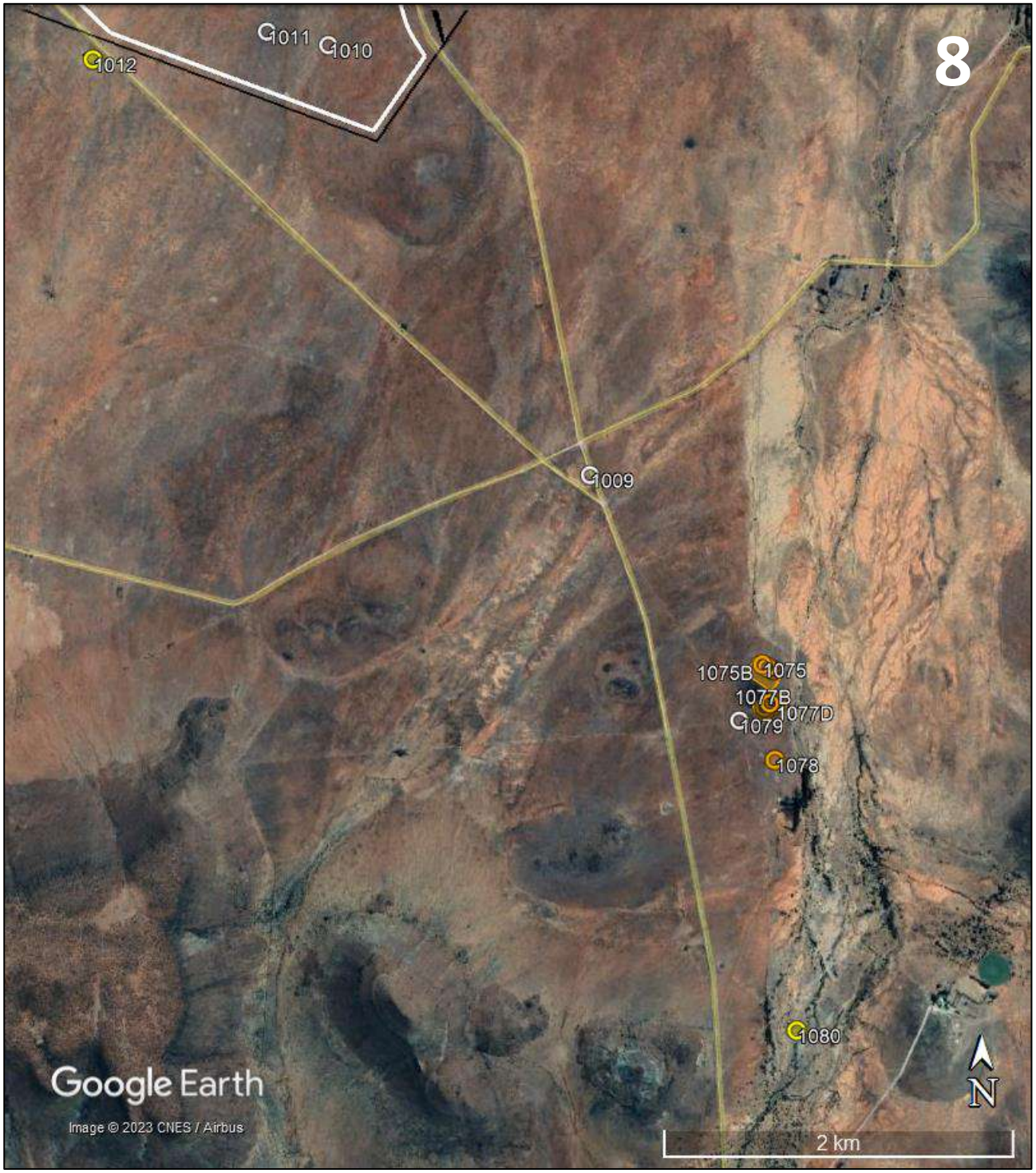

5a
Google Earth
Image © 2023 Maxar Technologies
1059
1057
1056
1054C
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1054
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1058
1069
1068
1067
N
100 m


Google Earth
Image © 2023 Maxar Technologies
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6
1002
1004
1003
1072
1038
1050
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1026
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1043
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1018
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PV5
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6a
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1037
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1008
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1015
Google Earth
Image © 2023 Maxar Technologies
300 m
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6b
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1015
1016
1017
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1020
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Image © 2023 Maxar Technologies
N
100 m


Google Earth
Image © 2023 Maxar Technologies
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7
PV1
PV2
PV3
PV4
PV5
1072
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1034
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1010
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N
1 km


8
1012
1011
1010
1009
1075B
1075
1077B
1077D
1079
1078
1080
Google Earth
Image © 2023 CNES / Airbus
N
2 km



CHAPTER 12:
Palaeontology



CSIR
Touching lives through innovation

SITE SENSITIVITY VERIFICATION REPORT (IN TERMS OF PART A OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020)

PROPOSED DEVELOPMENT OF THE KUDU SOLAR PHOTOVOLTAIC FACILITIES AND ASSOCIATED INFRASTRUCTURE NEAR PHILIPSTOWN AND DE AAR, PIXLEY KA SEME DISTRICT, NORTHERN CAPE PROVINCE

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Version 3: April 2023



ABO Wind renewable energies (PTY) Ltd is proposing to develop the Kudu Solar Photovoltaic (PV) cluster[1] and associated Electricity Grid Infrastructure (EGI) near De Aar in the Pixley Ka Seme District, Northern Cape Province. The Kudu solar facility and grid connection project area largely comprises low-relief terrain mantled with thick Late Caenozioic calcrete hardpans, alluvial deposits, surface gravels and soils that are generally of low palaeosensitivity. Natural bedrock exposure here is very limited and mainly involves unfossiliferous dolerite as well as baked Ecca Group metasediments (probable Waterford Formation) building *kranzes* on upper hillslopes that will not be directly impacted by the proposed development. Early to Middle Permian basinal mudrocks of the Tierberg Formation (Ecca Group, Karoo Supergroup) underlie the majority of the project area but are rarely exposed and, where seen, are generally weathered, friable and extensively disrupted by near-surface calcrete veins. The offshore mudrocks of the Tierberg Formation are not known elsewhere to have a rich fossil record. In the present project area the potential for well-preserved fossils is further reduced by near-surface weathering, calcrete veining as well as baking of sedimentary bedrocks by intensive regional dolerite intrusion in Early Jurassic times. The only fossils recorded from the Ecca Group sediments during the 2-day palaeontological site visit comprise sparse, low diversity trace fossil assemblages of low scientific or conservation interest. Thick sandy to gravelly alluvial deposits associated with long-established drainage lines are extensively calcretised. No fossil remains were recorded within them.

[1] Each PV Facility will have a separate Project Applicant i.e., Kudu Solar Facility 1 (PTY) Ltd to Kudu Solar Facility 12.

According to the Department of Forestry, Fisheries and the Environment (DFFE) screening tool mapping, the majority of the Kudu solar PV facilities and associated grid connection corridor is of Medium to High palaeosensitivity. **This provisional assessment is *contested* in the present Site Sensitivity Verification Report**, based on a 2-day palaeontological site visit and several previous field-based and desktop Palaeontology Impact Assessment (PIA) studies in the broader De Aar – Kimberley region. **It is concluded that the Kudu solar PV and grid connection project areas are in fact of LOW to VERY LOW palaeosensitivity in general.** The only two fossil sites recorded in the region fall *outside* the PV project areas (Appendix 3) and are of low scientific / conservation interest so no mitigation is recommended with regard to them. The potential for rare, largely unpredictable fossil sites of High palaeosensitivity associated with older alluvial and pan deposits hidden in the subsurface cannot be discounted. Most such fossil sites would probably be protected during construction by environmental buffer zones along drainage lines. If any fossiliferous deposits are exposed by surface clearance or excavations during the construction phase of the development, the Chance Fossils Finds Protocol outlined in Appendix 2 to this report should be fully implemented. These recommendations should be included within the Environmental Management Programmes (EMPrs) for the Kudu Solar PV Facilities and associated infrastructure developments.

The project area for all the solar PV facilities, on-site substations, grid connection corridors and associated infrastructure currently under consideration are of LOW to VERY LOW palaeosensitivity. Provided that the Chance Fossil Finds Protocol tabulated in Appendix 2 is incorporated into the EMPrs and fully implemented during the construction phase of the solar PV facility and grid connection developments, there are no objections on palaeontological heritage grounds to authorisation of the proposed renewable energy developments. Pending the discovery of significant new fossil finds before or during construction, no further specialist palaeontological studies, reporting, monitoring or mitigation are recommended for these renewable energy projects.

These conclusions and recommendations apply equally to all solar PV Facility developments within the Kudu Solar PV cluster as well as to the development of associated Electricity Grid Infrastructure (See summary table below).

Tabulated summary of conclusions regarding palaeontological heritage for each of the Kudu Solar PV Facilities

Kudu PV Facility	Rock units present near surface	Desktop & field-based Palaeosensitivity	Recorded fossils	Recommended mitigation
PV1	Tierberg Formation (Ecca Group) Late Caenozoic superficial sediments (alluvium, calcrete hardpans, soils, eluvial surface gravels)	**LOW** **LOW**	**NONE**	**Application of Chance Fossil Finds Protocol during Construction Phase**
PV2	Tierberg Formation (Ecca Group) Late Caenozoic superficial sediments (alluvium, calcrete hardpans, soils, eluvial surface gravels)	**LOW** **LOW**	**NONE**	**Application of Chance Fossil Finds Protocol during Construction Phase**
PV3	Tierberg Formation (Ecca Group) Late Caenozoic superficial sediments (alluvium, calcrete hardpans, soils, eluvial surface gravels)	**LOW** **LOW**	**NONE**	**Application of Chance Fossil Finds Protocol during Construction Phase**
PV4	Tierberg Formation (Ecca Group) Late Caenozoic superficial sediments (alluvium, calcrete hardpans, soils, eluvial surface gravels)	**LOW** **LOW**	**NONE**	**Application of Chance Fossil Finds Protocol during Construction Phase**
PV5	Tierberg Formation (Ecca Group) Late Caenozoic superficial sediments (alluvium, calcrete hardpans, soils, eluvial surface gravels)	**LOW** **LOW**	**NONE**	**Application of Chance Fossil Finds Protocol during Construction Phase**
PV6	Tierberg Formation (Ecca Group) Late Caenozoic superficial sediments (alluvium, calcrete hardpans, soils, eluvial surface gravels)	**LOW** **LOW**	**NONE**	**Application of Chance Fossil Finds Protocol during Construction Phase**
PV7	Tierberg Formation (Ecca Group) Late Caenozoic superficial sediments (alluvium, calcrete hardpans, soils, eluvial surface gravels)	**LOW** **LOW**	**NONE**	**Application of Chance Fossil Finds Protocol during Construction Phase**
PV8	Tierberg Formation (Ecca Group)	**LOW** **LOW**	**NONE**	**Application of Chance Fossil Finds Protocol during Construction Phase**

Kudu PV Facility	Rock units present near surface	Desktop & field-based Palaeosensitivity	Recorded fossils	Recommended mitigation
	Late Caenozoic superficial sediments (alluvium, calcrete hardpans, soils, eluvial surface gravels)			
PV9	Tierberg Formation (Ecca Group) Late Caenozoic superficial sediments (alluvium, calcrete hardpans, soils, eluvial surface gravels)	**LOW** **LOW**	**NONE**	**Application of Chance Fossil Finds Protocol during Construction Phase**
PV10	Tierberg Formation (Ecca Group) Late Caenozoic superficial sediments (alluvium, calcrete hardpans, soils, eluvial surface gravels)	**LOW** **LOW**	**NONE**	**Application of Chance Fossil Finds Protocol during Construction Phase**
PV11	Tierberg Formation (Ecca Group) Late Caenozoic superficial sediments (alluvium, calcrete hardpans, soils, eluvial surface gravels)	**LOW** **LOW**	**NONE**	**Application of Chance Fossil Finds Protocol during Construction Phase**
PV12	Tierberg Formation (Ecca Group) Late Caenozoic superficial sediments (alluvium, calcrete hardpans, soils, eluvial surface gravels)	**LOW** **LOW**	**NONE**	**Application of Chance Fossil Finds Protocol during Construction Phase**

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Figure A3.1: Google Earth© satellite image showing the project area for the Kudu Solar Photovoltaic Facilities and associated infrastructure near Philipstown and De Aar, Northern Cape (black and blue polygons) as well as the buildable area/development footprint for each PV project (yellow polygon) and proposed on-site substation complex sites (small, pale blue polygons). The two recorded fossil sites are indicated by the numbered yellow circles (Please see following figure for more detail). *N.B.* North is towards the LHS. 45

Figure A3.2: Google Earth© satellite image showing the project area for the southern cluster of Kudu Solar Photovoltaic Facilities and associated infrastructure near Philipstown and De Aar, Northern Cape. The two recorded fossil sites indicated by the numbered yellow circles (583, 586) both fall *outside* the PV buildable areas/development footprints and are of low scientific / conservation value so no mitigation is proposed with regard to them. *N.B.* North is towards the LHS. 46

1. INTRODUCTION

The Project Applicant, ABO Wind renewable energies (PTY) Ltd and Kudu Solar Facility 1 (Pty) Ltd to Kudu Solar Facility 12 (Pty) Ltd, is proposing to develop the Kudu Solar Photovoltaic (PV) cluster and associated Electricity Grid Infrastructure (EGI) near the towns of De Aar and Philipstown in the Pixley Ka Seme District, Northern Cape Province (Figs. 1 & 2). Land parcels concerned with the development are shown in the satellite map in Figure 3; this is the study area covered by the present Site Sensitivity Verification report. The Kudu renewable energy project will entail the proposed development of up to several Solar PV Facilities as well as associated infrastructure and EGI[2]. Each solar PV facility will have a range of associated infrastructure including, but not limited to, an on-site substation complex and battery energy storage systems (BESS) and is proposed to connect to an existing 400 kV power line *via* dedicated 132 kV power lines. Each of the PV facilities would be its own project and would require its own, separate Environmental Authorisation (EA).

The proposed PV projects are not located within any of the Renewable Energy Development Zones (REDZs) that were gazetted in Government Notice (GN) 114 in February 2018 and GN 144 in February 2021. Therefore, full Scoping and Environmental Impact Assessment (EIA) Processes are needed for the PV projects. The proposed EGI projects are located within the Central Strategic Transmission Corridor that was gazetted in GN 113 in February 2018. Therefore, Basic Assessment (BA) and/or EGI Standard Registration Processes are needed for the EGI projects.

According to the Department of Forestry, Fisheries and the Environment (DFFE) National Web-Based Environmental Screening Tool (hereafter referred to as the “screening tool”), the majority of the Kudu Solar PV Facility and associated grid connection corridor study area is of Medium to High palaeosensitivity (Fig. 32). In accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations of 2014, a combined field-based and desktop site sensitivity verification has therefore been undertaken in order to confirm or contest the environmental sensitivity of the proposed project area as identified by the Screening Tool.

The independent Environmental Practitioner co-ordinating the various Environmental Assessment processes for the proposed Kudu PV solar and associated infrastructure projects is the CSIR, Environmental Management Services (Contact details: Ms Rohaida Abed. CSIR - Environmental Management Services. P.O. Box 59081, Umbilo, Durban, 4075. Tel: 031 242 2318. E-mail: ems@csir.co.za).

This Palaeontology Site Verification Report has been compiled by Dr. John Almond of Natura Viva cc (CV included in Appendix 1, as well as a declaration of interest).

[2] The Scoping and EIA Process for the Solar PV Projects for Kudu Solar Facility 1 to 12 have commenced (Department of Forestry, Fisheries and the Environment (DFFE) Reference Numbers: 14/12/16/3/3/2/2244 to 14/12/16/3/3/2/2255). The Environmental Assessment Processes for the EGI Projects will be undertaken at a later stage. This Site Sensitivity Verification Report covers both the Solar PV Projects and EGI.

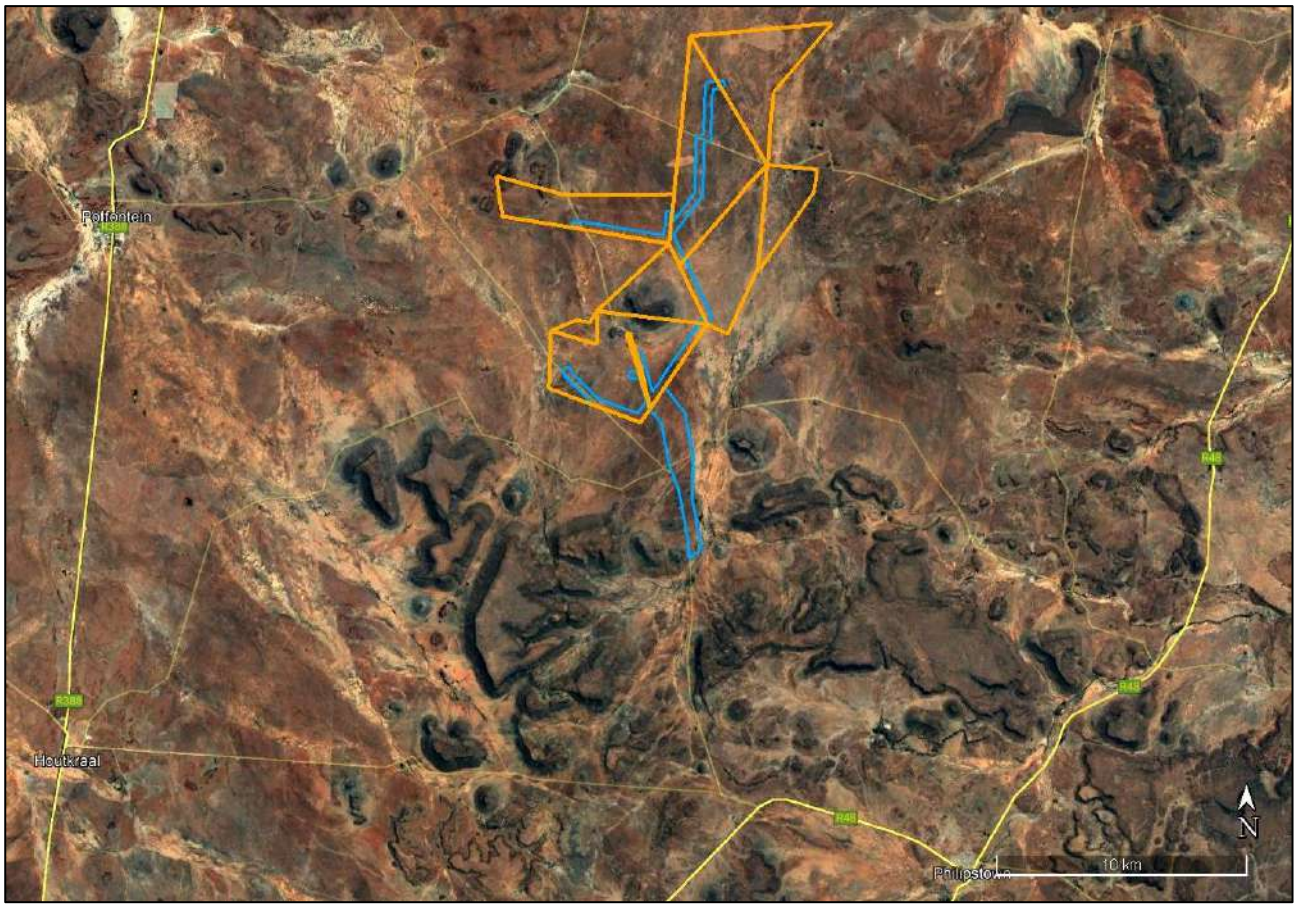


Figure 1: Google Earth© satellite image showing the project study area (orange polygon) for the proposed Kudu Solar PV Facilities near Philipstown, Pixley Ka Seme District, Northern Cape Province. Corridors for the various grid connection route options are shown in blue, including a 400 kV Loop-In-Loop-Out (LILO) from the existing Hydra-Perseus 400 kV Overhead Power Line to the proposed MTS. Site Sensitivity Verification for the solar PV facility and EGI project area is based on a recent 2-day palaeontological heritage site visit. Land parcels concerned within the project area are identified in Figure 3 below.

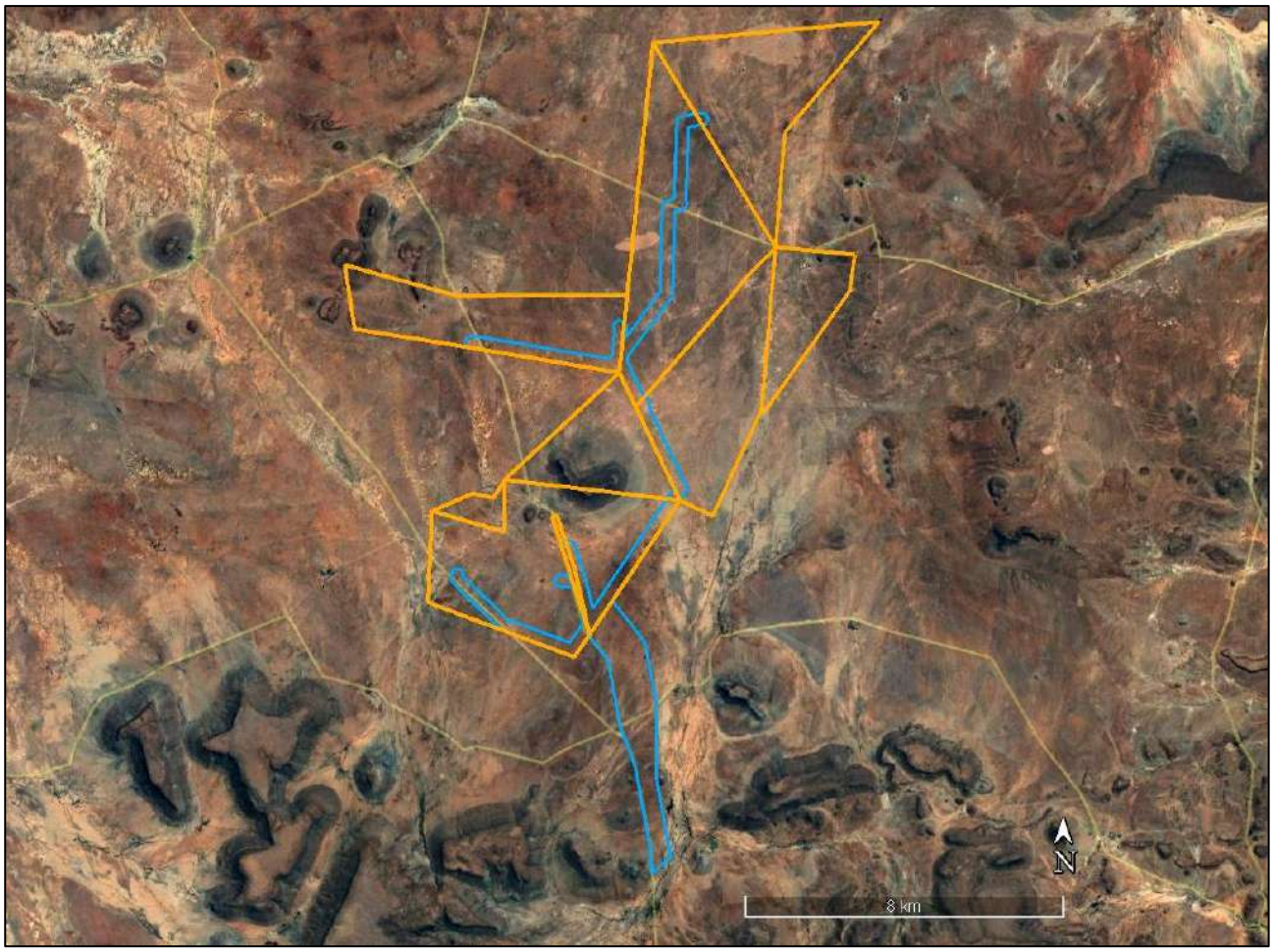


Figure 2: More detailed Google Earth© satellite image of the Kudu Solar PV cluster project area and associated EGI project area (blue polygon). Most of the project area features low relief, grassy terrain with very little or no bedrock exposure.

2. DATA SOURCES

The palaeontological heritage site sensitivity verification report for the Kudu solar facility and associated infrastructure project area is based on:

- Detailed project descriptions, maps, kmz files, DFFE screening reports and other relevant background documentation provided by the CSIR.

- A desktop review of (a) 1:50 000 scale topographic maps (3024AB Jakkalskuil, 3024AD Philipstown) and the 1:250 000 scale topographic map (sheet 3024 Colesberg), (b) Google Earth© satellite imagery, (c) published geological and palaeontological literature, including 1:250 000 geological maps (sheet 3024 Colesberg) and relevant sheet explanation (Le Roux 1993), as well as (d) several previous desktop and field-based fossil heritage (PIA) assessments in the De Aar – Kimberley region by the author (See References under Almond).

- A two day field survey of representative rock exposures within the broader PV and associated infrastructure project study area by the author on 22 and 23 April 2022.

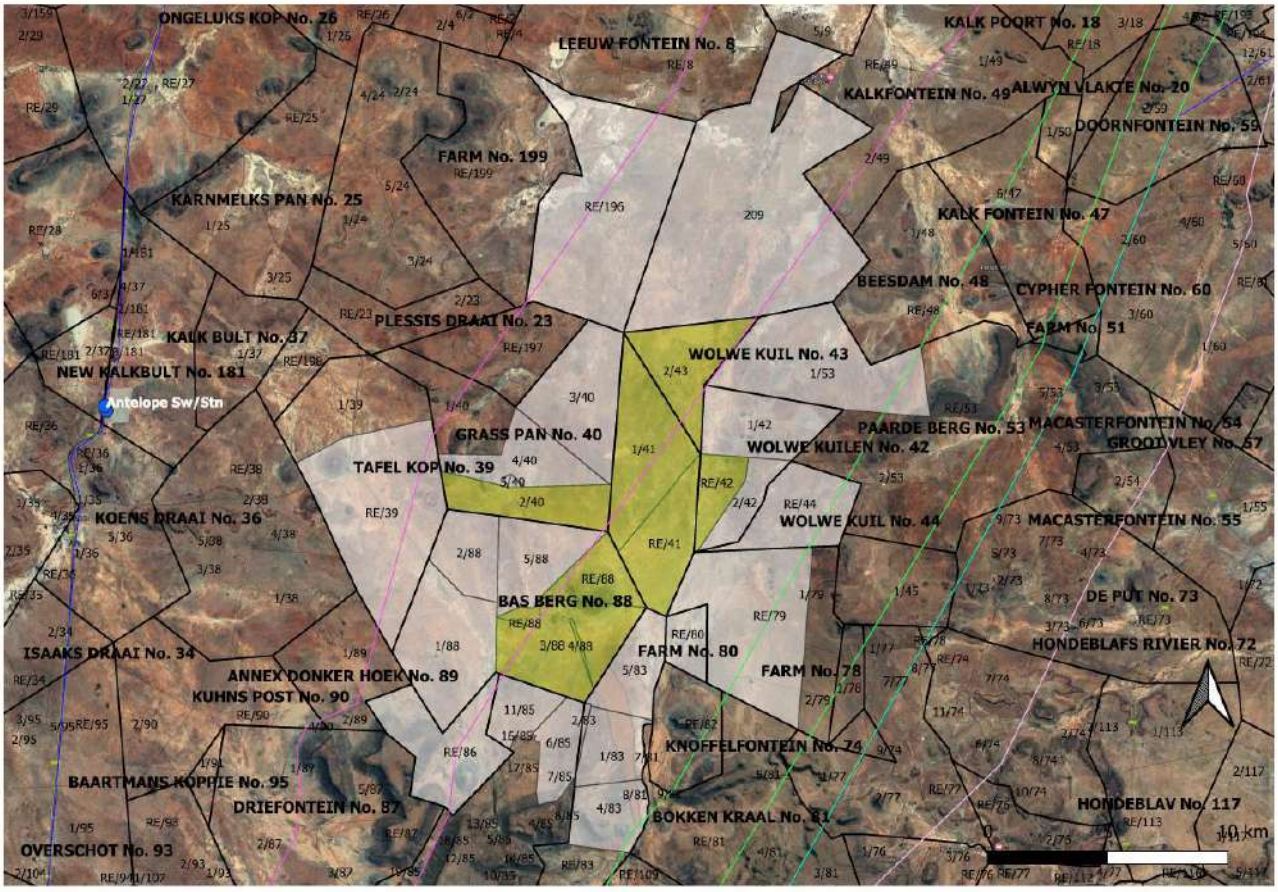


Figure 3: Overlay on satellite image showing the component land parcels concerned with the Kudu solar renewable energy project near De Aar (Image provided by the CSIR).

3. STATEMENT ON THE STUDY AREA

The study area for all the proposed Kudu Solar Facilities is the full extent of the eight affected farm properties[3] on which the proposed PV Facilities will be constructed (Figure 3), and the EGI Corridor. The full extent of these properties and the EGI Corridor has been assessed in this study in order to identify environmental sensitivities and no-go areas. The total **study area** for all the Kudu Solar Facilities is approximately 8 150 hectares (ha), as well as the EGI corridor.

At the commencement of this Scoping and EIA Process, Original Scoping Buildable Areas were identified by the Project Developer following the completion of high-level environmental screening based on the Screening Tool.

Following the identification of sensitivities during the Scoping Phase, the Project Developer considered such sensitivities and formulated the Revised Scoping Buildable Areas. The Revised Scoping Buildable Areas were

[3] These farm properties are Remaining Extent of the Farm Bas Berg No. 88 (C05700000000008800000); Remaining Extent of Portion 3 of the Farm Bas Berg No. 88 (C05700000000008800003); Portion 4 (Portion of Portion 3) of the Farm Bas Berg No. 88 (C05700000000008800004); Remaining Extent of Portion 2 (Middel Plaats) (a Portion of Portion 1) of the Farm Grasspan No. 40 (C05700000000004000002); Remaining Extent of the Farm Annex Wolve Kuil No. 41 (C05700000000004100000); Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41 (C05700000000004100001); Portion 2 of the Farm Wolve Kuil No. 43 (C05700000000004300002); and Remaining Extent of the Farm Wolve Kuilen No. 42 (C05700000000004200000). Note that the farm names are extracted from the title deeds, and that all reference to these farm portions throughout this report refer to it as such.

used to inform the design of the layout and were further assessed during this EIA Phase in order to identify the preferred development footprint of the proposed project on the approved site as contemplated in the accepted Scoping Report. The development footprint is where the actual development will be located, e.g. the footprint containing the PV solar arrays and associated infrastructure.

The development footprints or detailed layouts are considered suitable from a palaeontological perspective. Changes to the detailed layouts are deemed acceptable if the changes remain within the approved development footprint and area assessed in the EIA (with avoidance of no-go areas identified by relevant specialists).

4. GEOLOGICAL CONTEXT

The project study area for the proposed Kudu Solar Facilities and associated infrastructure (including EGI) is situated in low-relief, semi-arid, karroid to grassy terrain some 40 km SW of the Gariep River in the Northern Cape Province (Figs. 1, 2, 4 to 6). The towns of Philipstown and De Aar lie some 30 km to the SE and 60 km to the SSW respectively. The project study area lies just to the north of a range of low, dolerite-capped hills (*e.g.* Swartkoppies / Tierberg / Perdekop) and includes the small isolated *koppie* Basberg (1466 m amsl). The landscape slopes very broadly towards the north, from around 1370 down to 1250 m amsl. Drainage in this largely flat-lying region is ill-defined, comprising several N-flowing, shallow, intermittently-flowing water courses (unnamed), such as that running through Wolwekuil towards Jakkalskuil, and small pans (larger named pans such as Grasspan and Karringmelkpan lie shortly outside the project study area). Apart from dolerite-capped *koppies* and ridges as well as occasional borrow pits, bedrock exposure within the project area is very limited indeed due to pervasive cover by calcrete, alluvium and soils as well as dense grassy vegetation and *bossieveld*.



Figure 4: View from a dolerite-capped *koppie* just east of Wolwekuil farmstead (seen in middle ground on Wolwe Kuilen RE/42), looking south-westwards across the Kudu solar project area with the isolated *koppie* Basberg in the distance. The project area consists largely of low-relief, grassy terrain with almost no bedrock exposure.



Figure 5: Flat terrain with dense grassy vegetation and no bedrock exposure, typical of large portions of the Kudu solar project area, seen here on Annex Wolwe Kuil RE/41 with Basberg in the background.



Figure 6: Open patch within grassy vegetation exposing orange-brown sandy soils and sparse scatter of fine surface gravels (mainly calcrete, hornfels and dolerite clasts), looking due south towards Basberg, on Farm Grass Pan 2/40. These open areas were searched for reworked blocks of petrified wood.

The geology of the Kudu solar and EGI project area is outlined on 1: 250 000 geology sheet 3024 Colesberg (Council for Geoscience, Pretoria) with a short accompanying sheet explanation by Le Roux (1993) (Fig. 7). The majority of the area is underlain at depth by non-marine basinal mudrocks of the **Tierberg Formation** (**Ecca Group**, **Karoo Supergroup**) of Early to Middle Permian age whose type section has been designated on hillslopes on the farm Swart Koppies 86, just south of the present study area (Viljoen 2005).

The Tierberg Formation *sensu stricto* is a recessive-weathering, mudrock-dominated succession consisting predominantly of dark, well-laminated, carbonaceous shales with subordinate thin, fine-grained sandstones (Visser *et al.* 1977, Prinsloo 1989, Zawada 1992, Bosch 1993, Le Roux 1993, Viljoen 2005, Johnson *et al*., 2006). The Tierberg shales are Early to Middle Permian in age and were deposited in a range of offshore, quiet water environments below wave base. These include basin plain, distal turbidite fan and distal prodelta settings in ascending order (Viljoen 2005, Almond 2008a). Thin, coarsening-upwards cycles occur towards the top of the formation with local evidence of soft-sediment deformation, ripples and common calcareous concretions (often rusty-brown with well-developed cone-in-cone structures). A restricted, brackish water environment is reconstructed for the Ecca Basin at this time. Close to the contact with Karoo dolerite intrusions the Tierberg mudrocks are baked to a dark grey hornfels which typically develops an orange to reddish-brown surface weathering crust or patina (Prinsloo 1989).

These Ecca sedimentary bedrocks are currently only mapped at surface on the slopes of Basberg (Pt, pale brown in Fig. 7) as well as the *koppies* just east of Wolwekuil farmstead on Farm 42/RE where they crop out intermittently as low cliffs of metasediments which have been thermally metamorphosed by dolerite intrusion Figs. 8 to 10). More recent mapping along the Ecca – Beaufort Group contact in the northern sector of the Main Karoo Basin suggests that the prominent-weathering packages of wackes seen at higher elevations on hillslopes here, and which were originally included within the upper Tierberg Formation (*e.g.* Viljoen 2005), should be referred rather to the deltaic **Waterford Formation** (*cf* Groenewald *et al.* 2022). These delta front and platform sediments build the uppermost part of the Ecca Group succession and are conformably overlain by continental sediments of the **Adelaide Subgroup** (undifferentiated) in the De Aar region (cf Almond 2012a). Since neither the Waterford Formation nor Adelaide Subgroup bedrocks will be directly or indirectly impacted by the proposed Kudu renewable energy developments, they will not be discussed further here.

Well-developed sills and dykes of the Early Jurassic **Karoo Dolerite Suite** build and / or cap all the *koppies* within and on the margins of the Kudu project area (including Basberg) and also underlie some lower-lying areas (Figs. 15 to 18). Rubbly **colluvial deposits** of dolerite blocks and corestones mantle steeper hillslopes and obscure most underlying sedimentary bedrocks. Weathering of calcium-rich dolerite under semi-arid climates – probably in Pleistocene times for the most part - has contributed to the development of a pervasive, thick (up to 1 to 2 m or more) hardpan of cream-coloured **pedogenic calcrete** across most of the project area (Qc, yellow in Fig. 7). This hardpan is usually obscured by soil, alluvium and vegetation but is well exposed in occasional borrow pits inside and just outside the project area where extensive veining and disruption of weathered Ecca bedrocks by calcrete veins can also be seen (Figs. 12, 23 to 25). These pedogenic limestone deposits reflect seasonally arid climates in the region over the last five or so million years and are briefly described for the Britstown sheet area by Le Roux (1993). Although calcrete is still forming in the study area today, it forms subsurface and when exposed at the surface is “almost definitely fossil” (Botha 1988). The older, Pliocene - Pleistocene calcretes in the broader Kalahari region, including sandy limestones and calcretised conglomerates, have been assigned to the **Mokalanen Formation** of the **Kalahari Group** and are possibly related to a globally arid time period between 2.8 and 2.6 million years ago, *i.e.* late Pliocene (Partridge *et al.* 2006). Key review papers on South African calcretes are those by Netterberg (1969a-b, 1978, 1980, 1985, among other works). Calcrete types commonly encountered in the Northern Cape study area include glaebular calcrete (with discrete nodules), honeycomb calcrete (with coalescent glaebules) and hardpan calcrete (solid limestone within at most minor voids). The surface limestones may reach thicknesses of over 10m, but are often much thinner, and are locally conglomeratic with clasts of reworked calcrete as well as exotic pebbles.

Thick deposits of orange-brown, **sandy to sparsely gravelly older alluvium** of probable late Caenozoic age (perhaps Pleistocene or older) are associated with major drainage lines, such as that running just east of the EGI corridor (Figs. 19 to 22). Roadside borrow pit exposures of these sandy to gritty sediments on farm Koppy Alleen 83 show that they are semi- to well-consolidated and extensively calcretised (3D polygonal networks of calcrete veins, intermittent thin hardpans). The upper part of the succession includes calcretised gravel lenses incorporating flaked hornfels artefacts showing that at least these upper layers are of Pleistocene age or younger. Other Late Caenozoic superficial deposits encountered within the Kudu project area include eluvial (downwasted / sheetwashed) surface gravels – mainly composed of hornfels, dolerite, siltstone flakes and calcrete rubble with some grey-green wacke – as well as thick silty to sandy soils (Figs. 6, 26 to 29). Middle Stone Age (MSA) artefacts of patinated hornfels are common within the unconsolidated younger soils and are often concentrated along the interface with the underlying calcrete hardpan. Some of the orange-hued unconsolidated or partially calcretised surface sands within the project area might be relict patches of aeolian sands of the **Gordonia Formation** (**Kalahari Group**) of Pleistocene or younger age (*cf* Almond 2013b). Pale rounded features up to several decameters in diameter seen in flat-lying areas on satellite images are characterised by thick sandy soils with calcrete glaebules which are often extensively burrowed by modern mammals.

Representative exposures of the various rock units seen within or on the margins of the project area are illustrated below in Figures 8 to 29 with explanatory figure legends.

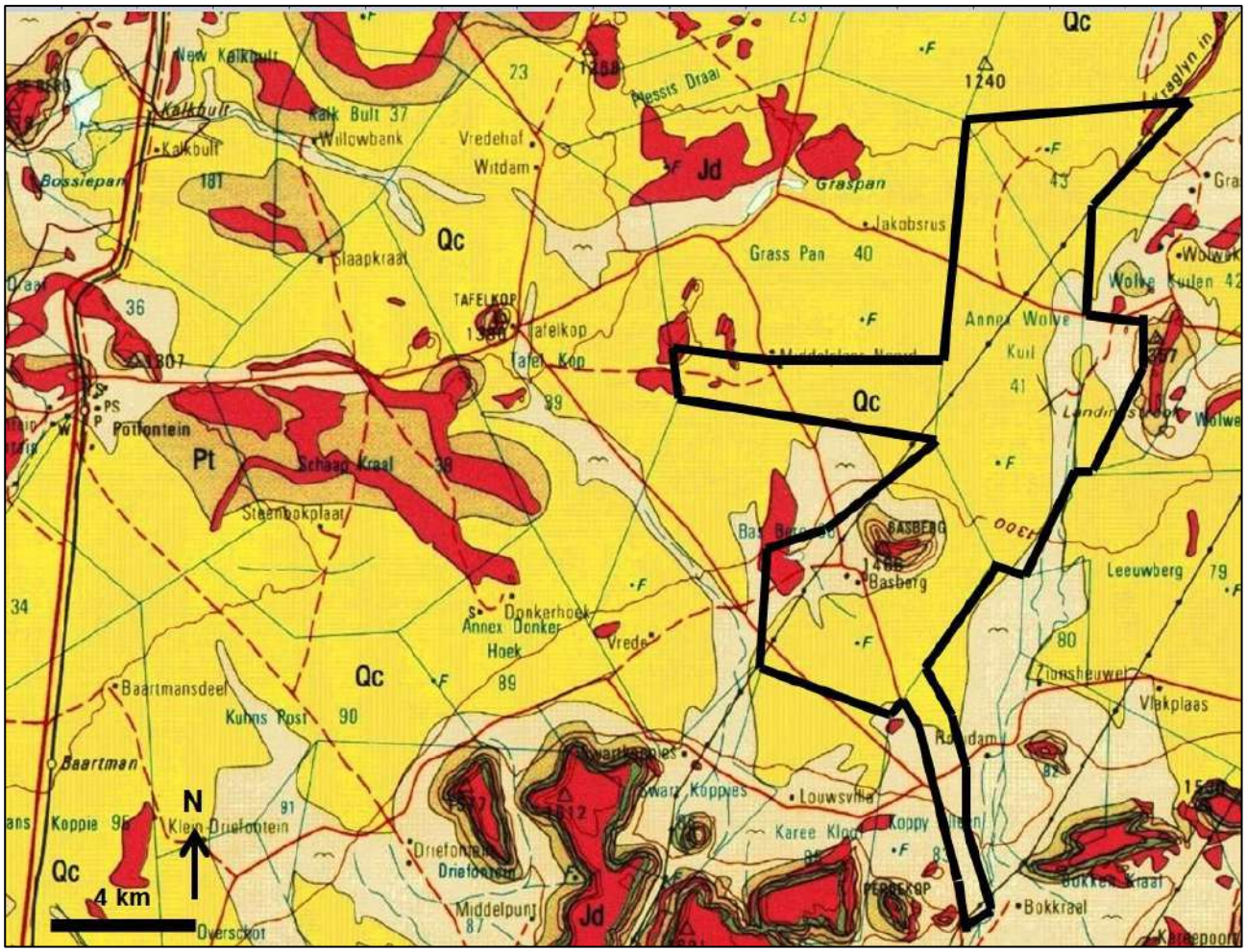


Figure 7: Extract from 1: 250 000 geology map 3024 Colesberg (Council for Geoscience, Pretoria) showing the project study area for the proposed Kudu solar facilities and associated infrastructure (including EGI corridor) near Philipstown and De Aar, Pixley Ka Seme District, Northern Cape (black polygon).
The main geological units mapped within the wider study region include:
Tierberg Formation (Ecca Group, Karoo Supergroup) – Pt (pale brown) (*N.B.* the upper part of this succession is now referred to the Waterford Formation)
Adelaide Subgroup – Pa (pale green) (*outside* Kudu project area)
Karoo Dolerite Suite – Jd (red)
Quaternary calcrete hardpans – Qc (yellow)
Late Caenozoic alluvium – off white (flying –bird symbol)
Unmapped Late Caenozoic superficial sediments include colluvium, eluvial surface gravels and soils (including possible relict aeolian sands of the Gordonia Formation, Kalahari Group).



Figure 8: Upper north-eastern slopes of the isolated *koppie* Basberg on Farm Bas Berg RE/88 showing baked Ecca metasediments (EC, probably Waterford Formation) sandwiched between sills of dolerite (Jd). See following figure for more detail.



Figure 9: Close-up of brownish-weathering, bedded wackes of the Ecca Group on Basberg seen in the previous illustration. These beds are mapped as basinal Tierberg Formation but probably belong to the overlying deltaic Waterford Formation (uppermost Ecca Group). They will not be directly impacted by the proposed Kudu renewable energy projects.



Figure 10: Thin bedded, baked shales and / or wackes of the Tierberg Formation exposed among doleritic colluvium on the higher southern slopes of the *koppie* just east of Wolwekuil homestead on Farm Wolwe Kuilen RE/42 (Image kindly provided by Dr Jayson Orton, ASHA Consulting).



Figure 11: View westwards towards *koppie* on Zionsheuwel 82 (just east of and outside EGI corridor) showing laterally-persistent *kranz* of prominent-weathering Waterford Formation wackes on middle slopes as well as dolerite sill capping. The low-lying EGI corridor project area in the foreground is underlain by the Tierberg Formation but the recessive-weathering bedrocks are not exposed here.



Figure 12: Dark grey, weathered, crumbly Tierberg Formation mudrocks with extensive secondary calcrete veination (probably Quaternary age) exposed in roadside borrow pit excavation on Farm Wolwe Kuilen 1/42, just north of Wolwekuil farmstead on Farm Wolwe Kuilen RE/42.



Figure 13: Rusty-brown weathering large carbonate concretion weathered out at surface from the Tierberg Formation on Bas Berg 3/88 (scale in cm and mm). Such diagenetic concretions might contain fossil palynomorphs (spores *etc*) or microvertebrate remains.



Figure 14: Isolated downwasted block of greyish, baked wacke of the Tierberg Formation among doleritic rubble, Wolwe Kuilen RE/42 (hammer = 30 cm).



Figure 15: Apron of orange-patinated hornfels gravels on the margins of the dolerite-capped *koppie* on Wolwe Kuilen RE/42. The hornfels forms an important raw material for Stone Age artefacts in the region.



Figure 16: Dolerite sill showing well-developed columnar jointing capping Tafelkop, *c*. 4.5 km west of and outside the Kudu solar project area (Tafel Kop 39).



Figure 17: Ecca Group bedrocks on hillslopes below dolerite sills are typically very poorly exposed due to cover by rubbly doleritic colluvium, soils and vegetation, as seen here on Wolwe Kuilen RE/42.



Figure 18: Shallow stream exposure of a pervasive subsurface calcrete hardpan covered by orange-brown sandy soils of alluvial and / or aeolian provenance, EGI corridor on Koppy Alleen 83.



Figure 19: Large roadside borrow pit on Koppy Alleen 1/83 excavated into calcretised sandy alluvial deposits such as those represented beneath large portions of the EGI corridor and related to the long-established drainage line just to the east of the corridor.



Figure 20: 3D polygonal network of calcrete veins and calcrete hardpans within orange-brown, gritty to sandy alluvium exposed in the borrow pit shown in the previous illustration (hammer = 30 cm).



Figure 21: Lens of calcretised fine gravels within the consolidated alluvium shown in the previous two figures (scale in cm). The incorporated gravel clasts include several flaked hornfels artefacts showing that the deposits are Pleistocene or younger in age.



Figure 22: Heavily calcretised, orange-brown cover sands overlying weathered Tierberg Formation bedrocks on the margins of a borrow pit on Farm Wolwe Kuilen 1/42, just north of Wolwekuil farmstead on Farm Wolwe Kuilen RE/42 (See Figure 12) (hammer = 30 cm).



Figure 23: Good borrow pit exposure of the pervasive, thick calcrete hardpan overlying most of the low-lying terrain within the Kudu renewable energy project area, seen here on farm RE/197, outside and *c*. 4.7 km west of the project area itself.



Figure 24: Sporadic exposure of a near-surface calcrete hardpan and overlying rubbly calcrete gravels as well as hornfels clasts on Annex Wolwe Kuil 1/41.



Figure 25: Good exposure of dark-grey, weathered, friable Tierberg Formation mudrocks showing extensive near-surface disruption and veining by Quaternary calcrete veins, seen here in an elongate roadside borrow pit on farm Grass Pan 1/40, *c*. 6.5 km west of and outside the Kudu renewable energy project area.



Figure 26: Occasional greyish areas on satellite images of the project area prove, on the ground, to represent weathered siltstone bedrocks of the Tierberg Formation with downwasted surface gravels of flaky mudrock, hornfels and dolerite (seen here on Portion 0 (RE) of Farm Wolve Kuilen 42). Well-preserved fossils are unlikely in this context.



Figure 27: Close-up of weathered, fissile, greyish Tierberg Formation siltstones and surface gravels shown in the previous image (hammer = 30 cm).



Figure 28: Eluvial, sheetwashed surface gravels of dolerite, hornfels and wacke overlying sandy soils on the southern side of Basberg (Bas Berg 3/88). Reworked blocks of silicified wood from the Waterford Formation *might* occur in such contexts but none were recorded here.



Figure 29: Patches of thick, orange-brown sands with dispersed calcrete rubble are often intensely burrowed by modern mammals, as seen here on Annex Wolwe Kuil 1/41. They appear as pale rounded features on satellite images and probably have a biological basis (*cf heuweltjies*). The sands themselves might originally have had an aeolian provenance.

5. PALAEONTOLOGICAL HERITAGE

Potential and recorded fossils within the various rock units mapped within the Kudu solar PV project and grid connection project areas have already been reviewed in some detail in several previous PIA reports for the De Aar – Kimberley region by the author (See References). Since the Waterford Formation (Ecca Group) and Adelaide Subgroup beds in the region will not be impacted by the proposed developments, they are not treated further here.

The fossil record of the **Tierberg Formation** has been reviewed in detail by Almond (2008a). Rare body fossil records include disarticulated microvertebrates (*e.g.* fish teeth and scales) from calcareous concretions in the Koffiefontein sheet area (Zawada 1992) and allochthonous plant remains (drifted leaves, petrified wood). The latter become more abundant in the upper, more proximal (prodeltaic) facies of the Tierberg (*e.g.* Wickens 1984). Prinsloo (1989) records numerous plant impressions and unspecified "fragmentary vertebrate fossils" (possibly temnospondyl amphibians) within fine-grained sandstones in the Britstown sheet area. Dark carbonaceous Ecca mudrocks are likely to contain palynomorphs (*e.g.* pollens, spores, acritarchs). Bosch (1993) and Visser *et al.* (1977) briefly mention body fossils within the Tierberg mudrocks in the broader Kimberley region. Concretions within the lower part of the formation may contain fish scales, coprolites and sponge spicules. Records of abundant silicified wood within the upper Tierberg succession are now referred to the Waterford Formation (see below).

The commonest fossils by far in the Tierberg Formation are sparse to locally concentrated assemblages of trace fossils that are often found in association with thin event beds (*e.g.* distal turbidites, prodeltaic sandstones) within more heterolithic successions. A modest range of ten or so different ichnogenera have been recorded from the Tierberg Formation (*e.g.* Abel 1935, Anderson 1974, 1976, Wickens 1980, 1984, 1994, 1996, Prinsloo 1989, De Beer *et al*., 2002, Viljoen 2005, Almond 2008a). These are mainly bedding parallel, epichnial and hypichnial traces, some preserved as undertracks. Penetrative, steep to subvertical burrows are rare, perhaps because the bottom sediments immediately beneath the sediment / water interface were anoxic. Most Tierberg ichnoassemblages display a low diversity and low to moderate density of traces. Apart from simple back-filled and / or lined horizontal burrows (*Planolites, Palaeophycus*) they include arthropod trackways (*Umfolozia*) and associated resting impressions (*Gluckstadtella*), undulose fish swimming trails (*Undichna*) that may have been generated by bottom-feeding palaeoniscoids, horizontal epichnial furrows (so-called *Scolicia*) often attributed to gastropods (these are also common in the co-eval Collingham Formation; Viljoen 1992, 1994), arcuate, finely-striated feeding excavations of an unknown arthropod (*Vadoscavichnia*), beaded traces ("*Hormosiroidea*" or "*Neonereites*"), small sinusoidal surface traces (*Cochlichnus*), small star-shaped feeding burrows (*Stelloglyphus*) and zigzag horizontal burrows (*Beloraphe*), as well as possible narrow (<1cm) *Cruziana* scratch burrows. The symmetrical, four-pronged trace *Broomichnium* (= *Quadrispinichna* of Anderson, 1974 and later authors) often occurs in groups of identical size (*c*. 3.5cm wide) and similar orientation on the bedding plane. This trace has frequently been misinterpreted as a web-footed tetrapod or arthropod trackway (*e.g.* Van Dijk *et al*. 2002 and references therein). However, Braddy and Briggs (2002) present a convincing case that this is actually a current-orientated arthropod resting trace (cubichnion), probably made by small crustaceans that lived in schools of similar-sized individuals and orientated themselves on the seabed with respect to prevailing bottom currents. Distinctive broad (3-4cm), strap-shaped, horizontal burrows with blunt ends and a more-or-less pronounced transverse ribbing occur widely within the Tierberg mudrocks. They have been described as "fucoid structures" by earlier workers (*e.g.* Ryan 1967) by analogy with seaweeds, and erroneously assigned to the ichnogenera *Plagiogmus* by Anderson (1974) and *Lophoctenium* by Wickens (1980, 1984). Examples up to one metre long were found in Tierberg mudrocks near Calvinia in 1803 by H. Lichtenstein, who described them as "eel fish". These are among the first historical records of fossils in South Africa (MacRae 1999). These as yet unnamed burrows are infilled with organized arrays of faecal pellets (Werner 2006). Sandstone sole surfaces with casts of complex networks of anastomosing (branching and fusing) tubular burrows have been attributed to the ichnogenus *Palaeodictyon*

(Prinsloo 1989) but may more appropriately assigned to *Megagrapton* (Almond 1998). These so-called graphoglyptid burrows are associated with turbidite facies from the Ordovician to Recent times and have been interpreted as gardening burrows or *agrichnia* (Seilacher, 2007). Microbial mat textures, such as *Kinneyia*, also occur in these offshore mudrocks but, like the delicate grazing traces with which they are often associated, are generally under-recorded.

The fossil record of the **Kalahari Group** is generally sparse and low in diversity. The **Gordonia Formation** dune sands were mainly active during cold, drier intervals of the Pleistocene Epoch that were inimical to most forms of life, apart from hardy, desert-adapted species. Porous dune sands are not generally conducive to fossil preservation. However, mummification of soft tissues may play a role here and migrating lime-rich groundwaters derived from the underlying bedrocks (including, for example, dolerite) may lead to the rapid calcretisation of organic structures such as burrows and root casts. Occasional terrestrial fossil remains that might be expected within this unit include calcretized rhizoliths (root casts) and termitaria (*e.g. Hodotermes*, the harvester termite), ostrich egg shells (*Struthio*) and shells of land snails (*e.g. Trigonephrus*) (Almond 2008a, Almond & Pether 2008). Other fossil groups such as freshwater bivalves and gastropods (*e.g. Corbula, Unio*) and snails, ostracods (seed shrimps), charophytes (stonewort algae), diatoms (microscopic algae within siliceous shells) and stromatolites (laminated microbial limestones) are associated with local watercourses and pans. Microfossils such as diatoms may be blown by wind into nearby dune sands (Du Toit 1954, Dingle *et al*., 1983). These Kalahari fossils (or subfossils) can be expected to occur sporadically but widely, and the overall palaeontological sensitivity of the Gordonia Formation is therefore considered to be low. Underlying calcretes of the **Mokolanen Formation** might also contain trace fossils such as rhizoliths, termite and other insect burrows, or even mammalian trackways. Mammalian bones, teeth and horn cores (also tortoise remains, and fish, amphibian or even crocodiles in wetter depositional settings such as pans; Partridge & Scott 2000) may be expected occasionally expected within Kalahari Group sediments and calcretes, notably those associated with ancient, Plio-Pleistocene alluvial gravels.

No High Palaeosensitivity fossil sites of scientific or conservation value were identified within the Kudu renewable energy project area during the palaeontological two-day site visit.

The only fossil material recorded from bedrock exposures here comprises low diversity trace fossil assemblages within fossil mudrocks of the Tierberg Formation excavated from a deep, steep-sided trench on farm Bas Berg RE 88 (30.245804° S, 24.315688° E) (Fig. 30 and Appendix 3, Fig. A3.1). The traces comprise poorly-preserved, simple to possibly branching horizontal burrows of *c*. 5 to 10 mm diameter which appear variously darker or paler than the surrounding speckled, grey-green siltstone matrix. Siltstone float blocks encountered among surface gravels sometimes contain broadly comparable simple horizontal burrows (*e.g.* south of Basberg on Bas Berg 3/88; 30.241383° S, 24.327129° E) (Fig. 31 and Appendix 3 Figure A3.1). These ichnoassemblages are of very widespread occurrence within the Tierberg Formation outcrop area and are not of significant scientific or conservation interest.

No fossils at all were recorded from the various Late Caenozoic superficial deposits within the Kudu renewable energy project area during the site visit. The potential for rare, largely unpredictable fossil sites of High palaeosensitivity associated with older alluvial and pan deposits in the subsurface cannot be entirely discounted (*e.g.* local concentrations of mammalian teeth, horncores and bones, non-marine molluscs, calcretised termitaria). Reworked blocks of silicified wood are likely to occur within surface gravels in the region but none were identified during the recent site visit.



Figure 30: Excavated block of speckled, grey-green Tierberg Formation siltstone containing vague, pale horizontal burrows (scale in cm and half-cm), farm Bas Berg RE 88 (30.245804° S, 24.315688° E). See Loc. 583 on satellite maps in Appendix 3.



Figure 31: Simple horizontal burrows preserved in dark material contrasting with the pale yellowish-grey matrix which is probably of baked Tierberg Formation mudrock, float block on farm Bas Berg 3/88 (30.241383° S, 24.327129° E) (scale in cm and mm). See Loc. 586 on satellite maps in Appendix 3.

6. SITE SENSITIVITY VERIFICATION

Provisional site sensitivity mapping for palaeontological heritage prepared by the CSIR using the DFFE National Web-Based Environmental Screening Tool suggests that the Kudu solar facility project area as well as the associated grid connection corridors are largely of Medium to High palaeosensitivity, with scattered small areas of zero or negligible sensitivity reflecting intrusions of Karoo dolerite (Fig. 32).

Based on several previous desktop and field-based PIA studies by the author in the broader De Aar region (listed in References) as well as the recent 2-day palaeontological site, it is concluded that the Kudu solar facility and grid connection project areas are in fact of **Low to Very Low palaeosensitivity overall**, although the potential for rare, largely unpredictable fossil sites of High palaeosensitivity associated with older alluvial and pan deposits in the subsurface cannot be entirely discounted. The DFFE-based palaeosensitivity mapping is accordingly *contested* here.

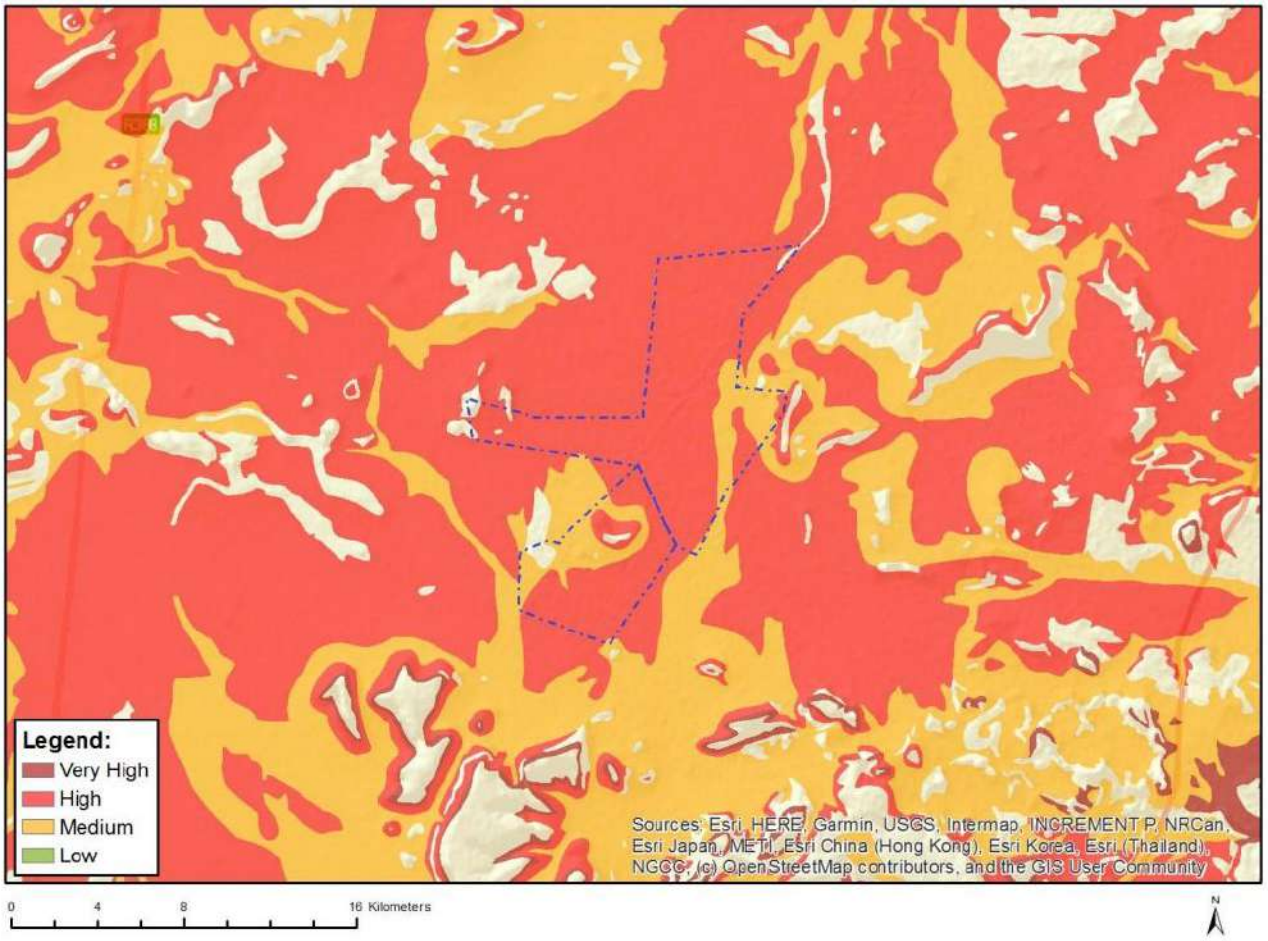


Figure 32: Palaeontological sensitivity map for the Kudu solar facility project area near De Aar, Northern Cape (blue dotted polygon), abstracted from the DFFE Screening Report prepared by the CSIR (February 2022[4]). The outcrop area of the Tierberg Formation is assigned a High palaeosensitivity, Late Caenozoic alluvium a Medium sensitivity while Karoo dolerite intrusions are designated as insensitive, according to the Screening Tool. This sensitivity mapping is *contested* in this report which concludes the entire Kudu project study area (including EGI corridor in the southeast) is of Low to Very Low palaeosensitivity overall.

[4] Screening Tool Reports generated in December 2022 and May 2023 do not result in any changes to the sensitivities depicted in this report.

7. CONCLUSIONS

The Kudu solar facility and grid connection project area near De Aar, Northern Cape, largely comprises low-relief terrain mantled with thick Late Caenozioic calcrete hardpans, alluvial deposits, surface gravels and soils that are generally of low palaeosensitivity. Natural bedrock exposure here is very limited and mainly involves unfossiliferous dolerite as well as baked Ecca Group metasediments (probable Waterford Formation) building *kranzes* on upper hillslopes (*e.g.* Basberg) that will not be directly impacted by the proposed development. Early to Middle Permian basinal mudrocks of the Tierberg Formation (Ecca Group, Karoo Supergroup) which are mapped as underlying the majority of the project area are hardly ever exposed and, where seen (*e.g.* in borrow pits), they are generally weathered, friable and extensively disrupted by near-surface calcrete veins. The offshore mudrocks of the Tierberg Formation are not known elsewhere to have a rich fossil record (mainly low-diversity trace fossil assemblages, petrified wood, palynomorphs and rare microvertebrate remains such as fish scales and teeth). In the present project area the potential for well-preserved fossils is further reduced by near-surface weathering, calcrete veining as well as baking of sedimentary bedrocks by intensive regional dolerite intrusion in Early Jurassic times. The only fossils recorded from the Ecca Group sediments during the 2-day palaeontological site visit comprise sparse, low diversity trace fossil assemblages of low scientific or conservation interest. Thick sandy to gravelly alluvial deposits associated with long-established drainage lines are extensively calcretised. No fossil remains were recorded within them.

According to the DFFE screening tool mapping, the majority of the Kudu solar PV facility and associated grid connection corridor is of Medium to High palaeosensitivity. This provisional assessment is *contested* in the present Site Sensitivity Verification Report, based on a 2-day palaeontological site visit and several previous field-based and desktop PIA studies in the broader De Aar - Kimberley region. It is concluded that the Kudu solar PV and grid connection project areas are in fact of LOW to VERY LOW palaeosensitivity in general. However, the potential for rare, largely unpredictable fossil sites (*e.g.* mammalian bones, teeth, horncores, non-marine molluscs, calcretised termitaria) of High palaeosensitivity associated with older alluvial and pan deposits hidden in the subsurface cannot be discounted. Most such fossil sites would probably be protected during construction by environmental buffer zones along drainage lines.

If any fossiliferous deposits are exposed by surface clearance or excavations during the construction phase of the development, the Chance Fossils Finds Protocol outlined in Appendix 2 to this report should be fully implemented. These recommendations should be included within the Environmental Management Programmes (EMPrs) for the Kudu Solar PV Facilities and associated infrastructure developments.

All of the various sites for solar PV facilities, on-site substations, grid connection corridors and associated infrastructure currently under consideration are of LOW to VERY LOW palaeosensitivity. The only two fossil sites recorded in the region fall *outside* the PV project areas (Appendix 3) and are of low scientific / conservation interest so no mitigation is recommended with regard to them. Provided that the Chance Fossil Finds Protocol tabulated in Appendix 2 is incorporated into the EMPrs and fully implemented during the construction phase of the solar PV facility and grid connection developments, there are no objections on palaeontological heritage grounds to authorisation of the proposed renewable energy developments. Pending the discovery of significant new fossil finds before or during construction, no further specialist palaeontological studies, reporting, monitoring or mitigation are recommended for these renewable energy projects.

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APPENDIX 1: John Almond Short CV

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and the University of Tübingen in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa and Madagascar. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out numerous palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest Province, Mpumalanga, Gauteng, KwaZulu-Natal and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as a member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence (See overleaf)

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



Dr John E. Almond
Palaeontologist
***Natura Viva* cc**

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

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NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 - 12), near De Aar, Northern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
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1. SPECIALIST INFORMATION

Specialist Company Name:	Natura Viva cc			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100
Specialist name:	Dr John Edward Almond			
Specialist Qualifications:	PhD (Palaeontology) University of Cambridge, UK			
Professional affiliation/registration:	Palaeontological Society of Southern Africa Association of Professional Heritage Practitioners (Western Cape)			
Physical address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN			
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Postal code:	8001	Cell:	071 947 0577	
Telephone:	021 462 3622	Fax:	n/a	
E-mail:	naturaviva@universe.co.za			

2. DECLARATION BY THE SPECIALIST

I, **Dr John Edward Almond**, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

J n E Almond

Signature of the Specialist

NATURA VIVA CC

Name of Company:

3 July 2023

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, **Dr John Edward Almond,** swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

John E Almond

Signature of the Specialist

NATURA VIVA CC

Name of Company

3 July 2023

Date

Signature of the Commissioner of Oaths

03 July 2023

Date

KERRY AUGUST
Commissioner of Oaths
Master HR Professional (MHRP)
Member Number: 53544596
25 Bordeaux Close
Stellenbosch
7600

SABPP™
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Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

APPENDIX 2: Kudu Solar PV Facilities and Associated Infrastructure near De Aar

<table>
<tr><td>Province & region:</td><td colspan="2">Northern Cape: Pixley Ka Seme District</td></tr>
<tr><td>Responsible Heritage Resources Agency</td><td colspan="2">SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za).</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Early to Middle Permian Tierberg and Waterford Formation (Ecca Group), Late Caenozoic calcrete hardpans, alluvium, aeolian sands, pan sediments, surface gravels (Kalahari Group)</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Trace fossil assemblages, petrified wood, microvertebrate remains within Ecca Group sediments.
Potential for concentrations of mammalian fossil remains (bones, teeth, horncores), trace fossils, non-marine molluscs in association with calcrete hardpans.
Fossil mammal bones, teeth, horn cores, freshwater molluscs, plant material in Late Caenozoic alluvium and pan deposits.</td></tr>
<tr><td rowspan="5">Environmental Control Officer (ECO) protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
Context – describe position of fossils within stratigraphy (rock layering), depth below surface
Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation
Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Agency for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
Photograph fossils against a plain, level background, with scale
Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Agency, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Agency</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Agency. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Agency minimum standards.</td></tr>
</table>

APPENDIX 3: Fossil Locality Data for Kudu Solar Photovoltaic Facilities

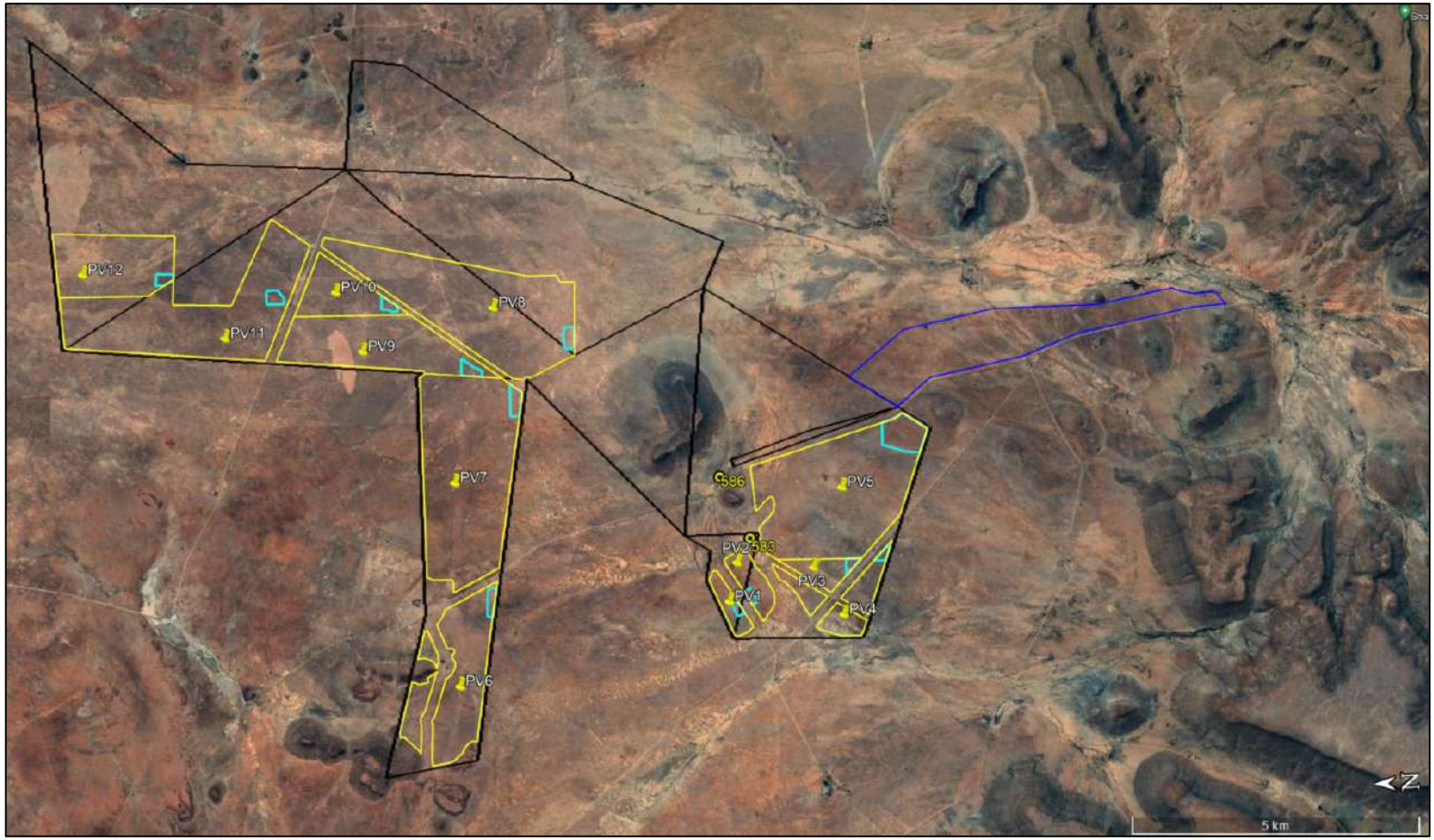


Figure A3.1: Google Earth© satellite image showing the project area for the Kudu Solar Photovoltaic Facilities and associated infrastructure near Philipstown and De Aar, Northern Cape (black and blue polygons) as well as the buildable area/development footprint for each PV project (yellow polygon) and proposed on-site substation complex sites (small, pale blue polygons). The two recorded fossil sites are indicated by the numbered yellow circles (Please see following figure for more detail). *N.B.* North is towards the LHS.

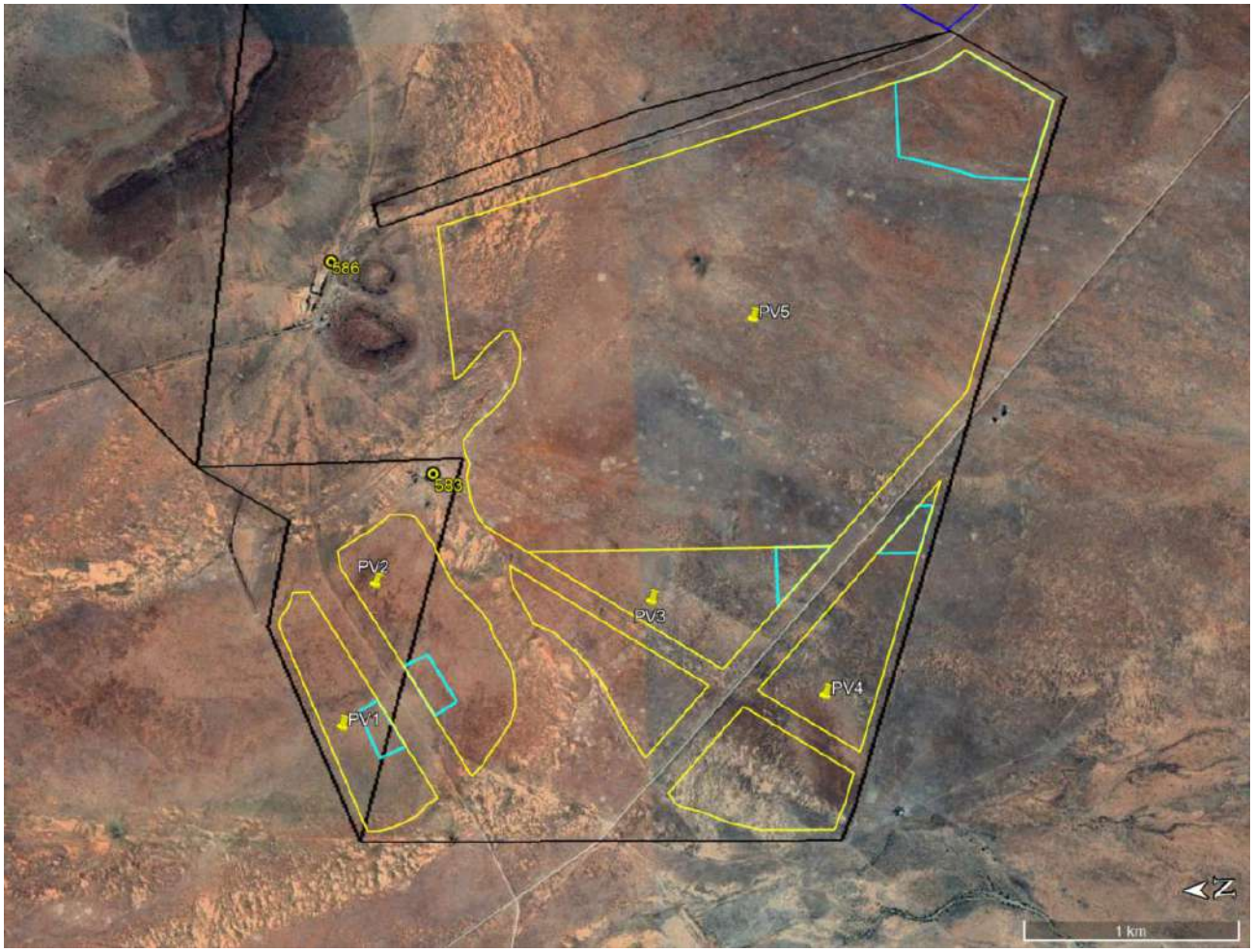


Figure A3.2: Google Earth© satellite image showing the project area for the southern cluster of Kudu Solar Photovoltaic Facilities and associated infrastructure near Philipstown and De Aar, Northern Cape. The two recorded fossil sites indicated by the numbered yellow circles (583, 586) both fall *outside* the PV buildable areas/development footprints and are of low scientific / conservation value so no mitigation is proposed with regard to them. *N.B.* North is towards the LHS.

Table A3.1: Palaeontological heritage data for Kudu Solar Photovoltaic Facilities

Kudu Solar PV Facility project	Recorded fossil heritage	Recommended mitigation
PV1	None	Application of Chance Fossil Finds Protocol during Construction Phase
PV2	None	Application of Chance Fossil Finds Protocol during Construction Phase
PV3	None	Application of Chance Fossil Finds Protocol during Construction Phase
PV4	None	Application of Chance Fossil Finds Protocol during Construction Phase
PV5	None	Application of Chance Fossil Finds Protocol during Construction Phase
PV6	None	Application of Chance Fossil Finds Protocol during Construction Phase
PV7	None	Application of Chance Fossil Finds Protocol during Construction Phase
PV8	None	Application of Chance Fossil Finds Protocol during Construction Phase
PV9	None	Application of Chance Fossil Finds Protocol during Construction Phase
PV10	None	Application of Chance Fossil Finds Protocol during Construction Phase
PV11	None	Application of Chance Fossil Finds Protocol during Construction Phase
PV12	None	Application of Chance Fossil Finds Protocol during Construction Phase

PALAEONTOLOGICAL SSV SITE VISIT APRIL 2022		
LOC	**GPS data**	**Comments**
583	**30.245804° S, 24.315688° E**	**Excavated block of speckled, grey-green Tierberg Formation siltstone containing vague, pale horizontal burrows (scale in cm and half-cm), farm Bas Berg RE 88. Provisional Field Rating IIIC Local Resource. Located *outside* PV project development area. No mitigation recommended.**
586	**30.241383° S, 24.327129° E**	**Simple horizontal burrows preserved in dark material contrasting with the pale yellowish-grey matrix which is probably of baked Tierberg Formation mudrock, float block on farm Bas Berg 3/88. Provisional Field Rating IIIC Local Resource. Located *outside* PV project development area. No mitigation recommended.**



CHAPTER 13:

Socio-Economic Assessment



CSIR
Touching lives through innovation

SOCIO-ECONOMIC ASSESSMENT

KUDU PV 4 SOLAR ENERGY FACILITY

NORTHERN CAPE PROVINCE

VERSION 0: APRIL 2023
VERSION 1: JULY 2023

Prepared

By

Tony Barbour and Schalk van der Merwe

Tony Barbour
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EXECUTIVE SUMMARY

INTRODUCTION AND LOCATION

The CSIR was appointed to manage the Environmental Impact Assessment (EIA) process for the proposed Kudu PV Solar Energy Facility (SEF) Cluster located approximately 60km north of the town of De Aar in the Northern Cape Province. The project site is situated within the Renosterberg Local Municipality (RLM), which is located within the Pixley Ka Seme District Municipality (PKSDM). The Kudu PV4 SEF (50 MW) forms part of a cluster consisting of 12 PV SEFs (PV1-PV12) with a combined generation capacity of 2 180 MW.

Tony Barbour was appointed to undertake a specialist Socio-economic Assessment as part of the EIA process. This report assesses the social impacts associated with the 50 MW Kudu PV 4 SEF.

SUMMARY OF KEY FINDINGS

KEY FINDINGS

The key findings of the study are summarised under the following sections:

- Fit with policy and planning.
- Construction phase impacts.
- Operational phase impacts.
- Cumulative impacts.
- Decommissioning phase impacts.
- No-development option.

POLICY AND PLANNING ISSUES

The development of and investment in renewable energy is supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all refer to and support renewable energy. The PKSDM Spatial Development Framework (SDF) and Integrated Development Plan (IDP) also support the development of renewable energy. The development of the proposed SEF is therefore supported by key policy and planning documents.

CONSTRUCTION PHASE

Potential positive impacts

- Creation of employment and business opportunities, and the opportunity for skills development and on-site training.

The construction phase is expected to extend over a period of 12 to 18 months and create approximately 150 employment opportunities. The total wage bill for the construction phase is estimated to be in the region of R 30 million (2023 Rand value). A percentage of the wage bill will be spent in the local economy which will also create opportunities for local businesses in the local towns in the area and the RLM and Emthanjeni Local Municipality (ELM).

Members from the local communities in De Aar, Philipstown and Petrusville may potentially qualify for low skilled and semi-skilled and some skilled employment opportunities. Most of these employment opportunities will accrue to Historically Disadvantaged (HD) members of the community. Given relatively high local unemployment levels and limited job opportunities in the area, this will represent a significant, if localised, social benefit. However, in the absence of specific commitments from the developer to employ local contractors the potential for meaningful skills to local employment targets the benefits for members from the local communities may be limited. In addition, the low education and skills levels in the area may also hamper potential opportunities for local communities.

The capital expenditure associated with the construction phase will be approximately R 1.5 – 2 billion (2023 Rand value). This will create opportunities for local companies and the regional and local economy. Due the lack of diversification in the local economy the potential for local companies is likely to be limited. The majority of benefits are therefore likely to accrue to contractors and engineering companies based outside the RLM and ELM. The local service sector will also benefit from the construction phase. The potential opportunities would be linked to accommodation, catering, cleaning, transport, and security, etc. associated with the construction workers on the site.

Potential negative impacts

- Impacts associated with the presence of construction workers on local communities.
- Impacts related to the potential influx of job seekers.
- Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site.
- Increased risk of grass fires associated with construction related activities.
- Noise, dust, and safety impacts of construction related activities and vehicles.
- Impact on productive farmland.

The findings of the SIA indicate that the significance of all the potential negative impacts with mitigation are likely to be **Low Negative**. The potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented. Table 1 summarises the significance of the impacts associated with the construction phase.

Table 1: Summary of social impacts during construction phase

Impact	Significance No Mitigation/Enhancement	Significance With Mitigation/Enhancement
Creation of employment and business opportunities	Medium (+)	Medium (+)
Presence of construction workers and potential impacts on family structures and social networks	Medium (-)	Low (-)
Influx of job seekers	Low (-)	Low (-)
Safety risk, stock theft and damage to farm infrastructure associated with presence of construction workers	Medium (-)	Low (-)
Increased risk of grass fires	Medium (-)	Low (-)
Impact of heavy vehicles and construction activities	Medium (-)	Low (-)
Loss of farmland	Medium (-)	Low (-)

OPERATIONAL PHASE

Potential positive impacts
- Establishment of infrastructure to improve energy security and support renewable sector.
- Creation of employment opportunities.
- Benefits associated with socio-economic contributions to community development.
- Benefits for local landowners.

The proposed project will supplement South Africa's energy and assist to improve energy security. In addition, it will also reduce the country's reliance on coal as an energy source. This represents a positive social benefit.

Potential negative impacts
- Visual impacts and associated impacts on sense of place.
- Potential impact on property values.
- Potential impact on tourism.

The findings of the SIA indicate that the significance of all the potential negative impacts with the exception of visual impacts will be **Low Negative** with mitigation. The majority of potential negative impacts can therefore be effectively mitigated. The significance of the impacts associated with the operational phase are summarised in Table 2.

Table 2: Summary of social impacts during operational phase

Impact	Significance No Mitigation/Enhancement	Significance With Mitigation/Enhancement
Establishment of infrastructure to improve energy security and support renewable sector	High (+)	High (+)
Creation of employment and business opportunities during maintenance	Low (+)	Medium (+)
Benefits associated with socio-economic contributions to community development	Medium (+)	High (+)
Benefits for landowners	Low (+)	High (+)
Visual impact and impact on sense of place	Low (-)	Low (-)
Impact on property values	Low (-)	Low (-)
Impact on tourism	Low (-)	Low (-)

CUMULATIVE IMPACTS

Cumulative impact on sense of place
The establishment of the proposed PV SEF and other renewable energy facilities in the area will create the potential for combined and sequential visibility impacts. This impact is rated as **Moderate Negative**.

Cumulative impact on local services and accommodation
The significance of this impact with effective mitigation was rated as **Low Negative**.

Cumulative impact on local economy
The significance of this impact with enhancement was rated as **Moderate Positive**.

DECOMMISSIONING

Given the moderate number of people employed during the operational phase (~ 30), the potential negative social impacts associated with the decommissioning phase can also be effectively managed with the implementation of a retrenchment and downscaling programme. With mitigation, the impacts are assessed to be **Low Negative**.

NO-DEVELOPMENT OPTION

The No-Development option would represent a lost opportunity for South Africa to improve energy security and supplement its current energy needs with clean, renewable energy. Given South Africa's current energy security challenges and its

position as one of the highest per capita producers of carbon emissions in the world, this would represent a significant negative social cost. The No-Development option is not supported by the findings of the SIA.

ASSESSMENT OF BESS SITE

Based on the findings of the SIA the proposed BESS site and both proposed technology alternatives are suitable from a social impact assessment point of view.

CONCLUSIONS AND RECOMMENDATIONS

The findings of the SIA indicate that the proposed Kudu PV 4 SEF will result in several social and socio-economic benefits, including creation of employment and business opportunities during both the construction and operational phases. The project will also create economic development opportunities for the local community. The enhancement measures listed in the report should be implemented in order to maximise the potential benefits. The significance of this impact is rated as **High Positive**. The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the negative environmental and socio-economic impacts associated a coal-based energy economy and the challenges created by climate change, represents a significant positive social benefit for society as a whole. The Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) has resulted in significant socio-economic benefits, both at a national level and at a local, community level. These benefits are linked to foreign Direct Investment, local employment and procurement and investment in local community initiatives.

The findings also indicate that the potential negative impacts associated with both the construction and operational phase are likely to be **Low Negative** with mitigation. The potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented.

Statement and reasoned opinion
The establishment of the proposed Kudu PV 4 SEF and associated infrastructure is therefore supported by the findings of the SIA.

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Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	Section 1.6, Annexure C
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Section 1.7, Annexure D
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1, Section 1.2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1.2, Section 3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A for SIA
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.2, Annexure B
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 4, Section 5
(g) an identification of any areas to be avoided, including buffers;	N/A
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 3
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.5
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment, or activities;	Section 4, Section 5,
(k) any mitigation measures for inclusion in the EMPr;	Section 4
(l) any conditions for inclusion in the environmental authorisation;	Section 4, Section 5
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	N/A
(n) a reasoned opinion— i. as to whether the proposed activity, activities or portions thereof should be authorised; iA. Regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan;	Section 5.3
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
(p) any other information requested by the competent authority	N/A
Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	

ACRONYMS

BESS	Battery Energy Storage System
DEA	Department of Environmental Affairs
DEA&DP	Department of Environmental Affairs and Development Planning
DM	District Municipality
EIA	Environmental Impact Assessment
ELM	Emthanjeni Local Municipality
HD	Historically Disadvantaged
IDP	Integrated Development Plan
IPP	Independent Power Producer
kV	Kilovolts
LED	Local Economic Development
LM	Local Municipality
MW	Megawatt
NC	Northern Cape
NCPPGDS	Northern Cape Province Provincial Growth and Development Strategy
NCSDF	Northern Cape Spatial Development Framework
PGDS	Provincial Growth and Development Strategy
PKSDM	Pixley Ka Seme District Municipality
RLM	Renosterberg Local Municipality
SDF	Spatial Development Framework
SED	Socio-economic Development
SEF	Solar Energy Facility
SIA	Social Impact Assessment

SECTION 1: INTRODUCTION

1.1 INTRODUCTION

The CSIR was appointed to manage the Environmental Impact Assessment (EIA) process for the proposed Kudu PV Solar Energy Facility (SEF) Cluster located approximately 60km north of the town of De Aar in the Northern Cape Province (Figure 1.1). The project site is situated within the Renosterberg Local Municipality (RLM), which is located within the Pixley Ka Seme District Municipality (PKSDM). The Kudu PV SEF Cluster consists of 12 PV SEFs (PV1-PV12).

Tony Barbour was appointed to undertake a specialist Social Impact Assessment (SIA) as part of the EIA process. This report assesses the social impacts associated with the 50 MW Kudu PV 4 SEF.

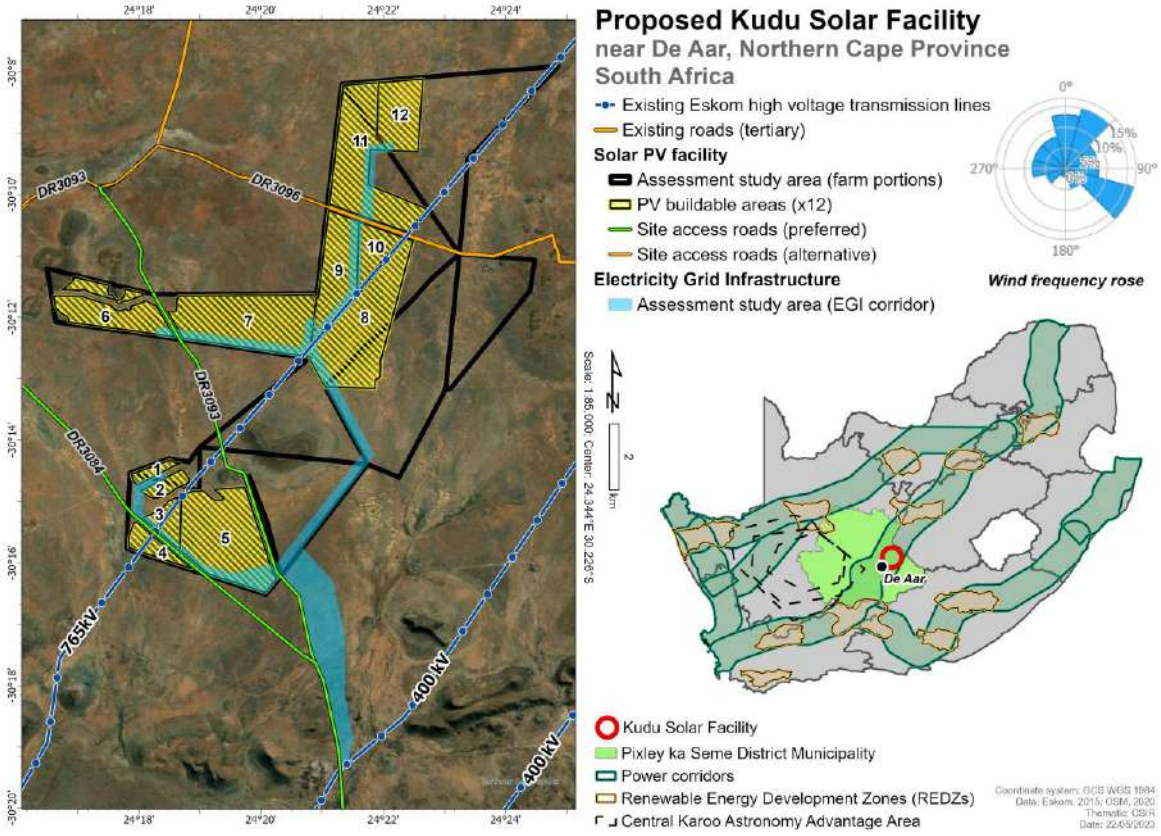


Figure 1.1: Location of the Kudu PV4 SEF within the SEF cluster

1.2 TERMS OF REFERENCE AND APPROACH

The approach to the SIA study is based on the WC DEA&DP Guidelines for Social Impact Assessment (February 2007). These guidelines are based on international best practice and are used throughout South Africa. The key activities in the SIA process embodied in the guidelines include:

- Describing and obtaining an understanding of the proposed intervention (type, scale, and location), the settlements, and communities likely to be affected by the proposed project.
- Collecting baseline data on the current social and economic environment.
- Identifying the key potential social issues associated with the proposed project. This requires a site visit to the area and consultation with affected individuals and communities. As part of the process a basic information document was prepared and made available to key interested and affected parties. The aim of the document was to inform the affected parties of the nature and activities associated with the construction and operation of the proposed development to enable them to better understand and comment on the potential social issues and impacts.
- Assessing and documenting the significance of social impacts associated with the proposed intervention.
- Identifying and assessing alternatives and recommending alternatives and mitigation measures.

In this regard the study involved:

- Review of socio-economic data for the study area.
- Review of relevant planning and policy frameworks for the area.
- Review of information from similar studies, including the SIAs undertaken for other renewable energy projects.
- Site visit and interviews with key stakeholders.
- Identifying the key potential social issues associated with the proposed project.
- Identifying and assessing the significance of social impacts associated with the proposed project.
- Identification of enhancement and mitigation measures aimed at maximizing opportunities and avoiding and or reducing negative impacts.

Annexure A contains a list of the secondary information reviewed and interviews conducted. Annexure B summarises the assessment methodology used to assign significance ratings to the assessment process.

1.3 PROJECT DESCRIPTION

ABO Wind is intending to develop the proposed Kudu PV SEF Cluster. As noted above, the project will entail the proposed development of up to 12 Solar PV SEFs and associated electrical infrastructure. The proposed projects are not located within any of the Renewable Energy Development Zones (REDZs) that were gazetted in Government Notice (GN) 114 in February 2018 and GN 144 in February 2021. Therefore, full Scoping and EIA Processes are needed.

During the scoping phase, the specialists considered the entire study area, which included the Original Scoping Buildable Areas that included the development of up to 15 Solar PV Facilities. However, following the identification of sensitivities and the Bidding Window 6 Request for Proposal capacity limits, the proposed projects were re-clustered and a total of up to 12 Solar PV Facilities are now being proposed. The 50 MW Kudu PV 4 SEF will consist of:

- Solar PV array comprising fixed-tilt, single axis tracking, dual axis tracking, mono-facial or bi-facial PV technology (Photograph 1.1).
- Access roads. Existing roads will be used as main access were possible, and may need to be widened or expanded.

- New internal service roads will need to be established and these would either comprise farm (compacted dirt/gravel) roads or be paved.
- Underground cabling (22-33 kV), with the potential for above-ground routing where needed (22-33 kV).
- On-site substation complex at each PV Facility including the following:
  - On-site Independent Power Producer (IPP) or Facility Substation (+-1 ha).
  - Battery Energy Storage System (discussed below).
  - Switching Station and Collector Station (this is the subject of a separate Environmental Assessment process).
- Overhead powerlines (132 kV) (this is the subject of a separate Environmental Assessment (EA) process).
- Laydown areas.
- Temporary site compound.
- Auxiliary buildings to be developed include, but are not limited to Operations and Maintenance (O&M) buildings, site offices, staff lockers, bathrooms, warehouses/workshops, guardhouses, etc.
- Battery energy storage systems (BESS) of 500 MW (or 500 MWh), which could be either lithium-ion or redox flow technology only (Photograph 1.2).

It is the developer's intention to bid the proposed project under the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme (or similar programme), with the aim of evacuating the generated power into the national grid. This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP).

Refer to Chapter 2 of the EIA Report for an illustration of the detailed layout of the proposed project.



Photograph 1.1: Typical PV SEF facility



Photograph 1.2: Example of BESS located in storage containers

1.4 ASSUMPTIONS AND LIMITATIONS

1.4.1 Assumptions

Technical suitability
It is assumed that the development site represents a technically suitable site for the establishment of the proposed PV SEF and associated infrastructure.

Strategic importance of the project
The strategic importance of promoting renewable and other forms of energy is supported by the national and provincial energy policies.

Fit with planning and policy requirements
Legislation and policies reflect societal norms and values. The legislative and policy context therefore plays an important role in identifying and assessing the potential social impacts associated with a proposed development. In this regard, a key component of the SIA process is to assess the proposed development in terms of its fit with key planning and policy documents. As such, if the findings of the study indicate that the proposed development in its current format does not conform to the spatial principles and guidelines contained in the relevant legislation and planning documents, and there are no significant or unique opportunities created by the development, the development cannot be supported.

1.4.2 Limitations

Demographic data
Some of the provincial documents do not contain data from the 2011 Census and or 2016 Household Community Survey. However, where required the relevant 2011 and 2016 data has been provided.

1.5 SPECIALIST DETAILS

Tony Barbour, the lead author of this report, is an independent specialist with 30 years' experience in the field of environmental management. In terms of SIA experience Tony Barbour has undertaken in the region of 300 SIAs and is the author of the Guidelines for Social Impact Assessments for EIA's adopted by the DEA&DP in the Western Cape in 2007. Annexure C contains a copy of Tony Barbour's CV.

Schalk van der Merwe, the co-author of this report, has an MPhil in Environmental Management from the University of Cape Town and has worked closely with Tony Barbour over the last seventeen years.

1.6 DECLARATION OF INDEPENDENCE

This confirms that Tony Barbour and Schalk van der Merwe, the specialist consultants responsible for undertaking the study and preparing the SIA Report, are independent and do not have any vested or financial interests in the proposed power line being either approved or rejected. Annexure D contains a signed declaration of independence.

1.7 REPORT STRUCTURE

The report is divided into five sections, namely:

- Section 1: Introduction.
- Section 2: Summary of key policy and planning documents.
- Section 3: Overview of the study area.
- Section 4: Identification and assessment of key social issues.
- Section 5: Summary of key findings and recommendations.

SECTION 2: POLICY AND PLANNING ENVIRONMENT

2.1 INTRODUCTION

Legislation and policy embody and reflect key societal norms, values, and developmental goals. The legislative and policy context therefore plays an important role in identifying, assessing, and evaluating the significance of potential social impacts associated with any given proposed development. An assessment of the "policy and planning fit[1]" of the proposed development therefore constitutes a key aspect of the Social Impact Assessment (SIA). In this regard, assessment of "planning fit" conforms to international best practice for conducting SIAs.

Section 2 provides an overview of the policy and planning environment affecting the proposed project. For the purposes of meeting the objectives of the SIA the following policy and planning documents were reviewed:

- National Energy Act (2008).
- White Paper on the Energy Policy of the Republic of South Africa (December 1998).
- White Paper on Renewable Energy (November 2003).
- Integrated Resource Plan (IRP) for South Africa (2019).
- National Infrastructure Plan (NIP) (2012 and 2021).
- National Development Plan (2011).
- Northern Cape Provincial Growth and Development Strategy (2004-2014).
- Northern Cape Climate Change Response Strategy.
- Northern Cape Spatial Development Framework (2012).
- Northern Cape Province Green Document (2017/2018).
- Pixley ka Seme District Municipality Integrated Development Plan (2019-2020).
- Pixley ka Seme District Municipality Spatial Development Framework (2017).
- Emthanjeni Local Municipality Integrated Development Plan (2021-2022).
- Renosterberg Local Municipality Integrated Development Plan [2].

The section also provides a review of the renewable energy sector in South Africa.

2.2 NATIONAL POLICY ENVIRONMENT

2.2.1 National Energy Act (Act No 34 of 2008)

The National Energy Act was promulgated in 2008 (Act No 34 of 2008). One of the objectives of the Act was to promote diversity of supply of energy and its sources. In this regard, the preamble makes direct reference to renewable resources, including solar and wind:

"To ensure that diverse energy resources are available, in sustainable quantities, and at affordable prices, to the South African economy, in support of economic

[1] Planning fit" can simply be described as the extent to which any relevant development satisfies the core criteria of appropriateness, need, and desirability, as defined or circumscribed by the relevant applicable legislation and policy documents at a given time.

[2] At the time of undertaking the study a copy of the 2017-2022 Renosterberg Local Municipality Integrated Development Plan (IDP) could not be sourced.

growth and poverty alleviation, taking into account environmental management requirements (…); to provide for (…) increased generation and consumption of renewable energies…"(Preamble).

2.2.2 White Paper on the Energy Policy of the Republic of South Africa

Investment in renewable energy initiatives, such as the proposed SEF, is supported by the White Paper on Energy Policy for South Africa (December 1998). In this regard, the document notes:

"Government policy is based on an understanding that renewables are energy sources in their own right, are not limited to small-scale and remote applications, and have significant medium and long-term commercial potential".

"Renewable resources generally operate from an unlimited resource base and, as such, can increasingly contribute towards a long-term sustainable energy future".

The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly ***solar*** and wind and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account.

Government policy on renewable energy is thus concerned with meeting the following challenges:

- Ensuring that economically feasible technologies and applications are implemented.
- Ensuring that an equitable level of national resources is invested in renewable technologies, given their potential, and compared to investments in other energy supply options; and,
- Addressing constraints on the development of the renewable industry.

The White Paper also acknowledges that South Africa has neglected the development and implementation of renewable energy applications, despite the fact that the country's renewable energy resource base is extensive, and many appropriate applications exist.

The White Paper also notes that renewable energy applications have specific characteristics that need to be considered. Advantages include:

- Minimal environmental impacts in operation in comparison with traditional supply technologies; and
- Generally lower running costs, and high labour intensities.

Disadvantages identified at the time include:

- Higher capital costs in some cases.
- Lower energy densities.
- Lower levels of availability, depending on specific conditions, especially with sun and wind-based systems.

2.2.3 White Paper on Renewable Energy

The White Paper on Renewable Energy (November 2003) (further referred to as the White Paper) supplements the *White Paper on Energy Policy*, which recognizes that

the medium and long-term potential of renewable energy is significant. This Paper sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa.

The White Paper notes that while South Africa is well endowed with renewable energy resources that have the potential to become sustainable alternatives to fossil fuels, these have thus far remained largely untapped. As signatory to the Kyoto Protocol[3], Government is determined to make good the country's commitment to reducing greenhouse gas emissions. To this purpose, Government has committed itself to the development of a framework in which a national renewable energy framework can be established and operate.

South Africa is also a signatory of the Copenhagen Accord, a document that delegates at the 15th session of the Conference of Parties (COP 15) to the United Nations Framework Convention on Climate Change agreed to "take note of" at the final plenary on 18 December 2009. The accord endorses the continuation of the Kyoto Protocol and confirms that climate change is one of the greatest challenges facing the world. In terms of the accord South Africa committed itself to a reduction target of 34% compared to business as usual. In this regard, the IRP 2010 aims to allocate 43% of new energy generation facilities in South Africa to renewables.

Apart from the reduction of greenhouse gas emissions, the promotion of renewable energy sources is aimed at ensuring energy security through the diversification of supply (in this regard, also refer to the objectives of the National Energy Act).

Government's long-term goal is the establishment of a renewable energy industry producing modern energy carriers that will offer in future years a sustainable, fully non-subsidised alternative to fossil fuels.

2.2.4 Integrated Resource Plan (2019)

South Africa's National Development Plan (NDP) 2030 offers a long-term plan for the country. It defines a desired destination where inequality and unemployment are reduced, and poverty is eliminated so that all South Africans can attain a decent standard of living. Electricity is one of the core elements of a decent standard of living. In formulating its vision for the energy sector, the NDP took as a point of departure the Integrated Resource Plan (IRP) 2010–2030 promulgated in March 2011. The IRP is an electricity infrastructure development plan based on least-cost electricity supply and demand balance, taking into account security of supply and the environment (minimize negative emissions and water usage).

On 27 August 2018, the then Minister of Energy published a draft IRP which was issued for public comment (Draft IRP). Following a lengthy public participation and consultation process the Integrated Resource Plan 2019 (IRP 2019) was gazetted by the Minister of Mineral Resources and Energy, Gwede Mantashe, on 18 October

[3] The Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC), aimed at fighting global warming. The UNFCCC is an international environmental treaty with the goal of achieving "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The Protocol was initially adopted on 11 December 1997 in Kyoto, Japan and entered into force on 16 February 2005. As of November 2009, 187 states have signed and ratified the protocol (Wikipedia).

2019, updating the energy forecast for South Africa from the current period to the year 2030. The IRP is an electricity capacity plan which aims to provide an indication of the country's electricity demand, how this demand will be supplied and what it will cost.

The IRP notes that South Africa is a signatory to the Paris Agreement on Climate Change and has ratified the agreement. The energy sector contributes close to 80% towards the country's total Green House Gas (GHG) emissions of which 50% are from electricity generation and liquid fuel production alone. A transmission from a fossil fuel-based energy sources is therefore critical to reducing GHG emissions. In September 2021 South Africa released its latest emission targets, indicating that it intended to limit Green House Gas (GHG) emissions to 398-510 MrCo2e by 2025, and 350-420 MrCo2e by 2030. These emissions are significantly lower than 2016 emission targets and will see South Africa's emissions decline in absolute terms from 2025, a decade earlier than planned (World Resource Institute, 2021).

The IRP (2019) notes that 39 730 MW of new generation capacity must be developed. Of the 39 730 MW determined, about 18 000 MW has been committed to date. This new capacity is made up of 6 422 MW under the REIPPP with a total of 3 876 MW operational on the grid. Under the Eskom build programme, the following capacity has been commissioned: 1 332 MW of Ingula pumped storage, 1 588MW of Medupi, 800 MW of Kusile and 100MW of Sere Wind Farm. In addition, IPPs have commissioned 1 005 MW from two Open Cycle Gas Turbine (OCGT) peaking plants (IRP 2019, page 14).

In terms of IRP (2019) provision has been made for the following new additional capacity by 2030:

- 1 500 MW of coal.
- 2 500 MW of hydro.
- 6 000 MW of solar PV.
- 14 400 MW of wind.
- 1 860 MW of nuclear.
- 2 088 MW for storage.
- 3 000 MW of gas/diesel.
- 4 000 MW from other distributed generation, co-generation, biomass and landfill technologies.

Figure 2.1 provides a summary of the allocations and commitments between the various energy sectors.



	Coal	Coal (Decommis-sioning)	Nuclear	Hydro	Storage	PV	Wind	CSP	Gas & Diesel	Other (Distributed Generation, CoGen, Biomass, Landfill)
Current Base	37,149		1 860	2,100	2 912	1 474	1 980	300	3 830	499
2019	2,155	-2,373					244	300		Allocation to the extent of the short term capacity and energy gap.
2020	1,433	-557				114	300			
2021	1,433	-1403				300	818			
2022	711	-844			513	400 1,000	1,600			
2023	750	-555				1000	1,600			500
2024			1,860				1,600		1000	500
2025						1000	1,600			500
2026		-1,219					1,600			500
2027	750	-847					1,600		2000	500
2028		-475				1000	1,600			500
2029		-1,694			1575	1000	1,600			500
2030		-1,050		2,500		1000	1,600			500
TOTAL INSTALLED CAPACITY by 2030 (MW)	33,364		1,860	4,600	5,000	8,288	17,742	600	6,380	
% Total Installed Capacity (% of MW)	43		2.36	5.84	6.35	10.52	22.53	0.76	8.1	
% Annual Energy Contribution (% of MWh)	58.8		4.5	8.4	1.2*	6.3	17.8	0.6	1.3	

Figure 2.1: Summary of energy allocations and commitments based on the 2019 IRP

As indicated above, the changes from the Draft IRP capacity allocations see an increase in solar PV and wind, and a significant decrease in gas and diesel; and new inclusions include nuclear and storage.

In terms of renewable energy, six bidding rounds have been completed for renewable energy projects under the RE IPP Procurement Programme. The most dominant technology in the IRP2019 is renewable energy from wind and solar PV technologies, with wind being identified as the stronger of the two technologies. There is a consistent annual allocation of 1 600 MW for wind technology commencing in the year 2022 up to 2030. The solar PV allocation of 1 000 MWs per year is incremental over the period 2022 to 2030, with no allocation in the years 2024 (being the year the Koeberg nuclear extension is expected to be commissioned) and the years 2026 and 2027 (presumably since 2 000 MW of gas is expected in the year 2027). The IRP 2019 states that although there are annual build limits, in the long run such limits will be reviewed to take into account demand and supply requirements.

2.2.5 National Development Plan

The National Development Plan (NDP) contains a plan aimed at eliminating poverty and reducing inequality by 2030. The NDP identifies 9 key challenges and associated remedial plans. Managing the transition towards a low carbon national economy is identified as one of the 9 key national challenges. Expansion and acceleration of commercial renewable energy is identified as a key intervention strategy.

2.2.6 The New Growth Path Framework

The aim of the New Economic Growth Path Framework is to enhance growth, employment creation and equity. Central to the New Growth Path is a massive investment in infrastructure as a critical driver of jobs across the economy. In this regard, the framework identifies investments in five key areas namely: energy, transport, communication, water, and housing.

The New Growth Path also identifies five other priority areas as part of the programme, through a series of partnerships between the State and the private sector. The Green Economy as one of the five priority areas to create jobs, including expansions in construction and the production of technologies for solar, wind and biofuels. In this regard, clean manufacturing and environmental services are projected to create 300 000 jobs over the next decade.

2.2.7 National Infrastructure Plan

Government adopted a National Infrastructure Plan (NIP) in 2012. The aim of the plan is to transform the economic landscape while simultaneously creating significant numbers of new jobs and strengthening the delivery of basic services. The aim of the NIP is support investments is to improve South Africans' access to healthcare facilities, schools, water, sanitation, housing and electrification. The plan also notes that investment in the construction of ports, roads, railway systems, ***electricity plants***, hospitals, schools, and dams will contribute to improved economic growth.

As part of the National Infrastructure Plan, Cabinet established the Presidential Infrastructure Coordinating Committee (PICC). The Committee identified and developed 18 strategic integrated projects (SIPS). The SIPs cover social and economic infrastructure across all nine provinces (with an emphasis on lagging regions) and included three energy SIPs, namely SIP 8, 9 and 10.

- SIP 8: Green energy in support of the South African economy.
- SIP 9: Electricity generation to support socio-economic development.
- SIP 10: Electricity transmission and distribution for all.

The NIP 2050 was gazetted for public comment on 10 August 2021[4]. The first phase of the NIP 2050 focuses on four critical network sectors that provide a platform, namely, energy, freight transport, water, and digital infrastructure. In line with the NDP, the vision for the energy sector is to promote:

- Economic growth and development through adequate investment in energy infrastructure" (generation, transmission, and distribution) and reliable and efficient energy service at competitive rates, while supporting economic growth through job creation by stimulating supply chains.
- Social equity through expanded access to energy at affordable tariffs and through targeted, sustainable subsidies for needy households.
- Environmental sustainability through efforts to reduce pollution, reduce water usage and mitigate the effects of climate change.

The NIP 2050 notes that by 2030, the NDP set a target that more than 90% of the population should enjoy access to grid connected or off-grid electricity by 2030. To

[4] Gazette No. 44951

realise this vision, South Africa's energy system will be supported by effective policies, institutions, governance systems, regulation and, where appropriate, competitive markets. In terms of energy mix, NIP 2050 notes that coal will contribute significantly less to primary-energy needs in the future, while gas will have an important enabling role, energy supply will be ***increasingly dominated by renewable energy resources– especially wind and solar which are least cost and where South Africa has a comparative advantage.***

NIP 2050 also notes that South Africa is a signatory of the Paris Agreement which aims to achieve Net Zero greenhouse gas emissions by 2050. To achieve this will require a shift to a least cost energy path that is increasingly reliant on renewables. For South Africa this is imperative for the following reasons:

- SA cannot afford to overspend while dramatically expanding capacity
- Renewables can be built quickly and in modular form thereby avoiding many of the challenges associated with mega projects.
- Trade partners are expected to increasingly impose border carbon taxes harming SA exports.
- SA will need to commit to emission reductions as a global citizen.

2.2.8 Astronomy Geographic Advantage Act

The purpose of the Act (Act No 21 of 2007) is to preserve the geographic advantage areas that attract investment in astronomy. The entire Northern Cape Province, excluding the Tsantsabane Municipality, has been declared an astronomy advantage area. The Northern Cape optical and radio telescope sites were declared core astronomy advantage areas. The Act allowed for the declaration of the Southern Africa Large Telescope (SALT), Meerkat and Square Kilometre Array (SKA) as astronomy and related scientific endeavours that has to be protected.

2.3 PROVINCIAL AND LOCAL LEVEL POLICY AND PLANNING

2.3.1 Northern Cape Province Provincial Growth and Development Strategy

The Northern Cape Provincial Growth and Development Strategy (NCPGDS) (2004-2014)[5] identifies poverty reduction as the most significant challenge facing the government and its partners. All other societal challenges that the province faces emanate predominantly from the effects of poverty. The NCPGDS notes that the only effective way to reduce poverty is through long-term sustainable economic growth and development. The sectors where economic growth and development can be promoted include:

- Agriculture and Agro-processing.
- Fishing and Mariculture.
- Mining and mineral processing.
- Transport.
- Manufacturing.
- Tourism.

However, the NCPGDS also notes that economic development in these sectors also requires:

[5] An updated PGDS has not been prepared.

- Creating opportunities for lifelong learning.
- Improving the skills of the labour force to increase productivity.
- Increasing accessibility to knowledge and information.

The achievement of these primary development objectives depends on the achievement of a number of related objectives that, at a macro-level, describe necessary conditions for growth and development. These are:

- Developing requisite levels of human and social capital.
- Improving the efficiency and effectiveness of governance and other development institutions.
- Enhancing infrastructure for economic growth and social development.

Of specific relevance to the SIA the NCPGDS makes reference to the need to ensure the availability of inexpensive energy. The section notes that in order to promote economic growth in the Northern Cape the availability of electricity to key industrial users at critical localities at rates that enhance the competitiveness of their industries must be ensured. At the same time, the development of new sources of energy through the promotion of the adoption of energy applications that display a synergy with the province's natural resource endowments must be encouraged. In this regard the NCPGDS notes "the development of energy sources such as solar energy, the natural gas fields, bio-fuels, etc., could be some of the means by which new economic opportunity and activity is generated in the Northern Cape". The NCPGDS also highlights the importance of close co-operation between the public and private sectors in order for the economic development potential of the Northern Cape to be realised.

The NCPGDS also highlights the importance of enterprise development and notes that the current level of private sector development and investment in the Northern Cape are low. In addition, the province also lags in the key policy priority areas of Small Micro Medium Enterprises (SMME) Development and Black Economic Empowerment. The proposed SEF therefore has the potential to create opportunities to promote private sector investment and the development of SMMEs in the Northern Cape Province.

In this regard, care will need to be taken to ensure that the proposed development and associated renewable energy facilities do not negatively impact on the region's natural environment. In this regard, the NCPGDS notes that the sustainable utilisation of the natural resource base on which agriculture depends is critical in the Northern Cape with its fragile eco-systems and vulnerability to climatic variation. The document also indicates that due to the province's exceptional natural and cultural attributes, it has the potential to become the preferred adventure and ecotourism destination in South Africa.

2.3.2 Northern Cape Provincial Spatial Development Framework

Northern Cape Provincial Spatial Development Framework (NCSDF) (2012) lists a number of sectoral strategies and plans that are to be read and treated as key components of the Provincial SDF (PSDF). Of these there are a number that are relevant to the proposed SEFs. These include:

- Sectoral Strategy 1: Provincial Growth and Development Strategy of the Provincial Government.
- Sectoral Strategy 2: Comprehensive Growth and Development Programme of the Department of Agriculture, Land Reform and Rural Development.

- Sectoral Strategy 5: Local Economic Development (LED) Strategy of the Department of Economic Development and Tourism.
- Sectoral Strategy 11: SMME Development Strategy of the Department of Economic Development and Tourism.
- Sectoral Strategy 12: Tourism Strategy of the Department of Economic Development and Tourism.
- Sectoral Strategy 19: Provincial renewable energy strategy (to be facilitated by the Department of Economic Development and Tourism).

Section C8.2.3, Energy Objectives, sets out the energy objectives for the Northern Cape Province. The section makes specific reference to renewable energy. Of relevance the objectives listed in 2012 include:

- Promote the development of renewable energy supply schemes. Large-scale renewable energy supply schemes are strategically important for increasing the diversity of domestic energy supplies and avoiding energy imports while minimizing detrimental environmental impacts.
- There is a national electricity supply shortage, and the country is now in a position where it needs to commission additional plants urgently. Consequently, renewable energy projects are a high priority.
- Develop and institute innovative new energy technologies to improve access to reliable, sustainable, and affordable energy services with the objective to realize sustainable economic growth and development. The goals of securing supply, providing energy services, tackling climate change, avoiding air pollution, and reaching sustainable development in the province offer both opportunities and synergies which require joint planning between local and provincial government as well as the private sector.
- Develop and institute energy supply schemes with the aim to contribute to the achievement of the targets set by the White Paper on Renewable Energy (2003). This target relates to the delivery of 10 000 GWh of energy from renewable energy sources (mainly biomass, wind, solar, and small-scale hydro) by 2013[6].

Section C8.3.3, Energy Policy, sets out the policy guidelines for the development of the energy sector, with specific reference to the renewable energy sector.

- The construction of telecommunication infrastructure must be strictly regulated in terms of the spatial plans and guidelines put forward in the PSDF. They must be carefully placed to avoid visual impacts on landscapes of significant symbolic, aesthetic, cultural or historic value and should blend in with the surrounding environment to the extent possible.
- Renewable energy sources such as wind, solar, thermal, biomass and domestic hydroelectricity are to constitute 25% of the province's energy generation capacity by 2020. The following key policy principles for renewable energy apply:
  - Full cost accounting: Pricing policies will be based on an assessment of the full economic, social and environmental costs and benefits of energy production and utilisation.
  - Equity: There should be equitable access to basic services to meet human needs and ensure human well-being. Each generation has a duty to avoid impairing the ability of future generations to ensure their own well-being.

[6] Note: The PSDF is dated 2012. The targets for renewable energy have been updated in terms of the 2019 IRP (see above).

- Global and international cooperation and responsibilities: Government recognises its shared responsibility for global and regional issues and act with due regard to the principles contained in relevant policies and applicable regional and international agreements.
- Allocation of functions: Government will allocate functions within the framework of the Constitution to competent institutions and spheres of government that can most effectively achieve the objectives of the energy policy.
- The implementation of sustainable renewable energy is to be promoted through appropriate financial and fiscal instruments.
- An effective legislative system to promote the implementation of renewable energy is to be developed, implemented, and continuously improved.
- Public awareness of the benefits and opportunities of renewable energy must be promoted.
- The development of renewable energy systems is to be harnessed as a mechanism for economic development throughout the province in accordance with the Sustainable Development Initiative (SDI) approach (refer to Toolkit D10) or any comparable approach.
- Renewable energy must, first, and foremost, be used to address the needs of the province before being exported.

2.2.3 Northern Cape Provincial Climate Change Response Strategy

The key aspects of the Provincial Climate Change Response Strategy (PCCRS) are summarised in the MEC's (NCPG: Environment and Nature Conservation) 2011 budget speech: "The Provincial Climate Change Response Strategy will be underpinned by specific critical sector climate change adaptation and mitigation strategies that include the Water, Agriculture and Human Health sectors as the 3 key Adaptation Sectors, the Industry and Transport alongside the Energy sector as the 3 key Mitigation Sectors with the Disaster Management, Natural Resources and Human Society, livelihoods and Services sectors as 3 remaining key Sectors to ensure proactive long term responses to the frequency and intensity of extreme weather events such as flooding and wild fire, with heightened requirements for effective disaster management".

Key points from MEC's address include the NCPG's commitment to develop and implement policy in accord with the National Green Paper for the National Climate Change Response Strategy (2010), and an acknowledgement of the NCP's extreme vulnerability to climate-change driven desertification. The development and promotion of a provincial green economy, including green jobs, is identified as an important provincial intervention in addressing climate change. The renewable energy sector, including solar and wind energy (but also biofuels and energy from waste), is explicitly indicated as an important element of the Provincial Climate Change Response Strategy. The MEC also indicated that the NCP was involved in the processing a number of Wind Energy Facility (WEF) and SEF EIA applications.

2.2.4 Northern Cape Province Green Document

The NCP Green Document (2017-2018) was prepared by the Northern Cape Department of Economic Development and Tourism and provides an impact assessment of IPPs on the communities in the province located within a 50 km radius from existing facilities. The document notes that the NCP is nationally a leader in commercial-scale renewable energy projects. By 2018 a total of 23 IPP

projects in the province had been integrated into the national grid[7]. These projects include Solar PV, Concentrated Solar and WEFs. The document notes that through their economic development obligations these projects have already made a significant positive contribution to affected communities. Much of the effort has been directed at supporting local education. The document also notes that, as these projects are committed to 20-year minimum lifespans and collectively hold a tremendous potential for socio-economic upliftment.

Key issues identified with regard to improving the potential beneficial impact of IPPs in the NCP (as at 2018) include:

- Local community members abusing project benefits for personal gain.
- Difficulty in outreach to local community beneficiaries due to high local illiteracy levels.
- A lack of business skills generally hampers the successful establishment of local small enterprises which could benefit from projects.
- Community benefit obligations are currently met in a piecemeal and uncoordinated fashion.
- Anticipated community benefits are often frustrated by inadequate engagement and insufficient ongoing consultation.
- The scarcity of people skilled in maths and sciences in local communities hampers meaningful higher-level local skills development and employment.
- Insufficient support from local municipalities for IPP development.

2.3.4 Pixley ka Seme District Municipality Integrated Development Plan

The vision for the PKSDM is "Developed and Sustainable District for Future Generations" (2019-2020).

To mission statement that underpins the vision is:

- Supporting our local municipalities to create a home for all in our towns, settlements, and rural areas to render dedicated services.
- Providing political and administrative leadership and direction in the development planning process.
- Promoting economic growth that is shared across and within communities.
- Promoting and enhancing integrated development planning in the operations of our municipalities.
- Aligning development initiatives in the district to the National Development Plan.

The Strategic Objectives to address the vision that are relevant to the project includes the promotion of economic growth in the district and enhance service delivery. Chapter 4, Development of Strategies, highlights the key strategies of the PKSDM. The promotion of economic development is the most relevant strategy for the project. The IDP also notes that the growth and development context in the district has also changed radically since 2013 (after it had been stagnant for decades) owing mainly to private and public investments in the area as a hub for renewable energy generation and astronomy.

The IDP notes that the economy in the Pixley ka Seme municipal area is characterized by:

[7] This total would be higher in 2022.

- High levels of poverty and low levels of education.
- Low levels of development despite the strategic location in terms of the national transport corridors.
- High rate of unemployment, poverty and social grant dependence.
- Prone to significant environmental changes owing to long-term structural changes (such as climate change, energy crises and other shifts).

Of specific relevance the IDP highlights the potential for renewable energy to help address some of these challenges.

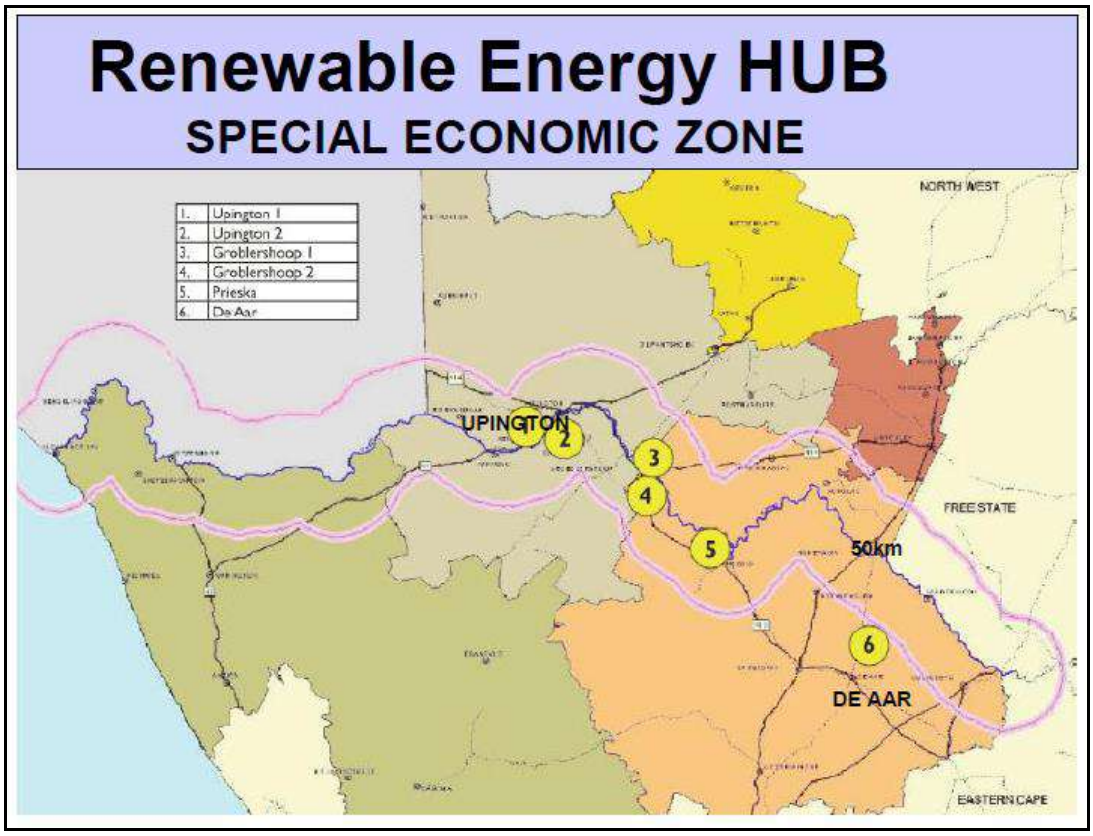
2.3.5 Pixley ka Seme District Municipality Spatial Development Framework

The SDF (2017) notes that the vision for the PKSDM is "Pixley Ka Seme DM, pioneers of development, a home and future for all". The Mission Statement that underpins the vision refers to:

- Effective and efficient service delivery.
- Optimal human and natural resource development.
- Local economic growth and development, job creation and poverty alleviation.
- A vibrant tourism industry.
- To participate in the fight to reduce the infection rate and lessen the impact of HIV/ Aids and other communicable diseases.
- A safe, secure and community friendly environment.

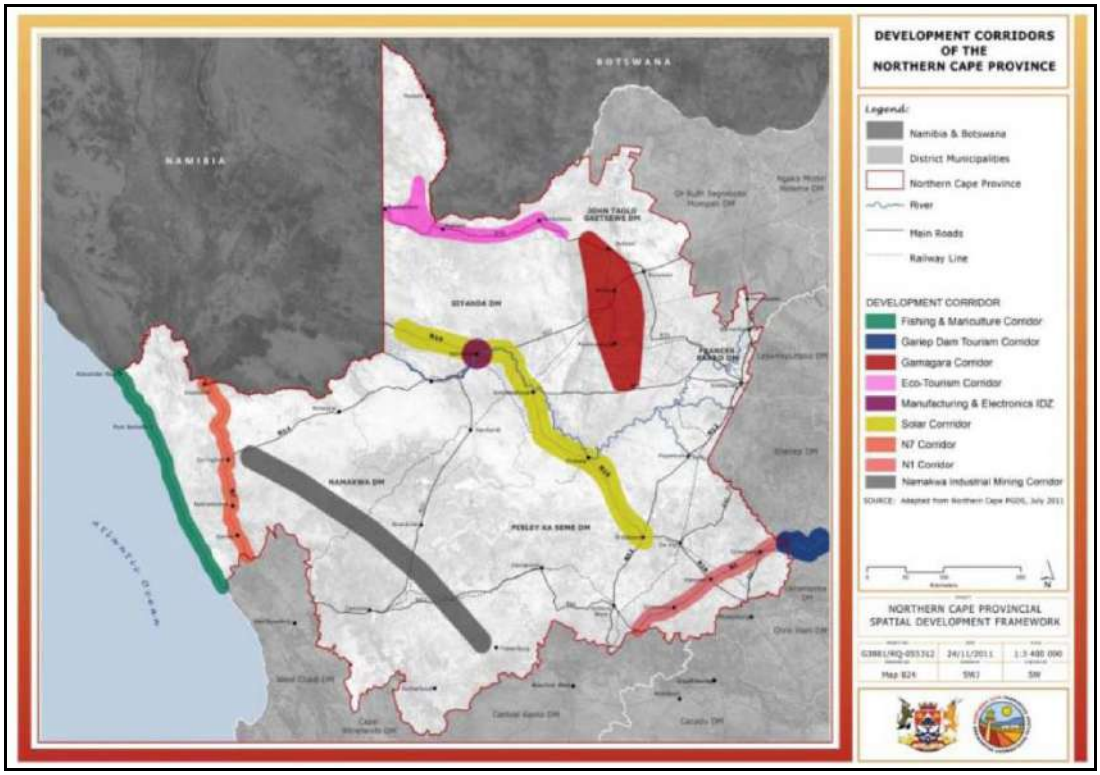
The SDF identifies the opportunities and constraints associated with the district. The opportunities that are of relevance to the project are discussed below.

Renewable energy and the identification of a renewable energy hub in the region. The natural environment and maintenance and conservation of the pristine natural environment to support sustainable farming into the future is also identified as an opportunity. The SDF notes that Pixley Ka Seme District area with its abundance of sunshine and vast tracts of available land has attracted considerable interest from solar energy investors. The high solar index of the area provides many opportunities in terms of the development of renewable energy. This has been acknowledged by the Northern Cape Government with the identification of the Renewable Energy Hub. Section 5.6.1 of the SDF refers to the establishment of a Renewable Energy Hub stretching from the west coast up to De Aar region (Figure 2.3). A number of special economic development zones are located within the area, including the De Aar (No.6, Figure 2.2). The PKSDM also falls within the Solar Development Corridor as identified in the Northern Cape Provincial Spatial Development Framework. The corridor extends from Kakamas to Upington and down to De Aar in the south-east (Figure 2.3). The proposed project is located within the corridor.



Source: Northern PKSDM SDF

Figure 2.2: Northern Cape Renewable Energy Hub



Source: Northern Cape SDF

Figure 2.3: Northern Cape Development Corridors-Solar Corridor (yellow)

The SDF does however also note that the area is known for its clean air and open skies with limited light pollution. Potential visual impacts are therefore an issue that needs to be considered.

In this regard the SDF notes that the topography of Pixley Ka Seme region is one of its main assets with vast open spaces and unspoilt panoramic visual vistas stretching over great distances. This asset makes for excellent scenic drives throughout the whole of the region from the flat plains to crossing the main rivers of South Africa. Visual vistas, ridges and "koppies" are assets within the region and they must be handled with sensitivity.

The relevant constraints include high levels of poverty and unemployment, backlog in basic services, including electricity and housing in rural areas, the limited supply of water and overall scarcity of water in the region to support economic development.

The development challenges that face the Pixley Ka Seme District Municipality include high unemployment and poverty rates and low income which are placing increasing demand on service delivery because very few people are able to pay for services. Declining population numbers, and alcohol and substance abuse are also key challenges.

In terms of services, inadequate schools in farming areas results in children having to travel long distances to areas where they go to school. There are also insufficient health centres and lack of amenities and recreational services. Where these services do exist, they are often poorly managed and maintained. The level of key services, such as refuse removal, are also low, while many rural and a number of urban households rely on boreholes for their water supply.

Climate change is also identified as a key risk. The SDF notes that the Karoo is predicted to experience more drought periods, coupled with increased evaporation and temperatures and this will negatively impact already restricted water supply. It is likely that the greatest impacts will be on water supply.

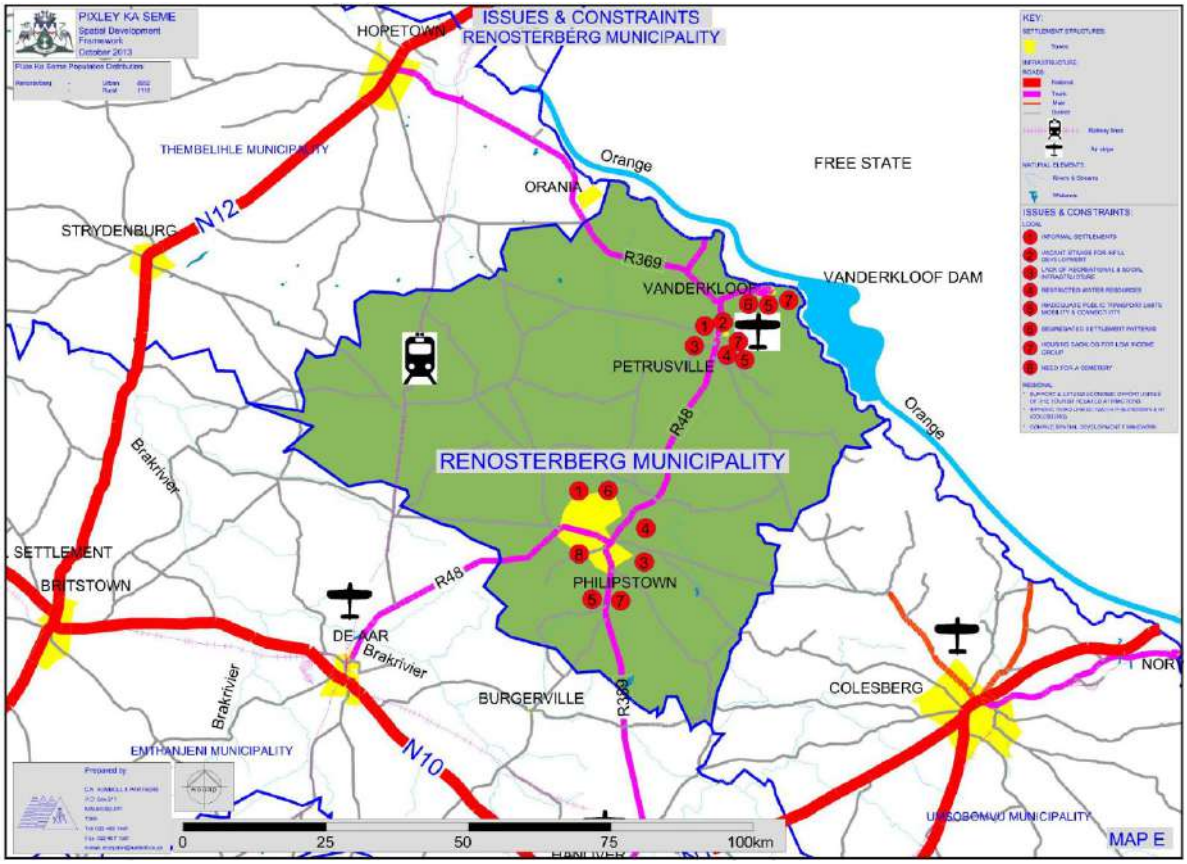
2.3.6 Renosterberg Local Municipality Integrated Development Plan

As indicated above, a copy of the latest five-year IDP (2017-2021) for the RLM was not available at the time preparing this report. This is likely linked to the dissolution of RLM by the Northern Cape Provincial Government on 7 September 2020[8]. A statement by the Premier of the Northern Cape, Dr, Zamai Saul (7 September 2020) noted that the "Renosterberg Local Municipality has been plagued with political and administrative challenges and failing to fulfil the prescripts of Chapter 7 as enshrined in Section 152 of the Constitution". The statement also notes that the intervention efforts made by the Department of Cooperative Governance, Human Settlements and Traditional Affairs (CoGHSTA), Provincial Treasury and the PKSDM and the respective MECs to monitor and provide support to RLM had not succeeded. The Municipal Council has also failed to implement and support the National Treasury discretionary Financial Recovery Plan that commenced in 2018 and was on-going until November 2019.

[8] Premier Zamani Saul: Dissolution of Renosterberg Municipal Council South African Government (www.gov.za)

The information on the RLM is therefore based on the information contained in the Pixley Ka Seme District SDF 2013 - 2018 Sixth Draft May 2014.

The locality of the RLM along the southern bank of the Gariep (Orange) River provides a sustainable water resource and creates a number of development opportunities in terms of tourism and agriculture. Development opportunities are also supported by close locality of Phillipstown to the N10 and N1 as major transport routes that cross the Pixley District Municipal Area. The municipal area consists of the towns of Petrusville, Phillipstown and Vanderkloof (Figure 2.4). The administrative centre is Petrusville.



Source: PKSSDF (2017)

Figure 2.4: Renosterberg Local Municipality

The small town of Petrusville is located on the northern part of the of the Renosterberg Municipal area, near the Vanderkloof Dam and functions as a service centre for the surrounding farming areas. The economic opportunities for the town are linked to expanding its role at the areas administrative centre and capitalising on the proximity of the Vanderkloof Dam and the N1 (to the east) and N12 (to the west). The socio-economic challenges include water shortages during the dry months, shortage of lower income housing and lack of recreational and social facilities. The construction of a pipeline from the Vanderkloof Dam has been identified as a solution to address the water issue.

Philipstown is located on the southern section of the Renosterberg Municipal area, to the northeast of De Aar. The economic opportunities for the town are linked to the proximity of the N1 (to the east), N12 (to the west) and N10 (to the south). The socio-economic challenges include high levels of youth unemployment, water

shortages during the dry months, shortage of lower income housing and lack of recreational and social facilities. The construction of a pipeline from the Vanderkloof Dam has been identified as a solution to address the water issue. The tourism potential of the town and surrounding area is linked to farm stays and hunting. There are also a number of San Rock Art sites in the area.

Vanderkloof is located on the southern bank of the Vanderkloof Dam in the northern section of the Renosterberg Municipal area. The main focus of the town is for residential and recreational purposes and the town is a well-established holiday resort town. The tourism potential of the town and the surrounding area are linked to the water sports activities in the Vanderkloof Dam (boating, swimming, fishing etc), and the Vanderkloof and Rolfontein Nature Reserves. The socio-economic challenges include a shortage of lower income housing units.

2.3.7 Emthanjeni Local Municipality Integrated Development Plan

The IDP for the Emthanjeni Local Municipality (ELM) (2019-2021) notes that the municipality borders onto the southern boundary of the Renosterberg Local Municipality (RLM) and is a category B municipality consisting of three towns, namely, De Aar, Britstown and Hanover. The vision of the RLM is "Leading sustainable development for inclusive economic growth". The mission statement linked to the vision is "To create a viable economic development plan that is relevant to the characteristics of the Emthanjeni Municipal area, designed to create and maintain a sound and healthy local economy, drawing upon local strengths and resources". This will be achieved through:

- Strategic partnerships and collaboration.
- Effective stakeholder communications.
- Supporting existing businesses and encourage the expansion and repositioning of desirable commercial and industrial uses.
- To increase the number of farms or agricultural land in the community.

The Integrated Development Plan (IDP) refers to the national economic pillars adopted on the National Framework for Local Economic Development in South Africa which launched in 2014. The pillars are aligned to the main thrusts and opportunities within RLM to ensure an integrated approach for optimal rate of implementation and economic development in the municipality. The five pillars are:

- Pillar 1: Building a Diverse Economic Base.
- Pillar 2: Developing learning and skilful economies.
- Pillar 3: Developing Inclusive Economies.
- Pillar 4: Enterprise Development and Support.
- Pillar 5: Economic Governance and Infrastructure.

Pillars 1, 2, 3 and 4 are relevant to the proposed development.

Pillar 1: Building a Diverse Economic Base
The first pillar focuses on building a diverse economic base and growing the local economy through industrial and sector-specific (e.g., Tourism, Mining, Agriculture, Manufacturing, etc.).

Pillar 2: Developing learning and skilful economies
The IDP notes that addressing the skills gap and improving skills levels is critical to the to the successful implementation of all the other pillars, as increased skills lead to increased opportunities for stimulating local economies.

Pillar 3: Developing Inclusive Economies
Creating decent work and sustainable livelihoods improves the living standards and ensures a dignified existence for individuals.

Pillar 4: Enterprise Development and Support
The IDP highlights the importance of supporting economic development and creating a diverse economic sector. The need to support SMMEs is also noted.

The development of the project will support these pillars, specifically the SED and ED spend linked to the project. The IDP also lists 7 Key Performance Areas (KPAs) of which KPA 1: Basic Services and Infrastructure Development, KPA 5: Local Economic Development and KPA 7: Social Development, are relevant to the project.

The IDP highlights the importance to the renewable energy sector and refers to a number of IPP projects located in the RLM and PKSDM.

2.4 OVERVIEW OF THE RENEWABLE ENERGY SECTOR IN SOUTH AFRICA

The section below provides an overview of the potential benefits associated with the renewable energy sector in South Africa. Given that South Africa supports the development of renewable energy at national level, the intention is not to provide a critical review of renewable energy. The focus is therefore on the contribution of renewable energy, specifically in terms of supporting economic development.

The following documents were reviewed:

- Independent Power Producers Procurement Programme (IPPPP): An Overview (December 2021), Department of Energy, National Treasury and DBSA.
- Green Jobs Study (2011), IDC, DBSA Ltd and TIPS.
- Powering the Future: Renewable Energy Roll-out in South Africa (2013), Greenpeace South Africa.
- WWF SA, Renewable Energy Vision 2030, South Africa, 2014.
- Jacqueline M. Borel-Saladin, Ivan N. Turok, (2013). The impact of the green economy on jobs in South Africa), South African Journal of Science, *Volume 109 /Number 9/10, September/October 2013.*
- The potential for local community benefits from wind farms in South Africa, Louise Tait (2012), Master's Thesis, Energy Research Centre University of Cape Town.

2.4.1 Independent Power Producers Procurement Programme (IPPPP): An Overview

The document presents an overview of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) undertaken by the Department of Energy, National Treasury, and the Development Bank of South Africa in December 2021. The programme's primary mandate is to secure electrical energy from the private sector for renewable and non-renewable energy sources. With regard to renewables, the programme is designed to reduce the country's reliance on fossil fuels, stimulate an indigenous renewable energy industry and contribute to socio-economic development and environmentally sustainable growth. The IPPPP has been designed not only to procure energy but has also been structured to contribute to the broader national development objectives of job creation, social upliftment and broadening of economic ownership.

The Integrated Resource Plan for electricity (IRP) provides South Africa's long-term plan for electricity generation. It primarily aims to ensure security of electricity supply, minimise the cost of that supply, limit water usage and reduce greenhouse gas (GHG) emissions, while allowing for policy adjustment in support of broader socio-economic developmental imperatives. The IRP 2019 was promulgated in October 2019 and replaced the IRP 2010 as the country's official electricity infrastructure plan.

It calls for 37 696 MW of new and committed capacity to be added between 2019 and 2030 from a diverse mix of energy sources and technologies as ageing coal plants are decommissioned and the country transitions to a larger share of renewable energy. By 2030, the electricity generation mix is set to comprise of 33 364 MW (42.6%) coal, 17 742 MW (22.7%) wind, 8 288 MW (10.6%) solar photovoltaic (PV), 6 830 MW (8.7%) gas or diesel, 5 000 MW (6.4%) energy storage, 4 600 MW (5.9%) hydro, 1 860 MW (2.4%) nuclear and 600 MW (0.8%) concentrating solar power (CSP). Additionally, a short-term gap of at least 2000 MW is to be filled between 2019 and 2022, thereby further raising new capacity requirements, while distributed or embedded generation for own-use is positioned to add 4 000 MW between 2023 and 2030. The IRP is intended to be frequently updated, which could impact future capacity allocations from various energy sources and technologies.

Energy supply
By the end of December 2021, the REIPPPP had made the following significant impacts.

- 6 323 MW of electricity had been procured from 92 RE Independent Power Producers (IPPs) in BW1-4.
- 5 661 MW of electricity generation capacity from 85 IPP projects has been connected to the national grid.
- 71 073 GWh of energy has been generated by renewable energy sources procured under the REIPPPP since the first project became operational in November 2013.

Renewable energy IPPs have proved to be very reliable. Of the 85 projects that have reached COD, 77 projects have been operational for longer than a year. The energy generated over the past 12-month period for these 77 projects is 14 117 GWh, which is 95% of their annual energy contribution projections (P50) of 14 924 GWh over a 12-month delivery period. Thirty-one (31) of the 77 projects (40%) have individually exceeded their P50 projections.

Comparatively, the following statistics were presented at the REIPPPP Bid Window 6 Bidders Conference on 7 July 2022 by the IPP Office based on data as of March 2022 following seven bid rounds (IPP Office, 2022[9]):

- 92 IPPs have been selected as preferred bidders.
- 6 323 MW of electricity capacity procured.
- 5 826 MW already operational from 87 IPPs.
- 74 805 GWh energy generated by Renewable Energy sources.

[9] IPP Office (2022). RENEWABLE ENERGY INDEPENDENT POWER PRODUCER PROCUREMENT PROGRAMME (REIPPPP) BID WINDOW 6 BIDDERS' CONFERENCE, 7 JULY 2022 [online]. Accessed July 2022. https://www.ipp-renewables.co.za/PressCentre/GetPressRelease?fileid=16a21004-f9fd-ec11-9578-2c59e59ac9cd&fileName=BW6%20Bidders%20Conference%20Consolidated.pdf.

Energy costs

In line with international experience, the price of renewable energy is increasingly cost competitive when compared with conventional power sources. The REIPPPP has effectively captured this global downward trend with prices decreasing in every bid window. Energy procured by the REIPPPP is progressively more cost effective and has approached a point where the wholesale pricing for new coal-and renewable-generated energy intersect.

Through the competitive bidding process, the IPPPP effectively leveraged rapid, global technology developments and price trends, buying clean energy at lower and lower rates with every bid cycle, resulting in SA getting the benefit of renewable energy at some of the lowest tariffs in the world. The price for wind power has dropped by 50% to R0.94/kWh, while solar PV has dropped with 75% to R1.14/kWh between BW1 and BW4. This compares with the industry estimates in April 2020 of R1.45/kWh for Medupi. Considering the on-going delays incompletion, indications are that these costs may even be significantly higher.

Prices contracted under the REIPPPP for all technologies are well below the published REFIT prices. The REIPPPP has effectively translated policy and planning into delivery of clean energy at very competitive prices. As such it is contributing to the national aspirations of secure, affordable energy, lower carbon intensity and a transformed 'green' economy.

Investment

The document notes that the REIPPPP has attracted significant investment in the development of the REIPPs into the country. The total investment (total project costs[10]), including interest during construction, of projects under construction and projects in the process of closure is R209.6 billion (this includes total debt and equity of R209 billion, as well as early revenue and VAT facility of R0.5 billion).

The REIPPPP has attracted R42 billion in foreign investment and financing in the seven bid windows (BW1 – BW4). This is almost double the inward FDI attracted into South Africa during 2015 (R22.6 billion). The document notes that the share of foreign investment and equity showed an increase in the most recent bid window (2S2), suggesting that the REIPPPP continued to generate investor confidence despite the poor economic conditions in South Africa in recent years.

Comparatively, based on the information presented at the REIPPPP Bid Window 6 Bidders Conference on 7 July 2022 by the IPP Office (IPP Office, 2022), approximately R209.6 billion investment has been attracted for energy infrastructure in all bid windows; and as of March 2022 an actual R1.9 billion contribution was realised for socio-economic development.

South African citizen shareholding

The importance of retaining local shareholding in IPPs is key condition of the procurement requirements. The RFP notes that bidders are required to have South African Equity Participation of 40% in order to be evaluated. South African (local) equity shareholding across BW1-4 equates to 52% (R31.4 billion) of the total equity shareholding (R61.0 billion) was held by South Africans across BW1 to BW4, 1S2 and 2S2. This equates to substantially more than the 40% requirement. Foreign equity amounts to R29.6 billion and contributes 49% of total equity.

[10] Total project costs means the total capital expenditure to be incurred up to the commercial operations date in the design, construction, development, installation, and or commissioning of the project)

The REIPPPP also contributes to Broad Based Black Economic Empowerment (BBBEE) and the creation of black industrialists. In this regard, Black South Africans own, on average, 34% of projects that have reached financial close (BW1-BW4), which is 4% higher than the 30% target. This includes black people in local communities that have ownership in the IPP projects that operate in or near their communities and represents the majority share of total South African Entity Participation.

On average, black local communities own 9% of projects that have reached financial close. This is well above the 5% target. In addition, an average of 21% shareholding by black people in engineering, procurement, and construction (EPC) contractors has been attained for projects that have reached financial closure. This is higher than 20% target. The shareholding by black people in operating companies of IPPs has averaged 30% (against the targeted 20%) for the 85 projects in operation (i.e. in BW1–4).

The target for shareholding by black people in top management has been set at 40%, with an average 68% achieved to date. The target has therefore been significantly exceeded.

Community shareholding and community trusts

The regulations require a minimum ownership of 2.5% by local communities in IPP projects as a procurement condition. This is to ensure that a substantial portion of the investments has been structured and secured as local community equity. An individual community's dividends earned will depend on the terms of each transaction corresponding with the relevant equity share. To date all shareholding for local communities have been structured through the establishment of community trusts. For projects in BW1 to BW4, qualifying communities will receive R25.5 billion net income over the life of the projects (20 years). The report notes that the bulk of the money will however only start flowing into the communities from 2028 due to repayment obligations in the preceding years (repayment obligations are mostly to development funding institutions). However, despite the delay, this represents a significant injection of capital into mainly rural areas of South Africa. If the net projected income for the first seven bid windows (BW1-BW4) was structured as equal payments overtime, it would represent an annual net income of R1.27 billion per year.

Income to all shareholders only commences with operation of the facility. Revenue generated to date by the 85 operational IPPs amounts to R149.9 billion.

Procurement spend

In addition to the financial investments into the economy and favourable equity structures aimed at supporting BEE, the REIPPPP also targets broader economic and socio-economic investment. This is through procurement spend and local content.

The total projected procurement spend for BW1 to BW4 during the construction phase was R71.1 billion, while the projected operations procurement spend over the 20 years operational life is estimated at 75.2 billion. The combined (construction and operations) procurement value is projected as R146.3 billion of which R92.1 billion has been spent to date. For construction, of the R71.1 billion already spent to date, R71 billion is from the 85 projects which have already been completed. These 85 projects had planned to spend R64.2 billion. The actual procurement construction costs have therefore exceeded the planned costs by 11% for completed projects.

Preferential procurement

The share of procurement that is sourced from Broad Based Black Economic Empowered (BBBEE) suppliers, Qualifying Small Enterprises (QSE), Exempted Micro Enterprises (EME) and women owned vendors are tracked against commitments and targeted percentages. The IA target requirement for BBBEE is 60% of total procurement spend. However, the actual share of procurement spend by IPPs from BBBEE suppliers for construction and operations combined is currently reported as 83%, which is significantly higher than the target of 60%, but also the 71% that had been committed by IPPs. BBBEE, as a share of procurement spend for projects in construction, is also reported as 84% with operations slightly lower at 74%.

The majority of the procurement spend to date has been for construction purposes. Of the R76 billion spent on procurement during construction, R64.3 billion has reportedly been procured from BBBEE suppliers, achieving 84.6% of total procured. Actual BBBEE spend during construction for BW1 and BW2 alone was R25.5 billion, 81% more than the 14.1 billion planned by the IPPs. The R64.3 billion spent on BBBEE during construction is 30% more than the R49.7 billion that had originally been anticipated by all IPPs procured in BW1-4.

Total procurement spend by IPPs from QSE and EMEs has amounted to R28.1 billion (construction and operations) to date, which exceeds commitments by 250% and is 30% of total procurement spend to date (while the required target is 10%). QSE and EME's procurement spend for construction was 31% of construction procurement to date and 26% of operational procurement, exceeding the 10% targets set. QSE and EME share of construction procurement spend totals R23.8 billion, which is 5.4 times the planned spend for construction of R4.4 billion during this procurement phase.

In terms of procurement from women-owned vendors to date, 5% of total construction procurement spend has been from woman-owned vendors (against a targeted 5%), and 6% of operational procurement spend has been realised from woman-owned vendors to date, thereby exceeding the targeted 5%. In terms of construction spend, R 4.1 billion was undertaken by women-owned vendors, which is almost double the R 1.8 billion expected to be spent for the construction of projects that have reached financial close.

The REIPPPP has therefore created significant employment opportunities for black South African citizens and local communities beyond planned targets. This highlights the importance of the programme in terms of employment equity and the creation of more equal societies.

Local Content[11]

The report notes that the REIPPP programme represents the country's most comprehensive strategy to date in achieving the transition to a greener economy. Local content minimum thresholds and targets were set higher for each subsequent bid window. The report notes that for a programme of this magnitude, with construction procurement spend alone estimated at R71.1 billion, the result is a substantial stimulus for establishing local manufacturing capacity. The local content strategy has created the required incentives for a number of international technology and component manufactures to establish local manufacturing facilities.

[11] Local content is expressed as a % of the total project value and not procurement or total project costs.

The documents notes that for the portfolio as a whole, the expectation would reasonably be for local content spend to fall between 25% and 65% of the total project value (considering the range of targets and minimum requirements). Local content commitments by IPPs amount to R66.3 billion or 45% of total project value (R148.2 billion for all bid windows).

Actual local content spend reported for IPPs that have started construction amounts to R63.3 billion against a corresponding project value (as realised to date) of R127.2 billion. This means that 50% of the project value has been locally procured, exceeding the 45% commitment from IPPs and the thresholds for BW1 – BW4 (25-45%).

To date, the R63.3 billion local content spend reported by active IPPs is already 96% of the R66 billion local content expected. This is with 6 projects still in construction, and 85 of the 91 active projects having reached COD (i.e. 93% of the active portfolio complete). For the 85 projects that have reached COD, local content spend has been R58.72 billion of a committed R58.67 billion, which is 0.1% more than the planned local spend.

Leveraging employment opportunities

To date, a total of 63 291 job years[12] have been created for South African citizens, of which 48 110 job years were in construction and 15 182 in operations. These job years should rise further past the planned target as more projects enter the construction phase. Employment opportunities across BW1-4 are 143% of the planned number during the construction phase (i.e. 33 707 job years), with 6 projects still in construction and employing people. The number of employment opportunities is therefore likely to continue to grow beyond the original expectations. By the end of December 2021, 85 projects had successfully completed construction and moved into operation. These projects created 44 172 job years of employment, compared to the anticipated 30 488. This was 45% more than planned.

The report notes that employment thresholds and targets were consistently exceeded across the entire portfolio. The average share of South African citizens of total South Africa based employees for BW1 – BW4 was 91% during construction (against a target of 80%), while it was 96% during operations for BW1 – BW4 (against a target of 80%). The report notes that the construction phase offers a high number of opportunities over shorter durations, while the operations phase requires fewer people, but over an extended operating period.

To date, 48 110 job years for SA citizens were achieved during construction, which is 43% above the planned 33 707 job years for active projects. These job years are expected to rise further since 6 projects are still in construction.

In terms of benefits for local communities, significantly more people from local communities were employed during construction than was initially planned. For active projects, the expectation for local community participation was 13 284 job years. To date 25 272 job years have been realised (i.e. 90% more than initially planned), with 6 projects still in, or entering, construction. The number of black SA citizens employed during construction also exceeded the planned numbers by 74%.

[12] The equivalent of a full-time employment opportunity for one person for one year

Black South African citizens, youths and rural or local communities have been the major beneficiaries during the construction phases, as they respectively represent 81%, 44% and 48% of total job opportunities created by IPPs to date. However, woman and disabled people could still be significantly empowered as they represent a mere 10% and 0.4% of total jobs created to date, respectively. Nonetheless, the fact that the REIPPPP has raised employment opportunities for black South African citizens and local communities beyond planned targets, indicates the importance of the programme to employment equity and the drive towards more equal societies.

The share of black citizens employed during construction (81%) and the early stages of operations (85%) has significantly exceeded the 50% target and the 30% minimum threshold. Likewise, the share of skilled black citizens (as a percentage of skilled employees) for both construction (71%) and operations (82%) has also exceeded the 30% target and minimum threshold of 18%. The share of local community members as a share of SA-based employees was 48% and 70% for construction and operations respectively – significantly exceeding the minimum threshold of 12% and the target of 20%.

Socio-economic development (SED) contributions

An important focus of the REIPPPP is to ensure that the build programme secures sustainable value for the country and enables local communities to benefit directly from the investments attracted into the area. In this regard, IPPs are required to contribute a percentage of projected revenues accrued over the 20-year project operational life toward SED initiatives. These contributions accrue over the 20-year project operation life and are used to invest in housing and infrastructure as well as healthcare, education, and skills development.

The minimum compliance threshold for SED contributions is 1% of the revenue with 1.5% the targeted level over the 20-year project operational life. For the current portfolio of projects, the average commitment level is 2%, which is 101% higher than the minimum threshold level. To date (across BW1-4) a total contribution of R22.8 billion has been committed to SED initiatives. Assuming an even, annual revenue spread, the average contribution per year would be R1.1 billion. Of the total commitment, R18.5 billion is specifically allocated for local communities where the IPPs operate. With every new IPP on the grid, revenues and the respective SED contributions will increase.

As a percentage of revenue, SED obligations become effective only when operations commence, and revenue is generated. Of the 91 IPPs that have reached financial close (BW1–BW4), 85 are operational. The SED contributions associated with these 85 projects has amounted to R 1.8 billion to date.

In terms of ED and SED spend, education, social welfare, and health care initiatives have a SED focus. SED spend on education has been almost double the expenditure on enterprise development. This is despite enterprise development being a stand-alone commitment category in terms of the IA. This is, in part, due to the fact that some early childhood development programmes have also been incorporated in educational programmes. IPPs have supported 1 388 education institutions with a total of R437 million in contributions, from 2015 to the end of June 2021. A total of 1 276 bursaries, amounting to R210.8 million, have been awarded by 67 IPPs from 2015 until the end of June 2021. The largest portion of the bursaries were awarded to African and Coloured students (97.4%), with women and girls receiving 56.3% of total bursaries. The Northern Cape province benefitted most from the bursaries

awarded, with 57.2%, followed by the Eastern Cape (20.2%) and Western Cape (14.1%). Enterprise development and social welfare are the focus areas that have received the second highest share of the contributions to date.

Enterprise development contributions
The target for IPPs to spend on enterprise development is 0.6% of revenues over the 20- year project operational life. However, for the current portfolio, IPPs have committed an average of 0.63% or 0.03% more than the target. Enterprise development contributions committed for BW1-4, amount to R7.2 billion. Assuming an equal distribution of revenue over the 20-year project operational life, enterprise development contributions would be R358 million per annum. Of the total commitment, R5.6 billion is specifically committed directly within the local communities where the IPPs operate, contributing significantly to local enterprise development. A total contribution of R504.1 million has already been made to the local communities (i.e. 94%of the total R537.9 million enterprise development contributions made to date).

Contribution to cleaner energy and water savings
As part of the global commitment, South Africa is targeting an emissions trajectory that peaks at 34% below a "business as usual" case in 2020, 42% below in 2025 and from 2035 declines in absolute terms. The REIPPPP contributes constructively to economic stability, energy security and environmental sustainability.

The emission reductions for the programme during the preceding 12 months (June 2019-June 2020) is calculated as 15.1 million tonnes CO_2 ($MtonCO_2$) based on the 14 835 GWh energy that has been generated and supplied to the grid over this period. This represents 75% of the total projected annual emission reductions (20.5 $MtonCO_2$) achieved with only partial operations. A total of 72.1 Mton CO_2 equivalent reduction has been realised from programme inception to date.

The March 2019 Report also notes that since operation, the IPPs have saved 42.8 million kilolitres of water related to fossil fuel power generation. This saving will have increased with the increase in energy generated by renewable energy since 2019. The REIPPPP therefore contributes significantly towards meeting South Africa's GHG emission targets and, at the same time, supporting energy security, economic stability, and environmental sustainability.

2.4.2 Green Jobs Study

The study notes that South Africa has one of the most carbon-intensive economies in the world, therefore making the greening of the electricity mix a national imperative. Within this context the study notes that the green economy could be an extremely important trigger and lever for enhancing a country's growth potential and redirecting its development trajectory in the 21st century. The attractiveness of wind and solar technologies is not only supported by local conditions, but also by the relatively mature stage of their technological development.

The aim of the Green Jobs study was to provide information on the net direct job creation anticipated to emerge in the formal economy across a wide range of technologies/activities that may be classified as green or contributing to the greening of the economy. The study looked at the employment potential for a number of green sectors, including power generation, over three consecutive timeframes, namely, the short term (2011 – 12), medium term (2013 – 17) and long term (2018 – 25). The analysis attempts to estimate the employment potential associated with: building, construction and installation activities;

operations and maintenance services; as well as the possible localisation spin-offs for the manufacturing sector as the domestic production of equipment, parts and components benefits from preferential local procurement.

It is also worth noting that the study only considered direct jobs in the formal economy. Multiplier effects were not taken into account. As a result, the analysis only captures a portion of the potential employment impact of a greening economy. International studies have indicated that there are considerable backward and forward linkages through various value chains of production, as well as of indirect and induced employment effects. The employment figures can therefore be regarded as conservative.

The analysis reveals the potential of an unfolding green economy to lead to the creation of approximately 98 000 new direct jobs, on average, in the short term, almost 255 000 in the medium term and around 462 000 employment opportunities in the formal economy in the long term. The number of jobs linked to the power generation was estimated to be ~ 12 500 in the short term, 57 500 in the medium term and 130 000 in the long term. Power generation jobs therefore account for 28% of the employment opportunities created in the long term. However, the report notes that the contribution made by a progressively expanding green energy generation segment increases from 14% of the total in the short term, or just over 13 500 jobs, to more than 28% in the long term (166 400) (Table 2.3). The study also found that energy generation is expected to become an increasingly important contributor to green job creation over time, as projects are constructed or commissioned.

Table 2.3: Net direct employment potential estimated for the four broad types of activity and their respective segments in the long term, and an indication of the roll-out over the three timeframes

Broad green economy category		Segment	Technology/product	Total net direct employment potential in the long-term	Net direct manufacturing employment potential in the long-term	Total net direct employment potential (ST, MT, LT)	Net direct manufacturing employment potential (ST, MT, LT)
ENERGY GENERATION	Renewable (non-fuel) electricity	Wind power	Onshore wind power	5 156	2 105	VL, L, M	L, M, H
			Offshore wind power				
		Solar power	Concentrated solar power	3 014	608	N, VL, M	N, VL, M
			Photovoltaic power	13 541	8 463	M, H, H	H, VH, VH
		Marine power	Marine power	197	0	N, N, VL	N, N, N
		Hydro power	Large hydro power	272	111	VL, VL, VL	VL, M, VL
			Micro-/small-hydro power	100	0	VL, VL, VL	N, N, N
	Fuel-based renewable electricity	Waste-to-energy	Landfills	1 178	180	VL, VL, L	VL, VL, L
			Biomass combustion	37 270	154	VL, H, VH	VL, VL, L
			Anaerobic digestion	1 429	591	VL, VL, L	VL, L, M
			Pyrolysis/Gasification	4 348	2 663	VL, L, M	VL, H, H
			Co-generation	10 789	1 050	L, M, H	M, H, H
	Liquid fuel	Bio-fuels	Bio-ethanol	52 729	6 641	M, H, VH	L, H, VH
			Bio-diesel				
ENERGY GENERATION SUB-TOTAL				**130 023**	**22 566**		
ENERGY & RESOURCE EFFICIENCY		Green buildings	Insulation, lighting, windows	7 340	838	L, M, M	L, M, M
			Solar water heaters	17 621	1 225	L, H, H	L, M, H
			Rain water harvesting	1 275	181	VL, VL, L	VL, VL, L
		Transportation	Bus Rapid Transport	41 641	350	VH, VH, VH	H, M, L
		Industrial	Energy efficient motors	-566	4	VL, VL, VL	VL, VL, VL
			Mechanical insulation	666	89	VL, VL, VL	VL, VL, VL
ENERGY & RESOURCE EFFICIENCY SUB-TOTAL				**67 977**	**2 586**		
EMMISIONS AND POLLUTION MITIGATION		Pollution control	Air pollution control	900	166	N, VL, VL	N, L, L
			Electrical vehicles	11 428	10 642	VL, L, H	N, H, VH
			Clean stoves	2 783	973	VL, VL, L	VL, L, M
			Acid mine water treatment	361	0	VL, VL, VL	N, N, N
		Carbon Capture and Storage		251	0	N, VL, VL	N, N, N
		Recycling		15 918	9 016	M, H, H	H, VH, VH
EMMISIONS AND POLLUTION MITIGATION SUB-TOTAL				**31 641**	**20 797**		
NATURAL RESOURCE MANAGEMENT		Biodiversity conservation & eco-system restoration		121 553	0	H, VH, VH	N, N, N
		Soil & land management		111 373	0	VH, VH, VH	N, N, N
NATURAL RESOURCE MANAGEMENT SUB-TOTAL				**232 926**	**0**		
TOTAL				**462 567**	**46 049**		

(Source: Green Jobs Study, 2011)

Notes:

- VH = very high (total employment potential > 20 000 direct jobs; manufacturing employment potential > 3 000 direct jobs);
- H = high (total employment potential > 8 000 but < 20 000; manufacturing employment potential > 1 000 but < 3 000);
- M = medium (total employment potential > 3 000 but < 8 000; manufacturing employment potential > 500 but < 1 000);
- L = low (total employment potential > 1 000 but < 3 000; manufacturing employment potential > 150 but < 500);
- VL = very low (total employment potential > 0 but < 1 000; manufacturing employment potential > 0 but < 150);
- N = negligible/none (total employment potential = 0; manufacturing employment potential = 0).

Of relevance the study also notes that the largest gains are likely to be associated with operations and maintenance (O&M) activities, particularly those involved in the various natural resource management initiatives. In this regard, operations and maintenance employment linked to renewable energy generation plants will also be substantial in the longer term. The employment growth momentum related to building, construction and installation activities peaks in the medium term, largely propelled by mass transportation infrastructure, stabilising thereafter as green building methods become progressively entrenched.

In addition, as projects related to a greening economy are progressively commissioned, the potential for local manufacturing also become increasingly viable. Employment gains in manufacturing are also expected to be relatively more stable than construction activities, since the sector should continue exhibiting growth potential as new and replacement components are produced, as additional markets are penetrated and as new green technologies are introduced. Manufacturing segments with high employment potential in the long term would include suppliers of components for wind and solar farms. The study does note that a shortage of skills in certain professional fields pertinent to renewable energy generation presents a challenge that must be overcome.

The study also identifies a number of advantages associated with renewable energy with a large 'technical' generation potential. In this regard, renewable energy, such as solar and wind, does not emit carbon dioxide (CO_2) in generating electricity and is associated with exceptionally low lifecycle emissions. The construction period for renewable energy projects is much shorter than those of conventional power stations, while an income stream may, in certain instances, be provided to local communities through employment and land rental. The study also notes that the greenhouse gases (GHG) associated with the construction phase are offset within a short period of time compared with the project's lifespan. Renewable power therefore provides an ideal means for reaching emission reduction targets in a relatively easy manner. In addition, and of specific relevance to South Africa, renewable energy source is not dependent on water (as compared to the massive water requirements of conventional power stations), has a limited footprint and therefore does not impact on large tracts of land, poses limited pollution and health risks, specifically when compared to coal and nuclear energy plants.

Of relevance, the study also notes that renewable energy projects in rural areas create an opportunity to benefit the local and regional economy through the creation of jobs and tax revenues.

2.4.3 Powering the Future: Renewable Energy Roll-out in South Africa

The study notes that South Africa has higher CO_2 emissions per GDPppp (2002 figures) from energy and cement production than China or the USA (Letete, T et al, n.d.). Energy accounts for 83% of the total GHG emissions (excluding land use, land use change and forestry) with fuel combustion in the energy industry accounting for 65% of the energy emissions of South Africa (DEA, 2011).

Within a broader context of climate change, coal energy does not only have environmental impacts, it also has socio-economic impacts. Acid mine drainage from abandoned mines in South Africa impacts on water quality and poses the biggest threat to the country's limited water resources. Huge volumes of water are also required to wash coal and cool operating power stations. Eskom uses an estimated 10 000 litres of water per second due to its dependency on coal (Greenpeace, 2012).

The report notes that the concerns relating to whether South Africa can afford renewable energy arise out of the perception that renewable energy (RE) is expensive while fossil and nuclear technologies are cheap. The premise also ignores life cycle costing of the technologies which is favourable to renewable technologies where the sources of fuel are free or cheap.

2.4.4 WWF SA Renewable Energy Vision 2030

In its vision the WWF motivated for a more ambitious plan, suggesting that the IRP should provide for an 11-19% share of electricity capacity by 2030, depending on the country's growth rate over the next fifteen years. The vision is to increase renewable energy at the expense of new coal-fired and nuclear capacity. The report notes that in addition to the obvious environmental benefits of this scenario, it will enable South Africa to add flexibility to energy supply capacity on an on-demand basis.

The report notes that REIPPPP introduced in 2011, has by all accounts been highly successful in quickly and efficiently delivering clean energy to the grid. Increasingly competitive bidding rounds have led to substantial price reductions. In this regard, the study indicates that in three years, wind and solar PV have reached pricing parity with supply from new coal-fired power stations from a levelised cost of electricity (LCOE) perspective.

In bidding window 3 of August 2013, the average tariffs bid for wind and solar PV were R0,66/kWh and R0.88/kWh respectively, well below the recent estimates of R1.05/kWh for supply from the coal-fired Medupi and Kusile power stations (Papapetrou 2014).

The report also notes that the REIPPPP has several contracting rounds for new renewables supply. A robust procurement process, extension of a 20-year sovereign guarantee on the power purchase agreement (PPA) and, especially, ideal solar power conditions, have driven the investment case for RE in South Africa. In this regard, South Africa has been identified as one of the worlds' leading clean energy investment destinations (Figure 2.5).

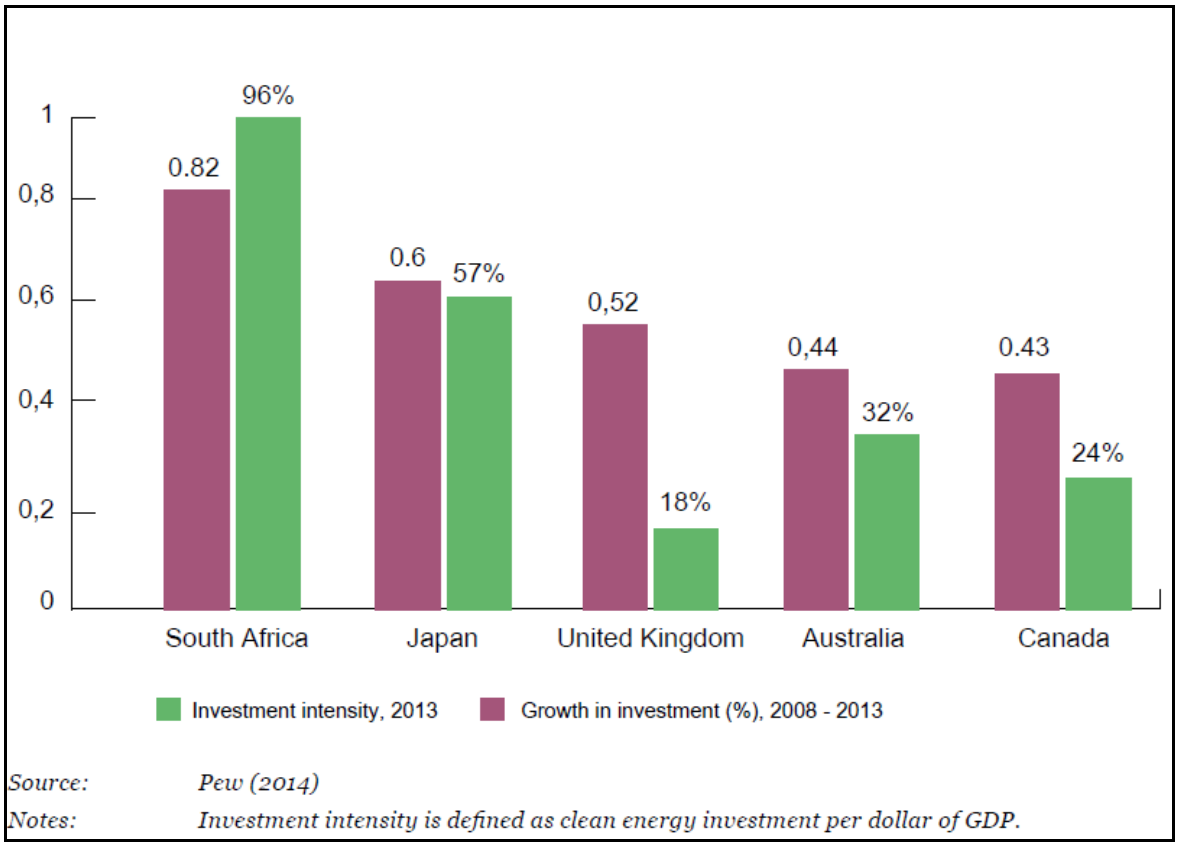


Figure 2.5: South Africa leads as a clean energy investment destination

The WWF study considers a low and high growth renewable energy scenario. The capital requirements for the low growth scenario are estimated at R474 billion over the period 2014-2030 (2014 Rand value), rising to R1.084 trillion in the high-growth scenario, in which 35 GW of capacity is built. Each annual round of purchasing 2 200 MW of RE capacity would cost approximately R77 billion in 2014 Rand value terms. In relative economic terms, this equates to 2% of the GDP per annum or approximately one quarter of Government's planned annual investment in infrastructure over the medium term. In the low economic growth scenario, which is arguably the more realistic one, the average annual new liability over the period is approximately R40 billion.

The study also points out that infrastructure spend is more beneficial than other government expenditure due to the infrastructure multiplier effect. This refers to the beneficial impact of infrastructure on economic growth in both the short term, resulting from expansion in aggregate demand, as well as in the longer term (six to eight years) due to enhanced productive capacity in the economy. A recent USA study on highway expenditure revealed the infrastructure multiplier to be a factor of two on average, and greater during economic downturns (Leduc & Wilson 2013). This means that one dollar spent on infrastructure raises GDP by two dollars. If the same were to hold true, as similar analysis suggests it would (Kumo 2012, Ngandu et al 2010), this indicates that the construction of renewable energy plants could be a valuable economic growth driver at a time when fears of recession abound.

The report concludes that the WWF is optimistic that South Africa can achieve a much more promising clean energy future than current plans allow for. With an

excellent solar resource and several good wind-producing pockets, the country is an ideal candidate for a renewable energy revolution.

The report indicates that the levelised cost of producing renewable energy already competes favourably with the three main alternatives, namely coal, gas and nuclear. In addition, renewable energy would contribute to a more climate-resilient future and insulate South Africa from dependence on expensive and unreliable fuel sources priced in dollars. Critical from a planning perspective, the report notes that renewable energy can also provide added flexibly on an 'as needed' basis, as electricity demand grows. This is vital in a highly uncertain environment.

2.4.5 The impact of the green economy on jobs in South Africa

The paper notes that greening the economy is particularly important in South Africa for two basic reasons: (1) the exceptional level of unemployment that the country is experiencing and (2) the high carbon impact of the economy.

In terms of employment, the paper refers to the IDC *Green Jobs R*eport (2011). In summary, the short-term (next 2 years)[13] estimate of total net employment potential is 98 000 jobs, and the long-term (next 8 years) employment potential is 462 567 jobs. Natural resource management is predicted to lead to the greatest number of these at 232 926 long-term jobs. Green energy generation is estimated to produce 130 023 long-term jobs, with energy and resource efficiency measures adding another 67 977 long-term jobs.

The paper notes that the Green Jobs Report was prepared by seventeen primary researchers from three prominent organisations, namely the IDC, the Development Bank of South Africa, and Trade and Industrial Policy Strategies. Many role players from other organisations were also consulted, including the World Wide Fund for Nature, the Green Building Council, the Economic Development Department and private companies involved in green industries.

Despite questions surrounding the employment estimates contained in the Green Jobs Report, green economic activity does appear to generate more local jobs than fossil-fuel-based industries. Some of the estimates also indicate the potential for significant employment. The paper concludes that the figures represent a promising starting point that warrants further research and policy involvement in greening the economy in South Africa.

2.4.6 The potential for local community benefits

In her thesis, Tait[14] notes that the distributed nature of renewable energy generation can induce a more geographically dispersed pattern of development. As a result, RE sites can be highly suited to rural locations with otherwise poor potential to attract local inward investment therefore enabling to target particularly vulnerable areas.

In her conclusion, Tait notes that the thesis has found positive evidence for the establishment of community benefit schemes in the wind sector in South Africa. These benefits would also apply to solar projects. The BBBEE requirements for

[13] Note, the Green Jobs study was prepared in 2011 and therefore predates the REIPPPP.
[14] The potential for local community benefits from wind farms in South Africa, Louise Tait (2012), Master's Thesis, Energy Research Centre University of Cape Town. Similar benefits are also likely to be associated with solar energy projects.

developers as set out in the DoE's IPPPP for renewables is the primary driver for such schemes. The procurement programme, in keeping with the objective of maximising the economic development potential from this new sector, includes a specific focus on local communities in which wind farms are located.

The procurement programme, typical of all Government tendering processes, includes a BBBEE scorecard on which renewable energy projects are evaluated. However, the renewables scorecard appears to play an important part in a renewed focus on the broad-based Aspects of the legislation, as enforced by a recent national review of the BBBEE Act. In this regard, the renewables scorecard includes specifications for local communities in respect of broad-based ownership schemes, socio--economic development and enterprise development contributions. This approach to legislating social responsibilities of business in all sectors definitely has a South African flavour, borne out of the political history of the country and the imperatives for social transformation laid out in the constitution.

While Tait notes that it is still early days for the development of this sector and one cannot determine the impact that such benefit schemes may have, it is clear though that targeted development expenditure will be directed to multiple rural communities and there seems to be a strong potential to deliver socio-economic benefits.

SECTION 3: OVERVIEW OF STUDY AREA

3.1 INTRODUCTION

Section 3 provides a baseline description of the study area with regard to:

- The administrative context.
- Provincial context.
- Overview of district and local municipalities.
- Site and the surrounding land uses.

3.2 ADMINISTRATIVE CONTEXT

The study area is located within the Renosterberg Local Municipality (RLM), which falls within the Pixley ka Seme District Municipality (PKSDM) in the Northern Cape Province (Figure 3.1). The PKSDM is made up of eight category B local municipalities which include Emthanjeni, Kareeberg, Thembelihle, Renosterberg, Siyathemba, Ubuntu, Siyancuma and Umsobomvu municipalities. De Aar is the administrative seat of the PKSDM. The administrative seat of the RLM is Petrusville.



Source: SA municipalities website

Figure 3.1: Location of the Renosterberg Local Municipality within the Pixley Ka Seme District Municipality

3.3 PROVINCIAL CONTEXT[15]

The proposed site located in the Northern Cape Province, which is the largest province in South Africa and covers an area of 361 830 km^2 and, constitutes approximately 30% of South Africa. The province is divided into five district municipalities (DM), namely, Frances Baard, Karoo, Namakwa, Pixley Ka Seme and ZF Mgcawu District Municipality (known before 1 July 2013 as Siyanda DM). The site itself is located in the Pixley Ka Seme DM.

Population
Despite having the largest surface area, the Northern Cape has the smallest population of 1 193 780 (Community Household Survey, 2016) or 2.2% of the population of South Africa. Of the five districts, Frances Baard has the largest population (32.5%), followed by ZF Mgcawu District Municipality (21.2%), John Taolo Gaetsewe (20.3%), Pixley ka Seme (16.4%) and Namakwa (9.7%). The majority of the population in the Northern Cape Province are Black African (48.1%), followed by Coloureds (43.7%) and Whites (7.7%).

In terms of age, 36.5% of the Northern Cape population is between 15 and 34 years old, which is the highest age distribution, followed by 29.2% of those aged 35–64 years, while only 6.6% comprised those aged 65 years and older. Similarly, this pattern is also seen across all districts in the province. The district profile shows that the highest proportions of persons aged 15–34 years were recorded in Pixley Ka Seme, ZF Mgcawu and John Taolo Gaetsewe districts. The figures for these three districts were also above the provincial average of 36.5%. The proportion of persons aged 65 years and older was higher in Namakwa (9.5%) and Frances Baard (8.2%).

Education
Based on the information contained in the NCPSDF the average adult education attainment levels in the Northern Cape are lower than the adult education attainment levels of South Africa as a whole. Approximately 19.7% of the Northern Cape adults have no schooling in comparison to South Africa's 18.1%. The Northern Cape has the second lowest percentage of adult individuals (5.5%) that obtained a tertiary education in South Africa. The LED Strategy for the Northern Cape indicates that Pixley ka Seme has the lowest adult education attainment levels in the Northern Cape with 27.3% of the adult population having no form of schooling, whilst John Taolo Gaetsewe is second with 25.4% having no schooling. The highest number of the adult population with tertiary education (6.4%) is located in Frances Baard.

The Northern Cape also has the smallest portion (11.1%) of highly skilled formal employees in South Africa, while Gauteng has the highest (14.3%). Linked to this the Northern Cape has the second largest portion of semi and unskilled formal employees in the country. A lack of skilled people often results in both the public and the private sector being unable to implement planned growth strategies and achieve the desired productivity, service delivery and service quality (NCSDF, 2012).

[15] The information in this section is based on the Northern Cape Provincial Growth and Development Strategy 2004-2014. This document does not include 2011 Census Data. Where possible data from the 2011 Census and 2016 Community Household Survey has been used to update the information.

Economic development

Over the past 8 years there has been little to no variance in the Human Development Index (HDI) figures for the Northern Cape, indicating no increase or decrease in the overall standard of living[16]. This trend is unlikely to change in the foreseeable future, mainly due to the marginal economic base of the poorer areas, and the consolidation of the economic base in the relatively better-off areas. It is important to note that the HDI for the Northern Cape (0.55) is substantially below the South African figure of 0.72. The HDI of 0.55 displays a pattern of semi-development, and there is a definite inequality between the different population groups, with the Whites having a higher development lifestyle than the African or Coloured groups.

The percentage of Northern Cape people living below the poverty line has decreased from 40% in 1995 to 27% in 2011, while the poverty gap has decreased from 11% in 1995 to 8% in 2011 (Figure 3.2). The goal set by the province is to decrease the percentage of people living below the poverty line to 20% by 2015 (NCSDF, 2012). The alleviation of poverty is one of the key challenges for economic development. Higher levels of economic growth are a key challenge for poverty eradication. Investment in people is pivotal to the eradication of poverty and inequality. Investment in people is also, to a large extent, about delivering social and economic infrastructure for education, welfare, health, housing, as well as transport and bulk infrastructure.

[16] The Human Development Index (HDI) was developed by the United Nations Development Programme (UNDP) based on the philosophy that the goal of development was to ensure that individuals live long, informed and comfortable lives. The HDI consists of three components: Longevity, which is measured by life expectancy at birth; Educational attainment, which is measured by two education variables, namely adult literacy and combined gross primary, secondary and tertiary enrolment ratio, and; Income, which is measured by gross domestic product (GDP) per capita. Performance in each dimension is expressed as a value between 0 and 1, and the HDI index gives an internationally accepted measure of the wellness (quality of life) of the population of the area under consideration. The closer the HDI is to 1.0, the higher the level of "living condition". For example, Sweden has an index of 0.91 defined as high, South Africa at 0.72 is defined as middle and Lesotho at 0.47 is defined as low.

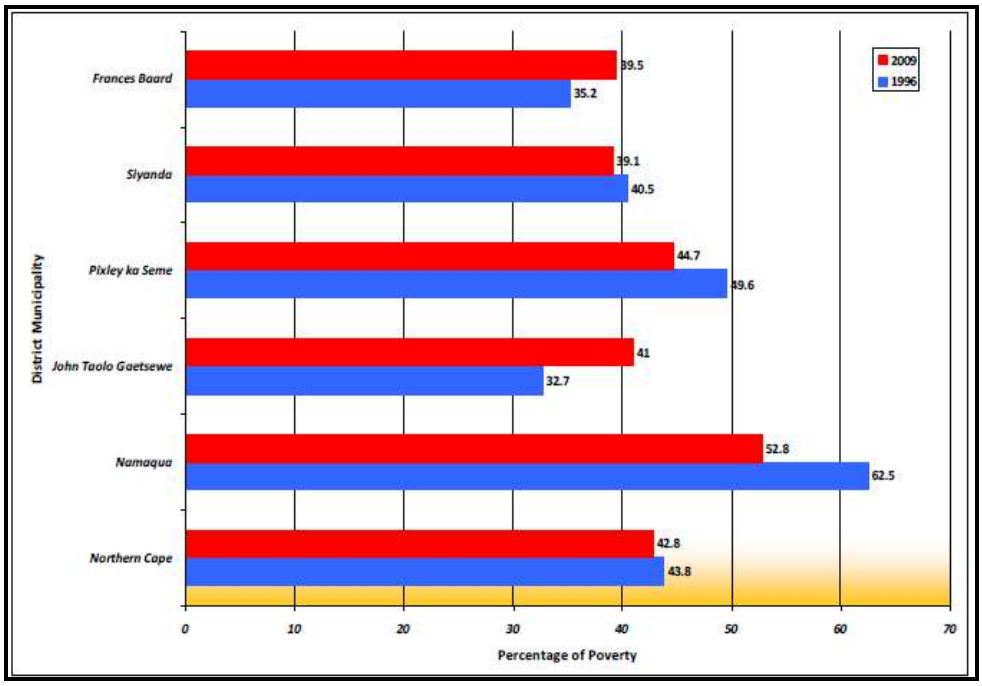


Figure 3.2: Percentage of people living in poverty in the Northern Cape (Source: Global Insight, 2009 as cited in the PGDS, July 2011)[17].

In terms of per capita income, the Northern Cape Province has the third highest per capita income of all nine provinces, however, income distribution is extremely skewed, with a high percentage of the population living in extreme poverty. The measure used in the PGDS document to measure poverty is the percentage of people living below the poverty line or breadline is used[18].

Economic sectors

The Northern Cape economy has shown significant recovery since 2000/2001 when it had a negative economic growth rate of -1.5% (LED Strategy). The provincial economy reached a peak of 3.7% in 2003/2004 and remained the lowest of all provinces. The Northern Cape is the smallest contributing province to South Africa's economy (only 2% to South Africa GDP per region in 2007).

The mining sector is the largest contributor to the provincial GDP, contributing 28.9% to the GDP in 2002 and 27.6% in 2008. The mining sector is also important at a national level. In this regard, the Northern Cape produces approximately 37% of South Africa's diamond output, 44% of its zinc, 70% of its silver, 84% of its iron-ore, 93% of its lead and 99% if its manganese.

Agriculture and agri-processing sectors are also key economic sectors. Approximately 2% of the province is used for crop farming, mainly under irrigation in the Orange River Valley and Vaalharts Irrigation Scheme. Approximately 96% of the land is used for stock farming, including beef cattle and sheep or goats, as well as game farming. The agricultural sector contributed 5.8% to the Northern Cape

[17] Siyanda DM is now called the ZF Mgcawu DM.

[18] In terms of the poverty line, a person is considered poor if his or her consumption or income level falls below some minimum level necessary to meet basic needs. The minimum level is usually called the poverty line. In South Africa the poverty income level is set at R800/month for an individual or R 3 200 per month for a household of four.

GDP per region in 2007 which was approximately R1.3 billion, and it employs approximately 19.5% of the total formally employed individuals (NCSDF, 2012). The sector is experiencing significant growth in value-added activities, including game-farming. Food production and processing for the local and export market is also growing significantly.

The main agricultural produce of the Northern Cape include:

- High-value horticultural products such as table grapes, sultanas and wine grapes, dates, nuts, cotton, fodder, and cereal crops are grown along the Orange River.
- Wheat, fruit, groundnuts, maize, and cotton in the Vaalharts irrigation scheme in the vicinity of Hartswater and Jan Kempdorp.
- Vegetables and cereal crops at the confluence of the Vaal River and the Orange Rivers in the vicinity of Douglas.
- Wool, mohair, karakul, Karoo lamb, ostrich meat and leather, and venison throughout most of the province.

Economic development in the Northern Cape is hampered by the vastness of the area and the remoteness of its communities in rural areas. Development is also hampered by the low education and skills levels in the province. As a result, unemployment in the Northern Cape presents a major challenge.

Employment

According to Statistics South Africa Labour (2012) the community and social services sector is the largest employer in the province at 29%, followed by the agricultural sector (16.5%), wholesale and retail trade (14%), finance (8%), manufacturing (6%) and mining (6%), etc. (Figure 3.3).

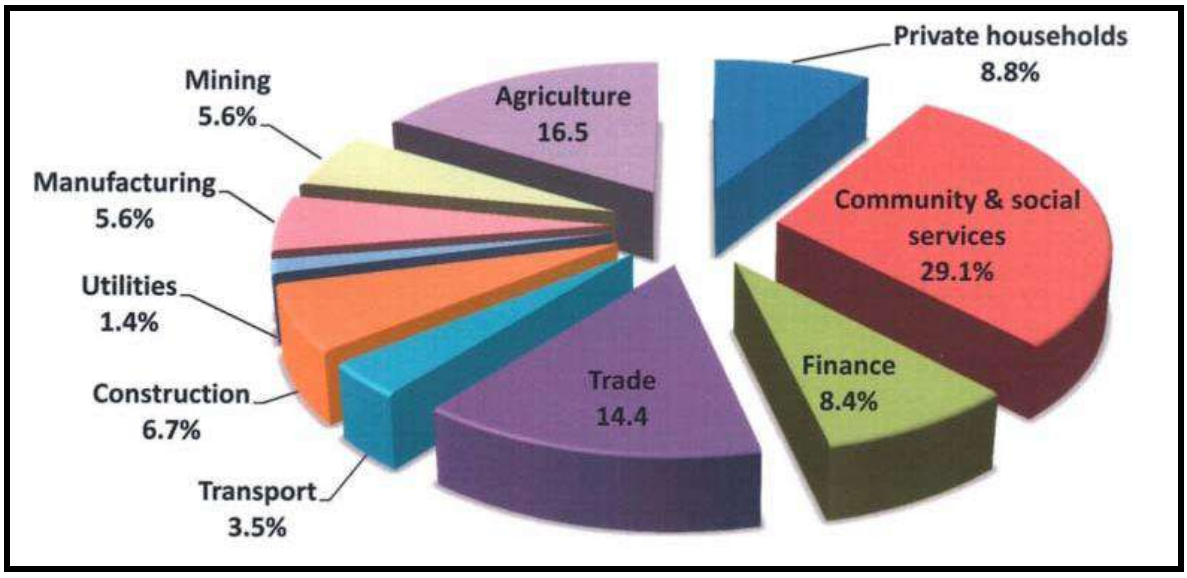


Figure 3.3: Employment by Economic Sector and Industry (Source: Statistics South Africa 2012).

3.4 MUNICIPAL OVERVIEW

Population

The population of the RLM in 2016 was 11 818. The RLM is therefore a sparsely populated municipality. Of this total, 37% were under the age of 18, 56.8% were between 18 and 64, and the remaining 6.1% were 65 and older. The RLM therefore has a relatively large young population. This creates challenges in terms of creating employment opportunities. In terms of race groups, Coloureds made up 57% of the population, followed by Black Africans (32.8%) and Whites (9.8%). The main first language spoken in the RLM was Afrikaans (69.9%), followed by IsiXhosa (26.3%) and Sesotho (1%).

The high percentage of young people in the RLM means that a large percentage of the population is dependent on a smaller productive sector. The dependency ratio is the ratio of non-economically active dependents (usually people younger than 15 or older than 64) to the working age population group (15-64). The higher the dependency ratio the larger the percentage of the population dependent on the economically active age group. This in turn translates reduced revenue for local authorities to meet the growing demand for services. The national dependency ratio in 2011 was 52.7%, similar to that of the Northern Cape Province (55.7%). The dependency ratio for the RLM (2011) was 64%. The traditional approach is based on people younger than 15 or older than 64. The 2016 information provides information for the age group under 18. The total number of people falling within this age group will therefore be higher than the 0-15 age group. However, most people between the age of 15 and 17 are not economically active (i.e., they are likely to be at school).

Using information on people under the age of 18 is therefore likely to represent a more accurate reflection of the dependency ratio. Based on these figures, the dependency ratio for the RLM in 2016 was 75.8%. This figure is significantly higher than the national and provincial levels in 2011 (52.7% and 55.7% respectively). The higher dependency ratio reflects the limited employment opportunities in the area and represent a significant risk to the district and local municipality. The high dependency ratio also highlights the importance to maximising local employment opportunities and the key role played by training and skills development programmes.

Households and house types

Based on the information from the 2016 Community Survey there were a total of 3 563 households in the RLM. Most of the households reside in formal houses (71.4%). The figure for the RLM is lower than the district (78.1%) and Provincial (74.4%) figures. Approximately 14.7% of the households in the RLM reside in shacks and 7.5% in backyard flats. A relatively high percentage of the households therefore live in informal structures.

Based on the information from the 2016 Community Household Survey 34.4% of the households in the RLM are headed by females. The figure for RLM was lower than the District and Provincial figures of 37% and 39% respectively. The high number of female-headed households at the local municipal reflects the lack on formal employment and economic opportunities in the RLM. As a result, job seekers from the RLM need to leave the areas to seek work in the larger centres. The majority of the job seekers are likely to be males. This is due to traditional rural patriarchal societies where the role of the women is usually linked to maintaining

the house and raising the children, while the men tend to be the ones that migrate to other areas in search of employment.

Household income

Based on the data from the 2011 Census, 11.7% of the population of the RLM had no formal income, 3.8% earned less than R4 800, 6.3% earned between R5 000 and R10 000 per annum, 23.8% between R10 000 and R20 000 per annum and 23.4% between R20 000 and R40 000 per annum (2011). The poverty gap indicator produced by the World Bank Development Research Group measures poverty using information from household per capita income/consumption. This indicator illustrates the average shortfall of the total population from the poverty line. This measurement is used to reflect the intensity of poverty, which is based on living on less than R3 200 per month for an average sized household (~ R40 000 per annum). Based on this measure, in the region of 70% of the households in the RLM live close to or below the poverty line. This figure is higher than the provincial level of 62.9%. The low-income levels reflect the limited employment opportunities in the area and dependence on the agricultural sector. This is also reflected in the high unemployment rates.

The low-income levels are a major concern given that an increasing number of individuals and households are likely to be dependent on social grants. The low-income levels also result in reduced spending in the local economy and less tax and rates revenue for the RLM. This in turn impacts on the ability of the RLM to maintain and provide services.

Employment

The official unemployment figure in 2011 for the RLM was 14.3%. The figures also indicate that the majority of the population are not economically active, namely 41.8%. These figures are similar to the official unemployment rate for the Northern Cape Province (14.5%) and Pixley ka Seme District (14.8%). This reflects the limited employment opportunities in the area, which in turn are reflected in the low income and high poverty levels. Unemployment Rate in South Africa averaged 26.32% from 2000 until 2021, reaching an all-time high of 34.90 % in the third quarter of 2021 (StatSA). Even more concerning, the Youth Unemployment Rate in South Africa averaged 54.21% from 2013 until 2021, reaching an all-time high of 64.40 % in the second quarter of 2021. The current rates in the RLM are therefore likely to be significantly higher than the 2011 rates. These rates will also have been exacerbated by the impact of COVID-19 pandemic.

Education

In terms of education levels, the percentage of the population over 20 years of age in the RLM with no schooling was 11.2% in 2011, compared to 7.9% for the Northern Cape Province and 11.9% for the district. The percentage of the population over the age of 20 with matric was 33.6%, which was significantly higher that the provincial and district figures of 29.1% and 25.3% respectively. Only 1.4% and 2% of the population over the age of 20 years in the RLM had an undergraduate and postgraduate qualification, respectively. Despite the higher matric qualification rate, the relatively poor education levels in the RLM pose potential challenge for economic development.

3.5 MUNICIPAL SERVICES

Access to electricity
Based on the information from the 2016 Community Survey 91.6% of households in the RLM had access to electricity. Of this total 65.6% had inhouse prepaid meters and 24.2% have conventional in-house meters.

Access to water
Based on the information from the 2016 Community Survey 91.9% of households were supplied by a regional or local service provider, while 7.5% relied on their own supply, which reflects the rural nature of the municipality. The provincial and district figures for water provided by a service provider were 88.6% and 90.7% respectively.

Sanitation
Based on the information from the 2016 Community Survey, 89.8% of households have access to flush toilets, while 7.4% had not access to access to toilet facilities. The figures in terms of access to flush toilets are higher than provincial (71.4%) and District (82.8%) figures. For Ward 6, 72.7% of households had access to flush toilets and 7.2% had no access to toilets. Approximately 16% relied on pit latrines.

Refuse collection
Based on the information from the 2016 Community Survey, 54.7% of households have their refuse collected on a regular basis by a local authority or private company, while 25.2% relied on communal dumps, 8.1% use their own dumps, and 9.4% are not serviced. The provincial and district figures for refuse collection provided by a service provider on a regular basis were 64.9% and 78.1% respectively. The figures for the RLM are therefore lower that the district and provincial service levels.

3.6 HEALTH AND COMMUNITY FACILITIES

The PKSDM is served by 3 District Hospitals, 8 Community Health Centres, 28 Primary Health Care Clinics, 4 satellite clinics and 1 mobile clinic, distributed over the district. The RLM has 1 District Hospital and 6 Primary Health Care clinics. There are no community health centres within RLM that provide a 24hour service. A new hospital was built in De Aar and was opened in 2017. The Central Karoo Hospital serves as the referral hospital for the district. Minor operations are performed at the facility. Specialists visit the district on a monthly basis from Kimberley Hospital Complex. In terms of education the RLM has 16 schools of which 13 are no-fee schools. The RLM also has libraries.

3.7 ECONOMIC OVERVIEW

Agriculture
Agriculture is the key economic sector in the PKSDM and RLM. Many of the towns within the district municipal area function mainly as agricultural service centres, with the level of services provided at the centres to a large extent reliable on the intensity of the farming practices in the surrounding area. Despite the largely semi-arid and arid environment in the district, the fertile land that lies alongside the Orange, Vaal and Riet Rivers supports the production of some of the country's finest quality agricultural products, including grapes and vegetables. The main livestock farming in the region include cattle, sheep, and goat farming. Game

breeding has also been identified as one of the opportunities which could be linked with the tourism sector for Game reserves and hunting activities. However, despite the key role played by agriculture there is limited value adding to the farming products within the district and the area is prone to droughts and climate change.

Mining
The main deposits in Pixley ka Seme include alluvial diamond mining along the Orange River and various semi-precious stones, such as tiger-eye and zinc deposits. The region also has various saltpans for the potential of salt production. Uranium deposits also occur in the district.

Tourism
The tourism sector in the district contributes 15.6% to the provincial gross value added (GVA). The municipalities Emthanjeni, Kareeberg, Umsobomvu and Siyancuma municipalities are the biggest contributors to the provincial gross value added (GVA). The PKSDM IDP notes that the tourism opportunities in the district will increase due to the Karoo Array Telescope (KAT), a project being driven at a national level. Of relevance, the PKSDM notes that care needs to be taken with developments that have the potential to negatively impact on the Karoo landscapes.

Renewable energy
Of key relevance the PKSDM IDP identifies renewable energy as key economic sector and refers to the substantial socio-economic development (SED) and enterprise development (ED) contributions leveraged by the IPPPP commitments. The IDP notes that the towns of Prieska and Carnarvon have in recent years changed character from small rural towns to potentially regional hubs as a result of investments in renewable energy generation and the Square Kilometre Array (SKA) radio telescope project, respectively.

3.8 OVERVIEW OF STUDY AREA

3.8.1 General context

The Kudu 4 PV project is one of 12 Kudu PV projects being concurrently proposed (separate applications) and is located approximately 25 km[19] northwest and 39 km southeast of the small towns of Philipstown and Petrusville respectively in the south-eastern Northern Cape Province (NCP) (Figure 3.4). Petrusville and Philipstown are the largest towns in the Renosterberg Local Municipality (RLM). De Aar (Emthanjeni LM), located approximately 50 km to the south-west of the site, is the nearest large town. The nearest higher order service centres are Kimberley (~170 km to the north-northeast) and Bloemfontein (~220 km to the northeast).

[19] All distances linear.

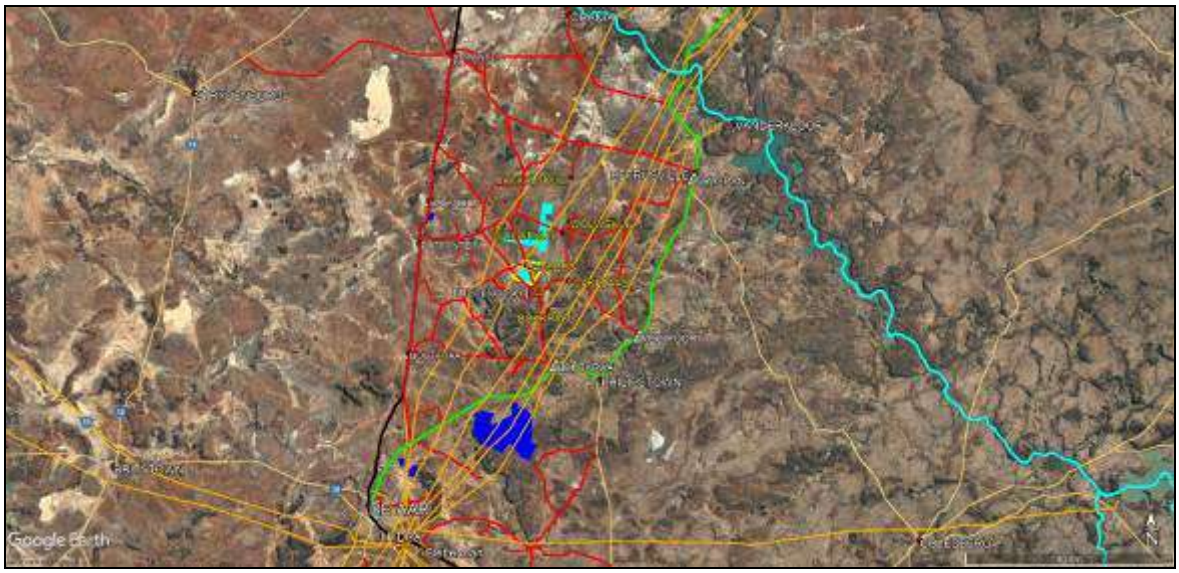


Figure 3.4: Kudu 4 PV site property (yellow outline) in relation to other proposed Kudu 1-12 PV sites (light blue fill), settlements, provincial boundaries (light blue lines), existing transmission lines (orange), the R48 (green) and study area gravel road network (red), railway line (black) and operational REFs (dark blue fill).

The study area (approximately 8 150 hectares (ha)) for all the proposed Kudu Solar Facilities is the full extent of the eight affected farm properties on which the proposed PV Facilities are planned to be constructed. These farm properties are listed below, along with the associated Surveyor General (SG) Codes:

- Remaining Extent of the Farm Bas Berg No. 88 (C05700000000008800000).
- Remaining Extent of Portion 3 of the Farm Bas Berg No. 88 (C05700000000008800003).
- Portion 4 (Portion of Portion 3) of the Farm Bas Berg No. 88 (C05700000000008800004).
- Remaining Extent of Portion 2 (Middel Plaats) (a Portion of Portion 1) of the Farm Grasspan No. 40 (C05700000000004000002).
- Remaining Extent of the Farm Annex Wolve Kuil No. 41 (C05700000000004100000).
- Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41 (C05700000000004100001).
- Portion 2 of the Farm Wolve Kuil No. 43 (C05700000000004300002).
- Remaining Extent of the Farm Wolve Kuilen No. 42 (C05700000000004200000).

Note that the farm names listed above are extracted from the title deeds, and that all reference to these farm portions throughout this report refer to it as such.

The study area is primarily accessed off the R48 via a network of intersecting public gravel roads. The R48 links Petrusville to De Aar via Philipstown. The road currently carries significant ore truck traffic and stretches of the road are in a poor condition. The key intersecting public gravel roads providing access to the study area (from north to south) are the Graspan-, Rooipoort- and Houtkraal Roads (Photograph 3.1). The relevant roads are connected by a network of further gravel roads. Many properties are accessible (albeit via detours) by more than on road.



Photograph 3.1: Intersection of R48 (De Aar road) and Houtkraal public gravel road.

The study area is located on the Great Escarpment in the arid Central Karoo region. Annual rainfall is around 300 mm, and the area is prone to droughts. The landscape is general flat, punctuated by small ranges of koppies and low mountains (Photograph 3.2). The veld consists of karroid scrub on plains and shrubland on the slopes of koppies. The scrub is characterized by the predominance of grasses in good rainfall years, increasing the risk of veld fires. The landscape is essentially treeless, with trees confined to ephemeral drainage courses and farmyards.



Photograph 3.2: Veld on Basberg, Basberg Mountain in the background.

The study area properties are used primarily for farming livestock, predominantly sheep (Photograph 3.3). The area is a wool farming area. Carrying capacities are modest, around 3 ha per sheep.[20] Most operations rely on networks of boreholes and watering points. No significant cropping activities are associated with the study area, although a few livestock operations grow modest quantities of irrigated fodder for own use. Economic farming units in the study area are large, typically consisting of several properties. Some farmers lease additional land. The study area settlement is consequently sparse, and mainly concentrated on a few base farms, typically near public roads. Labourers typically live on the base properties. Caretaker staff reside on a few secondary properties. Farmsteads and labourers' houses on several properties have become redundant and are no longer inhabited.

[20] https://gis.elsenburg.com/apps/cfm/#



Photograph 3.3: Sheep grazing on Bokkraal.

Game occurs on most study area properties. Several properties offer annual (winter) hunting opportunities. Trophy hunting in the Petrusville-Philipstown area is currently only associated with mixed livestock operations based on Wolwekuil (42/1), Vlakplaas and Jakkalskuil, none of which are in significant proximity to the PV 1 site. Each of these properties offer accommodation for hunting parties. Jakkalskuil is the only operation primarily focused on international hunters. No safari tourism is associated with any of these three operations. No farm stay accommodation or other tourism is associated with the study area. No protected natural areas are located in or in significant proximity of the study area.

The study area is traversed by a broad northeast-southwest -aligned transmission line corridor between Eskom's large Perseus (Dealesville) and Hydra (De Aar) substations. The corridor measures around 25 km in width and accommodates 7 lines in effectively 6 alignments. Most study area landowners are affected by at least one line (Photograph 3.4).



Photograph 3.4: Transmission line on Wolwekuil north of the site property, Basberg Mountain in the background.

3.8.2 Site and adjacent properties

The Kudu 4 PV site is proposed on a portion of one property, Bas Berg 88/3. The site property borders onto 7 properties (Figure 3.5). Figure 3.5 also illustrates some of the other nearby proposed projects, such as the concurrently proposed Crossroads PV Phase 1 project, which is not the subject of this assessment, and thus outside of this current EIA process for the proposed Kudu Solar Facilities.



Figure 3.5: Kudu 4 PV site (bold light blue fill), project substation (dark blue fill), and site properties (bold yellow outlines) in relation to adjacent properties (white outlines), proposed Kudu access points (red triangles), other Kudu PV projects (light blue fill), concurrently proposed Crossroads PV Phase 1 sites[21] (pink fill), existing transmission lines (orange), and the study area existing road network (red).

The site property as well as adjacent Bas Berg 88/RE and 88/4 are owned by XXXX[22] (Table 3.1). The remaining 6 adjacent properties belong to 4 landowners, namely XXXX, XXXX, XXXX and XXXX - with the latter accounting for 5 of the properties. XXXX is not based in the study area. Her properties have been leased out to XXXX of near-adjacent Bokkraal since 1994. The four adjacent landowners are based on site-adjacent (XXXX, XXXX) or near-adjacent farms (XXXX, XXXX).

[21] Sites for Crossroads Phases 2 and 3 have not been finalized yet. Only Crossroads Phase 1 is currently being assessed concurrently (separate developers, separate processes) with the Kudu projects. Please refer to Figure 3.7. for an overview of historic, current, and envisaged REF projects in the broader study area.

[22] Note that the names and surnames of the landowners have been replaced by 'XXXX' in this document in order to comply with the POPI Act.

Table 3.1: Overview of Kudu 4 site property and adjacent properties (site, then clockwise from north)

PROPERTY	OWNER[23]	LAND USE	RES[24] [km]	COMMENT[25]
Bas Berg 88/3	XXXX	Livestock [leased out to XXXX, Bokkraal]	Basberg [2.8; 3]	Proposed Kudu 1-5 PVs; 1 x 765 kV [existing];
Bas Berg 88/RE			n.a.	1 x 765 kV [existing]; Proposed Kudu 1 and 2 PVs
Bas Berg 88/4			n.a.	~31 ha parcel
Annexe Wolve Kuil 41/RE	XXXX	Livestock	n.a.	Proposed Kudu 8 PV
Kopy Alleen 83/5	XXXX	Livestock	n.a.	Proposed Kopy Alleen PV (part of the Crossroads PV Development)
Kopy Alleen 83/2	XXXX	Livestock	n.a.	~40 ha parcel
Karee Kloof 85/6		Livestock	n.a.	
Karee Kloof 85/11		Livestock	n.a.	1 x 765 kV [existing]
Swartkoppies 86/RE	XXXX	Livestock	Kareekloof [2.7; 3.3]	1 x 765 kV [existing]
Bas Berg 88/1	XXXX	Livestock	Vrede [2.7; 4.1]	
Bas Berg 88/5		Livestock	n.a.	1 x 765 kV [existing]; Proposed Vrede PV (part of the Crossroads PV Development)

Dwellings are located on Bas Berg 88/3 (Basberg), Swartkoppies 86/RE (XXXX, Kareekloof), and Bas Berg 88/1 (XXXX, Vrede). The Basberg farmstead is not inhabited, but is used by the owner during occasional visits (Photograph 3.5). A caretaker and his family reside on Basberg (Photograph 3.6). Kareekloof and Vrede are base farms of larger farming operations (Photograph 3.7).



Photograph 3.5: Uninhabited farmstead and outbuildings on Basberg.

[23] Shading indicates owner directly affected by either Crossroads PV Phase 1 or ABO Kudu suite projects.
[24] Shading indicates inhabited dwellings within 5 km of the PV site and substation, resp.
[25] Shading indicates properties on which REFs are currently proposed.



Photograph 3.6: Inhabited labourer's dwelling on Basberg.

All the site and adjacent properties are used for farming livestock. As indicated, the XXXX properties have been leased to XXXX, and are farmed as part of his operation based on Bokkraal located approximately midway between the site and the R48 (Houtkraal road intersection) (Photograph 3.7) The XXXX operation provides full-time employment to 18 people and seasonal opportunities to shearing teams three times a year. The XXXX properties account for approximately 26% of the operation's grazing (XXXX, pers. comm). No trophy hunting, tourist accommodation or other tourism facilities or activities are associated with any of the site or adjacent properties.



Photograph 3.7: Bokkraal farm yard seen from the road to Basberg

The site property as well as 4 adjacent ones are currently affected by transmission line infrastructure. Apart from XXXX, all affected landowners are affected by other current PV proposals on one or more of their properties. The site property is also proposed to accommodate Kudu 1-5 PVs. Portions of Kudu 1 and 2 are also proposed on Bas Berg 88/RE (XXXX). Site-adjacent Annexe Wolve Kuil 41/RE (XXXX) is proposed to accommodate Kudu 8 PV, while Kopy Alleen 83/5 (XXXX) is proposed to accommodate the Kopy Alleen PV (Crossroads), and Bas Berg 88/5 (XXXX) the Vrede PV (Crossroads).

3.8.3 Relationship to receptors

The site property is used for grazing (sheep). The Kudu PV 4 site would occupy approximately 70 ha (2.8%) of the three (~2485 ha) XXXX properties. Cumulatively, Kudu PV1-5 would occupy approximately 762 ha (30.7%) of the XXXX properties. The PV 1-5 sites would occupy level ground with good grazing

veld. A large portion of the remainder of the properties is occupied by Basberg mountain (XXXX, pers. comm).

Inhabited dwellings within 5 km of the site are only located on only three properties, namely the site property Bas Berg 88/3 (Basberg, 2.8 km), and adjacent Vrede (2.7 km) and Kareekloof (2.7 km). As indicated above, only one labourer's dwelling is inhabited on Basberg, while Vrede and Kareekloof are base farms. The Vrede PV is proposed on a portion of the larger Vrede property. The dwellings on Louwsvilla (part of Vrede farm) are no longer inhabited (which is part of the separate proposed Crossroads PV development). Only one receptor (Basberg, 3 km) is located within a 3 km range of the proposed project substation site. No visually sensitive land uses are located in significant proximity to the site. No accommodation or other tourism facilities are associated with the immediate study area.

The proposed project study area / preferred site can be accessed via various existing main roads and unnamed farm gravel roads (Figure 3.6). Note that these are not alternatives in terms of the EIA Process, but only options investigated by the Project Applicant and traffic specialist):

- Access Route Option 1:
  - Route A: Along TR3801, DR3093, and DR3096;
  - Route B: Along TR3801, DR3093 and DR3084;
- Access Route Option 2 (Figure 2.10):
  - Route A: Along MR790, DR3093 and DR3084;
  - Route B: Along MR790 and DR3093;
  - Route C: Along MR790, DR3093 and DR3096;
- Access Route Option 3:
  - Route A: Along TR3801, TR3802, and DR3096;
  - Route B: Along TR3801, TR3802, DR3096 and DR3093; and
  - Route C: Along TR3801, TR3802, DR3096, DR3093 and DR3084.



Figure 3.6: Access Route Options (Source: Traffic Impact Assessment for the proposed Kudu Solar Facilities, Sturgeon Consulting, 2023). Red dots indicate dwellings recorded on the relevant 1: 50 000 map rasters; red circles indicate inhabited dwellings <500 m of the road.

Inhabited farmyards located within 500 m of proposed routes are associated with Option 2 A and B (Tafelkop) and Option 3 A and 3 B (Vorstersdam, Beauclaire, Paardeberg, Gouvernia and Wolwekuil 42/RE). With the exception of Gouvernia and Wolwekuil 42/RE, inhabited dwellings on the relevant properties are located within 100 m of the roads. Option 1 would be located within 500 m of inhabited caretaker labourer's dwellings on Olievenfontein (1A and 1B) and Basberg (1A). The farmsteads on the properties are however not inhabited.

3.8.4 Other renewable energy facilities

The Kudu 4 PV site is not located within a Renewable Energy Development Zone (REDZ). The DFF&E's Renewable Energy website indicates historic clustering around and north of De Aar. Historic proposals within a 30 km radius of the centre of the PV site are also concentrated around Kalkbult along the De Aar-Kimberley railway line to the NW of the site, and to the south of Philipstown SE of the site (Figure 3.7).

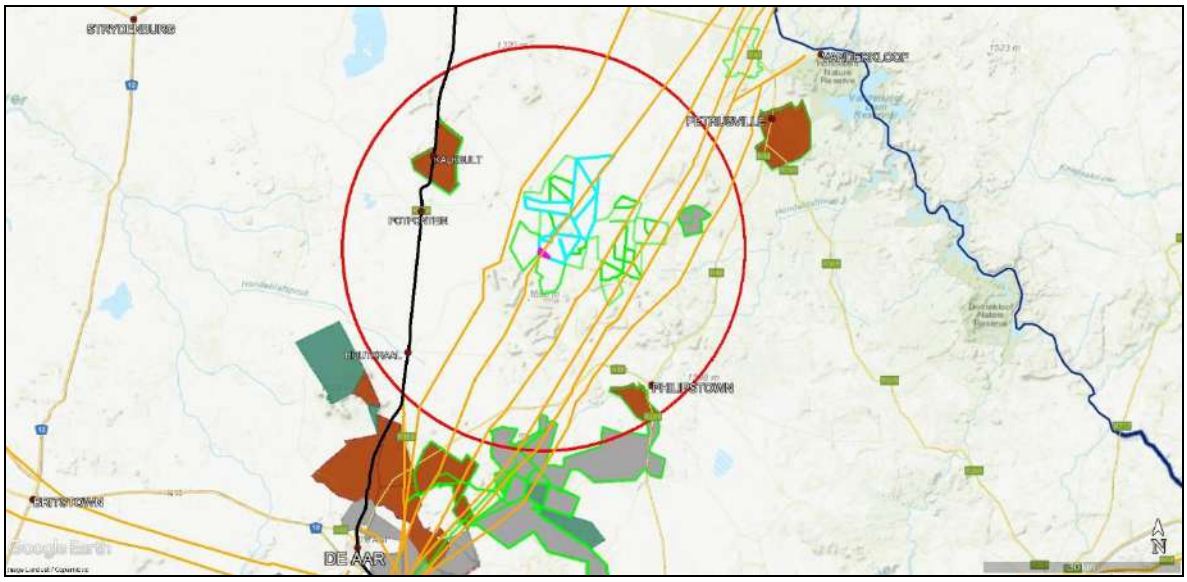


Figure 3.7: Historic REF applications within a 30 km radius (red circle) of the centre of the Kudu 4 PV site (pink outline). Also indicated are the Kudu PV project site properties (light blue); other historic, current and envisaged REF projects (affected property outlines, green); the De Aar-Kimberley railway line (black), and existing transmission lines (orange) (Source: DFFE, CSIR).

Only three operational REFs are located within this 30 km radius, namely the Kalkbult PV SEF adjacent to the railway line approximately 17.5 km NW of the site, and the Long Yuan/ De Aar Phase 1 and Phase 2 WEFs approximately 25 km to the south of the site. The De Aar WEF is located on elevated terrain. Aviation lights are visible at night on most of the R48 between Petrusville and De Aar. As indicated, the Kudu 4 PV project is one of 12 Kudu PV projects currently proposed in the Petrusville-Philipstown area west of the R48. Figure 3.7 reflects REF projects of varying status. Key active projects in the immediate study area include Crossroads Phases 1-3 PV. As indicated, Crossroads Energy is concurrently proposing 9 PV projects in the study area (Crossroads Phase 1 PV). Two more Crossroads Phases (not yet in assessment stage) are envisaged by the relevant developer.

SECTION 4: OVERVIEW OF KEY SOCIAL ISSUES

4.1 INTRODUCTION

Section 4 provides an assessment of the key social issues identified during the study. The identification of key issues was based on:

- Review of project related information.
- Review of key policy and planning documents.
- Site visit to the study area.
- Interviews with key stakeholders.
- Experience with similar projects.

The assessment section is divided into the following sections:

- Assessment of compatibility with relevant policy and planning context ("planning fit").
- Assessment of social issues associated with the construction phase.
- Assessment of social issues associated with the operation phase.
- Assessment of decommissioning phase.
- Assessment of the "no development" alternative.
- Assessment of cumulative impacts.

From a stakeholder engagement perspective, comments related to socio-economic impacts associated with the proposed project were raised by Interested and Affected Parties during the review period of the Draft EIA Report. These comments are similar to those submitted and considered during the Scoping Phase, and therefore similar responses apply (as captured in Appendix F.11 of the Final EIA Report). Concerns were raised about the potential benefits that the proposed Kudu Solar Facilities will have on the farming community in the surrounding region (Benefits to the Farming Community); queries on the socio-economic benefits of the development for farmers and their employees in the greater region, as well as the equitability of involving only two landowners in the proposed developments; not distributing the benefits compared to other proposed projects; cognisance of the perceived negative realities of the project to the social and socio-economic impact and challenges of the Bo-Karoo and its inhabitants; and loss of grazing land. Responses have been provided in Appendix H.7 of the Final EIA Report.

4.2 ASSESSMENT OF POLICY AND PLANNING FIT

The development of and investment in renewable energy is supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all refer to and support renewable energy. The PKSDM Spatial Development Framework (SDF) and Integrated Development Plan (IDP) also support the development of renewable energy. The development of the proposed SEF is therefore supported by key policy and planning documents.

4.3 CONSTRUCTION PHASE SOCIO-ECONOMIC IMPACTS

Potential positive impacts

- Creation of employment and business opportunities, and opportunity for skills development and on-site training.

Potential negative impacts

- Impacts associated with the presence of construction workers on local communities.
- Impacts related to the potential influx of job-seekers.
- Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site.
- Increased risk of grass fires associated with construction related activities.
- Nuisance impacts, such as noise, dust, and safety, associated with construction related activities and vehicles.
- Impact on productive farmland.

4.3.1 Creation of local employment, skills development, training, and business opportunities

The construction phase will extend over a period of approximately 12 to 18 months and create in the region of 150 employment opportunities. Members from the local communities in the area, specifically De Aar, would be in a position to qualify for most of the low skilled and semi-skilled employment opportunities. Most of these employment opportunities will accrue to Historically Disadvantaged (HD) members of the community. Based on information from similar projects the total wage bill will be in the region of R 30 million (2023 Rand values). A percentage of the wage bill will be spent in the local economy which will also create opportunities for local businesses in the local towns in the area.

Given relatively high local unemployment levels and limited job opportunities in the area, this will represent a significant, if localised, social benefit. The capital expenditure associated with the construction phase will be approximately R 1.5 – 2 billion (2023 Rand value).

Due the lack of diversification in the local economy the potential for local companies is likely to be limited. The majority of benefits are therefore likely to accrue to contractors and engineering companies based outside the RLM and ELM. The local service sector will also benefit from the construction phase. The potential opportunities would be linked to accommodation, catering, cleaning, transport, and security, etc. associated with the construction workers on the site.

The hospitality industry in the area will also benefit from the provision of accommodation and meals for professionals (engineers, quantity surveyors, project managers, product representatives etc.) and other (non-construction) personnel involved on the project. Experience from other construction projects indicates that the potential opportunities are not limited to on-site construction workers but also to consultants and product representatives associated with the project.

Table 4.1: Impact assessment of employment and business creation opportunities during the construction phase

<table>
<tr><td colspan="5">Nature: Creation of employment and business opportunities during the construction phase</td></tr>
<tr><td colspan="2">Impact Criteria</td><td>Significance Without Enhancement</td><td>Significance With Enhancement</td><td>Confidence</td></tr>
<tr><td>Status</td><td>Positive</td><td rowspan="7">Low</td><td rowspan="7">Moderate</td><td rowspan="7">High</td></tr>
<tr><td>Spatial Extent</td><td>Regional</td></tr>
<tr><td>Duration</td><td>Medium Term</td></tr>
<tr><td>Consequence</td><td>Moderate</td></tr>
<tr><td>Probability</td><td>Likely</td></tr>
<tr><td>Reversibility</td><td>N/A</td></tr>
<tr><td>Irreplaceability</td><td>N/A</td></tr>
<tr><td>Can impact be enhanced?</td><td colspan="4">Yes</td></tr>
<tr><td colspan="5">Enhancement:
Employment
• Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase.
• Where reasonable and practical, the proponent should appoint local contractors and implement a ‘locals first’ policy, especially for semi and low-skilled job categories. However, due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area.
• Where feasible, efforts should be made to employ local contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria.
• Before the construction phase commences the proponent should meet with representatives from the RLM and ELM to establish the existence of a skills database for the area. If such as database exists, it should be made available to the contractors appointed for the construction phase.
• The local authorities, community representatives, and organisations on the interested and affected party database should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that the proponent intends following for the construction phase of the project.
• Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
• The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.

Business
• The proponent should liaise with the RLM and ELM with regards the establishment of a database of local companies, specifically BBBEE companies, which qualify as potential service providers (e.g., construction companies, catering companies, waste collection companies, security companies etc.) prior to the commencement of the tender process for construction service providers. These companies should be notified of the tender process and invited to bid for project-related work.

Note that while preference to local employees and companies is recommended, it is recognised that a competitive tender process may not guarantee the employment of local labour for the construction phase.</td></tr>
</table>

Assessment of No-Go option:
There is no impact as the current status quo would be maintained.

4.3.2 Impact of construction workers on local communities

The presence of construction workers poses a potential risk to family structures and social networks. While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can impact on local communities. The most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to potentially risky behaviour, mainly of male construction workers, including:

- An increase in alcohol and drug use.
- An increase in crime levels.
- The loss of girlfriends and/or wives to construction workers.
- An increase in teenage and unwanted pregnancies.
- An increase in prostitution.
- An increase in sexually transmitted diseases (STDs), including HIV.

The objective will be to source as many of the low and semi-skilled workers locally. These workers will be from the local community and form part of the local family and social networks. This will reduce the risk and mitigate the potential impacts on the local community. However, based on experience with renewable energy projects in the area the potential for local employment, specifically for semi- and skilled workers, is likely to be limited. The majority of semi and skilled workers will therefore need to be accommodated in the nearby towns of Philipstown, Petrusville and De Aar.

The total number of construction workers employed, and duration of the construction phase will depend on the timing and phasing of the construction of the Kudu PV SEF Cluster. This will have a bearing on the potential impact on local communities and services. This issue is discussed under cumulative impacts. The assessment below relates to a single PV SEF.

While the risks associated with construction workers at a community level will be low, at an individual and family level they may be significant, especially in the case of contracting a sexually transmitted disease or an unplanned pregnancy. However, given the nature of construction projects, it is not possible to totally avoid these potential impacts at an individual or family level.

Table 4.2: Assessment of impact of the presence of construction workers in the area on local communities

Nature: Potential impacts on family structures and social networks associated with the presence of construction workers				
Impact Criteria		**Significance Without Enhancement**	**Significance With Enhancement**	**Confidence**
Status	Negative	Very Low	Very Low	High
Spatial Extent	Regional			
Duration	Medium Term			
Consequence	Slight			
Probability	Unlikely			
Reversibility	Moderate			

Irreplaceability	Low			
Can impact be mitigated?	Yes			

Mitigation:

- Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase.
- Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase.
- The SEP and CHSSP should include a Grievance Mechanism that enables stakeholders to report resolve incidents.
- Where possible, the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically for semi and low-skilled job categories.
- The proponent should consider the option of establishing a Monitoring Committee (MC) for the construction phase that include representatives from local landowners, farming associations, and the local municipality. This MC should be established prior to commencement of the construction phase and form part of the SEP.
- The proponent and contractor should develop a Code of Conduct (CoC) for construction workers. The code should identify which types of behaviour and activities are not acceptable. Construction workers in breach of the code should be subject to appropriate disciplinary action and/or dismissed. All dismissals must comply with the South African labour legislation. The CoC should be signed by the proponent and the contractors before the contractors move onto site. The CoC should form part of the CHSSP.
- The proponent and the contractor should implement an HIV/AIDS, COVID-19 and Tuberculosis (TB) awareness programme for all construction workers at the outset of the construction phase. The programmes should form part of the CHSSP.
- The contractor should provide transport for workers to and from the site on a daily basis. This will enable the contactor to effectively manage and monitor the movement of construction workers on and off the site.
- The contractor must ensure that all construction workers from outside the area are transported back to their place of residence within 2 days for their contract coming to an end.
- No construction workers, except for security personnel, should be permitted to stay over-night on the site.

Assessment of No-Go option

There is no impact as the current status quo would be maintained.

4.3.3 Influx of job seekers

Large construction projects tend to attract people to the area in the hope that they will secure a job, even if it is a temporary job. These job seekers can in turn become "economically stranded" in the area or decide to stay on irrespective of finding a job or not. While the proposed project on its own does not constitute a large construction project, the establishment of a number of renewable energy projects in the area may attract job seekers to the area. As in the case of construction workers employed on the project, the actual presence of job seekers in the area does not in itself constitute a social impact. However, the way in which they conduct themselves can impact on the local community. The main areas of concern associated with the influx of job seekers include:

- Impacts on existing social networks and community structures.
- Competition for housing, specifically low-cost housing.
- Competition for scarce jobs.
- Increase in incidences of crime.

These issues are similar to the concerns associated with the presence of construction workers and are discussed in Section 4.3.1. The potential for

economically motivated in-migration and subsequent labour stranding is likely to be negligible. This is due to the isolated location of the area and the limited economic and employment opportunities in the nearby towns of Philipstown, Petrusville and De Aar.

The potential for an influx of job seekers may also be affected by the timing and phasing of the timing and phasing of the construction of the Kudu PV SEF Cluster. This issue is discussed under cumulative impacts. The assessment below relates to a single PV SEF.

Table 4.3: Assessment of impact of job seekers on local communities

<table>
<tr><td colspan="5">Nature: Potential impacts on family structures, social networks and community services associated with the influx of job seekers</td></tr>
<tr><td colspan="2">Impact Criteria</td><td>Significance Without Enhancement</td><td>Significance With Enhancement</td><td>Confidence</td></tr>
<tr><td>Status</td><td>Negative</td><td rowspan="7">Very Low</td><td rowspan="7">Very Low</td><td rowspan="7">High</td></tr>
<tr><td>Spatial Extent</td><td>Regional</td></tr>
<tr><td>Duration</td><td>Medium Term</td></tr>
<tr><td>Consequence</td><td>Slight</td></tr>
<tr><td>Probability</td><td>Unlikely</td></tr>
<tr><td>Reversibility</td><td>Moderate</td></tr>
<tr><td>Irreplaceability</td><td>Low</td></tr>
<tr><td>Can impact be mitigated?</td><td colspan="4">Yes</td></tr>
<tr><td colspan="5">Mitigation:
• Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase.
• Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase.
• The proponent, in consultation with the LM, should investigate the option of establishing a Monitoring Committee (MC) to monitor and identify potential problems that may arise due to the influx of job seekers to the area.
• The proponent should implement a “locals first” policy, specifically with regard to unskilled and low skilled opportunities.
• The proponent should implement a policy that no employment will be available at the gate.</td></tr>
</table>

Assessment of No-Go option
There is no impact as the current status quo would be maintained.

4.3.4 Risk to safety, livestock, and farm infrastructure

The presence on and movement of construction workers on and off the site poses a potential safety threat to local famers and farm workers in the vicinity of the site. In addition, farm infrastructure, such as fences and gates, may be damaged and stock losses may also result from gates being left open and/or fences being damaged, or stock theft linked either directly or indirectly to the presence of construction workers on the site. The potential risks to farmers and farming operations was identified as an issue by local landowners interviewed.

The potential risks (safety, livestock, and farm infrastructure) can be effectively mitigated by careful planning and managing the movement of construction workers on and off the site during the construction phase.

Table 4.4: Assessment of risk to safety, livestock, and damage to farm infrastructure

Nature: Potential risk to farmers and farm workers, livestock and damage to farm infrastructure associated with the presence and activities of construction workers on site				
Impact Criteria		**Significance Without Mitigation**	**Significance With Mitigation**	**Confidence**
Status	Negative	Moderate	Low	High
Spatial Extent	Local			
Duration	Medium Term			
Consequence	Substantial			
Probability	Unlikely			
Reversibility	High			
Irreplaceability	Replaceable			
Can impact be mitigated?	Yes			

Mitigation:

- Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase.
- Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase.
- The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property as a result of the construction phase will be compensated for. The agreement should be signed before the construction phase commences.
- All farm gates must be closed after passing through.
- Contractors appointed by the proponent should provide daily transport for low and semi-skilled workers to and from the site.
- The proponent should establish a MC and CoC for workers (see above).
- The proponent should hold contractors liable for compensating farmers and communities in full for any stock losses and/or damage to farm infrastructure that can be linked to project construction workers. This should be contained in the CoC to be signed between the proponent, the contractors, and neighbouring landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities (see below).
- The proponent should implement a Grievance Mechanism that provides local farmers with an effective and efficient mechanism to address issues related to damage to farm infrastructure, stock theft and poaching etc.
- The Environmental Management Programme (EMPr) must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested.
- Contractors appointed by the proponent must ensure that all workers are informed at the outset of the construction phase of the conditions contained in the CoC, specifically consequences of stock theft and trespassing on adjacent farms.
- Contractors appointed by the proponent must ensure that construction workers who are found guilty (by the courts) of stealing livestock and/or damaging farm infrastructure are dismissed and charged. This should be contained in the CoC. All dismissals must be in

accordance with South African labour legislation.
- It is recommended that no construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.

Assessment of No-Go option
There is no impact as the current status quo would be maintained.

4.3.5 Increased risk of grass fires

The presence of construction workers and construction-related activities on the site poses an increased risk of grass fires that could, in turn pose, a threat to livestock, crops, wildlife and farm infrastructure. The potential risk of grass fires will be higher during the dry, windy winter months from May to October. The impacts will be largely local and can be effectively mitigated.

The potential risk of grass fires and the impact on grazing and farming operations was raised as a concern by local farmers.

Table 4.5: Assessment of impact of increased risk of grass fires

Nature: Potential loss of livestock, crops and houses, damage to farm infrastructure and threat to human life associated with increased incidence of grass fires				
Impact Criteria		**Significance Without Mitigation**	**Significance With Mitigation**	**Confidence**
Status	Negative	Moderate	Low	High
Spatial Extent	Local			
Duration	Medium Term			
Consequence	Substantial			
Probability	Unlikely			
Reversibility	High			
Irreplaceability	Replaceable			
Can impact be mitigated?	Yes			

Mitigation:
- Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase.
- Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase.
- The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property as a result of the construction phase will be compensated for. The agreement should be signed before the construction phase commences.
- Contractor should ensure that open fires on the site for cooking or heating are not allowed except in designated areas.
- Smoking on site should be confined to designated areas.
- Contractor should ensure that construction related activities that pose a potential fire risk, such as welding, are properly managed and are confined to areas where the risk of fires has been reduced. Measures to reduce the risk of fires include avoiding working in high wind conditions when the risk of fires is greater. In this regard special care should be taken during the high risk dry, windy summer months.

- Contractor should provide adequate fire-fighting equipment on-site, including a fire fighting vehicle and fire extinguishers placed at designated locations across the site.
- Contractor should provide fire-fighting training to selected construction staff.
- No construction staff, with the exception of security staff, to be accommodated on site overnight.
- As per the conditions of the Code of Conduct, in the event of a fire being caused by construction workers and or construction activities, the appointed contractors must compensate farmers for any damage caused by the project to their farms. The contractor should also compensate the fire-fighting costs borne by farmers and local authorities.

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.3.6 Nuisance impacts associated with construction related activities

Construction related activities, including the movement of heavy construction vehicles of and on the site, has the potential to create dust, noise and safety impacts and damage roads. The impacts will be largely local and can be effectively mitigated. The number of potentially sensitive social receptors, such as farmsteads, will also be low due to the sparse settlement patterns and small number of farmsteads in the area.

Damage to local public and internal farm roads was raised as concern by local farmers and will need to be addressed during the construction phase. Local landowners also indicated that dust generated by the construction traffic associated with the establishment of the Kalkbult SEF along the De Aar-Kimberley railway line impacted on the veld.

Table 4.6: **Assessment of the impacts associated with construction related activities**

Nature: Potential noise, dust and safety impacts associated with construction related activities				
Impact Criteria		**Significance Without Mitigation**	**Significance With Mitigation**	**Confidence**
Status	Negative	Moderate	Low	High
Spatial Extent	Local			
Duration	Medium Term			
Consequence	Substantial			
Probability	Unlikely			
Reversibility	High			
Irreplaceability	Replaceable			
Can impact be mitigated?	Yes			
Mitigation: • Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase. • Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase. • Timing of construction activities should be planned to avoid / minimise impact on key				

farming activities.
- The proponent should establish a MC to monitor the construction phase and the implementation of the recommended mitigation measures. The MC should be established before the construction phase commences, and should include key stakeholders, including representatives from local farmers and the contractor(s). The MC should also address issues associated with damage to roads and other construction related impacts.
- Ongoing communication with landowners and road users during construction period. This should be outlined in the SEP.
- The proponent should implement a Grievance Mechanism that provides local farmers and other road users with an effective and efficient mechanism to address issues related to construction related impacts, including damage to local gravel farm roads.
- Implementation of a road maintenance programme throughout the construction phase to ensure that the affected roads are maintained in a good condition and repaired once the construction phase is completed.
- Repair of all affected road portions at the end of construction period where required (for roads where the developer/contractor has legal mandate to undertake such repairs). In the event of damage to public roads affected by construction traffic the proponent should engage with the relevant road authorities to ensure that damage is repaired before the operational phase commences.
- Dust suppression measures must be implemented on un-surfaced roads, such as wetting on a regular basis and ensuring that vehicles used to transport building materials are fitted with tarpaulins or covers.
- All vehicles must be roadworthy, and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits.

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.3.7 Impacts associated with loss of farmland

The activities associated with the construction phase and establishment of the proposed project and associated infrastructure will result in the disturbance and loss of land available for grazing. The impact on farmland associated with the construction phase can be mitigated by minimising the footprint of the construction related activities and ensuring that disturbed areas are fully rehabilitated on completion of the construction phase. In addition, the landowner will be compensated for the loss of land.

The impact on farmland associated with Kudu PV 1-5 was noted as a concern by the affected landowner, XXXX, who leases her properties to XXXX of near-adjacent Bokkraal. PVs 1-4 would each occupy relatively modest portions of the XXXX properties (<5%). PV 5 would however occupy 21.6% of the combined properties. Cumulatively, PV 1-5 would result in the loss of 30.7% of the XXXX properties. The cumulative loss of farmland was not raised as an issue by the owner. However, she did indicate that the portion to the north of the farmstead around Basberg Mountain should not be developed due to visual and sense of place reasons (XXXX, pers. comm). The latter has been taken into consideration by ABO Wind and no Kudu Solar Facilities have been proposed in this area. It must also be re-iterated that at the commencement of this Scoping and EIA Process, approximately 14 Kudu Solar Facilities were proposed. However, following the identification of sensitivities, the Bidding Window 6 Request for Proposal capacity limits, as well as discussions with the said landowner of the Basberg properties, the proposed projects were re-clustered, and two originally proposed Kudu Solar Facilities on Farm 88/3 were

removed from the development proposal, and a total of up to 12 Solar PV Facilities are now being proposed. Therefore, such concerns have been taken into consideration by the Project Developer. Also note that the impact of the proposed project on sense of place and the rural character, and cultural landscape have been assessed in the separate Visual Impact Assessment and Heritage Impact Assessment, respectively.

The lessee, XXXX, is however concerned about the loss of good grazing to his operation. The concern is that alternative land to rent is scarce in the broader study area (XXXX, pers. comm).

In this regard the general concerns raised by affected landowners pertained to the Kudu SEFs related to the loss of good grazing areas and the impact that this would have on farming activities in an area where there is limited land to buy and or lease.

Table 4.7: Assessment of impact on farmland due to construction related activities

Nature: The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the project etc. will damage farmlands and result in a loss of farmlands for grazing.				
Impact Criteria		**Significance Without Mitigation**	**Significance With Mitigation**	**Confidence**
Status	Negative	Moderate	Low	High
Spatial Extent	Local			
Duration	Medium Term			
Consequence	Substantial			
Probability	Likely			
Reversibility	High			
Irreplaceability	Replaceable			
Can impact be mitigated?	Yes			
Mitigation: • The loss of high-quality agricultural land should be avoided and or minimised by careful planning of the final layout of the proposed SEF facility. The recommendations of the agricultural / soil assessment should be implemented. • Affected landowners should be consulted about the timing of construction related activities in advance. • The footprint associated with the construction related activities (access roads, construction platforms, workshop etc.) should be minimised. • An Environmental Control Officer (ECO) should be appointed to monitor the establishment phase of the construction phase. • All areas disturbed by construction related activities, such as access roads on the site, construction platforms, workshop area etc., should be rehabilitated at the end of the construction phase. • The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed. The specifications for the rehabilitation programme should be included in the EMPr. • The implementation of the Rehabilitation Programme should be monitored by the ECO.				

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.4 OPERATIONAL PHASE SOCIAL IMPACTS

Potential positive impacts
- The establishment of infrastructure to improve energy security and support the renewable sector.
- Creation of employment opportunities.
- Benefits to the affected landowners.
- Benefits associated with the socio-economic contributions to community development.

Potential negative impacts
- Visual impacts and associated impacts on sense of place.
- Impact on property values.
- Impact on tourism.

4.4.1 Improve energy security and support the renewable energy sector

The primary goal of the proposed project is to improve energy security in South Africa by generating additional energy. The proposed PV SEF also reduces the carbon footprint associated with energy generation. The project should therefore be viewed within the context of the South Africa's current reliance on coal powered energy to meet the majority of its energy needs, and secondly, within the context of the success of the REIPPPP.

Improved energy security
South Africa's energy crisis, which started in 2007 and is ongoing, has resulted in widespread rolling blackouts (referred to as load shedding) due to supply shortfalls. The load shedding has had a significant impact on all sectors of the economy and on investor confidence. The mining and manufacturing sector have been severely impacted and will continue to be impacted until such time as there is a reliable supply to energy. The Minister of Mineral Resources and Energy, Gwede Mantashe, indicated in February 2023 that the cost of load shedding was estimated at R1 billion a day [26]. The South African Reserve Bank indicated in February 2023 that stage 3 and stage 6 loadshedding cost the South African economy between R204 million and R899 million a day.[27]

A survey of 3 984 small business owners in 2019 found that 44% said that they had been severely affected by load shedding with 85% stating that it had reduced their revenue, with 40% of small businesses losing 20% or more or revenue during due to load shedding period[28].

Impact of a coal powered economy
As highlighted in Section 2 of this report, the Green Jobs study (2011) notes that South Africa has one of the most carbon-intensive economies in the world, thus

[26] https://www.citizen.co.za/news/load-shedding-cost-economy-billion/
[27] https://businesstech.co.za/news/energy/662515/stage-6-load-shedding-costs-south-africa-r900-million-a-day-sarb/
[28] "How does load shedding affect small business in SA?". The Yoco Small Business Pulse (3: Q1 2019):

making the greening of the electricity mix a national imperative. The study notes that renewable energy provides an ideal means for reaching emission reduction targets in a relatively easy manner. In addition, and of specific relevance to South Africa renewable energy is not as dependent on water compared to the massive water requirements of conventional power stations, has a limited footprint, and therefore does not impact on large tracts of land, poses limited pollution and health risks, specifically when compared to coal and nuclear energy plants.

The Greenpeace Report (powering the future: Renewable Energy Roll-out in South Africa, 2013), also notes that within a broader context of climate change, coal energy does not only have environmental impacts, but it also has socio-economic impacts. These include acid mine drainage from abandoned mines in South Africa and the risk this poses on the country's limited water resources.

Benefits associated with REIPPPP

The overview of the IPPPP (December 2021) indicates that the REIPPPP has attracted R42 billion in foreign investment and financing in the seven bid windows (BW1 – BW4). This is almost double the inward FDI attracted into South Africa during 2015 (R22.6 billion). In terms of local equity shareholding, 52% (R31.4 billion) of the total equity shareholding (R61 billion) was held by South African's across BW1 to BW4, 1S2 and 1S2. This equates to substantially more than the 40% requirement. Foreign equity amounts to R 29.5 billion and contributes 49% to total equity. As far as Broad Based Black Economic Empowerment is concerned, Black South Africans own, on average, 34% of projects that have reached financial close, which is higher than the 30%

In terms of employment, to date, a total of 63 291 job years[29] have been created for South African citizens, of which 48 110 job years were in construction and 15 182 in operations. By the end of December 2021, 85 projects had been completed and moved in to operation. These projects created 44 172 job years of employment, compared to the anticipated 30 488. This represented 45% more than planned. The REIPPPP has therefore created significant employment opportunities for black South African citizens and local communities beyond planned targets. This highlights the importance of the programme in terms of employment equity and the creation of more equal societies.

Table 4.8: Improve energy security and support the renewable sector

Nature: Development of infrastructure to improve energy security and support renewable sector				
Impact Criteria		**Significance Without Enhancement**	**Significance With Enhancement**	**Confidence**
Status	Positive	Moderate	Moderate	High
Spatial Extent	National			
Duration	Long Term			
Consequence	Substantial			
Probability	Very Likely			
Reversibility	N/A			
Irreplaceability	N/A			

[29] The equivalent of a full-time employment opportunity for one person for one year

Can impact be Enhanced?	Yes
Enhancement: • Maximise the number of employment opportunities for local community members. • Implement training and skills development programs for members from the local community. • Maximise opportunities for local content and procurement.	

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.4.2 Creation of employment opportunities

The proposed development will of a single PV SEF will create in the region of 8 full time employment opportunities during the operational phase, of which 70% will be unskilled, 25% semi-skilled, and 5% skilled. Based on similar projects the annual operating budget will be in the region of R30 million (2022 Rand values), including wages.

Table 4.9: Assessment of employment and business creation opportunities

Nature: Creation of employment and business opportunities associated with the operational phase				
Impact Criteria		**Significance Without Enhancement**	**Significance With Enhancement**	**Confidence**
Status	Positive	Low	Low	High
Spatial Extent	Regional			
Duration	Long Term			
Consequence	Moderate			
Probability	Likely			
Reversibility	N/A			
Irreplaceability	N/A			
Can impact be enhanced?	Yes			
Enhancement: The enhancement measures listed in Section 4.3.1, i.e., to enhance local employment and business opportunities during the construction phase, also apply to the operational phase. In addition, the proponent should investigate providing training and skills development to enable locally based service providers to provide the required services for the operational phase.				

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.4.3 Generate income for affected landowners

The proponent will enter into rental agreements with the affected landowners for the use of the land for the establishment of the proposed PV SEF. In terms of the rental agreement the affected landowner will be paid an annual amount dependent upon the area affected. The additional income will reduce the risk to their

livelihoods posed by droughts and fluctuating market prices for sheep and farming inputs, such as fuel, feed etc. Given the low carrying capacity of the veld the additional income represents a significant benefit for the affected landowner.

However, a concern was raised that the Kudu projects benefit too few landowners (2 as opposed to 6 to 9 for the Crossroads Phase 1 Cluster). The potential benefits were therefore spread out amongst the local farming community. The Kudu projects will however create a number of broader socio-economic opportunities as discussed below.

Table 4.10: Assessment of benefits associated with income generated for the directly affected landowners

Nature: The generation of additional income represents a significant benefit for the local affected farmer(s) and reduces the risks to their livelihoods posed by droughts and fluctuating market prices for sheep and farming inputs, such as feed etc.				
Impact Criteria		**Significance Without Enhancement**	**Significance With Enhancement**	**Confidence**
Status	Positive	Low	Moderate	High
Spatial Extent	Local			
Duration	Long Term			
Consequence	Moderate			
Probability	Very Likely			
Reversibility	N/A			
Irreplaceability	N/A			
Can impact be Enhanced?	Yes			
Enhancement: • Implement agreements with affected landowners. • The loss of high-quality agricultural land should be avoided and or minimised by careful planning in the final layout of the proposed PV SEF facility. The recommendations of the agricultural / soil assessment should be implemented.				

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.4.4 Benefits associated with the socio-economic development contributions

The REIPPPP has been designed not only to procure energy but has also been structured to contribute to the broader national development objectives of job creation, social upliftment and broadening of economic ownership. Socio-economic development (SED) contributions are an important focus of the REIPPPP and are aimed at ensuring that local communities benefit directly from the investments attracted into the area. These contributions are linked to Community Trusts and accrue over the project operation life and, in so doing, create an opportunity to generate a steady revenue stream over an extended period. This revenue can be used to fund development initiatives in the area and support the local community. The long-term duration of the revenue stream also allows local municipalities and communities to undertake long term planning for the area.

Table 4.11: Assessment of benefits associated with socio-economic development contributions

Nature: Benefits associated with support for local communities from SED contributions.				
Impact Criteria		**Significance Without Enhancement**	**Significance With Enhancement**	**Confidence**
Status	Positive	Moderate	High	High
Spatial Extent	Regional			
Duration	Long Term			
Consequence	Substantial			
Probability	Very Likely			
Reversibility	N/A			
Irreplaceability	N/A			
Can impact be Enhanced?	Yes			
Enhancement: • The RLM or PKSDM should be consulted as to the structure and identification of potential trustees to sit on the Trust. The key departments in the RLM or PKSDM that should be consulted include the Municipal Managers Office, IDP Manager and LED Manager, where possible. • Clear criteria for identifying and funding community projects and initiatives in the area should be identified. The criteria should be aimed at maximising the benefits for the community as a whole and not individuals within the community. • Strict financial management controls, including annual audits, should be instituted to manage the funds generated for the Community Trust from the REF plant.				

Assessment of No-Go option
There is no impact as it maintains the current status quo. However, the potential opportunity costs in terms of the supporting the social and economic development in the area would be lost. This would also represent a negative impact.

4.4.5 Visual impact and impact on sense of place

The proposed PV SEF has the potential to impact on the area's existing rural sense of place. Based on an initial assessment of the location the potential impact on the areas sense of place associated with a single PV SEF is likely to be limited. The Visual Impact Assessment (VIA) undertaken for Kudu PV4 by Oberholzer and Lawson (May 2023) has assigned a **Low** overall impact significance to the proposed facility both during the construction and operational phases. This is linked to the low occurrence of sensitive visual receptors.

The affected landowner, XXXX, did however indicate that the portion to the north of the farmstead around Basberg Mountain should not be developed due to visual and sense of place reasons (XXXX, pers. comm). This issue has been addressed by the developer.

Table 4.12: Visual impact and impact on sense of place

Nature: Visual impact associated with the proposed facility and associated infrastructure and the potential impact on the areas rural sense of place.				
Impact Criteria		**Significance Without Mitigation**	**Significance With Mitigation**	**Confidence**
Status	Negative	Low	Low	High
Spatial Extent	Regional			
Duration	Long Term			
Consequence	Moderate			
Probability	Unlikely			
Reversibility	High			
Irreplaceability	Low			
Can impact be Mitigated?	Yes			
Mitigation: • The recommendations contained in the VIA should also be implemented.				

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.4.6 Potential impact on property values

The potential visual impacts associated with the proposed PV SEF have the potential to impact on property values. Based on the results of a literature review undertaken for wind farms (for comparative purposes), the potential impact on property values in rural areas is likely to be limited. In this regard a study undertaken in Australia in 2016 (Urbis Pty Ltd) found that:

- Appropriately located wind farms within rural areas, removed from higher density residential areas, are unlikely to have a measurable negative impact on surrounding land values.
- There is limited available sales data to make a conclusive finding relating to value impacts on residential or lifestyle properties located close to wind farm turbines, noting that wind farms in New South Wales (Australia) have been constructed in predominantly rural areas.

The impact of SEFs on property values is likely to be lower than the impact of WEFs due to the reduced visual impact. The impact of the proposed PV SEF on property values is therefore likely to be low.

Table 4.13: Assessment of potential impact on property values and operations

Nature: Potential impact of the SEF on property values. This is usually linked to the visual impact associated with the proposed facility and associated infrastructure and the potential impact on the areas rural sense of place.				
Impact Criteria		**Significance Without Mitigation**	**Significance With Mitigation**	**Confidence**
Status	Negative	Low	Low	High
Spatial Extent	Regional			
Duration	Long Term			
Consequence	Moderate			
Probability	Very Unlikely			
Reversibility	High			
Irreplaceability	Low			
Can impact be Mitigated?	Yes			
Mitigation: The recommendations contained in the VIA should also be implemented.				

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.4.7 Potential impact on tourism

The potential visual impacts associated with the PV SEF have the potential to impact on tourism facilities and tourism in the area. Based on the findings of the literature review there is limited evidence to suggest that the proposed SEF would impact on the tourism in the PKSDM and RLM at a local and regional level. At a local level there are a limited number of tourism facilities located in the study area. Based on the findings of the site visit there are no local tourism facilities in the areas that would be impacted. The limited number of facilities are also likely to benefit from providing accommodation to contractors and workers during both the construction and operational phase.

Table 4.14: Impact on tourism in the region

Nature: Potential impact of SEF on local tourism. This is usually linked to the visual impact associated with the proposed facility and associated infrastructure and the potential impact on the areas rural sense of place.				
Impact Criteria		**Significance Without Mitigation**	**Significance With Mitigation**	**Confidence**
Status	Negative	Low	Low	High
Spatial Extent	Regional			
Duration	Long Term			
Consequence	Moderate			
Probability	Very Unlikely			
Reversibility	High			

Irreplaceability	Low			
Can impact be Mitigated?	Yes			
Mitigation: The recommendations contained in the VIA should also be implemented.				

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.5 ASSESSMENT OF DECOMMISSIONING PHASE

Typically, the major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities. However, in the case of the proposed facility the decommissioning phase is likely to involve the disassembly and replacement of the existing components with more modern technology. This is likely to take place in the 20 - 25 years post commissioning. The decommissioning phase is therefore likely to create additional construction type jobs, as opposed to the jobs losses typically associated with decommissioning.

Given the relatively small number of people employed during the operational phase (~ 8), the social impacts associated with the decommissioning phase can be effectively managed with the implementation of a retrenchment and downscaling programme. With mitigation, the impacts are assessed to be Low (negative). Decommissioning will also create temporary employment opportunities, which would represent a positive temporary impact. The significance would be Low with enhancement due to limited opportunities and short duration.

Table 4.15: Impact of decommissioning

Nature: Social impacts associated with retrenchment including loss of jobs, and source of income. Decommissioning will also create temporary employment opportunities, which would represent a positive temporary impact				
Impact Criteria		**Significance Without Mitigation**	**Significance With Mitigation**	**Confidence**
Status	Negative	Moderate	Low	High
Spatial Extent	Local			
Duration	Short Term			
Consequence	Substantial			
Probability	Likely			
Reversibility	High			
Irreplaceability	Low			
Can impact be Mitigated?	Yes			
Mitigation: • The proponent should ensure that retrenchment packages are provided for all staff retrenched when the plant is decommissioned. • All structures and infrastructure associated with the proposed facility should be dismantled				

and transported off-site on decommissioning.
- Revenue generated from the sale of scrap metal during decommissioning should be allocated to aid in funding closure and rehabilitation of disturbed areas.

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.6 CUMULATIVE IMPACT ON SENSE OF PLACE

The potential cumulative impacts on the areas sense of place will be largely linked to potential visual impacts. In this regard the Scottish Natural Heritage (2005) describes a range of potential cumulative landscape impacts associated with wind farms on landscapes. These issues are also likely to be relevant to solar facilities and associated infrastructure. The relevant issues identified by Scottish Natural Heritage study include:

- Combined visibility (whether two or more wind farms will be visible from one location).
- Sequential visibility (e.g. the effect of seeing two or more wind farms along a single journey, e.g. road or walking trail).
- The visual compatibility of different wind farms in the same vicinity.
- Perceived or actual change in land use across a character type or region.
- Loss of a characteristic element (e.g. viewing type or feature) across a character type caused by developments across that character type.

The guidelines also note that cumulative impacts need to be considered in relation to dynamic as well as static viewpoints. The experience of driving along a tourist road, for example, needs to be considered as a dynamic sequence of views and visual impacts, not just as the cumulative impact of several developments on one location. The viewer may only see one renewable energy facility and the associated infrastructure at a time, but if each successive stretch of the road is dominated by views of renewable energy facilities, then that can be argued to be a cumulative visual impact (National Wind Farm Development Guidelines, July 2010).

As indicated above, the potential impact of a single PV SEF and associated infrastructure on the areas sense of place is likely to be limited. However, the establishment of 12 PV SEFs associated with the Kudu PV SEF Cluster will create cumulative impacts on the area's sense of place. The findings of the Visual Impact Assessment (VIA) undertaken for Kudu 4 PV by Oberholzer and Lawson (May 2023) found that the significance of the cumulative impact of the 12 Kudu projects was **moderate** seen in combination with other projects proposed in the area. The VIA however noted that proposed similar facilities on adjacent properties would reduce the visual sensitivity of the Kudu 4 PV site as the area would be seen as a node for solar energy.

Table 4.16: Cumulative impacts on sense of place and the landscape

Nature: Visual impacts associated with the establishment of more than one SEF and the potential impact on the area's rural sense of place and character of the landscape.				
Impact Criteria		**Significance Without Mitigation**	**Significance With Mitigation**	**Confidence**
Status	Negative	Moderate	Moderate	High
Spatial Extent	Regional			
Duration	Long Term			
Consequence	Substantial			
Probability	Likely			
Reversibility	High			
Irreplaceability	Low			
Can impact be Mitigated?	Yes			
Mitigation: The recommendations contained in the VIA should be implemented.				

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.7 CUMULATIVE IMPACT ON LOCAL SERVICES AND ACCOMMODATION

The establishment of a number of PV SEFs (up to 12) has the potential to place pressure on local services and accommodation, specifically during the construction phase. The objective will be to source as many low and semi-skilled workers for the construction phase from the RLM and ELM. This will reduce the pressure on local services and accommodation and the nearby towns of Philipstown, Petrusville and De Aar. The total number of construction workers that required accommodation will depend on the timing and phasing of the construction of the individual PV SEFs associated with the Kudu PV Cluster. Based on the findings of the site visit there is limited accommodation available in Philipstown and Petrusville. Accommodation is available in De Aar and the town has experience with the construction of renewable energy facilities. However, there is unlikely to be sufficient accommodation in De Aar and the surrounding towns if the construction phase of 3 or more renewable energy facilities overlaps. This issue will need to be addressed in the planning of the construction phase.

However, the potential impact should also be viewed within the context of the potential positive cumulative impacts for the local economy associated with the establishment of the proposed facility and associated renewable energy projects in the RLM and ELM. These benefits will create opportunities for investment in the RLM and ELM., including the opportunity to up-grade and expand existing services and the construction of new houses. Socio-economic development (SED) contributions also represent an important focus of the REIPPPP and is aimed at ensuring that the build programme secures sustainable value for the country and enables local communities to benefit directly from the investments attracted into the area. The SED contributions will extend over a period of 20-25 years and provide revenue that can be used by the RLM and ELM to invest in up-grading local services where required. It should also be noted that it is the function of national, provincial, and

local government to address the needs created by development and provide the required services. The additional demand for services and accommodation created by the establishment of renewable energy projects should therefore be addressed in the Integrated Development Planning process undertaken by the RLM and ELM.

Table 4.17: Cumulative impacts on local services

Nature: The establishment of a number of renewable energy facilities and associated projects, such as the proposed SEF, in the RLM has the potential to place pressure on local services, specifically medical, education and accommodation.				
Impact Criteria		**Significance Without Mitigation**	**Significance With Mitigation**	**Confidence**
Status	Negative	Low	Low	High
Spatial Extent	Regional			
Duration	Long Term			
Consequence	Moderate			
Probability	Unlikely			
Reversibility	High			
Irreplaceability	Low			
Can impact be Mitigated?	Yes			
Mitigation: The proponent should liaise with the RLM and ELM to address potential impacts on local services.				

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.8 CUMULATIVE IMPACT ON LOCAL ECONOMY

In addition to the potential negative impacts, the establishment of 12 PV SEFs and associated infrastructure will also create several socio-economic opportunities for the RLM and ELM. The positive cumulative opportunities include creation of employment, skills development and training opportunities, and downstream business opportunities.

The review of the REIPPPP (December 2021) indicates that the SED contributions associated with 85 operational projects has amounted to R 1.8 billion to date. In terms of Enterprise Development (ED), R 7.2 billion has been committed for BW1-4. Assuming an equal distribution of revenue over the 20-year project operational life, enterprise development contributions would be R358 million per annum. Of the total commitment, R5.6 billion is specifically committed directly within the local communities where the IPPs operate, contributing significantly to local enterprise development. Up until the end of December 2021 a total of R 504.1 million had already been made to the local communities located in the vicinity of the 68 operating IPPs. This represents 94% of the total R537.9 million enterprise development contributions made to date.

The potential cumulative benefits for the local and regional economy are therefore associated with both the construction and operational phase of renewable energy projects and associated infrastructure and extend over a period of 20-25 years. However, steps must be taken to maximise employment opportunities for members

from the local communities in the area and support skills development and training programmes.

Table 4.18: Cumulative impacts on local economy

Nature: The establishment of renewable energy facilities and associated projects, such as the SEF, in the RLM will create employment, skills development and training opportunities, creation of downstream business opportunities.				
Impact Criteria		**Significance Without Enhancement**	**Significance With Enhancement**	**Confidence**
Status	Positive	Moderate	Moderate	High
Spatial Extent	Regional			
Duration	Long Term			
Consequence	Substantial			
Probability	Likely			
Reversibility	High			
Irreplaceability	Low			
Can impact be Mitigated?	Yes			
Enhancement: The proponent should liaise with the RLM and ELM to identify potential opportunities for the local economy and businesses.				

Assessment of No-Go option
There is no impact as it maintains the current status quo.

4.9 ASSESSMENT OF NO-DEVELOPMENT OPTION

The primary goal of the proposed project is to assist in providing additional capacity to Eskom to assist in addressing the current energy supply constraints. The project also aims to reduce the carbon footprint associated with energy generation. As indicated above, energy supply constraints and the associated load shedding have had a significant impact on the economic development of the South African economy. South Africa also relies on coal-powered energy to meet more than 90% of its energy needs. South Africa is therefore one of the highest per capita producers of carbon emissions in the world and Eskom, as an energy utility, has been identified as the world's second largest producer of carbon emissions.

The No-Development option would represent a lost opportunity for South Africa to improve energy security and supplement is current energy needs with clean, renewable energy. Given South Africa's current energy security challenges and its position as one of the highest per capita producers of carbon emissions in the world, this would represent a significant negative social cost.

Table 4.19: Assessment of no-development option

Nature: The no-development option would result in the lost opportunity for South Africa to improve energy security and assist to support with the development of clean, renewable energy.				
Impact Criteria		**Significance Without Mitigation**30	**Significance With Enhancement**31	**Confidence**
Status	Negative / Positive	Moderate (-)	Moderate (+)	High
Spatial Extent	National			
Duration	Long Term			
Consequence	Substantial			
Probability	Likely			
Reversibility	N/A			
Irreplaceability	N/A			
Can impact be Enhanced?	Yes			
Enhancement: The proposed SEF should be developed, and the mitigation and enhancement measures identified in the SIA and other specialist studies should be implemented.				

4.10 ASSESSMENT OF BESS

The proposed BESS site is not located within significant proximity to any social receptors. The study area is very sparsely populated. No inhabited dwellings are located within 2 km of the site. The proposed site is therefore suitable from a social impact assessment point of view. Both proposed technology options (Redox flow and Lithium ion) are acceptable from a Social Assessment perspective Please also refer to the High-Level Safety, Health and Environment Risk Assessment contained in the EIA report.

30 Assumes project is not developed
31 Assumes project is developed

SECTION 5: KEY FINDINGS AND RECOMMENDATIONS

5.1 INTRODUCTION

Section 5 lists the key findings of the study and recommendations. These findings are based on:

- A review of key planning and policy documents pertaining to the area.
- A review of social and economic issues associated with similar developments.
- Site visit and interviews with key stakeholders
- A review of relevant literature on social and economic impacts.
- The experience of the authors with other renewable energy projects in the Northern Cape Province.

5.2 SUMMARY OF KEY FINDINGS

The key findings of the study are summarised under the following sections:

- Fit with policy and planning.
- Construction phase impacts.
- Operational phase impacts.
- Cumulative Impacts.
- Decommissioning phase impacts.
- No-development option.

5.2.1 Policy and planning issues

The development of and investment in renewable energy is supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all refer to and support renewable energy. The PKSDM Spatial Development Framework (SDF) and Integrated Development Plan (IDP) also support the development of renewable energy. The development of the proposed SEF is therefore supported by key policy and planning documents.

5.2.2 Construction phase impacts

The key social issues associated with the construction phase include:

Potential positive impacts

- Creation of employment and business opportunities, and the opportunity for skills development and on-site training.

The construction phase is expected to extend over a period of 12 to 18 months and create approximately 150 employment opportunities. The total wage bill for the construction phase is estimated to be in the region of R 30 million (2023 Rand value). A percentage of the wage bill will be spent in the local economy which will also create opportunities for local businesses in the local towns in the area and the RLM and ELM.

Members from the local communities in De Aar, Phillipstown and Petrusville may potentially qualify for low skilled and semi-skilled and some skilled employment opportunities. Most of these employment opportunities will accrue to Historically Disadvantaged (HD) members of the community. Given relatively high local unemployment levels and limited job opportunities in the area, this will represent a significant, if localised, social benefit. However, in the absence of specific commitments from the developer to employ local contractors the potential for meaningful skills to local employment targets the benefits for members from the local communities may be limited. In addition, the low education and skills levels in the area may also hamper potential opportunities for local communities.

The capital expenditure associated with the construction phase will be approximately R 1.5 – 2 billion (2023 Rand value). This will create opportunities for local companies and the regional and local economy. Due the lack of diversification in the local economy the potential for local companies is likely to be limited. The majority of benefits are therefore likely to accrue to contractors and engineering companies based outside the RLM and ELM. The local service sector will also benefit from the construction phase. The potential opportunities would be linked to accommodation, catering, cleaning, transport, and security, etc. associated with the construction workers on the site.

Potential negative impacts

- Impacts associated with the presence of construction workers on local communities.
- Impacts related to the potential influx of job seekers.
- Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site.
- Increased risk of grass fires associated with construction related activities.
- Noise, dust, and safety impacts of construction related activities and vehicles.
- Impact on productive farmland.

The findings of the SIA indicate that the significance of all the potential negative impacts with mitigation are likely to be **Low Negative**. The potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented. Table 5.1 summarises the significance of the impacts associated with the construction phase.

Table 5.1: Summary of social impacts during construction phase

Impact	Significance No Mitigation/Enhancement	Significance With Mitigation/Enhancement
Creation of employment and business opportunities	Medium (+)	Medium (+)
Presence of construction workers and potential impacts on family structures and social networks	Medium (-)	Low (-)
Influx of job seekers	Low (-)	Low (-)
Safety risk, stock theft and damage to farm infrastructure associated with presence of construction workers	Medium (-)	Low (-)
Increased risk of grass fires	Medium (-)	Low (-)
Impact of heavy vehicles and construction activities	Medium (-)	Low (-)
Loss of farmland	Medium (-)	Low (-)

5.2.3 Operational phase impacts

Potential positive impacts
- Establishment of infrastructure to improve energy security and support renewable sector.
- Creation of employment opportunities.
- Benefits associated with socio-economic contributions to community development.
- Benefits for local landowners.

The proposed project will supplement South Africa's energy and assist to improve energy security. In addition, it will also reduce the country's reliance on coal as an energy source. This represents a positive social benefit.

Potential negative impacts
- Visual impacts and associated impacts on sense of place.
- Potential impact on property values.
- Potential impact on tourism.

The findings of the SIA indicate that the significance of all the potential negative impacts with the exception of visual impacts will be **Low Negative** with mitigation. The majority of potential negative impacts can therefore be effectively mitigated. The significance of the impacts associated with the operational phase are summarised in Table 5.2.

Table 5.2: Summary of social impacts during operational phase

Impact	Significance No Mitigation/Enhancement	Significance With Mitigation/Enhancement
Establishment of infrastructure to improve energy security and support renewable sector	High (+)	High (+)
Creation of employment and business opportunities during maintenance	Low (+)	Medium (+)
Benefits associated with socio-economic contributions to community development	Medium (+)	High (+)
Benefits for landowners	Low (+)	High (+)
Visual impact and impact on sense of place	Low (-)	Low (-)
Impact on property values	Low (-)	Low (-)
Impact on tourism	Low (-)	Low (-)

5.2.4 Assessment of cumulative impacts

Cumulative impact on sense of place
The establishment of the proposed PV SEF and other renewable energy facilities in the area will create the potential for combined and sequential visibility impacts. This impact is rated as **Moderate Negative**.

Cumulative impact on local services and accommodation
The significance of this impact with effective mitigation was rated as **Low Negative**.

Cumulative impact on local economy
The significance of this impact with enhancement was rated as **Moderate Positive**.

5.2.5 Decommissioning phase

Given the moderate number of people employed during the operational phase (~ 8), the potential negative social impacts associated with the decommissioning phase can be effectively managed with the implementation of a retrenchment and downscaling programme. With mitigation, the impacts are assessed to be **Low Negative**.

5.2.6 Assessment of no-development option

The No-Development option would represent a lost opportunity for South Africa to improve energy security and supplement its current energy needs with clean, renewable energy. Given South Africa's current energy security challenges and its position as one of the highest per capita producers of carbon emissions in the

world, this would represent a significant negative social cost. The No-Development option is not supported by the findings of the SIA.

5.2.7 Assessment of BESS

Based on the findings of the SIA the proposed BESS site and both technology alternatives are suitable from a social impact assessment point of view.

5.3 CONCLUSIONS

The findings of the SIA indicate that the proposed Kudu PV 4 SEF will result in several social and socio-economic benefits, including creation of employment and business opportunities during both the construction and operational phases. The project will also create economic development opportunities for the local community. The enhancement measures listed in the report should be implemented in order to maximise the potential benefits. The significance of this impact is rated as **High Positive**. The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the negative environmental and socio-economic impacts associated a coal-based energy economy and the challenges created by climate change, represents a significant positive social benefit for society as a whole. The Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) has resulted in significant socio-economic benefits, both at a national level and at a local, community level. These benefits are linked to foreign Direct Investment, local employment and procurement and investment in local community initiatives.

The findings also indicate that the potential negative impacts associated with both the construction and operational phase are likely to be **Low Negative** with mitigation. The potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented.

Statement and reasoned opinion

The establishment of the proposed Kudu PV 4 SEF and associated infrastructure is therefore supported by the findings of the SIA.

ANNEXURE A

INTERVIEWS

- XXXX (telephonic 2023-03-29). Vlakplaas.
- XXXX (2023-03-24). Jakkalskuil, Ventersdam.
- XXXX (2023-03-24). Ruspoort.
- XXXX (2023-03-24). Wolwekuil.
- XXXX (telephonic 2023-03-16). Basberg.
- XXXX (2023-03-23). Wolwekuil.
- XXXX (2023-03-23). Tafelkop.
- XXXX (2023-03-23). Bokkraal.
- XXXX (2023-03-23). Vrede.

REFERENCES

- National Energy Act (2008).
- White Paper on the Energy Policy of the Republic of South Africa (December 1998).
- White Paper on Renewable Energy (November 2003).
- Integrated Resource Plan (IRP) for South Africa (2019).
- National Infrastructure Plan (NIP) (2012 and 2021).
- National Development Plan (2011).
- Northern Cape Provincial Growth and Development Strategy (2004-2014).
- Northern Cape Climate Change Response Strategy.
- Northern Cape Spatial Development Framework (2012).
- Northern Cape Province Green Document (2017/2018).
- Pixley ka Seme District Municipality Integrated Development Plan (2019-2020).
- Pixley ka Seme District Municipality Spatial Development Framework (2017).
- Emthanjeni Local Municipality Integrated Development Plan (2021-2022).
- Renosterberg Local Municipality Integrated Development Plan (2017-2022).

ANNEXURE B

METHODOLOGY FOR THE ASSESSMENT OF POTENTIAL IMPACTS

The impact assessment includes:

- *the nature, status, significance and consequences of the impact and risk;*
- *the extent and duration of the impact and risk;*
- *the probability of the impact and risk occurring;*
- *the degree to which impacts and risks can be mitigated;*
- *the degree to which the impacts and risks can be reversed; and*
- *the degree to which the impacts and risks can cause loss of irreplaceable resources.*

Terminology used in impact assessment can overlap. To avoid ambiguity, please note the following clarifications (that are based on NEMA and the EIA Regulations):

- *The term environment is understood to have a broad interpretation that includes both the natural (biophysical) environment and the socio-economic environment. The term socio-ecological system is also used to describe the natural and socio-economic environment and the interactions amongst these components.*
- *Significance = Consequence x Probability, which means that significance is equivalent to risk.*
- *The impact can have a positive or negative status. The significance of a negative impact may be called a risk, and the significance of a positive impact may be called an opportunity.*

The following principles are to underpin the application of this methodology:

- *Transparent and repeatable process - specialists are to describe the thresholds and limits they apply in their assessment, wherever possible.*
- *Adapt parameters to context (where justified) – the methodology proposes some thresholds (e.g. for spatial extent, in Step 3 below), however, if the nature of the impact requires a different definition of the categories of spatial extent, then this can be provided and described.*
- *Combination of a quantitative and qualitative assessment – where possible, specialists are to provide quantitative assessments (e.g. areas of habitat affected, decibels of noise, number of jobs), however, it is recognised that not all impacts can be quantified, and then qualitative assessments are to be provided.*

As per the DFFE Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect and cumulative:

- *Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.*
- *Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.*
- *Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective*

impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

The impact assessment methodology includes the aspects described below.

- ***Step 1**: **Nature** of impact/risk - The type of effect that a proposed activity will have on the environment.*

- ***Step 2**: **Status** - Whether the impact/risk on the overall environment will be:*
  - *Positive - environment overall will benefit from the impact/risk;*
  - *Negative - environment overall will be adversely affected by the impact/risk; or*
  - *Neutral - environment overall not be affected.*

- ***Step 3**: **Qualitatively** determine the **consequence** of the impact/risk by identifying the **a) SPATIAL EXTENT; b) DURATION; c) REVERSIBILITY; AND d) IRREPLACEABILITY**.*

  - ***A) Spatial extent** – The size of the area that will be affected by the impact/risk:*
    - *Site specific;*
    - *Local (<10 km from site);*
    - *Regional (<100 km of site);*
    - *National; or*
    - *International (e.g. Greenhouse Gas emissions or migrant birds).*

  - ***B) Duration** – The timeframe during which the impact/risk will be experienced:*
    - *Very short term (instantaneous);*
    - *Short term (less than 1 year);*
    - *Medium term (1 to 10 years);*
    - *Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration)); or*
    - *Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).*

  - ***C) Reversibility** of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):*
    - *High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);*
    - *Moderate reversibility of impacts;*
    - *Low reversibility of impacts; or*
    - *Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).*

  - ***D) Irreplaceability** of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):*
    - *High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);*
    - *Moderate irreplaceability of resources;*

- *Low irreplaceability of resources; or*
- *Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).*

Some of the criteria are quantitative (e.g. spatial extent and duration) and some may be described in a quantitative or qualitative manner (e.g. reversibility and irreplaceability). The specialist then combines these criteria in a qualitative manner to determine the ***consequence****.*

The consequence terms ranging from slight to extreme must be calibrated per Specialist Study so that there is transparency and consistency in the way a risk/impact is measured. For example, from a biodiversity and ecology perspective, the consequence ratings could be defined according to a reduction in population or occupied area in relation to Species of Conservation Concern (SCC) status, ranging from slight consequence for defined areas of Least Concern, to extreme consequence for defined areas that are Critically Endangered. For example, from a social perspective, a slight consequence could refer to small and manageable impacts, or impacts on small sections of the community; a moderate consequence could refer to impacts which affect the bulk of the local population negatively or may produce a net negative impact on the community; and an extreme consequence could refer to impacts which could result in social or political violence or institutional collapse.

- ***Consequence*** *– The anticipated consequence of the risk/impact is generally defined as follows:*
  - *Extreme (extreme alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they permanently cease);*
  - *Severe (severe alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease);*
  - *Substantial (substantial alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease;*
  - *Moderate (notable alteration of natural or socio-economic systems, patterns or processes, i.e. where the natural or socio-economic environment continues to function but in a modified manner; or*
  - *Slight (negligible and transient alteration of natural or socio-economic systems, patterns or processes, i.e. where natural systems/environmental or socio-economic functions, patterns, or processes are not affected in a measurable manner, or if affected, that effect is transient and the system recovers).*

- ***Step 4****: Rate the* ***probability*** *of the impact/risk using the criteria below:*

  - ***Probability*** *– The probability of the impact/risk occurring:*
    - *Extremely unlikely (little to no chance of occurring);*
    - *Very unlikely (<30% chance of occurring);*
    - *Unlikely (30-50% chance of occurring)*
    - *Likely (51 – 90% chance of occurring); or*
    - *Very Likely (>90% chance of occurring regardless of prevention measures).*

- ***Step 5****: Use both the* ***consequence*** *and* ***probability*** *to determine the* ***significance*** *of the identified impact/risk (qualitatively as shown in Figure 1). Significance definitions and rankings are provided below:*

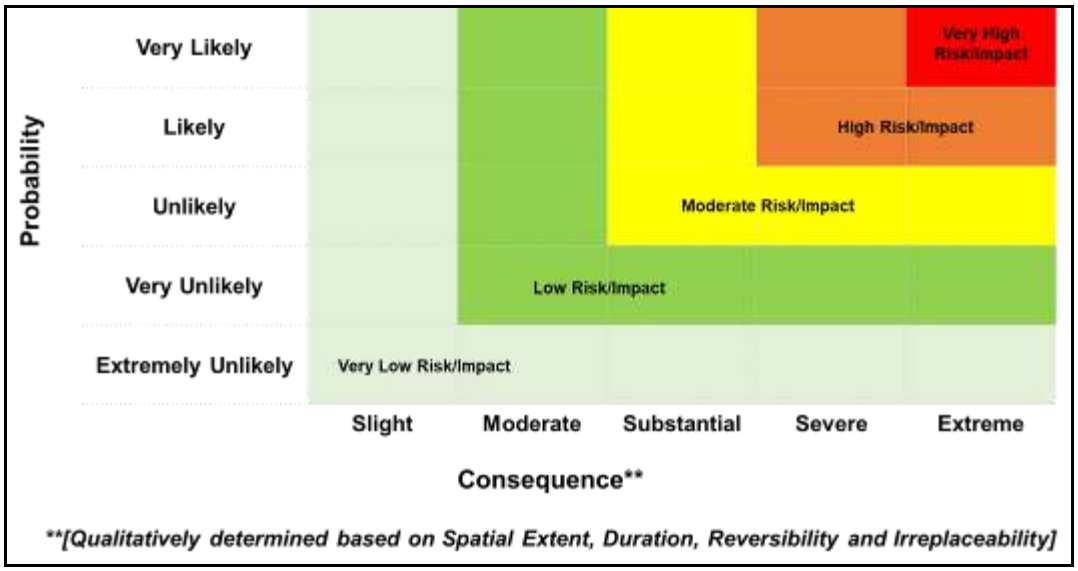


Figure 1. Guide to assessing risk/impact significance as a result of consequence and probability.

- ***Significance*** *– Will the impact cause a notable alteration of the environment?*
  - *Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
  - *Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
  - *Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);*
  - *High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and*
  - *Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).*

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- *Very low = 5;*
- *Low = 4;*
- *Moderate = 3;*
- *High = 2; and*
- *Very high = 1.*

The specialists must provide a written supporting motivation of the assessment ratings provided.

- ***Step 6****: Determine the* ***Confidence Level*** *– The degree of confidence in predictions based on available information and specialist knowledge:*
  - *Low;*
  - *Medium; or*
  - *High.*

ANNEXURE C

Tony Barbour
ENVIRONMENTAL CONSULTING AND RESEARCH

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Tony Barbour's has 26 years' experience in the field of environmental consulting and management. His experience includes working for ten years as a consultant in the private sector followed by four years at the University of Cape Town's Environmental Evaluation Unit. He has worked as an independent consultant since 2004, with a key focus on Social Impact Assessment. His other areas of interest include Strategic Environmental Assessment and review work.

EDUCATION

- BSc (Geology and Economics) Rhodes (1984);
- B Economics (Honours) Rhodes (1985);
- MSc (Environmental Science), University of Cape Town (1992)

EMPLOYMENT RECORD

- Independent Consultant: November 2004 – current;
- University of Cape Town: August 1996-October 2004**:** Environmental Evaluation Unit (EEU), University of Cape Town. Senior Environmental Consultant and Researcher;
- Private sector: 1991-August 2000: 1991-1996**:** Ninham Shand Consulting (Now Aurecon, Cape Town). Senior Environmental Scientist; 1996-August 2000: Steffen, Robertson and Kirsten (SRK Consulting) – Associate Director, Manager Environmental Section, SRK Cape Town.

LECTURING

- University of Cape Town: Resource Economics; SEA and EIA (1991-2004);
- University of Cape Town: Social Impact Assessment (2004-current);
- Cape Technikon: Resource Economics and Waste Management (1994-1998);
- Peninsula Technikon: Resource Economics and Waste Management (1996-1998).

RELEVANT EXPERIENCE AND EXPERTISE

Tony Barbour has undertaken in the region of 260 SIA's, including SIA's for infrastructure projects, dams, pipelines, and roads. All of the SIAs include interacting with and liaising with affected communities. In addition, he is the author of the Guidelines for undertaking SIA's as part of the EIA process commissioned by the Western Cape Provincial Environmental Authorities in 2007. These guidelines have been used throughout South Africa.

Tony was also the project manager for a study commissioned in 2005 by the then South African Department of Water Affairs and Forestry for the development of a Social Assessment and Development Framework. The aim of the framework was to enable the Department of Water Affairs and Forestry to identify, assess and manage social impacts associated with large infrastructure projects, such as dams. The study also included the development of guidelines for Social Impact Assessment, Conflict Management, Relocation and Resettlement and Monitoring and Evaluation.

Countries with work experience include South Africa, Namibia, Angola, Botswana, Zambia, Lesotho, Swaziland, Ghana, Senegal, Nigeria, Mozambique, Mauritius, Kenya, Ethiopia, Oman, South Sudan, Sudan and Armenia.

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 - 12), near De Aar, Northern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

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Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

Details of Specialist, Declaration and Undertaking Under Oath

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1. SPECIALIST INFORMATION

Specialist Company Name:	Tony Barbour Environmental Consulting			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Tony Barbour			
Specialist Qualifications:	BEcon (Hons). MSc (Environmental Science)			
Professional affiliation/registration:	IAIA			
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2. DECLARATION BY THE SPECIALIST

I, Tony Barbour, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Tony Barbour Environmental Consulting
Name of Company:

4 July 2023
Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Tony Barbour, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Tony Barbour Environmental Consulting
Name of Company

4 July 2023
Date

Signature of the Commissioner of Oaths

4 July 2023
Date

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environmental affairs

Department:
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REPUBLIC OF SOUTH AFRICA

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Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	freelance (for Tony Barbour Environmental)			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	n.a	Percentage Procurement recognition	n.a.
Specialist name:	Schalk van der Merwe			
Specialist Qualifications:	MPhil (Environmental science)			
Professional affiliation/registration:	none			
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Postal code:	2001	Cell:	082 0900 521	
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E-mail:	lilah@mweb.co.za			

2. DECLARATION BY THE SPECIALIST

I, Schalk van der Merwe, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

(freelance)
Name of Company:

2023-05-25
Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

3. **UNDERTAKING UNDER OATH/ AFFIRMATION**

I, Schalk van der Merwe, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

TBEL (freelance for)
Name of Company

2023-05-24
Date

Signature of the Commissioner of Oaths

2023/05/24
Date

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COMMUNITY SERVICE CENTRE
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Details of Specialist, Declaration and Undertaking Under Oath

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CHAPTER 14:
Traffic Impact Assessment

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TRAFFIC ENGINEERING SPECIALIST ASSESSMENT:

Scoping and Environmental Impact Assessment (EIA) Process for the Proposed Development of a Solar Photovoltaic Facility (Kudu Solar Facility 4) and associated infrastructure, near De Aar, Northern Cape Province

Report prepared for:	***Report prepared by:***
CSIR – Environmental Management Services P O Box 320 Stellenbosch 7599 South Africa	Sturgeon Consulting 7 Waterberg Crescent, Clara Anna Fontein Durbanville 7550 South Africa

Version 1: March 2023



The purpose of the Traffic Engineering Impact Assessment of the proposed Kudu Solar Photovoltaic (PV) Facility 4 is to investigate the transport implications associated with the abnormal load vehicles transporting components, construction material, equipment and labourers to the site during the construction, operational and decommissioning phases of the project.

The construction phase will primarily consist of the removal of vegetation, excavation for infrastructure, the establishment of a laydown area for equipment, the transportation of materials and equipment to site and the construction of the solar field and additional infrastructure. The operational phase of the project is expected to be approximately 20 years and will primarily consist of the generation and supply of electricity from the proposed solar facility, the cleaning of the solar panels and the maintenance of the solar field and infrastructure. The purpose of the decommissioning phase is to return the land to its original condition before construction.

During the proposed project, the construction site will need to be accessed by single-unit trucks transporting building materials, double axel trucks transporting 40 foot long containers containing the solar panels, frames and inverters, minibus taxis and buses transporting labourers and abnormal load trucks transporting the transformers.

The report proposed three different access routes to the site and the preferred route was identified as the route between the Port of Ngqura and the site. The preferred haulage route is approximately 545 km and follows the N2 from the Port and then turns north onto the N10 to De Aar. From De Aar, the R48 can be taken east up to the access point of the site. Various provincial roads can provide access to the site via the R48 (Trunk Road 38/1 and Trunk Road 38/02). The preferred access is from the surfaced Divisional Road 3093 (DR3093), located along the R48, approximately 45km north-east of De Aar. This access will provide direct access from a surfaced road and sufficient shoulder sight distances (SSD) are available.

Access Route Option 1 will require the removal of the existing island at the TR38/01 and DR3093 intersection to accommodate the turning movements of the abnormal load vehicles. For Access Route Option 2, widening of the intersection at TR38/01 and MR790 will be required (the widening will exceed 6 m at certain points) and the widening of the MR790/DR3093 intersection by approximately 60m^2 and widening of the DR3093/DR3084 intersection by 170m^2 (the widening will exceed 6 m at certain points) will also be required. Access Route Option 3 will require the widening of the intersection at TR38/02 and DR3096 (the widening will exceed 4 m at certain points) and localised widening will be required along DR3096 at two locations (approximately 56m^2 and 50m^2).

Temporary SANRAL counting stations indicated the Average Daily Traffic (ADT) as approximately 62 vehicles (two-way) along DR3093 and approximately 8 vehicles (two-way) along Divisional Road 3084 (DR3084) per day in 2011. These numbers indicate that there are extremely low volumes of traffic along these roads in the vicinity of the site. Permanent SANRAL traffic counting stations, Station

13730 and Station 13731, are located along the R389 and the R48, respectively. The traffic information for 2021 indicated that the R389 carries an ADT of 626 vpd (two-way) and the R48 carries and ADT of 866 vpd (two-way). The R389 and the R48 both operate well below the capacity of 2000 vehicles per hour for a Class 1 principal arterial with two lanes.

Traffic will be generated during the construction, operational and decommissioning phases of the project. During the construction phase it is expected that trips will be generated by the transportation of materials and equipment, the transportation of labourers and the transportation of water for construction and dust control purposes. It was determined that a total of **30 daily trips (two-way)** will be generated by the proposed Solar PV Facility. During the decommissioning phase it is expected that the same number of trips will be generated as during the construction phase. During the operational phase it is expected that trips will be generated by the transportation of maintenance equipment, the transportation of labourers and the transportation of water for the cleaning of the solar panels and dust control purposes. It was determined that a total of **10 daily trips (two-way)** will be generated by the proposed Solar PV Facility.

Potential transport and traffic related impacts were identified for the different phases of the project. During the construction and decommissioning phases potential impacts include congestion and delays on the surrounding road network (very low impact significance), the impact on traffic safety and an increase in accidents (moderate impact significance), change in the quality of the surface conditions of the road (very low impact significance), dust pollution (low impact significance) and noise pollution (low impact significance). During the operational phase the traffic generated will have an insignificant impact on the surrounding road network.

To further mitigate the effects of the expected daily traffic impact on the existing road network during the construction and decommissioning phases it is proposed that delivery times be staggered and the transportation of labourers trips be scheduled outside of peak hours where possible, speed control by means of a stop-and-go be implemented within the construction site along with ensuring all vehicles are roadworthy, visible, adequately marked and operated by a licenced operator, regular maintenance of the internal farm access road and dust control be implemented on gravel roads within the construction site. If the mitigation measures are implemented the construction phase will have an overall low to very low impact significance, the operational phase will have an insignificant impact and the decommissioning phase will have a low to very low impact significance, similar to the construction phase.

It is very unlikely that all 12 Kudu PV projects will occur at the same time and construction will most likely be staggered based on project and site-specific aspects. However, the potential cumulative traffic impact related to the construction and decommissioning phases were investigated in this report. The cumulative traffic impact related to the operational phase can still be regarded as insignificant. If the mitigations are implemented the construction phase will have an overall low to very low impact significance, the operational phase will have an insignificant impact and the decommissioning phase will have a low to very low impact significance.

No other remedial or mitigation measures will be required to accommodate the additional traffic generated by the proposed project. Provided that the recommendations provided in this report are adhered to, the proposed development of the Solar PV facility can be supported from a traffic engineering perspective.



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ABBREVIATIONS

Abbreviations	
ADT	Average Daily Traffic
EIA	Environmental Impact Assessment
BA	Basic Assessment
DEA	Department of Environmental Affairs
PV	Photovoltaic
TIS	Traffic Impact Study
vph	Vehicles per Hour
COTO	Committee of Transport Officials
AMP	Access Management Plan
RCAM	Road Classification and Access Management Manual
LOS	Level of Service
AM	Morning
PM	Afternoon
SEF	Solar Energy Facility

14. TRAFFIC IMPACT ASSESSMENT

This chapter includes the Traffic Engineering Impact Assessment Specialist Assessment that was prepared by Sturgeon Consulting as part of the Scoping and Environmental Impact Assessment (EIA) Process for the proposed development of the Kudu Solar Facility 4 and associated infrastructure, near De-Aar, Northern Cape Province.

14.1 Introduction

14.1.1 Scope, Purpose and Objectives of this Specialist Report

ABO Wind is intending to develop a Solar Photovoltaic (PV) cluster, located to the northeast of De Aar in the Northern Cape Province, as shown in Figure 14-1. The project will entail the proposed development of 12 Solar PV facilities and associated electrical infrastructure. Each PV facility will have an estimated capacity ranging from up to 50 MWac to 350 MWac. This Traffic Impact Assessment (TIA) focuses on the Traffic Impact associated with Kudu Solar Facility 4, although the cumulative impact of all 12 Solar PV facilities will also be considered.

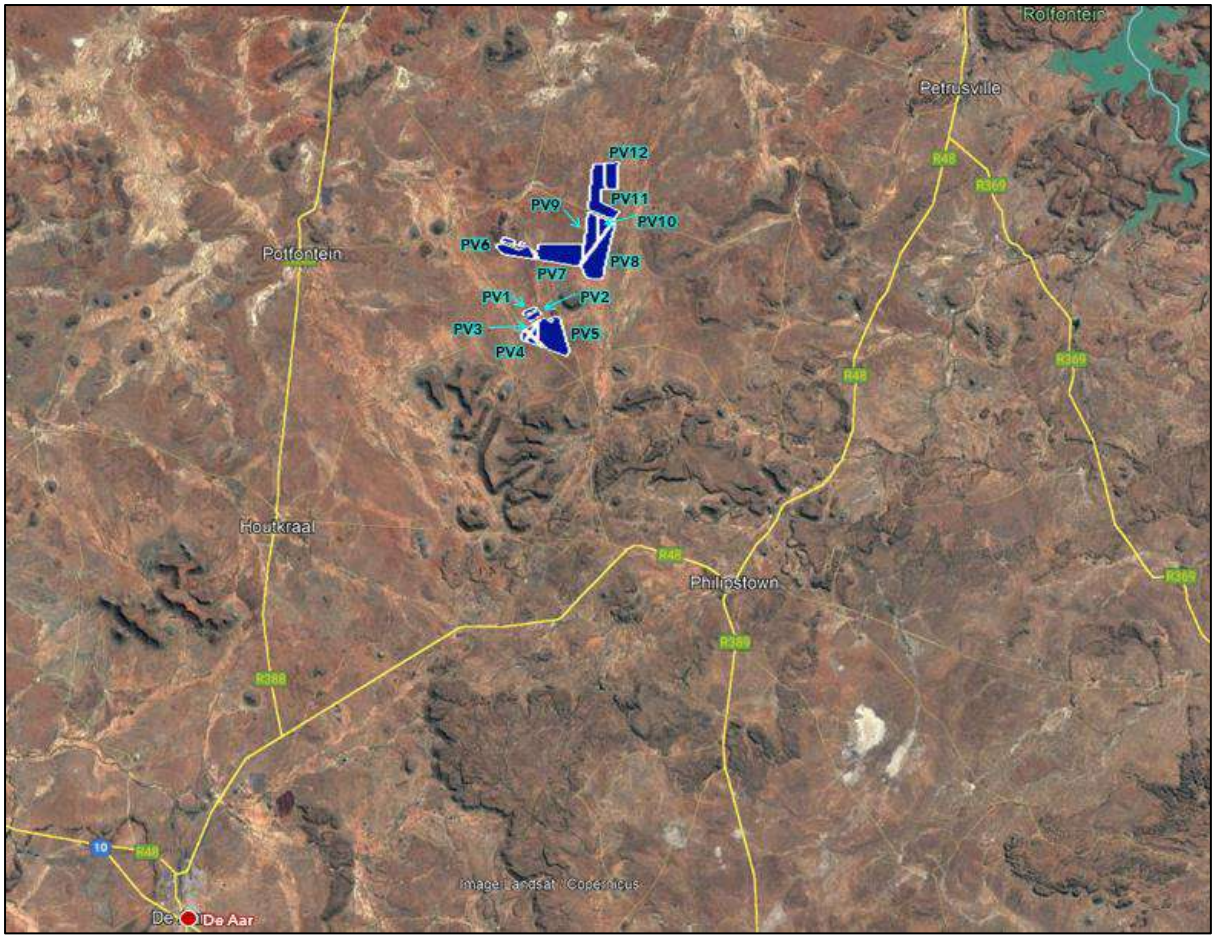


Figure 14-1: Locality Plan

The scope of the Traffic Engineering Impact Assessment is to investigate the transportation implications associated with the abnormal load vehicles transporting components to the site and the transportation of construction materials, equipment and workers to the site during the construction and operational phases.

The report identifies the preferred access route to the site, comments on the condition of the existing roads in the vicinity of the site and identifies possible access points to the site.

The primary purpose of this Traffic Engineering Impact Assessment is therefore to provide a specialist assessment of potential traffic related impacts in accordance with the requirements of Appendix 6 of the 2014 National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations (as amended).

Separate reports have been compiled for each PV facility. This chapter only addresses Kudu Solar Facility 4 (hereafter referred to as the "Kudu Solar Facility 4" or "proposed project").

14.1.2 Details of Specialist

This specialist assessment has been undertaken by Annebet Krige of Sturgeon Consulting (Pty) Ltd, Traffic Engineering and Transport Planning Specialists. Annebet Krige is registered with the Engineering Council of South Africa with Registration Number 20150161 in the field of Traffic Engineering. A curriculum vitae is included in Appendix A of this specialist input report.

In addition, a signed specialist statement of independence is included in Appendix B of this specialist input report.

14.1.3 Terms of Reference

The Terms of Reference for the TIA include:

- Extent of the traffic study and study area, including a description of the traffic and transportation context of the study area, focusing on aspects that are potentially affected by the proposed project;
- Site Observations by undertaking a site visit to gather relevant information in terms of access, road conditions etc. and to confirm if there are any aspects that need to be considered in the layout planning;
- Proposed development description in relation to traffic related impacts;
- Describe the baseline transport and traffic condition of the study area, as well as identified traffic features and potential traffic disturbances of the local area;
- Existing and Future Road Planning;
- Existing traffic volumes on external road network;
- Access Assessment;
- Acceptability from a traffic safety point of view of the location of the access route(s) to the proposed facility;
- Trip generation of the proposed development during Construction, Operation and Decommissioning;
- A description of assumptions and limitations;

- Consideration of the project layout;
- Determine the national and local haulage routes between port of entry/manufacturer and site;
- Assessment of freight requirements and permitting needed for abnormal loads;
- Risk posed by construction and operational vehicles;
- Consider traffic issues such as impact on the road network, congestion etc.;
- Impact assessment of the potential direct, indirect and cumulative impacts of the proposed development on the receiving environment from a traffic perspective;
- Based on existing volumes of traffic, recommendations for mitigations measures for traffic impacts where relevant;
- Determine mitigation and/or management measures, which could be implemented to as far as possible, reduce the effect of negative impacts and enhance the effect of positive impacts. Identify best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts for inclusion in the Environmental Management Programme (EMPr);
- Identification of any additional protocols, licensing and/or permitting requirements that are relevant to the project and the implications thereof;
- A reasoned opinion indicating the acceptability of the proposed development and a recommendation if the development should go ahead or not.

14.2 Approach and Methodology

The report assesses possible access routes for the haulage of imported materials, the road network surrounding the proposed facility, possible access options and the traffic impact of the proposed facility on the surrounding road network in the vicinity of the site during the Construction, Operational and Decommissioning phases of the project.

The broad methodology to be adopted for this specialist study is as follows:

- Site visit:
  - 23 and 24 March 2022.
  - Review of project background information.
  - Literature review and internet research.
- Access Routes and Access Point Assessment:
  - Evaluation of proposed access configurations.
  - Assessment of potential access roads.
- Traffic Impact:
  - Assessment of typical trip generation during the Construction, Operation and Decommissioning phases of the project.
  - Assessment of potential traffic impacts.
- Liaison with Applicant and/or project team.
- Preparation of report and figures.

14.2.1 Information Sources

The main information sources used for this Traffic Engineering Impact Assessment are listed below:

Data / Information	Source	Date	Type	Description
TMH 16 Volume 1 South African Traffic Impact and Site Traffic Assessment Manual	Committee of Transport Officials	August 2012	Manual	Requirements for Traffic Impact Studies in South Africa.
National Road Traffic Act, 1996 (Act No. 93 of 1996)	Department of Transport	1996	Government Gazette	To provide for road traffic matters which shall apply uniformly throughout the Republic and for matters connected therewith.
Amendment of the National Road Traffic Regulations	Department of Transport	2014	Government Notice	Regulations to the National Road Traffic Act, 1996 (Act No. 93 of 1996)
TRH 11: Dimensional and Mass Limitations and Other Requirements for Abnormal Load Vehicles	Department of Transport	August 2009	Government Notice	Description of abnormal loads and vehicle configurations and methods to determine road pavement damage

Data / Information	Source	Date	Type	Description
TRH 11: Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other events on Public Roads	Committee of State Road Authorities	March 2000	Report	Rules and Conditions which apply to the transport of abnormal loads and vehicles on public roads.

In addition to the above, the following Information was also used:

- Project Information provided by the Environmental Assessment Practitioner (EAP) and Applicant;
- Google Earth files provided by the EAP and Applicant;
- Google Earth Satellite Imagery;
- Information gathered during the site visit; and
- Project research of all available information.

14.2.2 Assumptions, Knowledge Gaps and Limitations

The following assumptions, knowledge gaps and limitations apply:

- The study is based on information supplied by the Applicant (ABO Wind) and the Environmental Consultants (CSIR);
- Haulage and access will be limited to existing surfaced national and provincial and gravel roads;
- The internal farm roads within the boundary of the PV Facility will not be included in this study;
- Construction materials are to be sourced and transported from local manufacturers where possible;
- All imported materials are to be transported from the nearest, most viable port of entry;
- Maximum vertical height clearance along the haulage route is 5.2m for abnormal loads.
- The power lines that will be constructed to facilitate grid connection, and the associated Main Transmission Substation and 400 KV Loop-in-Loop-Out (LILO) are subjected to separate Basic Assessment and/or Standard Registration Processes, and do not require a Traffic Impact Assessment.

14.2.3 Consultation Processes Undertaken

Due to the significance of the traffic related impact, no specific consultation processes were deemed necessary or undertaken for this specialist assessment.

14.3 Description of Project Aspects relevant to Traffic Engineering Assessment

The project can be divided into the following three main phases:

- Construction Phase;
- Operational Phase; and
- Decommissioning Phase.

14.3.1 Construction Phase

The main activities that will form part of the construction phase are:

- Removal of vegetation for the proposed infrastructure, where necessary, within the approved development footprint to facilitate the construction and/or establishment of infrastructure. Note that vegetation is planned to be trimmed within the PV array area (and not removed completely);
- Excavations for infrastructure and associated infrastructure;
- Establishment of a laydown area for equipment;
- Stockpiling of topsoil and cleared vegetation, where necessary (except for the PV array);
- Creation of employment opportunities and associated transport of employees to and from site;
- Transportation of material and equipment to site; and
- Construction of the solar field and additional infrastructure.

14.3.2 Operational Phase

The following activities will occur during the operational phase:

- The generation of electricity from the proposed solar facility and supply of electricity;
- Cleaning of panels and maintenance of the solar field and infrastructure.
- During the life span of the project (approximately 20 years), on-going cleaning and maintenance will be required on a scheduled basis.

14.3.3 Decommissioning Phase

The main aim of decommissioning is to return the land to its original, pre-construction condition. Should the unlikely need for decommissioning arise (i.e. if the actual solar facility becomes outdated or the land needs to be used for other purposes), the decommissioning procedures will be undertaken and the site will be rehabilitated and returned to its pre-construction state.

14.3.4 Transportation Requirements

During the project cycle, it is anticipated that the following vehicles will need to access the site:

- Building materials are to be transported by single-unit trucks within the road freight limitations of South Africa.

- Solar panels, frames and inverters are to be transported in 40 foot long containers (which have exterior dimensions of 12.19 m long x 2.44 m wide x 2.59 m high) on double axle trucks within the road freight limitations of South Africa.
- Workers from the surrounding area will be transported by taxi (mini-bus)/bus/shuttle or private car.
- Transformers will be transported by abnormal load trucks for which a permit will need to be applied for in terms of Section 81 of the National Road Traffic Act and authorisation needs to be obtained from the relevant road authorities to modify the road reserve to accommodate turning movements at intersections.

14.4 Baseline Environmental Description

14.4.1 Study Area Definition

The study area for the proposed Kudu Solar Facilities 1 to 12 is the full extent of the eight affected farm properties on which the proposed PV Facilities will be constructed. The full extent of these properties has been assessed in this study in order to identify environmental sensitivities and no-go areas. The total **study area** for Kudu Solar Facilities 1 to 12 is approximately 8 150 hectares (ha).

At the commencement of this Scoping and EIA Process, the **Original Scoping Buildable Areas**, which fall within the study area, were identified by the Project Developer following the completion of high-level environmental screening based on the Screening Tool.

Following the identification of sensitivities during the Scoping Phase, the Project Developer considered such sensitivities and formulated the **Revised Scoping Buildable Areas**. The **Revised Scoping Buildable Areas** were used to inform the design of the layout and further assessed during this EIA Phase of the project in order to identify the preferred development footprint of the proposed project on the approved site as contemplated in the accepted Scoping Report. The development footprint is where the actual development will be located, i.e. the footprint containing the PV solar arrays and associated infrastructure.

14.4.2 General Description – Existing Road Network

The proposed Kudu Solar PV 4 facility will be located to the north-east of De Aar in the Northern Cape as shown in Figure 14-2.



Figure 14-2: Proposed Kudu Solar PV4 Facility

14.4.2.1 Haulage of Imported Materials

There are three options for the haulage of imported materials to the proposed PV facility as shown in the figures below. The preferred option will be the route from the Port of Ngqura as shown in Figure 14-3. The route is approximately 545 km and follows the N2 from the Port and then turns north onto the N10 to De Aar. From De Aar, the R48 can be taken east up to the access point to the sites.

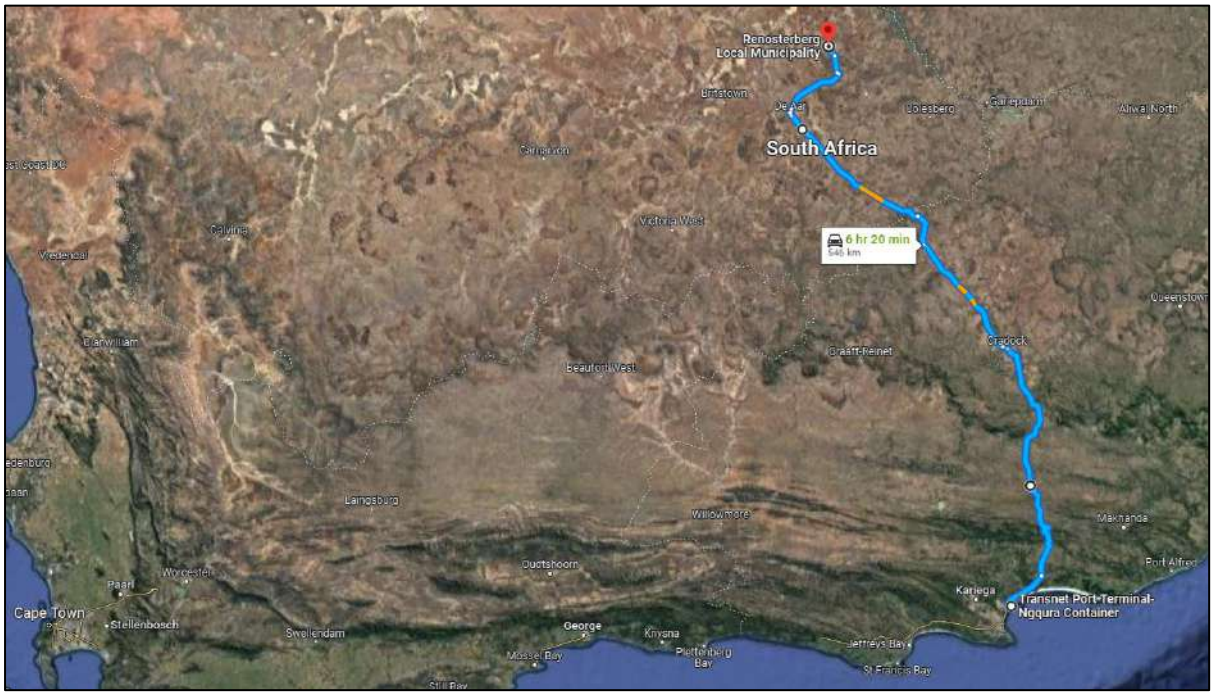


Figure 14-3: Preferred Route

The first alternative option will be the route from the Port of Cape Town as shown in Figure 14-4 by the blue line. This route is approximately 825 km and follows the N1 from the Cape Town Harbour and then turns north at Three Sisters onto the N12 to Britstown and then turns east towards De Aar. From De Aar, the R48 can be taken east up to the access point to the sites.

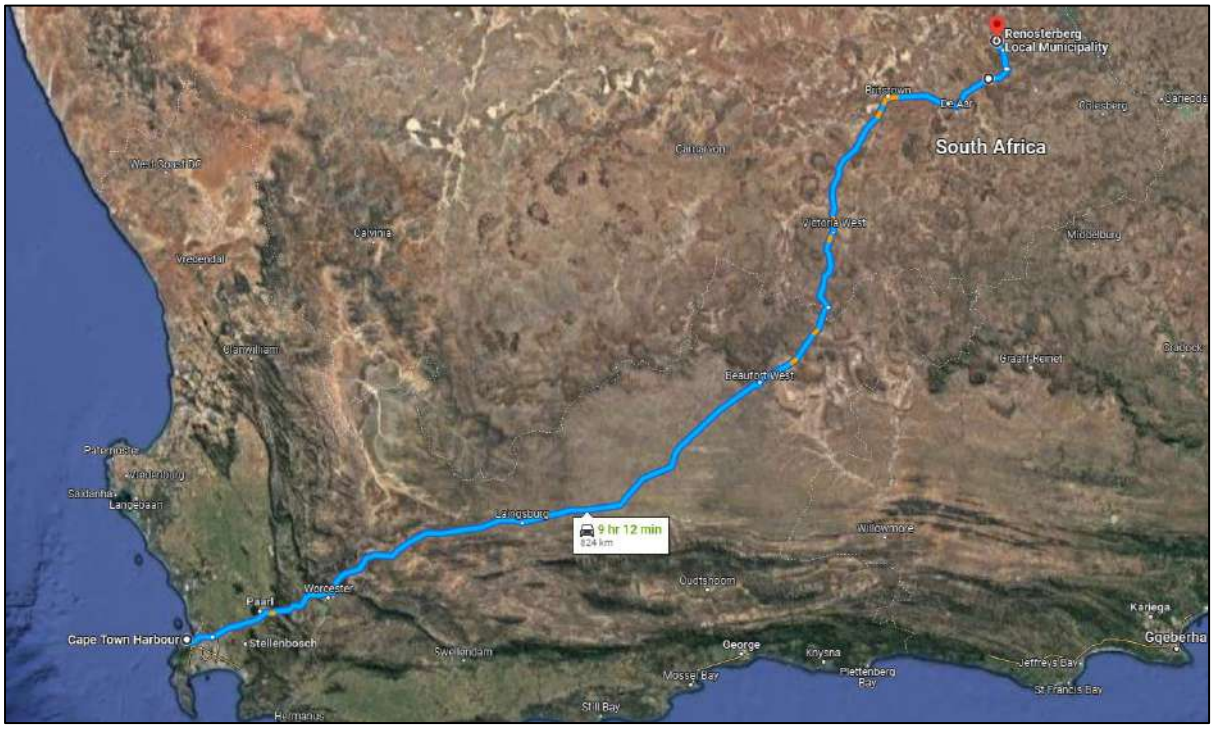


Figure 14-4: Proposed Route: Alternative 1

The second alternative option will be the route from the Port of Saldanha as shown in Figure 14-5 by the blue line. This route is approximately 845 km and follows the N7 from the Port and then turns east past Calvinia and Britstown to De Aar. From De Aar, the R48 can be taken east up to the access point to the sites.



Figure 14-5: Proposed Route: Alternative 2

It should be noted that the above-mentioned route alternatives will all need to navigate through intersections, over and underneath bridges and other road structures, across railway lines and also along mountain passes. It is critical that the abnormal load vehicles can move safely and without obstruction along these routes. It is however anticipated that this is achievable, considering other solar facilities in the vicinity of the proposed site.

14.4.2.2 Main Roads in the Vicinity of the Site

The main roads in the vicinity of the Kudu Solar PV 4 facility is shown in Table 14-1 and Figure 14-6. Table 14-1 also provides details with regards to the controlling and maintaining road authority, width of the road and whether the road is a gravel or surfaced (tarred) road.

Table 14-1: Main Roads in the Vicinity of the Site

Road Name	Road Authority	Road Width	Gravel / Surfaced
Divisional Road 3084 (DR 3084)	Northern Cape Provincial Government	Between ± 6.0m and ± 7.5m	Gravel
Divisional Road 3093 (DR 3093)	Northern Cape Provincial Government	Between ± 6.0m and ± 8.0m	Gravel
Trunk Road 38/1 (TR 38/01) (R48)	Northern Cape Provincial Government	± 6.2m blacktop and ± 2.5m gravel shoulders along both sides of the road	Surfaced
Main Road 790 (MR 790) (R388)	Northern Cape Provincial Government	± 8.0m	Gravel
Divisional Road 3096 (DR 3096)	Northern Cape Provincial Government	Between ± 6.5m and ± 8.0m	Gravel
Trunk Road 38/02 (TR 38/02) (R48)	Northern Cape Provincial Government	± 6.6m blacktop and ± 5m and more gravel shoulders along both sides of the road	Surfaced



Figure 14-6: Main Roads in the Vicinity of the Site

14.4.2.3 Main Access Considerations

As indicated in the previous paragraph, various existing provincial gravel roads from the R48 (Trunk Road 38/1 and Trunk Road 38/02) can provide access to the site. This can be seen in Figure 14-7 below.



Figure 14-7: Proposed Kudu Solar PV Facility Gravel Roads

The potential main access roads to the proposed facility as shown in Figure 14-7 and Figure 14-8 are:

- Access Route Option 1:
  - Route A: Along TR38/01, DR3093, and DR3096
  - Route B: Along TR38/01, DR3093 and DR3084
- Access Route Option 2:
  - Route A: Along MR790, DR3093 and DR3084
  - Route B: Along MR790 and DR3093
  - Route C: Along MR790, DR3093 and DR3096
- Access Route Option 3:
  - Route A: Along TR38/01, TR38/02, and DR3096
  - Route B: Along TR38/01, TR38/02, DR3096 and DR3093
  - Route C: Along TR38/01, TR38/02, DR3096, DR3093 and DR3084

Please also refer to Table 14-2 for an indication of all potential access roads.

Table 14-2: Potential Access Roads

Access Option	Proposed Access Roads	Main access point from the closest surfaced road	Description of Applicability to the Kudu PV Project	Applicable to Kudu Solar Facility 4?
Access Route Option 1	Route A: Along TR3801, DR3093, and DR3096	Intersection of the TR3801 and DR3093	This will provide access to all the proposed Kudu Solar Facilities. Alternatively, once the internal roads are constructed at Kudu Solar Facility 5, it can also be used to access Kudu Solar Facilities 1 to 4. Furthermore, once the internal roads are constructed at Kudu Solar Facility 7, it can also be used to access Kudu Solar Facilities 8 to 12.	Yes
	Route B: Along TR3801, DR3093 and DR3084	Intersection of the TR3801 and DR3093	This will provide access to the proposed Kudu Solar Facilities 1 to 5.	Yes
Access Route Option 2	Route A: Along MR790, DR3093 and DR3084	Intersection of the TR3801 and MR790	This will provide access to the proposed Kudu Solar Facilities 1 to 5.	Yes
	Route B: Along MR790 and DR3093	Intersection of the TR3801 and MR790	This will provide access to the proposed Kudu Solar Facilities 5, 6 and 7.	No
	Route C: Along MR790, DR3093 and DR3096	Intersection of the TR3801 and MR790	This will provide access to the proposed Kudu Solar Facilities 8, 9, 10, 11 and 12. Alternatively, once the internal roads are constructed at Kudu Solar Facility 7, it can also be used to access Kudu Solar Facilities 8 to 12.	No
Access Route Option 3	Route A: Along TR3801, TR3802, and DR3096	Intersection of the TR3802 and DR3096	This will provide access to the proposed Kudu Solar Facilities 8, 9, 10, 11 and 12.	No
	Route B: Along TR3801, TR3802, DR3096 and DR3093	Intersection of the TR3802 and DR3096	This will provide access to the proposed Kudu Solar Facilities 5, 6 and 7. Alternatively, once the internal roads are constructed at Kudu Solar Facility 8 to 10, it can also be used to access Kudu Solar Facilities 6 to 7.	No
	Route C: Along TR3801, TR3802, DR3096, DR3093 and DR3084	Intersection of the TR3802 and DR3096	This will provide access to the proposed Kudu Solar Facilities 1 to 5.	Yes



Figure 14-8: Proposed Access Roads

14.4.2.3.1 Access Route Option 1

The main access point for Access Route Option 1, Route A and Route B (refer to Table 14-2), from a surfaced road is from DR3093, located along the R48, approximately 45 km north-east of De Aar. This access will provide the most direct access from a surfaced road. This access road is considered the preferred option. Figure 14-9 indicates the sight distance to the left and right along the R48 and a photo of DR 3093 taken from the R48.



Sight Distance to the left at DR 3093 along the R48



Sight Distance to the right at DR 3093 along the R48



Divisional Road 3093

Figure 14-9: Divisional Road 3093

14.4.2.3.2 Access Route Option 2

The main access point for Access Route Option 2, Route A, Route B and Route C (refer to Table 14-2), from a surfaced road is at Main Road 790, located along the R48, approximately 14 km north-east of De Aar. Main Road 790 is a gravel road and crosses a railway line to gain access to DR3093. Figure 14-10 indicates the sight distance to the left and right at MR790 along the R48 and a photo of MR790 taken from the R48.



Sight Distance to the left at Main Road 790 along the R48



Sight Distance to the right at Main Road 790 along the R48



Main Road 790

Figure 14-10: Main Road 790

14.4.2.3.3 Access Route Option 3

The main access point for Access Route Option 3, Route A, Route B and Route C (refer to Table 14-2), from a surfaced road is from DR3096, located along Trunk Road 38/02 (R48), approximately 100 km north-east of De Aar. Site observations concluded that Trunk Road 38/02 is in a very bad condition with potholes present along most part of this portion of road. There will also be a large portion of travel distance on gravel roads along this access. This is the least favourable option. Figure 14-11 indicates the sight distance to the left and right along the R48 and a photo of DR3096 taken from the R48.



Sight Distance to the left at DR 3096 along the R48



Sight Distance to the right at DR 3096 along the R48



Divisional Road 3096

Figure 14-11: Divisional Road 3096

All routes to the site should however be further investigated to ensure that the abnormal loads are not obstructed at any point by geometric, height and width limitations along the route. The applicable permits to transport the abnormal loads should also be obtained. It should also be ensured that all the gravel haulage roads should be maintained during the construction phase and reinstated after the construction phase is completed, this is applicable for both provincial roads and also the private internal farm roads to an extent as agreed with the landowners.

14.4.3 Project Specific Description

14.4.3.1 Kudu Solar Facility 4 and associated infrastructure

Kudu Solar PV facility (PV4) is shown in Figure 14-12. The preferred access route will be from the R48 (TR38/01), along DR3093 and DR3084 gravel roads. Refer to Table 14-2 for additional information.



Figure 14-12: Kudu Solar Facility 4 (PV4)

Furthermore, direct access to the facility will be taken from DR3084 along an existing farm access as shown in Figure 14-13. The development footprint and detailed layout are acceptable as shown in Figure 14-13. Changes to the detailed layouts are deemed acceptable if the changes remain within the approved buildable areas / development footprints and area assessed during the Scoping and EIA Process with no-go sensitive areas avoided.



Figure 14-13: Kudu Solar Facility 4 (PV4) Access Location

14.4.4 Identification of Environmental Sensitivities

14.4.4.1 Sensitivities identified by the National Web-Based Environmental Screening Tool

Part of the terms of reference was to identify sensitivities by the National Web-Based Environmental Screening Tool (Screening Tool). However, it is important to note that there are no dedicated traffic or transport related themes on the Screening Tool, therefore the environmental sensitivity of the proposed project area as identified by the Screening Tool is not applicable. Therefore, no site sensitivity verification report is required (as indicated in Appendix C). Furthermore, there is no dedicated assessment protocol prescribed for Traffic. Therefore, the specialist assessment has been undertaken in compliance with Appendix 6 of the NEMA EIA Regulations of 2014.

14.4.5 Preliminary Vehicle Tracking Analysis and Road Widening/Lengthening Investigation

According to the NEMA EIA Regulations of 2014, the following relevant listed activities are noted:

Activity 56 of Listing Notice 1: The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre -
(i) where the existing reserve is wider than 13,5 meters; or
(ii) where no reserve exists, where the existing road is wider than 8 metres.

For Activity 56 of Listing Notice 1, *(i) where the existing reserve is wider than 13,5 meters* is relevant.

Activity 18 (g) (ii) (ee) (ii) of Listing Notice 3: The widening of a road by more than four meters, or the lengthening of a road by more than one kilometre in the:
g. Northern Cape
ii. Outside urban areas:
(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;
(ii) Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland.

Existing roads will be used as far as practically achievable. The proposed project study area can be accessed via various existing main roads and unnamed farm gravel roads. The potential access routes are discussed below, as per Section 14.4.2.3:

- Access Route Option 1:
    - Route A: Along TR38/01, DR3093, and DR3096;
    - Route B: Along TR38/01, DR3093 and DR3084;
- Access Route Option 2:
    - Route A: Along MR790, DR3093 and DR3084;
    - Route B: Along MR790 and DR3093;
    - Route C: Along MR790, DR3093 and DR3096;
- Access Route Option 3:
    - Route A: Along TR38/01, TR38/02, and DR3096;
    - Route B: Along TR38/01, TR38/02, DR3096 and DR3093; and
    - Route C: Along TR38/01, TR38/02, DR3096, DR3093 and DR3084.

The existing main roads, divisional roads and unnamed farm gravel roads may need to be upgraded for the proposed Kudu Solar cluster.

To accommodate the turning movements of abnormal vehicles, preliminary vehicle tracking was undertaken along the Access Route Options to determine areas where the existing road will need to be widened / lengthened. The following design vehicle was used (refer to Figure 14-14). The design vehicle will need to be confirmed during the geometric design process, however, the vehicle used is based on similar projects.

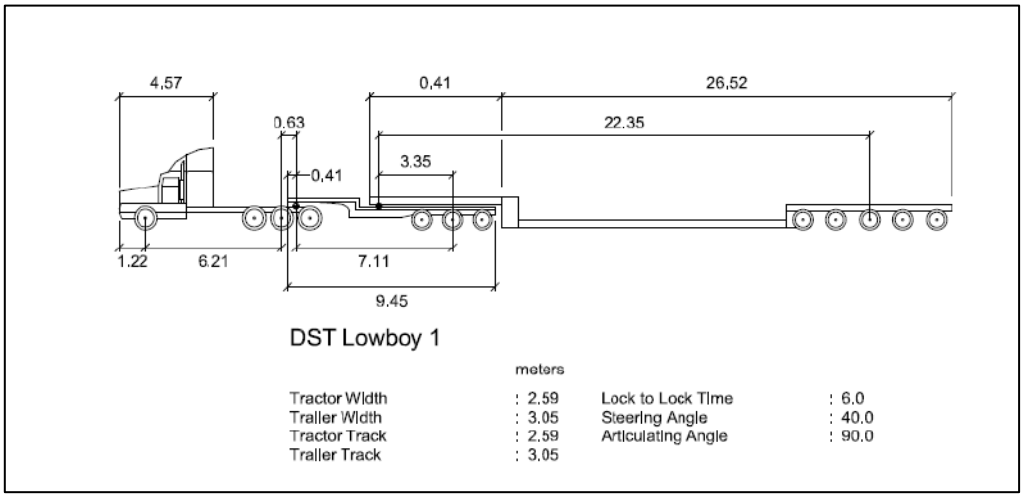


Figure 14-14: Abnormal Design Vehicle

Furthermore, based on similar studies, to accommodate the delivery of materials to site, the following intersection design at the main access point from the R48 is proposed as shown in Figure 14-15.

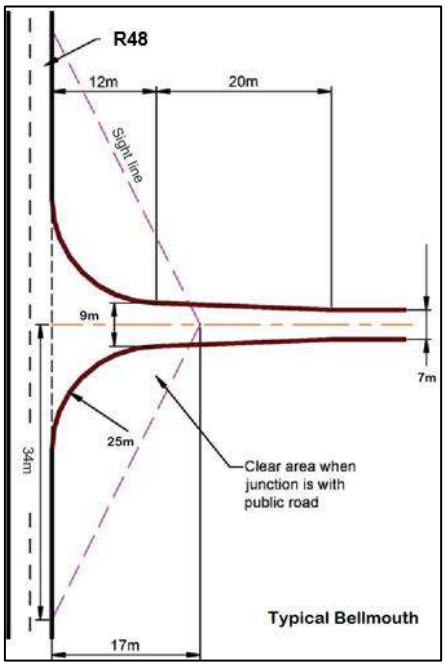


Figure 14-15: Intersection Design

The findings of the vehicle tracking based on the abnormal design vehicle for each access route option is discussed below.

14.4.5.1.1 Access Route Option 1

For this option, it is not anticipated that any widening of the intersection at TR38/01 and DR3093 will be required, however, the existing island will need to be removed (approximately 60 m^2) to accommodate the turning movements as shown in Figure 14-16 and in accordance with Figure 14-15.



Figure 14-16: DR3093 and TR38/01 Intersection

No other widening or lengthening of roads will be required along this route.

14.4.5.1.2 Access Route Option 2

For this option, widening of the intersection at TR38/01 and MR790 will be required (approximately 95m^2) to accommodate the turning movements as shown in Figure 14-17 and in accordance with Figure 14-15.



Figure 14-17: MR790 and TR38/01 Intersection

Furthermore, widening of the MR790/DR3093 intersection by approximately 60m^2 and widening of the DR3093/DR3084 intersection by 170m^2 will also be required as shown in Figure 14-18.

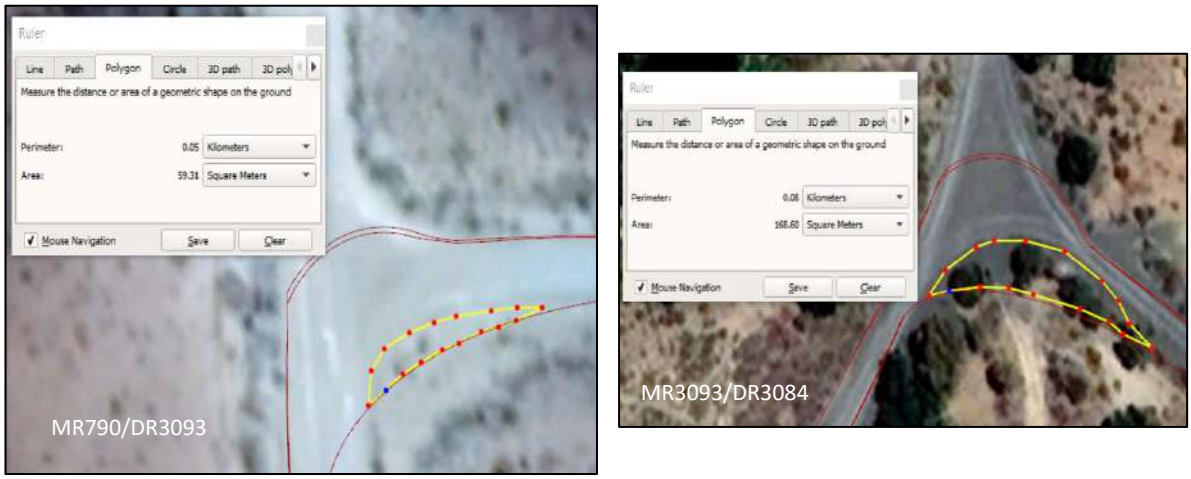


Figure 14-18: Access Route Option 2 Road Widening Requirements

No other widening or lengthening of roads will be required along this route.

14.4.5.1.3 Access Route Option 3

For this option, widening of the intersection at TR38/02 and DR3096 will be required (approximately 150m^2 in total) to accommodate the turning movements as shown in Figure 14-19 and in accordance with Figure 14-15.



Figure 14-19: Access Route Option 3 Road Widening Requirements

Furthermore, localised widening will be required along DR3096 at two locations (approximately 56m^2 heading north and 50m^2 heading west) and at the DR3093/DR3084 intersection (approximately 79m^2) as shown in Figure 14-20.

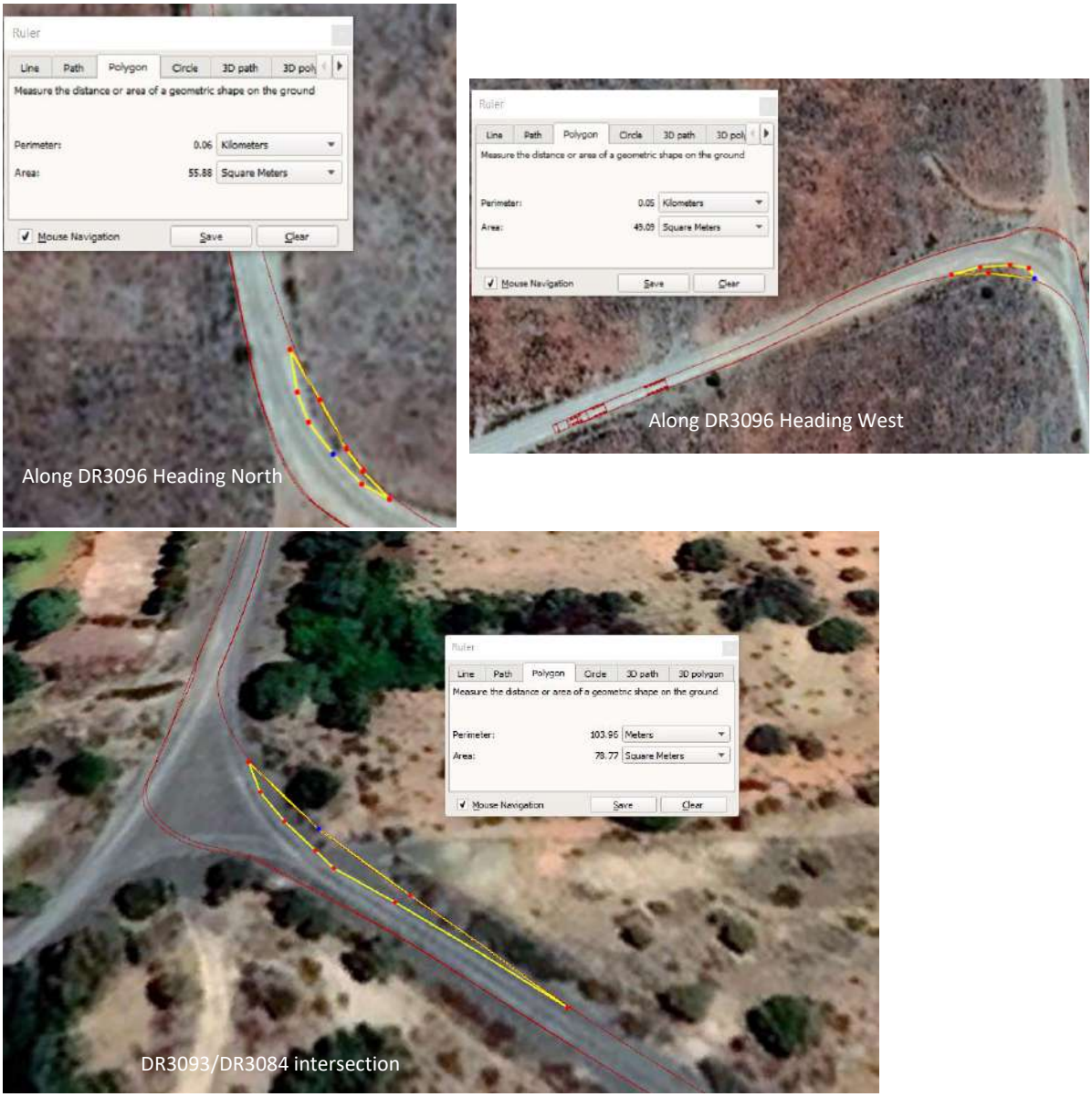


Figure 14-20: Access Route Option 3 Road Widening Requirements

No other widening or lengthening of roads will be required along this route.

14.4.5.2 Conclusion Statement

Based on the wheel tracking analysis of the abnormal load vehicles that are discussed in Section 14.4.5, it can be concluded that no road will need to be lengthened by more than 1 kilometre for Access Route Option 1, Access Route Option 2 and Access Route Option 3. However, road widening exceeding 6m will be required for Access Route Option 2 only at the TR38/01 and MR790 intersection

(approximately 12m at the widest point) and at the DR3093 and DR3084 intersection (approximately 6.6m at the widest point). This is shown in Figure 14-21.



Figure 14-21: Road Widening Width at TR38/01 and MR790 and DR3093 and DR3084 intersections

Road widening exceeding 4m will be required for Access Route Option 3 at the TR38/02 and DR3096 intersection (approximately 4.4m at the widest point). This is shown in Figure 14-22.

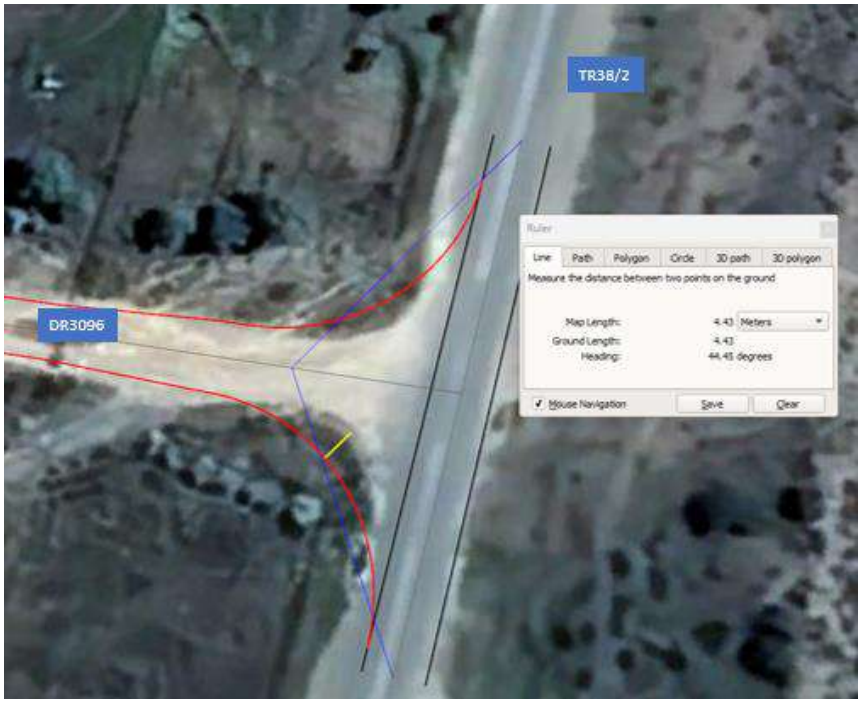


Figure 14-22: Road Widening Width at TR38/02 and DR3096 intersection

Road widening exceeding 4m and 6m will not be required for Access Route Option 1.

14.5 Existing Traffic Conditions

Temporary counting stations were commissioned by SANRAL in 2011 along the DR3093 and DR3084. The locations of the counting stations are indicated in Figure 14-23 below. The results of these counts indicated an Average Daily Traffic (ADT) of approximately 62 vehicles (two-way) along DR3093 and approximately 8 vehicles (two-way) along DR3084 per day. These numbers indicate that there are extremely low volumes of traffic along these roads in the vicinity of the study area. If an annual growth rate factor of 2% growth rate per annum is applied to these volumes, the ADT would increase to 79 vehicles (two-way) along DR3093 and 10 vehicles (two-way) along DR3084 per day, which is still extremely low traffic volumes. This growth rate relates to traffic growth experienced in low growth rate areas and is deemed appropriate for this area and could account for development that has taken place since 2011.



Figure 14-23: Location of Temporary Count Stations

SANRAL has two permanent counting stations, Station 13730 and Station 13731, in the vicinity of the site. Station 13730 is located along the R389 approximately 64 km northeast of De Aar and Station 13731 is located along the R48 approximately 102 km northeast of De Aar. The location of the counting stations is indicated in Figure 14-24 below.



Figure 14-24: Location of Permanent Count Stations

A summary of the ADT recorded at Station 13730 and Station 13731 is shown in Table 14-3 and Figure 14-25 below.

Table 14-3: Station 13730 and Station 13731 Count Data

Year	Average Traffic (ADT) (two-way)	
	Station 13730	Station 13731
2018	412	748
2019	454	648
2020	610	839
2021	626	866

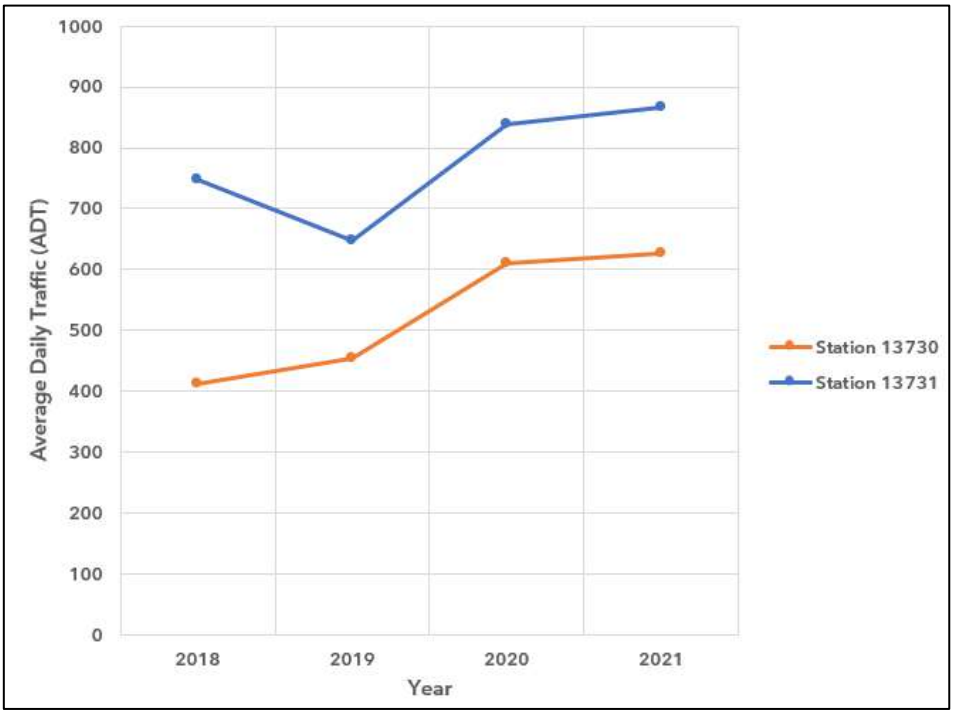


Figure 14-25: SANRAL Station 13730 and Station 13731 Historic Count Information

From the above information, it can be concluded that the growth rate from the recorded 2018 to 2021 ADT values is approximately 14% per annum along the R389 and approximately 5% per annum along the R48. Furthermore, the percentage of heavy vehicles recorded on the R389 was 78% during 2021 and 56% along the R48 during 2021. An increase in ADT is evident from 2020 onwards. This can possibly be attributed to increased mining activities and renewable energy projects. It should however be noted that the capacity of a Class 1 road with two lanes is in the order of 2000 vehicles per hour and therefore the traffic volumes recorded on this road is still significantly less than the capacity of the roads.

14.6 Trip Generation Rates

The trip generation rates discussed below are based on similar studies that have been undertaken for Solar Energy Facilities and associated electrical infrastructure (e.g. collector substation and transmission line). The trip generation rates discussed below relates to the anticipated trip generation rates associated with the 50MW Solar PV Facility.

14.6.1 Construction Phase

It is expected that the Construction Phase of the proposed Kudu Solar PV facility will be 12 to 18 months.

From experience with similar projects, it was assumed that for projects up to 150MW, the following number of truck trips (one-way) are expected:

- Panels = 273 truck trips
- Mounting Structure = 300 truck trips
- Inverters = 13 truck trips
- Field Transformers = 12 truck trips
- Cable and Battery Operating System (BOS) = 120 truck trips

It is assumed that each project will be constructed over a 12 to 18 month period. Therefore, based on an 18-month construction period and a 6 day work week (78 x 6 = 468 work days), this could result in approximately **2 daily truck trips (one-way)**.

It is also expected that approximately 3 single unit trucks carrying construction materials will visit the site on a daily basis, resulting in **3 daily single unit truck trips (one-way)**.

Furthermore, it is expected that approximately 150 workers will be transported to the site daily. It was assumed that 50% the workers will be transported to/from the site by 15-seater minibus taxis and 50% of the workers will be transported to/from the site by 80-seater buses from the surrounding areas resulting in approximately **5 daily staff minibus taxi trips (one-way)** and **1 daily bus trip (one-way)**. Experience has shown that during the construction period, approximately **2 daily private vehicle trips** are expected to come to/from the site from supervisors or senior personnel. Therefore, a total of **8 daily staff trips (one-way)** are expected.

Water will also be required during the construction phase for human consumption and construction activities, such as the installation of the solar panels, dust control along the gravel roads and potable water. As noted in Chapter 2 of this EIA Report, water may be sourced from the following sources, in order of priority: local municipality, third-party water supplier, existing boreholes or new drilled boreholes on site. For purposes of this TIA, the maximum development scenario in terms of water supply is used i.e. trucking in water from the local municipality. The water will be delivered to the site from a municipal water supply by 12 kilolitre water trucks on a daily basis. Based on similar projects, water demand will be in the order of approximately 9 000 m^3 per year for the construction phase for construction purposes and potable water. This equates to 750 000 litres per month. This relates to an additional ~ **2 daily water truck trips (one-way)** to the site.

Based on the above, a total of **15 one-way trips per day**, i.e. **30 trips in total per day (two-way)** are expected during the 18 month period construction phase.

14.6.2 Operational Phase

It is expected that the Operational Phase will take place during the life span of the project (approximately 20 years). During this time, it is anticipated that 1 - 2 light load trucks will visit the site on a weekly basis. This will conservatively equate to **1 daily light load truck trip (one-way)**.

It is expected that a workforce of 8 members, made up of staff, supervisors or senior personnel will commute to the site by private vehicles daily. It is assumed that 3 workers will share a private vehicle, resulting in a total of **3 daily staff trips (one-way)**.

Water will be required for cleaning the solar panels, which must be done 4 times per year. It is also anticipated that the gravel district road be watered daily to suppress dust during operation depending

on traffic volumes. Based on similar projects, water demand will be in the order of approximately 1 000 m^3 per year during the operational phase. This equates to 83 333 litres per month. The water will be delivered to the site from a municipal water supply by 12 kilolitre water trucks on a daily basis, resulting in **1 daily water truck trip (one-way)**.

Based on the above, a total of **5 one-way trips per day**, i.e. **10 trips in total per day (two-way)** are expected during the operational phase.

14.6.3 Decommissioning Phase

The Decommissioning Phase will generate similar trips as the Construction Phase over a similar time period of 18 months. This includes **2 daily truck trips (one-way)** trips for the transportation of the solar panels, **3 daily single unit truck trips (one-way)**, for the transportation of construction materials, **8 daily staff trips (one-way)** and **2 daily water truck trips (one-way)**.

Based on the above, a total of **15 one-way trips per day**, i.e. **30 trips in total per day (two-way)** are expected during the 18 month period decommissioning phase.

14.7 Trip Generation Summary

From the trip generation information gathered the following traffic impacts should be considered:

- Potential congestion and delays on the surrounding road network;
- Potential impact on traffic safety and increase in accidents with other vehicles or animals;
- Potential change in the quality of the surface condition of the roads; and
- Potential noise and dust pollution.

The number of additional daily trips per solar PV plant and associated electrical grid infrastructure are summarised below. These trips can be expected for the duration of the construction period and decommissioning phase (18 months) and for the operational phase of the project (20 years).

Construction Phase – 30 Daily Trips (two-way)

- 4 daily truck trips
- 6 daily light load trips
- 16 daily staff transport trips
- 4 daily water truck trips

Operational Phase – 10 Daily Trips (two-way)

- 2 daily light load truck trips
- 6 daily staff transport trips
- 2 daily water truck trips

Decommissioning Phase – 30 Daily Trips (two-way)

- 4 daily truck trips
- 6 daily light load trips
- 16 daily staff transport trips
- 4 daily water truck trips

It is anticipated that the PV facility will have an 18-month construction period. From historic traffic information in the vicinity of the site, traffic is evenly spread daily and the AM and PM peak hour trips each constitute approximately 7% of the daily traffic. This relates to approximately an additional 2 trips on the road network during the peak hours for the construction and decommissioning phase and approximately an additional 1 trip on the road network during the peak hours for the operational phase. **The additional peak hour trips during the construction, operational and decommissioning phases will have an insignificant traffic impact on the surrounding road network.**

However, possible mitigation measures to address the daily traffic impact are discussed in the following section.

14.8 Issues, Risks and Impacts

14.8.1 Identification of Potential Impacts/Risks

The potential transport and traffic related impacts identified are described below.

14.8.1.1 Construction Phase

The potential transport and traffic related impacts during the construction phase are listed below:

- Potential congestion and delays on the surrounding road network.
- Potential impact on traffic safety and increase in accidents with other vehicles or animals.
- Potential change in the quality of the surface condition of the roads.
- Potential noise and dust pollution.

14.8.1.2 Operational Phase

The traffic generated during the operational phase are mainly related to the staff that will be transported to and from the sites and are not anticipated to have a significant traffic impact on the surrounding road network.

14.8.1.3 Decommissioning Phase

The potential transport related impacts during the decommissioning phase are similar to the potential transport related impacts during the construction phase and are listed below:

- Potential congestion and delays on the surrounding road network.
- Potential impact on traffic safety and increase in accidents with other vehicles or animals.
- Potential change in the quality of the surface condition of the roads.
- Potential noise and dust pollution.

14.8.1.4 Cumulative Impacts

The cumulative transport impacts related to the proposed facility are listed below and apply to the construction and decommissioning phases:

- Congestion and delays on the surrounding road network.
- Impact on traffic safety and increase in accidents with other vehicles or animals.
- Change in the quality of the surface condition of the roads.
- Noise and dust pollution.

14.8.2 Summary of Issues identified during the Public Consultation Phase

During the 30-day review of the Draft Scoping Report, various comments were raised by stakeholders and Interested and Affected Parties (I&APs). The comments raised that relate to traffic related impacts are noted and summarised below, with responses provided by the specialist team:

NAME OF ORGANISATION/ I&AP	KEY ISSUE	RESPONSE
Adjacent Landowners	Queries on the maintenance of infrastructure (such as roads and water courses) and the management of dust pollution caused by the increased traffic.	Maintenance of existing infrastructure that is impacted by the proposed project during the construction and operational phase will be undertaken by the Project Developer. The requirements for maintenance are discussed in the Environmental Management Programme (EMPr). Similarly, mitigation measures to control and manage dust pollution that occurs as a result of the proposed project are included in the EMPr. The Applicant will place a significant emphasis on ensuring compliance with the management measures included. Dust pollution has been identified as a potential impact in this Traffic Impact Assessment, as well as the Visual Impact Assessment. Refer to Section 14.9 of this report for feedback on the potential dust pollution impact and mitigation measures, such as ensuring that speed control is implemented by means of a stop and go system and speed limit road signage within the construction site. Further management actions are also included in the EMPr.
Adjacent Landowner	A concern was raised regarding the dust pollution generated by the roads and the removal of vegetation.	The concerns regarding dust pollution are noted. Note that during the construction phase, vegetation is planned to be trimmed within the PV array area (and not removed completely). Therefore, even though it appears that a large area will be covered by the Solar PV array, not all the vegetation will be removed completely. This is also expected to reduce some of the dust generation. Nevertheless, dust management actions are included in the EMPr.

14.9 Impact Assessment

14.9.1 Potential Impacts during the Construction Phase

The impacts associated with the traffic generation of the proposed Kudu PV Facility 4 during the construction phase are summarised in Table 14-4 below, and discussed in detail below:

14.9.1.1 Impact 1: Potential congestion and delays on the surrounding road network.

Congestion and delays on the surrounding road network are identified as a potential impact as a result of increased traffic volumes relating to the trip generation of the construction activities during the peak hour periods. This impact is rated as neutral, with a local spatial extent and a medium-term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and is rated as replaceable (meaning the resources i.e. road network are replaceable). The potential impact is allocated a slight consequence and likely probability, which will render the impact significance as very low, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is also rated as very low. The recommended mitigation measures are detailed in Table 14-4 below.

14.9.1.2 Impact 2: Potential impact on traffic safety and increase in accidents with other vehicles or animals.

Traffic safety and an increase in accidents with other vehicles and animals is identified as a potential impact as a result of more vehicles travelling on the road to and from the construction site, increasing the likelihood of incidents. This impact is rated as negative, with a local spatial extent and a medium-term duration. The impact is rated with a low reversibility and high irreplaceability if the incident results in a fatality. The potential impact is allocated a substantial consequence and likely probability, which will render the impact significance as moderate, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is rated as low. The recommended mitigation measures are detailed in Table 14-4 below.

14.9.1.3 Impact 3: Potential change in the quality of the surface condition of the roads.

The potential change in the quality of the surface condition of the roads is identified as a potential impact as a result of the increase in especially heavy vehicle traffic on the roads. This impact is rated as neutral, with a local spatial extent and a medium-term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and is rated as replaceable (meaning the resources i.e. road network are replaceable). The potential impact is allocated a slight consequence and likely probability, which will render the impact significance as very low, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is also rated as very low. The recommended mitigation measures are detailed in Table 14-4 below.

14.9.1.4 Impact 4: Potential noise pollution.

The potential of noise pollution is identified as a potential impact as a result of increased traffic volumes during the construction phase of the project. This impact is rated as neutral, with a local spatial extent and a medium-term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and is rated as replaceable (meaning the resources i.e. road network are replaceable). The potential impact is allocated a moderate consequence and likely probability, which will render the impact significance as low, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is also rated as low. The recommended mitigation measures are detailed in Table 14-4 below.

14.9.1.5 Impact 5: Potential dust pollution.

The potential of dust pollution is identified as a potential impact as a result of the increased number of vehicles using the gravel roads to access the proposed construction site. This impact is rated as neutral, with a local spatial extent and a medium-term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and is rated as replaceable (meaning the resources i.e. road network are replaceable). The potential impact is allocated a moderate consequence and likely probability, which will render the impact significance as low, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is also rated as low. The recommended mitigation measures are detailed in Table 14-4 below.

14.9.1.6 Impact Summary Tables: Construction Phase

Table 14-4: Rating of Traffic Related Impacts During the Construction Phase

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Congestion and delays on road network	Status	Neutral	Very Low (5)	Stagger delivery trips and schedule trips, including staff trips outside of peak hours where possible.	Very Low (5)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Slight				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Replaceable				
Potential impact on traffic safety and increase in accidents with other vehicles and animals	Status	Negative	Moderate (3)	Implement speed control by means of a stop and go system and speed limit road signage within the construction site. Ensure all vehicles are roadworthy, visible, adequately marked, and operated by an appropriately licenced operator.	Low (4)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Substantial				
	Probability	Likely				
	Reversibility	Low				
	Irreplaceability	High				
Condition of road surface	Status	Neutral	Very Low (5)	Regular maintenance of internal farm access roads by the contractor. Ensure private access roads that are impacted on by the proposed development are restored to original pre-construction road condition.	Very Low (5)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Slight				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Replaceable				
Dust Pollution	Status	Neutral	Low (4)	Implement dust control on gravel roads within the construction site. Implement speed control by means of a stop and go system and speed limit road signage within the construction site.	Low (4)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Replaceable				
Noise Pollution	Status	Neutral	Low (4)	Stagger delivery trips.	Low (4)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Moderate				

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Replaceable				

14.9.2 Potential Impacts during the Operational Phase

The traffic generated during the operational phase will not have a significant impact on the surrounding road network.

14.9.3 Potential Impacts during the Decommissioning Phase

The impacts associated with the traffic generation of the proposed Kudu PV Facility during the decommissioning phase are summarised in Table 14-5 below:

14.9.3.1 Impact 1: Potential congestion and delays on the surrounding road network.

Congestion and delays on the surrounding road network are identified as a potential impact as a result of increased traffic volumes relating to the trip generation of the facility for decommissioning activities during the peak hour periods. This impact is rated as neutral, with a local spatial extent and a medium-term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and is rated as replaceable (meaning the resources i.e. road network are replaceable). The potential impact is allocated a slight consequence and likely probability, which will render the impact significance as very low, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is also rated as very low. The recommended mitigation measures are detailed in Table 14-5 below.

14.9.3.2 Impact 2: Potential impact on traffic safety and increase in accidents with other vehicles or animals.

Traffic safety and increase in accidents with other vehicles and animals is identified as a potential impact as a result of more vehicles travelling on the road to and from the facility for decommissioning activities, increasing the likelihood of incidents. This impact is rated as negative, with a local spatial extent and a medium-term duration. The impact is rated with a low reversibility and high irreplaceability if the incident results in a fatality. The potential impact is allocated a substantial consequence and likely probability, which will render the impact significance as moderate, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is rated as low. The recommended mitigation measures are detailed in Table 14-5 below.

14.9.3.3 Impact 3: Potential change in the quality of the surface condition of the roads.

The potential change in the quality of the surface condition of the roads is identified as a potential impact as a result of the increase in especially heavy vehicle traffic on the roads due to decommissioning activities. This impact is rated as neutral, with a local spatial extent and a medium-term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and is rated as replaceable (meaning the resources i.e. road network are replaceable). The potential impact is allocated a slight consequence and likely probability, which will render the impact significance as very low, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is also rated as very low. The recommended mitigation measures are detailed in Table 14-5 below.

14.9.3.4 Impact 4: Potential noise pollution.

The potential of noise pollution is identified as a potential impact as a result of increased traffic volumes during the decommissioning phase of the project. This impact is rated as neutral, with a local spatial extent and a medium-term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and is rated as replaceable (meaning the resources i.e. road network are replaceable). The potential impact is allocated a moderate consequence and likely probability, which will render the impact significance as low, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is also rated as low. The recommended mitigation measures are detailed in Table 14-5 below.

14.9.3.5 Impact 5: Potential dust pollution.

The potential of dust pollution is identified as a potential impact as a result of increased number of vehicles using the gravel roads to access the proposed facility for decommissioning activities. This impact is rated as neutral, with a local spatial extent and a medium-term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and is rated as replaceable (meaning the resources i.e. road network are replaceable). The potential impact is allocated a moderate consequence and likely probability, which will render the impact significance as low, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is also rated as low. The recommended mitigation measures are detailed in Table 14-5 below.

14.9.3.6 Impact Summary Tables: Decommissioning Phase

Table 14-5: Rating of Traffic Related Impacts During the Decommissioning Phase

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
DECOMMISSIONING PHASE						
Congestion and delays on road network	Status	Neutral	Very Low (5)	• Stagger delivery trips and schedule trips, including staff trips outside of peak hours where possible.	Very Low (5)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Slight				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Replaceable				
Potential impact on traffic safety and increase in accidents with other vehicles and animals	Status	Negative	Moderate (3)	• Implement speed control by means of a stop and go system and speed limit road signage within the decommissioning site. • Ensure all vehicles are roadworthy, visible, adequately marked, and operated by an appropriately licenced operator.	Low (4)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Substantial				
	Probability	Likely				
	Reversibility	Low				
	Irreplaceability	High				
Condition of road surface	Status	Neutral	Very Low (5)	• Regular maintenance of internal farm access roads by the contractor. • Ensure private access roads that are impacted on by the proposed development are restored to original pre-construction road condition.	Very Low (5)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Slight				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Replaceable				
Dust Pollution	Status	Neutral	Low (4)	• Implement dust control on gravel roads within the decommissioning site. • Implement speed control by means of a stop and go system and speed limit road signage within the decommissioning site.	Low (4)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Replaceable				
Noise Pollution	Status	Neutral	Low (4)	• Stagger delivery trips.	Low (4)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Moderate				

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Replaceable				

14.9.4 Cumulative Impacts

It is very unlikely that all 12 Kudu PV projects will occur at the same time and construction will most likely be staggered based on project and site-specific aspects. However, the potential cumulative traffic impact related to the construction and decommissioning phases are shown in the table below based on the assumption of all 12 PV projects being constructed at the same time. The cumulative traffic impact related to the operational phase can still be regarded as insignificant.

The biggest traffic impact associated with renewable energy facilities is during the construction phase (and similarly during the decommissioning phase). During the operational phase, the trips added to the road network is expected to be insignificant. It should be noted that all the applications for abnormal load transport are considered by the applicable authorities, and they will ensure that the trips are staggered on the road network to limit possible delays.

Other renewable energy and EGI developments within a 30 km radius are also considered in this cumulative impact assessment as part of the EIA Phase. Refer to Figure 14-26below for a map of the other renewable energy developments and EGI considered, as well as a corresponding list of projects in Table 14-6. Some of these projects are already constructed and operational (selected preferred bidders or existing power lines), currently in the Environmental Assessment phase, or have received Environmental Authorisation, or are planned. In reality it is however very unlikely that all the proposed projects will occur at the same time, as all these projects will be subject to a highly competitive bidding process and only a few projects would be allowed to enter into a power purchase agreement at a time. Construction will most likely be staggered based on project and site-specific issues. In addition, as noted above, the applicable authorities will consider abnormal load applications and work with the applicants to ensure that staggering and phasing of loads on public roads is achieved to minimise impacts.

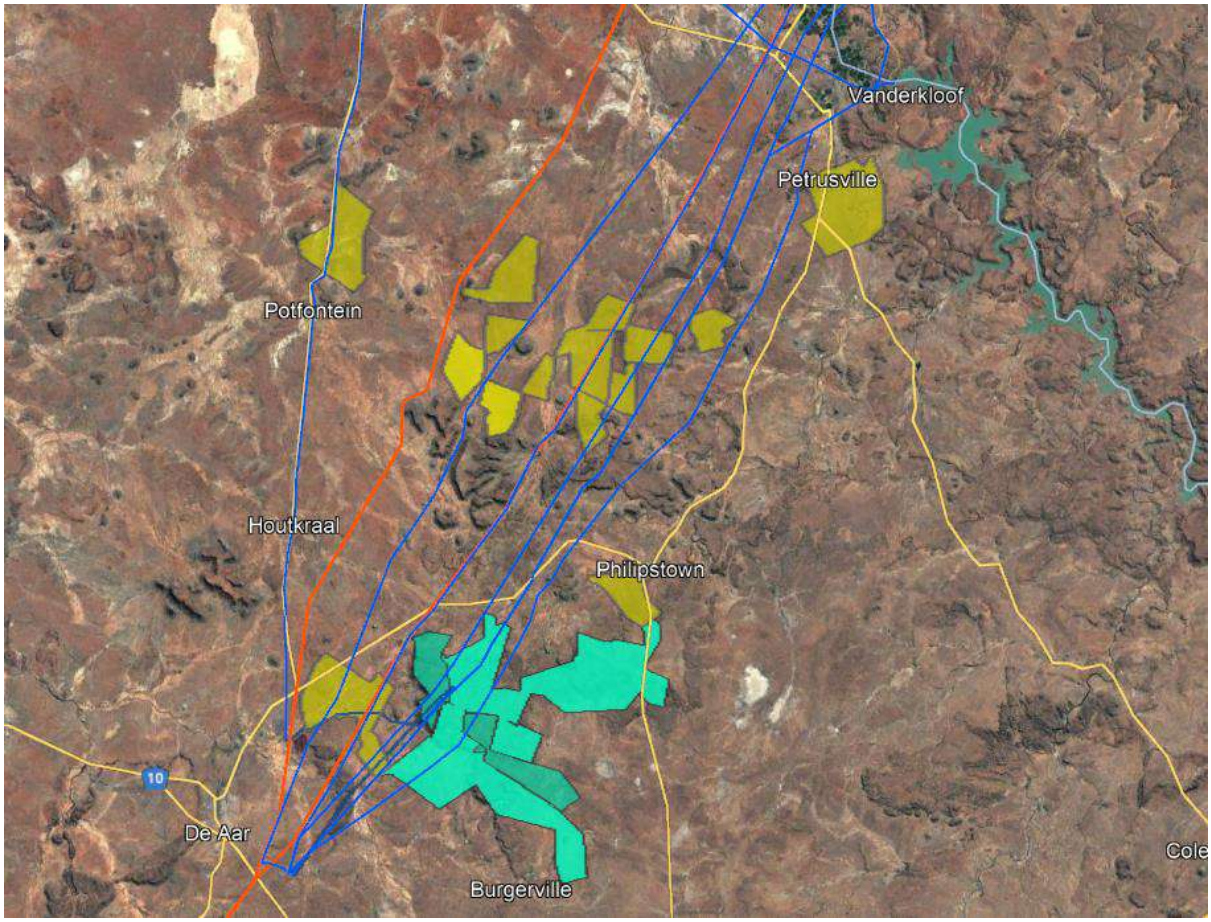


Figure 14-26: Renewable Energy Developments and EGI within 30km Radius

Table 14-6:Proposed renewable energy and EGI projects, located within 30 km of the proposed Kudu Solar Facilities, that are considered in the Cumulative Impact Assessment(Source: DFFE REEA, Quarter 4, 2022; and SAHRIS)

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
1	• 12/12/20/2258 • 12/12/20/2258/1	Solar PV	75	Approved and Preferred Bidder (Operational)	• The Proposed Establishment of Photovoltaic (Solar Power) Farms in the Northern Cape Province - Kalkbult	2010	Scoping and EIA	Scatec Solar SA Pty Ltd	Sustainable Development Projects cc
2	• 12/12/20/2463/1 • 12/12/20/2463/1/2 • 12/12/20/2463/1/A2 • 12/12/20/2463/1/AM3 • 12/12/20/2463/1/AM4 • 12/12/20/2463/1/AM5	Onshore Wind	140	Approved and Preferred Bidder (Operational)	• Longyuan Mulilo De Aar 2 North Wind Energy Facility • Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility • The Wind Energy Facility (North and South) situated on the Plateau Near De Aar, Northern Cape Province	2010 and 2014	Scoping and EIA and Amendment	Longyuan Mulilo De Aar 2 South (Pty)	Aurecon South Africa (Pty) Ltd and Holland and Associates Environmental Consultants
3	• 12/12/20/2463/2 • 12/12/20/2463/2/AM2	Onshore Wind	100	Approved and Preferred Bidder (Operational)	• Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility • The Wind Energy Facility (North and South) Situated on The Plateau Near De Aar, Northern Cape Province	2010 and 2014	Scoping and EIA and Amendment	Mulilo Renewable Energy (Pty) Ltd	Aurecon South Africa (Pty) Ltd
4	• 14/12/16/3/3/1/1166 14/12/16/3/3/1/1166/AM3 14/12/16/3/3/1/1166/AM4	Transmission line	132	Approved	• Basic Assessment for the proposed construction of a 132 kV transmission line corridor adjacent to the existing Eskom transmission line from Longyuan Mulilo De Aar 2 North Wind Energy Facility (WEF) to the Hydra Substation in De Aar, Northern Cape	2010 and 2014	Basic Assessment	Longyuan Mulilo De Aar 2 North (Pty) Ltd	Aurecon South Africa (Pty) Ltd
5	• 14/12/16/3/3/1/785	Transmission line	132	Approved	• Proposed construction of two 132kV transmission lines from the South & North Wind Energy Facilities on the Eastern Plateau (De Aar 2) near De Aar, Northern Cape.	2010	Basic Assessment	Mulilo Renewable Energy (Pty) Ltd	Aurecon South Africa (Pty) Ltd
6	• 14/12/16/3/3/2/278 • 14/12/16/3/3/2/278/1 • 14/12/16/3/3/2/278/2	Onshore Wind	118	Approved	• Proposed Castle Wind Energy Facility Project, located near De Aar, Northern Cape	2010 and 2014	Scoping and EIA	Castle Wind Farm (Pty) Ltd	Aurecon South Africa (Pty) Ltd; and Savannah Environmental Consultants (Pty) Ltd
7	• 14/12/16/3/3/2/564 • 14/12/16/3/3/2/564/AM1 • 14/12/16/3/3/2/564/AM2	Solar PV	75	To be confirmed	• Proposed Swartwater 75MW solar PV power facility in Petrusville within Renosterburg Local Municipality, Northern Cape	2010 and 2014	Scoping and EIA and Amendment	AE-AMD Renewable Energy (Pty) Ltd	USK Environmental and Waste Engineering (Pty) Ltd
8	• 14/12/16/3/3/2/740	Solar PV	300	Approved	• Proposed 300MW Solar Power Plant in Phillipstown area in Renosterberg Local Municipality	2010	Scoping and EIA	To be confirmed	Tshikovha Environmental and Communication Consultants
9	• 14/12/16/3/3/2/744	Solar PV	Unknown	Approved	• Proposed PV facility on farm Jakhalsfontein near De Aar	2010	Scoping and EIA	Solar Capital (Pty) Ltd	Eco Compliance (Pty) Ltd
10	• 14/12/16/3/3/2/739	Solar PV	70 - 100	To be confirmed	• Proposed 70 - 100 MW Solar Power Plant in Petrusville	2010	Scoping and EIA	To be confirmed	Tshikovha Environmental and Communication Consultants
11	• Not issued yet (it is understood that the project is still within the pre-application stage)	Solar PV	800 (Maximum)	Pre-Application	• The Proposed Keren Energy Odyssey Solar PV Facilities (Odyssey Solar 1, Odyssey Solar 2, Odyssey Solar 3, Odyssey Solar 4, Odyssey Solar 5, Odyssey Solar 6, Odyssey Solar 7 And Odyssey Solar 8)	2014	Scoping and EIA	Keren Energy Group Holdings	EnviroAfrica cc
12	• To be confirmed	Solar PV	3050	Scoping	• The Proposed Development of the Crossroads (formally referred to as the Hydra B) Green Energy Cluster of Renewable Energy Facilities and Grid Connection Infrastructure, Pixley Ka Seme District Municipality, Northern Cape Province. The Cluster entails the development of up to 21 solar energy facilities, with the Scoping and EIA Processes consisting of three phases. Phases 1, 2 and 3 consist of 9, 6 and 6 solar facilities, respectively. The Phase 1 Scoping and EIA Processes were launched in January 2023.	2014	Scoping and EIA	Akuo Energy Afrique	Savannah Environmental Consultants (Pty) Ltd
Study area shown on map	• 14/12/16/3/3/2/2244 • 14/12/16/3/3/2/2245 • 14/12/16/3/3/2/2246 • 14/12/16/3/3/2/2247 • 14/12/16/3/3/2/2248 • 14/12/16/3/3/2/2249 • 14/12/16/3/3/2/2250 • 14/12/16/3/3/2/2251 • 14/12/16/3/3/2/2252 • 14/12/16/3/3/2/2253	Solar PV	2180	Scoping and EIA Process underway	• Proposed Development of 12 Solar Photovoltaic (PV) Facilities (Kudu Solar Facility 1 to 12) and associated infrastructure, near De Aar, Northern Cape Province	2014	Scoping and EIA	Kudu Solar Facility 1 (Pty) Ltd to Kudu Solar Facility 12 (Pty) Ltd	CSIR

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
	• 14/12/16/3/3/2/2254 • 14/12/16/3/3/2/2255								
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• HYDRA ROODEKUIL 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• HYDRA ROODEKUIL 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	765	Existing Power Line	• BETA HYDRA 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• HYDRA PERSEUS 3	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• VAN DER KLOOF ROODEKUIL 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• VAN DER KLOOF ROODEKUIL 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• BETA HYDRA 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• HYDRA PERSEUS 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• KALKBULT/KAREEBOSCHPAN 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• ROODEKUIL/ORANIA 1	-	-	-	-
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Perseus to Gamma 2nd 765 kV line • Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line	-	-	-	-
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Relocate Beta-Hydra 765kV line to form Perseus-Hydra 1st 765kV line • Cape Corridor Phase 2: Zeus - Hydra 765kV Integration	-	-	-	-
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Perseus to Gamma 2nd 765 kV line • Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line	-	-	-	-

Refer to Table 14-7 below for a rating of the potential cumulative impacts.

Table 14-7: Rating of Cumulative Traffic Related Impacts during the Construction and Decommissioning Phase

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION AND DECOMMISSIONING PHASE						
Congestion and delays on road network	Status	Neutral	Moderate (3)	• Stagger delivery trips and schedule trips, including staff trips outside of peak hours where possible.	Low (4)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Substantial				
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	Replaceable				
Potential impact on traffic safety and increase in accidents with other vehicles and animals	Status	Negative	Moderate (3)	• Implement speed control by means of a stop and go system and speed limit road signage within the construction and decommissioning site. • Ensure all vehicles are roadworthy, visible, adequately marked, and operated by an appropriately licenced operator.	Low (4)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Substantial				
	Probability	Unlikely				
	Reversibility	Low				
	Irreplaceability	High				
Condition of road surface	Status	Neutral	Moderate (3)	• Regular maintenance of internal farm access roads by the contractor. • Ensure private access roads that are impacted on by the proposed development are restored to original pre-construction road condition.	Very Low (5)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Substantial				
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	Replaceable				
Dust Pollution	Status	Neutral	Low (4)	• Implement dust control on gravel roads within the decommissioning site. • Implement speed control by means of a stop and go system and speed limit road signage within the construction and decommissioning site.	Low (4)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Moderate				
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	Replaceable				
Noise Pollution	Status	Neutral	Low (4)	• Stagger delivery trips.	Low (4)	High
	Spatial Extent	Local				
	Duration	Medium Term				
	Consequence	Moderate				

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
	Probability	Unlikely				
	Reversibility	High				
	Irreplaceability	Replaceable				

14.9.5 Battery Energy Storage System

A Lithium-Ion Battery Energy Storage System (BESS) and Redox Flow BESS were both considered for the proposed project. For Redox Flow BESS, various chemical compositions are likely, such as Vanadium. Refer to Chapter 15 of this EIA Report for a High-Level Safety, Health and Environment Risk Assessment, which provides high level information on the safety, health and environmental risks of the BESS technologies.

Both BESS technologies have been considered in this assessment. This type of technology will have no significant influence on traffic; therefore, both are considered viable from a traffic perspective. The traffic impacts discussed in Section 14.9 are also associated with the BESS.

14.9.6 No-Go Option

The no-go option will result in no additional impacts on traffic and will result in the road and traffic status quo being maintained. However, with that being said, no fatal flaws were discovered in the course of the investigations for the proposed Kudu Solar Facilities, and with mitigation the potential impact significance is rated as mainly low to very low.

14.10 Impact Assessment Summary

The overall impact significance findings, following the implementation of the proposed mitigation measures are shown in the Table 14-8 below:

Table 14-8: Overall Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	Low to Very Low Risk / Impact (4-5)
Operational	Insignificant
Decommissioning	Low to Very Low Risk / Impact (4-5)
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Low Risk / Impact (4)
Cumulative - Operational	Insignificant
Cumulative - Decommissioning	Low to Very Low Risk / Impact (4-5)

14.11 Legislative and Permit Requirements

The Legislative and Permit requirements pertaining to the transport requirements for the proposed project is listed below:

- Abnormal load permits, (Section 81 of the National Road Traffic Act)
- Port permit (Guidelines for Agreements, Licenses and Permits in terms of the National Ports Act No. 12 of 2005), and
- Authorisation from Road Authorities to modify the road reserve to accommodate turning movements of abnormal loads at intersections.

14.12 Environmental Management Programme Inputs

The EMPr inputs for traffic related impacts is shown in Table 14-9 below.

Table 14-9: Environmental Management Programme for Traffic Impacts

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
A. PLANNING AND DESIGN PHASE					
▪ Increased traffic generation	Manage impact that additional traffic generation will have on road network	▪ If abnormal loads need to be transported by road to the site, a permit will need to be applied for in terms of Section 81 of the National Road Traffic Act and authorisation needs to be obtained from the relevant road authorities to modify the road reserve to accommodate turning movements at intersections (if necessary). ▪ It is not anticipated that any widening of the intersection at TR38/01 and DR3093 will be required, however, the existing island will need to be removed (approximately 60 m^2) to accommodate the turning movements of the abnormal load vehicles.	▪ Ensure that the permits and authorisations are applied for and obtained prior to commencement. ▪ Verify that this has been undertaken by reviewing approved permits.	▪ Once-off during the planning and design phase ▪ Once-off during the planning and design phase.	▪ Contractor ▪ ECO
		▪ The route to the sites should be further investigated to ensure that abnormal loads are not obstructed at any point by geometric, height and width limitations along the route.	▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off during the planning and design phase.	▪ Project Developer and Traffic Specialist
		▪ Discussions must be held with the relevant landowners on which the internal farm access roads leading to the site is located, prior to commencement to confirm requirements.	▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off during the planning and design phase.	▪ Project Developer and ECO
		▪ Ensure that the requirements for use of the internal farm access roads leading to the sites are addressed and considered in the design, as and where applicable.	▪ Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	▪ Once-off during the planning and design phase.	▪ Project Developer and ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		▪ Provide a Transport Traffic Plan to the Provincial and Municipal Road Department (if required).	▪ Ensure that the plan is compiled and submitted prior to commencement. ▪ Verify that this has been undertaken by reviewing approved plans.	▪ Once-off during the planning and design phase ▪ Once-off during the planning and design phase.	▪ Contractor ▪ ECO
▪ Accelerated degradation of road structure due to construction, operational and decommissioning phase traffic.	Limit the deterioration of the road condition due to construction, operational and decommissioning phase traffic.	▪ A Road Maintenance Plan should be developed for the internal farm access roads (i.e. internal private roads leading off the DR3093) that will be used. The plan should address requirements such as, but not limited to, grading, dust suppressant mechanisms, drainage (where required), signage, and speed limits. The Road Maintenance Plan must ensure regular maintenance of the roads. The Road Maintenance Plan must be communicated with the relevant authorities, where required, and must be provided to the surrounding community forum prior to commencement of construction.	▪ Ensure that the plan is compiled and submitted prior to commencement. ▪ Verify that this has been undertaken by reviewing approved plans.	▪ Once-off during the planning and design phase ▪ Once-off during the planning and design phase.	▪ Project Developer, Traffic Specialist and Contractor ▪ ECO
B. CONSTRUCTION PHASE					
▪ Increased traffic generation during the construction phase resulting in a reduction of road based level of service and potential congestion and delays on the surrounding road network.	Plan the project to spread and reduce the amount of road based traffic during the construction phase.	▪ Plan and stagger delivery trips and schedule deliveries so that they occur outside of peak traffic periods, where possible.	▪ Monitor and management of traffic generated and when trips are made.	▪ During construction	▪ Contractor and ECO
		▪ Suitable parking areas should be designated for construction trucks and vehicles at the construction site camp in order to promote order and improve safety.	▪ Monitor the placement of the designated parking area for trucks and vehicles via visual inspections and record and report any non-compliance.	▪ Once-off prior to construction and as required during the construction phase.	▪ Project Developer and ECO
		▪ The use of public transport (buses and/or minibus taxis) to convey construction personnel to the site should be encouraged. ▪ Staff trips should occur outside of peak hours, where possible.	▪ Contractor should record the arrival and departure times as well as the number of workers using public transport.	▪ Once a month on a randomly selected day.	▪ Appointed Contractor

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		▪ Ensure that the existing island removal at the intersection of TR38/01 and DR3093 is undertaken in an environmental conscious manner, once the relevant authorisations from the road authorities are obtained. Ensure that construction vehicles always remain within a demarcated area at the intersection, and that local road officials are informed of the planned island removal process.	▪ Monitor the island removal process via visual inspections and record and report any non-compliance.	▪ As required during the construction phase.	▪ Project Developer and ECO
▪ Increased level of road accidents (involving pedestrians, animals, other motorists on the surrounding road network) due to increased traffic during construction.	Minimise the impact of the construction activities on the local traffic and avoid accidents with pedestrians, animals and other drivers on the surrounding roads. Reduce number of road accidents due to increased traffic during construction.	▪ Well maintained vehicles should be used together with well-trained drivers during the construction phase. Vehicle maintenance and driver competency should be monitored. Proof of driver competency as well as the vehicle checks should be verified and undertaken to ensure that vehicles are roadworthy and hence, do not pose a safety risk. The Contractors must ensure that construction vehicles are roadworthy, visible, adequately marked, properly serviced and maintained, operated by an appropriately licensed operator, and respect the vehicle safety standards implemented by the Project Developer.	▪ Carry out random checks of driver licenses and conduct random visual inspections of construction vehicles for roadworthiness.	▪ Random visual inspection of vehicles weekly.	▪ Contractor
		▪ To ensure reduced speeds along the roads, implement speed control mechanisms within the construction site by means of a stop and go system, implement speed limits and placement of road signage for the speed limits.	▪ Implement speed control mechanisms within the construction site prior to commencement of construction. ▪ Carry out random inspections to verify whether proper speed control is being implemented.	▪ On-going ▪ Random during the construction phase	▪ Contractor and ECO ▪ ECO
		▪ Adhere to all speed limits applicable to all roads used.	▪ Ensure that speed limits are adhered to. ▪ Carry out random visual inspections to verify speed limits and general awareness of vehicle drivers.	▪ Daily ▪ Random during the construction phase	▪ Contractor and ECO ▪ ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		▪ Road kill monitoring programme (inclusive of wildlife collisions record keeping) should be established.	▪ Appropriate monitoring should be undertaken.	▪ Weekly	▪ Contractor and ECO
		▪ Implement clear and visible signage indicating movement of vehicles at intersections within the construction site and in the vicinity of the nearby farm steads.	▪ Implement clear signalisation. ▪ Carry out random inspections to verify whether proper construction signage is being implemented.	▪ On-going ▪ Random during the construction phase	▪ Contractor and ECO ▪ ECO
▪ Deterioration in the surface condition of the roads and accelerated degradation of road structure due to construction traffic.	Limit the deterioration of the road condition due to construction traffic.	▪ Ensure that there is regular maintenance of the internal farm access roads (i.e. internal private roads leading off the DR3093) that will be used, by the contractor during the construction phase in line with the agreed maintenance plan. ▪ Ensure that the upgrading of the internal farm access roads (i.e. internal private roads leading off the DR3093 that are impacted on by the proposed project and will be used), is undertaken to suitable standards as specified by the civil engineer and in accordance with the maintenance plan. ▪ Ensure that the internal farm access roads (i.e. internal private roads leading off the DR3093 that are impacted on by the proposed project and will be used) are restored to its original pre-construction road condition.	▪ Carry out visual inspections to verify if regular maintenance is being undertaken. ▪ Ensure that the internal farm access road to site is upgraded through photographic surveys and monitoring.	▪ Bi-monthly ▪ Ongoing	▪ Contractor and ECO ▪ Project Developer, Contractor and ECO
		▪ Construction activities will have a higher impact than the normal road activity and therefore the internal farm access roads (i.e. internal private roads leading off the DR3093) to site should be inspected on a weekly basis for structural damage.	▪ Ensure that the access road to site maintains current condition through photographic surveys and monitoring.	▪ Weekly	▪ Contractor and ECO
		▪ Implement management strategies for dust generation e.g. apply dust suppressant on the gravel roads on the construction site, exposed areas and stockpiles. Avoid the use of potable water for dust suppression during the	▪ Ensure dust management measures are in place to adequately decrease the generation of dust.	▪ On-going	▪ Contractor and ECO

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
		construction phase and consider the use of alternative approved sources, where possible.			
		▪ Vehicles must not be overloaded during the construction phase in order to reduce impacts on the road structures, particularly the access roads leading to the site. Random visual inspection of vehicles should be undertaken in order to monitor for overloading. The inspections should also verify if the trucks are covered with appropriate material (such as tarpaulin) if and where possible.	▪ Perform visual inspection of vehicles during the construction phase.	▪ Random visual inspection of vehicles weekly.	▪ Appointed Contractor
▪ Impact on air quality due to dust generation, noise and exhaust emissions from construction vehicles and equipment.	Limit the release of noise, pollutants and dust emissions	▪ Implement management strategies for dust generation e.g. apply dust suppressant on the gravel roads on the construction site, exposed areas and stockpiles. Avoid the use of potable water for dust suppression during the construction phase and consider the use of alternative approved sources, where possible.	▪ Ensure dust management measures are in place to adequately decrease the generation of dust.	▪ On-going	▪ Contractor and ECO
		▪ Postpone or reduce dust-generating activities during periods with strong wind. Earthworks may need to be rescheduled or the frequency of application of dust control/suppressant increased.	▪ Ensure dust management measures are in place to decrease the dust generated.	▪ On-going	▪ Contractor and ECO
		▪ Avoid using old and unmaintained construction equipment (which generate high sound levels and greater exhaust emissions) and ensure equipment is well maintained.	▪ Manage noise levels and air pollutants from construction vehicles through checking the condition of vehicles.	▪ On-going	▪ Contractor and ECO
C. OPERATIONAL PHASE					
▪ Increased level of road accidents (involving pedestrians, animals, other motorists on the surrounding tarred/ gravel road network) due to increased (but	Minimise the impact of the operational activities on the local traffic and avoid accidents with pedestrians, animals and other drivers on	▪ Well maintained vehicles should be used together with well-trained drivers during the operational phase, as required. Vehicle maintenance and driver competency should be monitored. Proof of driver competency as well as the vehicle checks should be verified and undertaken to ensure that vehicles are	▪ Carry out random checks of driver licenses and conduct random visual inspections of vehicles for roadworthiness.	▪ Random visual inspection of vehicles weekly.	▪ Project Developer

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
limited) traffic during the operational phase.	the surrounding tarred/ gravel roads. Reduce number of road accidents due to increased traffic during the operational phase.	roadworthy and hence, do not pose a safety risk. Vehicles must be roadworthy, visible, adequately marked, properly serviced and maintained, and operated by an appropriately licensed operator.			
		▪ Adhere to all speed limits applicable to all roads used.	▪ Ensure that speed limits are adhered to. ▪ Carry out random visual inspections to verify speed limits and general awareness of vehicle drivers.	▪ Daily ▪ Random during the operational phase	▪ Project Developer
		▪ Implement clear and visible signage indicating movement of vehicles at intersections and in the vicinity of the nearby farm steads.	▪ Implement clear signalisation. ▪ Carry out random inspections to verify whether proper signage is being implemented.	▪ Ongoing ▪ Random during the operational phase	▪ Project Developer
		▪ The use of public transport (buses and/or minibus taxis) or carpooling to convey operational personnel to the site should be encouraged. ▪ Staff trips should occur outside of peak hours, where possible.	▪ Monitor the requirements	▪ On-going	▪ Project Developer
		▪ Limit access to the site to operational personnel.	▪ Maintain a register of visitors and staff that enter site and restrict access to personnel.	▪ On-going	▪ Project Developer
▪ Accelerated degradation of road structure due to operational traffic.	Limit the deterioration of the road condition due to operational phase traffic.	▪ The main access roads to site should be inspected on a weekly basis for structural damage.	▪ Ensure that the main access road to site maintains current condition through photographic surveys and monitoring.	▪ Weekly	▪ Project Developer
		▪ Ensure that there is regular maintenance of the internal farm access roads (i.e. internal private roads leading off the DR3093) that will be used, by the operator during the operational phase in line with the agreed maintenance plan.	▪ Carry out visual inspections to verify if regular maintenance is being undertaken. ▪ Ensure that the internal farm access road to site is upgraded through	▪ Weekly	▪ Project Developer

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	**Frequency**	**Responsibility**
			photographic surveys and monitoring.		
		▪ Implement management strategies for dust generation e.g. apply dust suppressant on gravel roads on the operational site, exposed areas and stockpiles.	▪ Ensure dust management measures are in place to adequately decrease the generation of dust.	▪ On-going	▪ Project Developer
		▪ Vehicles must not be overloaded during the operational phase (where applicable) in order to reduce impacts on the road structures. Random visual inspection of vehicles should be undertaken in order to monitor for overloading (where applicable).	▪ Perform visual inspection of vehicles.	▪ Random visual inspection of vehicles weekly.	▪ Project Developer
D. DECOMMISSIONING PHASE					
▪ Ensure that the construction mitigation and management measures are adhered to during the decommissioning phase.					

14.13 Final Specialist Statement and Authorisation Recommendation

14.13.1 Statement and Reasoned Opinion

This report summarises the existing transportation conditions within the site vicinity and provides an assessment of the transportation impacts of the proposed development on the surrounding transport system. From the traffic impact investigation and discussions in the report the following conclusions can be made:

- The preferred route for the haulage of imported materials is from the Port of Ngqura to the site.
- The preferred access route option to the proposed facility will be from the R48 along DR3093, DR3084, and DR3096 gravel roads (i.e. Access Route Option 1). As noted above, Access Route Option 1 - Route A (along TR38/01, DR3093, and DR3096) will provide access to all the proposed Kudu Solar Facilities. Alternatively, once the internal roads are constructed at Kudu Solar Facility 5, it can also be used to access Kudu Solar Facilities 1 to 4. Furthermore, once the internal roads are constructed at Kudu Solar Facility 7, it can also be used to access Kudu Solar Facilities 8 to 12. Access Route Option 1 - Route B (Along TR38/01, DR3093 and DR3084) will provide access to the proposed Kudu Solar Facilities 1 to 5.
- Sufficient shoulder sight distances (SSD) are available along the R48 at the DR3093 in both directions.
- Direct access to the proposed development will be taken off DR3093.
- It is not anticipated that any widening of the intersection at TR38/01 and DR3093 will be required, however, the existing island will need to be removed (approximately 60m^2) to accommodate the turning movements of the abnormal load vehicles.
- Based on the wheel tracking analysis of the abnormal load vehicles, it can be concluded that no road will need to be lengthened by more than 1 kilometre for Access Route Option 1.
- Temporary counting stations recorded the ADT in 2011 as 62 vehicles (two-way) along DR3093 and as 8 vehicles (two-way) along DR3084 per day.
-
- If these volumes are increased by a growth rate of 2% per annum, this would relate to the ADT in 2023 as 79 vehicles (two-way) along DR3093 and as 10 vehicles (two-way) along DR3084 per day.
- Traffic information for 2021 indicated that the R389 carries an ADT of 626 vpd (two-way) and the R48 carries and ADT of 866 vpd (two-way).
- The R389 and the R48 operates well below the capacity of 2000 vehicles per hour for a Class 1 principal arterial with two lanes.
- Traffic will be generated during the Construction, Operational and Decommissioning phases of the project.
- During the Construction and Decommissioning phases, an additional **30 daily trips (two-way)** and **2 peak hour trips (two-way)** will be generated by the proposed solar PV facility.
- During the Operation phases, an additional **10 daily trips (two-way)** and **1 peak hour trip (two-way)** will be generated by the proposed solar PV facility.
- The following traffic impacts are related to the trips generated during the Construction and Decommissioning phases:
    - Potential congestion and delays on the surrounding road network.

  - Potential impact on traffic safety and increase in accidents with other vehicles or animals.
  - Potential change in the quality of the surface condition of the roads.
  - Potential noise and dust pollution.
- Traffic generated during the Operational phase will have an insignificant traffic impact on the surrounding road network.
- The proposed project will have a range of potential traffic related impacts ranging from very low to moderate significance before mitigation, which is expected to be reduced to very low to low significance with the appropriate mitigation. No fatal flaws were discovered during the investigations. The proposed project is supported, and it is therefore recommended that the activity is authorised, with the understanding that all mitigation measures recommended in this report will be strictly implemented.

14.13.2 EA Condition Recommendations

The following mitigation measures to address the potential traffic impacts are recommended for inclusion in the EMPr and EA conditions:

- Implement dust control of the gravel roads within the construction site.
- Undertake regular maintenance of the internal farm access roads by the contractor during the construction and decommissioning phases and then by the operator during the operational phase.
- Removal of the island at the TR38/01 and DR3093 intersection to accommodate the turning movements of the abnormal load vehicles.
- Upgrading of the internal farm access road (i.e. internal private roads leading off DR3093 that are impacted on by the proposed project) to suitable standards as specified by the civil engineer and regular maintenance of these access roads during all phases of the project, especially during the construction and decommissioning phases. Following construction, these specific internal private access roads should be restored to original pre-construction road condition.
- Implement speed control by means of a stop and go system and speed limit road signage within the construction site.
- Ensure all vehicles are roadworthy, visible, adequately marked and operated by an appropriately licensed operator.
- The route to the site should be further investigated to ensure that the abnormal loads are not obstructed at any point by geometric, height and width limitations along the route.
- The applicable permits to transport the abnormal loads should be obtained.
- Stagger delivery trips and schedule deliveries/trips outside of the peak traffic periods, where possible.
- Staff trips should also occur outside of the peak hours where possible.

No other remedial or mitigation measures will be required to accommodate the additional traffic generated by the proposed Solar PV Facility. Provided that the above recommendations are adhered to, the proposed development of the Solar PV facility can be supported from a traffic engineering perspective.

14.14 References

- Department of Transport, Guidelines for Traffic Impact Studies, Report No. PR93/645, Pretoria, 1995.
- Department of Transport, South African Trip Generation Rates, Report No. RR92/228, Pretoria, 1995.
- Committee of Transport Officials (COTO), South African Trip Data Manual, TMH 17, Committee Draft 2.2, August 2020.
- Committee of Transport Officials (COTO), South African Traffic Impact and Site Traffic Assessment Manual Standards and Requirements Manual, Volume 2 TMH 16, Committee Draft 2.0, October 2020.
- Committee of Transport Officials (COTO), South African Traffic Impact and Site Traffic Assessment Manual, Volume 1 TMH 16, Committee Draft 2.0, May 2018.
- SANRAL Geometric Design Guide
- Department of Transport, TRH17, Geometric Design of Rural Roads, 1988

APPENDICES

Appendix A - Specialist Expertise

Traffic Engineering & Transport Planning
STURGEON CONSULTING

CURRICULUM VITAE **ANNEBET KRIGE**



GENERAL INFORMATION:

Name	:	**ANNEBET KRIGE**
Date of Birth	:	20 November 1984
Marital Status	:	Married
Home Language	:	Afrikaans
Profession	:	Civil Engineer
Specialism	:	Transport Planning and Traffic Engineering
Joined Sturgeon	:	2018
Nationality	:	South African
Years' Experience	:	15+
Qualifications	:	M Eng (Transportation), B Eng (Civil)
Professional Associations	:	Engineering Council of South Africa (ECSA): Professional Engineer (20150161) South African Institution of Civil Engineering (SAICE): Member (206324)

KEY EXPERTISE:

AnneBet Krige is registered as a Professional Civil Engineer with the Engineering Council of South Africa (ECSA). Over the past 15 years, she has gained extensive knowledge in the Civil Engineering field and currently works as a Traffic Engineer for Sturgeon Consulting. She obtained her Masters' Degree in Transportation Engineering from the University of Stellenbosch in 2010 and specialises in this field.

Expertise & Specialised Skills:

AnneBet has gained extensive experience in the following fields:

- Traffic Studies and Transportation Planning (Statements, Assessments, Parking Studies);
- Design of Non-Motorised Transport Facilities;
- Design and Upgrading of Traffic Signals;
- Traffic Accommodation Plans;
- Design of Civil Engineering Infrastructure for various developments (Water, Sewerage, Stormwater, Roads);
- Rehabilitation and Reseal of existing National and Provincial Roads;
- Construction of new Roads;
- Tender Documentation.
- Contract Administration

EMPLOYMENT RECORD:

2021 - Present	Director, Sturgeon Consulting
2018 - 2021	Associate, Sturgeon Consulting
2011 - 2018	Traffic Engineer, Element Consulting Engineers
2006 - 2011	Engineer in Training, EFG Engineers

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October 2022

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STURGEON CONSULTING

CURRICULUM VITAE **ANNEBET KRIGE**

KEY QUALIFICATIONS/EDUCATION:

2010 : M Eng (Transportation), University of Stellenbosch
2006 : B Eng (Civil), University of Stellenbosch

PROFESSIONAL AFFILIATIONS

Professional Engineer, Engineering Council of South Africa (ECSA) – 20150161 – 1 May 2015

PROJECT EXPERIENCE – TRANSPORTATION ENGINEERING (TRAFFIC STUDIES)

Bottling Plant Farm Kaaldraai	Normandien Farms
Traffic Impact Study for the proposed Water Bottling Plant, Tulbagh	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2021	Study Value: R35 000

Ceres PV Farms	Veroniva Energy
Traffic Impact Assessment for nine 175MW Solar Photo Voltaic Farms, Tankwa Karoo	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2021	Study Value: R57 000

Mamre Service Station	Plan Africa Consulting
Traffic Impact Assessment for the proposed Rezoning of Erf 615, Mamre	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2019	Study Value: R34 700

Langebaanweg Truck Stop	West Coast Petroleum (Pty) Ltd
Access Investigation / Traffic Impact Assessment for the proposed Langebaanweg Truck Stop	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2020	Study Value: R89 800

Abbotsdale	CK Rumboll and Partners
Traffic Impact Assessment for the Industrial Development on Portion A of Erf 373, Abbotsdale	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2019	Study Value: R60 100

Grootfontein - Tsumkwe Feasibility Study	Pregon Consulting Engineers
Feasibility Study for the Upgrade to Bitumen Standard of M0074: Grootfontein - Tsumkwe	
Role & Responsibilities:	Traffic Engineer
Completed/Current: Current	Study Value: R163 600

Sleeper Site, East London	
Traffic Study for the Developmenet of the Sleeper Site, East London	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2017	Study Value: R255 000

Worcester Traffic Study	
Traffic Study at Pre-Determined intersections in Worcester	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2017	Project Value: R537 000

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PV Farm Hanover	
Traffic Impact Statement for the Proposed Solar PV Farm, Hanover	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2017	Study Value: R38 500

Malmesbury Sand Mine	Tip Trans Logistix
Traffic Impact Statement for a Sand Mine, Malmesbury	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2017	Study Value: R24 500

Strand Storage Facilities	Asla Devco
Traffic Impact Study for the proposed Storage and Office Facilities in Strand	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2017	Study Value: R33 500

Dube Tradeport	Dube Tradeport
Traffic Impact Study for Dube Tradeport, Durban	
Role & Responsibilities:	Traffic Engineer
Completed/Current: Current	Study Value: R80 000

PROJECT EXPERIENCE - GENERAL TRANSPORTATION ENGINEERING

Bonnievale Speed Survey	WCG
Speed Limit Survey for TR32/1, Bonnievale	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2021	Study Value: R70 000

Road Safety Audit	Namibia Roads Authority
Road Safety Audit for T0602: Gobabis to Buitepos	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2016	Contract Value:

Non-Motorised Transport, City of Cape Town	City of Cape Town
Implementation of the Non-Motorised Transport programme to the City of Cape Town	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2016	Contract Value: R50m

Westbury Pedestrian Bridge, Johannesburg	Johannesburg Development Agency
Traffic Accommodation Plan for the construction of the Westbury Pedestrian Bridge, Johannesburg	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2014	Contract Value: Unknown

Erven 13259 and 13585, Brackenfell	Group 5 Property Development
Traffic Accommodation Plan for the development of Erven 13259 and 13585, Brackenfell	
Role & Responsibilities:	Traffic Engineer
Completed/Current: 2014	Contract Value: R550 000

Lakeview and Klipspruit BRT Stations, Soweto	Johannesburg Roads Authority
Non-motorised Transport for Lakeview and Klipspruit BRT Stations, Soweto	
Role & Responsibilities:	Traffic Engineer / Design Engineer
Completed/Current: 2014	Contract Value: R35 million

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CURRICULUM VITAE **ANNEBET KRIGE**

PROJECT EXPERIENCE - REHABILITATION / RESEAL / NEW ROAD CONSTRUCTION

Upgrading of Medway Road, Richards Bay	
Upgrading of Medway Road	
Role & Responsibilities:	Assistant Engineer
Completed/Current: Current	Contract Value: R50 million

Trunk Road 32 between N2 and Herbertsdale	Provincial Government Western
The Reseal / Rehabilitation of a section of Main Road 342 between km 7.72 and Herbertsdale	
Role & Responsibilities:	Assistant Engineer
Completed/Current: Current	Contract Value: Unknown

National Route 7, Garies	SANRAL
Repair and Reseal of National Route 7 Section 7 between Garies and km 60	
Role & Responsibilities:	Assistant Engineer
Completed/Current: Current	Contract Value: R101.4 million

National Route 7, Okiep	SANRAL
Repair and Reseal of National Route 7 Section 7 to 8 between km 60 and Okiep	
Role & Responsibilities:	Assistant Engineer
Completed/Current: Current	Contract Value: R95.5 million

Roads P122/1, P249/1, P39/1, P241/1(D405) and K111, Muldersdrift	
Rehabilitation of Roads P122/1, P249/1, P39/1, P241/1(D405) and K111, Muldersdrift	
Role & Responsibilities:	Assistant Engineer
Completed/Current: Current	Contract Value: Unknown

Trunk Road 32 between Ashton and Swellendam	Provincial Government Western Cape
The Reseal of Trunk Road 32 Section 1 between Ashton and Swellendam, Main Road 283 and Divisional Road 1329	
Role & Responsibilities:	Assistant Engineer
Completed/Current: 2014	Contract Value: R60.8 million

National Route 14 Section 1 between Witputs and Pofadder	SANRAL
Repair and reseal N14 between Witputs and Pofadder	
Role & Responsibilities:	Assistant Engineer
Completed/Current: 2013	Contract Value: R70.3 million

National Route 14 Section 2 between Bladgrond and Kakamas	
Repair and reseal: National route 14 Section 2 between Bladgrond (Km 59.00) and Kakamas 9Km 131.00)	
Role & Responsibilities:	Assistant Engineer
Completed/Current: 2014	Contract Value: R89.1 million

PROJECT EXPERIENCE: CIVIL INFRASTRUCTURE

Sitari, Somerset West	
Civil Engineering Services for Sitari Fields, Somerset West	
Role & Responsibilities:	Assistant Resident Engineer
Completed/Current: Current	Contract Value: R350m

Van der Stel, Stellenbosch	
Upgrading of the Van der Stel Sport Complex parking area	
Role & Responsibilities:	Resident Engineer
Completed/Current: 2012	Contract Value: R700 000

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CURRICULUM VITAE **ANNEBET KRIGE**

CSP Plant, Upington	
Access to the proposed CSP Plant	
Role & Responsibilities:	Design Engineer
Completed/Current: 2012	Contract Value: Unknown

Droogfontein, Kimberley	
Upgrading of the existing access to the proposed PV Farm, Droogfontein, Kimberley	
Role & Responsibilities:	Design Engineer
Completed/Current: 2012	Contract Value: Unknown

Robben Island	
Repair & Maintenance of Water and Sewerage works on Robben Island	
Role & Responsibilities:	Assistant Resident Engineer
Completed/Current: 2011	Contract Value: R12 million

KFC Observatory	
Civil Engineering Services for KFC, Observatory	
Role & Responsibilities:	Assistant Resident Engineer
Completed/Current: 2010	Contract Value: R300 000

Blue Downs Development	
Upgrading of Roads and Accesses for the Blue Downs Development	
Role & Responsibilities:	Assistant Design Engineer
Completed/Current: 2010	Contract Value: R12 million

Shoprite, Strand	
Construction of Broadway Shoprite Access Road, Strand	
Role & Responsibilities:	Resident Engineer
Completed/Current: 2010	Contract Value: R950 000

Checkers, Burgundy	
Civil Infrastructure for Checkers, Burgundy Estate	
Role & Responsibilities:	Assistant Design Engineer, Assistant Resident Engineer
Completed/Current: 2009	Contract Value: R44 million

Appendix B - Specialist Statement of Independence

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 - 12), near De Aar, Northern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Sturgeon Consulting			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	Non-Compliant	Percentage Procurement recognition	
Specialist name:	Annebet Krige			
Specialist Qualifications:	M. Eng (Transportation) – Stellenbosch University 2010 B. Eng (Civil) – Stellenbosch University 2006			
Professional affiliation/registration:	Engineering Council of South Africa (ECSA) Registration Number: 20150161			
Physical address:	7 Waterberg Crescent, Clara Anna Fontein, Durbanville, Cape Town			
Postal address:				
Postal code:	7550	Cell:	084 610 0233	
Telephone:		Fax:		
E-mail:	Annebet@sturgeonsa.co.za			

2. DECLARATION BY THE SPECIALIST

I, _____ Annebet Krige _____, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

Sturgeon Consulting

Name of Company:

5 July 2023

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, _____ Annebet Krige _____, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.



Signature of the Specialist

Sturgeon Consulting

Name of Company

5 July 2023

Date



Signature of the Commissioner of Oaths

06 July 2023

Date



KERRY AUGUST
Commissioner of Oaths
Master HR Professional (MHRP)
Member Number: 53544596
25 Bordeaux Close
Stellenbosch
7600

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

Appendix C: Site Sensitivity Verification

It is important to note that there are no dedicated traffic or transport related themes on the National Web-based Environmental Screening Tool (Screening Tool), therefore the environmental sensitivity of the proposed project area as identified by the Screening Tool is not applicable. Therefore, no site sensitivity verification report is required. Furthermore, there is no dedicated assessment protocol prescribed for Traffic. Therefore, the specialist assessment has been undertaken in compliance with Appendix 6 of the NEMA EIA Regulations of 2014.

Appendix D: Impact Assessment Methodology

The impact assessment includes:

- *the nature, status, significance and consequences of the impact and risk;*
- *the extent and duration of the impact and risk;*
- *the probability of the impact and risk occurring;*
- *the degree to which impacts and risks can be mitigated;*
- *the degree to which the impacts and risks can be reversed; and*
- *the degree to which the impacts and risks can cause loss of irreplaceable resources.*

Terminology used in impact assessment can overlap. To avoid ambiguity, please note the following clarifications (that are based on NEMA and the EIA Regulations):

- *The term environment is understood to have a broad interpretation that includes both the natural (biophysical) environment and the socio-economic environment. The term socio-ecological system is also used to describe the natural and socio-economic environment and the interactions amongst these components.*
- *Significance = Consequence x Probability, which means that significance is equivalent to risk.*
- *The impact can have a positive or negative status. The significance of a negative impact may be called a risk, and the significance of a positive impact may be called an opportunity.*

The following principles are to underpin the application of this methodology:

- *Transparent and repeatable process - specialists are to describe the thresholds and limits they apply in their assessment, wherever possible.*
- *Adapt parameters to context (where justified) – the methodology proposes some thresholds (e.g. for spatial extent, in Step 3 below), however, if the nature of the impact requires a different definition of the categories of spatial extent, then this can be provided and described.*
- *Combination of a quantitative and qualitative assessment – where possible, specialists are to provide quantitative assessments (e.g. areas of habitat affected, decibels of noise, number of jobs), however, it is recognised that not all impacts can be quantified, and then qualitative assessments are to be provided.*

As per the DFFE Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect and cumulative:

- *Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.*
- *Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.*
- *Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.*

The impact assessment methodology includes the aspects described below.

- ***Step 1**: **Nature** of impact/risk - The type of effect that a proposed activity will have on the environment.*

- ***Step 2**: **Status** - Whether the impact/risk on the overall environment will be:*
  - *Positive - environment overall will benefit from the impact/risk;*
  - *Negative - environment overall will be adversely affected by the impact/risk; or*
  - *Neutral - environment overall not be affected.*

- ***Step 3**: **Qualitatively** determine the **consequence** of the impact/risk by identifying the **a) SPATIAL EXTENT; b) DURATION; c) REVERSIBILITY; AND d) IRREPLACEABILITY**.*

  - ***A) Spatial extent** – The size of the area that will be affected by the impact/risk:*
    - *Site specific;*
    - *Local (<10 km from site);*
    - *Regional (<100 km of site);*
    - *National; or*
    - *International (e.g. Greenhouse Gas emissions or migrant birds).*

  - ***B) Duration** – The timeframe during which the impact/risk will be experienced:*
    - *Very short term (instantaneous);*
    - *Short term (less than 1 year);*
    - *Medium term (1 to 10 years);*
    - *Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration)); or*
    - *Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).*

  - ***C) Reversibility** of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):*
    - *High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);*
    - *Moderate reversibility of impacts;*
    - *Low reversibility of impacts; or*
    - *Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).*

  - ***D) Irreplaceability** of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):*
    - *High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);*
    - *Moderate irreplaceability of resources;*
    - *Low irreplaceability of resources; or*

- *Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).*

Some of the criteria are quantitative (e.g. spatial extent and duration) and some may be described in a quantitative or qualitative manner (e.g. reversibility and irreplaceability). The specialist then combines these criteria in a qualitative manner to determine the ***consequence****.*

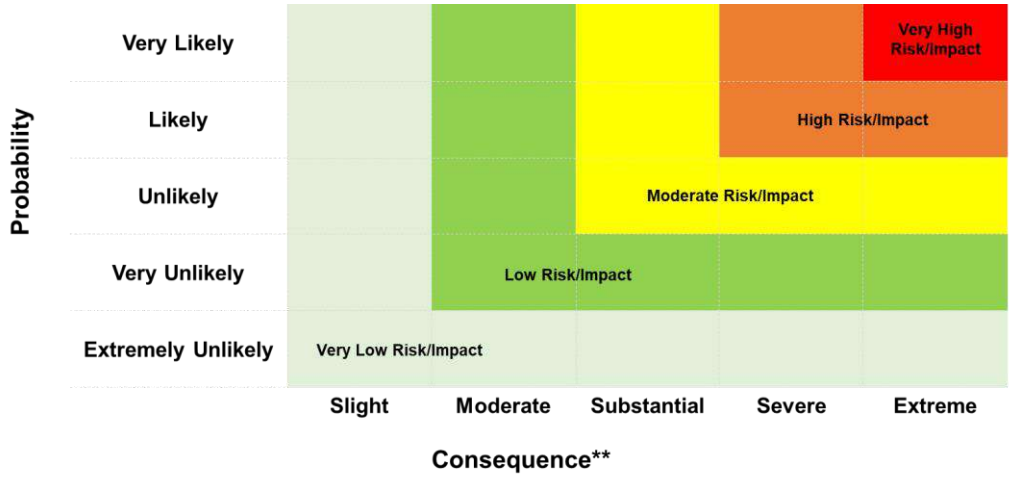
The consequence terms ranging from slight to extreme must be calibrated per Specialist Study so that there is transparency and consistency in the way a risk/impact is measured. For example, from a biodiversity and ecology perspective, the consequence ratings could be defined according to a reduction in population or occupied area in relation to Species of Conservation Concern (SCC) status, ranging from slight consequence for defined areas of Least Concern, to extreme consequence for defined areas that are Critically Endangered. For example, from a social perspective, a slight consequence could refer to small and manageable impacts, or impacts on small sections of the community; a moderate consequence could refer to impacts which affect the bulk of the local population negatively or may produce a net negative impact on the community; and an extreme consequence could refer to impacts which could result in social or political violence or institutional collapse.

- ***Consequence*** *– The anticipated consequence of the risk/impact is generally defined as follows:*
  - *Extreme (extreme alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they permanently cease);*
  - *Severe (severe alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease);*
  - *Substantial (substantial alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease;*
  - *Moderate (notable alteration of natural or socio-economic systems, patterns or processes, i.e. where the natural or socio-economic environment continues to function but in a modified manner; or*
  - *Slight (negligible and transient alteration of natural or socio-economic systems, patterns or processes, i.e. where natural systems/environmental or socio-economic functions, patterns, or processes are not affected in a measurable manner, or if affected, that effect is transient and the system recovers).*

- ***Step 4****: Rate the* ***probability*** *of the impact/risk using the criteria below:*

  - ***Probability*** *– The probability of the impact/risk occurring:*
    - *Extremely unlikely (little to no chance of occurring);*
    - *Very unlikely (<30% chance of occurring);*
    - *Unlikely (30-50% chance of occurring)*
    - *Likely (51 – 90% chance of occurring); or*
    - *Very Likely (>90% chance of occurring regardless of prevention measures).*

- ***Step 5****: Use both the* ***consequence*** *and* ***probability*** *to determine the* ***significance*** *of the identified impact/risk (qualitatively as shown in Figure 1). Significance definitions and rankings are provided below:*



[Qualitatively determined based on Spatial Extent, Duration, Reversibility and Irreplaceability]

Figure 1. Guide to assessing risk/impact significance as a result of consequence and probability.

- ***Significance*** *– Will the impact cause a notable alteration of the environment?*
    - *Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
    - *Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
    - *Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);*
    - *High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and*
    - *Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).*

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- *Very low = 5;*
- *Low = 4;*
- *Moderate = 3;*
- *High = 2; and*
- *Very high = 1.*

The specialists must provide a written supporting motivation of the assessment ratings provided.

- ***Step 6**: Determine the **Confidence Level** – The degree of confidence in predictions based on available information and specialist knowledge:*
    - *Low;*
    - *Medium; or*
    - *High.*

Appendix E: Compliance with the Appendix 6 of the 2014 EIA Regulations (as amended)

Requirements of Appendix 6 (Specialist Reports) of Government Notice R326 (Environmental Impact Assessment (EIA) Regulations of 2014, as amended)	***Section where this has been addressed in the Specialist Report***
1. (1) A specialist report prepared in terms of these Regulations must contain - *a) details of -* *i. the specialist who prepared the report; and* *ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;*	*Section 14.1.2 and Appendix A and Appendix B of this chapter*
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	*Appendix B of this chapter*
c) an indication of the scope of, and the purpose for which, the report was prepared;	*Section 14.1.1*
(cA) an indication of the quality and age of base data used for the specialist report;	*Section 14.2*
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	*Section 14.4 to Section 14.9*
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	*Section 14.2*
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	*Section 14.1 and Section 14.2*
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	*Section 14.4*
g) an identification of any areas to be avoided, including buffers;	*N/A*
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	*Section 14.4*
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	*Section 14.2.2*
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	*Section 14.4.4.3*
k) any mitigation measures for inclusion in the EMPr;	*Section 14.8 and Section 14.9*
l) any conditions for inclusion in the environmental authorisation;	*Section 14.8 and Section 14.9*
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	*Section 14.8 and Section 14.9*
n) a reasoned opinion- *i. whether the proposed activity, activities or portions thereof should be authorised;* *(iA) regarding the acceptability of the proposed activity or activities; and* *ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;*	*Section 14.13.1* *Section 14.13..2*
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	*N/A*
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	*N/A*
q) any other information requested by the competent authority.	*N/A*
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	*Part A of the Assessment Protocols published in GN 320 on 20 March 2020 is*

Requirements of Appendix 6 (Specialist Reports) of Government Notice R326 (Environmental Impact Assessment (EIA) Regulations of 2014, as amended)	***Section where this has been addressed in the Specialist Report***
	applicable (i.e. Site sensitivity verification requirements where a specialist assessment is required but no specific assessment protocol has been prescribed).



CHAPTER 15:

Battery Energy Storage Systems High Level Risk Assessment



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CHEMICAL PROCESS SAFETY ENGINEERS

HIGH LEVEL SAFETY HEALTH AND ENVIRONMENTAL RISK ASSESSMENT FOR THE DEVELOPMENT OF A BATTERY ENERGY STORAGE SYSTEM AT THE PROPOSED SOLAR PHOTOVOLTAIC FACILITY (KUDU SOLAR FACILITY 4), DE AAR, NORTHERN CAPE PROVINCE

28th May 2023

REPORT:	**HIGH LEVEL SAFETY HEALTH AND ENVIRONMENTAL RISK ASSESSMENT FOR THE DEVELOPMENT OF A BATTERY ENERGY STORAGE SYSTEM AT THE PROPOSED SOLAR PHOTOVOLTAIC FACILITY (SOLAR KUDU 4) NEAR DE AAR IN THE NORTHERN CAPE**
ASSIGNMENT NO:	J3115M - 4
REPORT DATE:	28th May 2023
RISK ASSESSOR, REPORT: **Telephone:** **Email:**	Debra Mitchell 011 201 4783/5 mitcheld@ishecon.co.za
TECHNICAL SIGNATORY: **Telephone:** **Mobile phone:** **Email:**	Debra Mitchell 011 201 4783/5 082 428 8844 mitchelld@ishecon.co.za
CLIENT:	CSIR on behalf of ABO Renewable Energies (Pty) Ltd
ENVIRONMENTAL ASSESSMENT PRACTITIONER:	Rohaida Abed on behalf of ABO +27 31 242 2318 rabed@csir.co.za
INSTALLATION REPRESENTATIVE	Du Toit Malherbe and Petrus Scheepers ABO (Pty) Ltd
ADDRESS OF INSTALLATION:	Renosterberg Local Municipality in the Pixley ka Seme District Municipality in the Northern Cape
ADDRESS OF COMPANY:	Unit B1, Mayfair Square, Century Way, Century City, 7441, South Africa

iSHEcon
CHEMICAL PROCESS SAFETY ENGINEERS

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CK 99/29022/23 VAT 4800182422

REPORT ADMINISTRATIVE RECORD

LIST OF ASSESSMENTS

Assessment	Rev. No.	Assessment Date	Description
SHE Risk Assessment	2	28th April 2023	J3115M - 4 – High-Level Safety Health and Environmental Risk Assessment for the Development of a Battery Energy Storage System At The Proposed Solar Photovoltaic Facility (Solar Kudu 4) Near De Aar In The Northern Cape - Issued By Ishecon

CONTRIBUTORS

The validity, results and conclusions of this assessment are based on the expertise, skills and information provided by the following contributing team members:

NAME	ORGANISATION	DISCIPLINE
Rohaida Abed	CSIR	Environmental Consultant
Du Toit Malherbe and Petrus Scheepers	ABO-Wind	Project Manager

DISCLAIMER

Although every effort has been made by ISHECON to obtain the correct information and to carry out an appropriate, independent, impartial and competent study, it remains the responsibility of the Contractor to ensure suitable Process Safety Measures are in place. ISHECON cannot be held liable for any accident or incident, due to negligence by the owner/operator, which directly or indirectly relates to the plant, equipment, facilities and systems analysed in this document and which may have an effect on the client or any other third party.

CONFIDENTIALITY

ISHECON will keep all information, results and findings confidential, and will not pass these on to other parties without the permission of the Client. However, as an Approved Inspection Authority for Department of Employment and Labour, ISHECON is also under legal obligation to the Department of Employment and Labour to report any obvious violations of the OHS Act.

RISK ASSESSMENT APPROVAL

This report is approved for issue by the undersigned Technical Signatory.

NAME	CAPACITY	REPORT DATE	SIGNATURE
D.C. Mitchell	Risk Assessment, Report preparation, Technical signatory	28th May 2023	

EXECUTIVE SUMMARY

The applicant, Kudu Solar Facility 4 (Pty) Ltd, is considering a Battery Energy Storage Systems (BESS) to complement a solar power (Kudu 4 Photo-voltaic (PV)) generation facility near the town of De Aar in the Northern Cape.

The BESS system will have a power generation capacity of up to 500 MW and will be able to deliver up to 500 MWh. It is proposed that Lithium Battery Technologies, such as Lithium-Ion Phosphate, Lithium Nickel Manganese Cobalt oxides or Redox flow technology, typically vanadium, will be considered as the possible battery technologies, however, the specific technology will only be determined following Engineering, Procurement and Construction (EPC) procurement. The batteries this would typically be housed within numerous containers although the redox flow type could be house in a single building.

Supplementary infrastructure and equipment may include substations, power cables, transformers, power converters, substation buildings & offices, HV/MV switch gear, inverters and other control equipment that may be positioned within the battery containers / separate dedicated containers / the battery building.

The proposed BESS is subject to an Environmental Impact Assessment (S&EIA) process. In 2019, the Department of Forestry, Fisheries and the Environment (DFFE) requested that EIA applications for BESSs, either on their own or as part of a power generation (e.g., PV or wind) application, should include a high-level Risk Assessment of the BESS considering all applicable risks (e.g., fire, explosion, contamination, end-of life disposal etc).

This report summaries the high-level Safety Health and Environmental Risk Assessment conducted by ISHECON for the proposed Solid-State Lithium (SSL) or Vanadium Redox Flow (VRFB) Battery Energy Storage Systems at the proposed Kudu 4 Solar PV facilities.

1. METHODOLOGY

This assessment of risk comprises:

- Identification of the likely hazards and hazardous events related to the construction, operation and decommissioning of the installation using a checklist approach.
- Estimation of the likelihood/probability of these hazardous events occurring.
- Estimation of the consequences of these hazardous events.
- Estimation of the risk and comparison against certain acceptability criteria.

For the purpose of this high-level Risk Assessment a desktop study of the available information, preliminary layout of the facility and associated BESS alternative locations, reports of related incidents and various literature sources was undertaken. The facility and the project were divided into the sections/phases and using a checklist approach the hazards in each section/phase were identified. Each identified hazard was then analysed in terms of causes, consequences, expected and suggested preventive and mitigative measures to be in place. Each hazard was qualitatively assessed using a qualitative risk ranking system.

2. FINDINGS

In order to highlight the maximum differences between the possible technology types, this study is based on the assumption that redox flow batteries (typically vanadium based chemistry) would most likely be installed within a building using bulk tanks, while solid state batteries (typically lithium based chemistry) would be installed in shipping containers that have hundreds of individual batteries combined into packs. Redox flow batteries can be installed in containers where the individual quantities of electrolyte involved would be smaller.

GENERAL

- This Risk Assessment has found that with suitable preventative and mitigative measures in place, none of the identified potential risks are excessively high, i.e., from a Safety, Health and Environment (SHE) perspective no fatal flaws were found with either type of technology for the proposed BESS installation at the Kudu 4 SEF near De Aar.

- At a large facility, without installation of the state-of-the art battery technology that includes protective features, there can be significant risks to employees and first responders. The latest battery designs include many preventative and mitigative measures to reduce these risks to tolerable levels. (Refer to tables in section 4 under preventative and mitigative measures). Where reasonably practicable, state-of-the-art technology should be used, i.e., not old technology that may have been prone to fire and explosion risks.

- The design should be subject to a full Hazard and Operability Study (HAZOP) prior to commencement of procurement. A HAZOP is a detailed technical systematic study that looks at the intricacies of the design, the control system, the emergency system etc. and how these may fail under abnormal operating conditions. Additional safeguards may be suggested by the team doing the study.

LITHIUM SOLID STATE CONTAINERIZED BATTERIES

- With lithium solid-state batteries, the most significant hazard with battery units is the possibility of thermal runaway and the generation of toxic and flammable gases. There have been numerous such incidents around the world with batteries at all scales and modern technology providers include many preventative and mitigative features in their designs. This type of event also generates heat which may possibly propagate the thermal runaway event to neighbouring batteries if suitable state of the art technology is not employed.

- The flammable gases generated may ignite leading to a fire which accelerates the runaway process and may spread the fire to other parts of the BESS or other equipment located near-by.

- If the flammable gases accumulate within the container before they ignite, they may eventually ignite with explosive force. This type of event is unusual but has happened with an older technology container installed at McMicken in the USA in 2019.

- Due to a variety of causes, thermal runaway could happen at any point during transport to the facility, during construction or operation / maintenance at the facility or during decommissioning and safe making for disposal.

- Due to the containerized approach as well as the usual good practice of separation between

containers, which should be applied on this project, and therefore the likely restriction of events to one container at a time, the main risks are close to the containers i.e., to transport drivers, employees at the facilities and first responders to incidents.

- In terms of a worst conceivable case container fires, the significant impact zone is likely to be limited to within 10m of the container and mild impacts to 20m. Based on the current proposed layouts, impacts at the closest isolated farmhouses are not expected.

- In terms of a worst conceivable case explosion, the significant impact zone is likely to be limited to with 10m of the container and minor impacts such as debris within 50m. Based on the current proposed layouts, impacts at the closest isolated farmhouses are not expected.

- In terms of a worst reasonably conceivable toxic smoke scenario, provided the units are placed suitably far apart to prevent propagation from one unit to another and large external fires are prevented, the amount of material burning should be limited to one container at any one time. In this case, beyond the immediate vicinity of the fire, the concentrations of harmful gases within the smoke should be low. The proposed BESS installation's location should ideally be over 500m from any occupied development / farmhouse. The BESS is well over 500m from the closest facility, and therefore the risks posed by BESS are acceptably low.

- Based on the above it is suggested that if the substation were over 20m from the closest BESS container there should be limited direct impacts of any fire or explosion on the substation. With this separation, fires at the substation are also not likely to lead to domino failures of the BESS.

VANADIUM REDOX FLOW BATTERY INSTALLATIONS

- The most significant hazard with VRFB units is the possibility of spills of corrosive and environmentally toxic electrolyte. Many preventative and mitigative features will be included in the design and operation, e.g., full secondary containment, level control on tanks, leak detection on equipment etc. (Refer to tables in section 4 under preventative and mitigative measures).

- VRFB units do not present significant fire and electrical arcing hazards provided they are correctly designed, operated, maintained and managed. Suitable Battery Management System (BMS), safety procedures, operating instructions, maintenance procedures, trips, alarms and interlocks should be in place. (Refer to tables in section 4 under preventative and mitigative measures).

TECHNOLOGY AND LOCATION OF BESS FACILITIES

- From a safety and health point of view, the above Risk Assessment shows that risks posed by VRFB systems may be slightly lower than those of SSL facilities, particularly with respect to fire and explosion risks. From an environmental spill and pollution point of view the VRFB systems present higher short-term risks than the SSL systems. However, the above conclusions may be due to the fact that the VRFB technology is not as mature as SSL technology and therefore there is not as much operating experience and accident information available for the VRFB. Overall, from and SHE RA points of view, there is no specific preference for a type of technology.

- From a SHE risk assessment point of view, where there is a choice of location that is further from public roads, water courses or isolated farmhouses/occupied developments, this would be preferred. VRFB

hazards are mostly related to possible loss of containment of electrolyte and SSL batteries to fires producing toxic smoke and fire fighting which may result in contaminated of firewater runoff. One would not want these liquids to enter water courses nor the smoke to pass close to houses / public traffic. The current chosen location meets these separation requirements, and the relevant specialists such as aquatic and geohydrology have provided inputs on setback distances.

- Changes to the detailed layouts post Environmental Authorisation (should such be granted) are deemed acceptable if the changes remain within the approved buildable areas / development footprints, and area assessed during this Scoping and EIA Process (with the avoidance of no-go sensitive areas) and any solid state (e.g. lithium) BESS is located over 500m from farm buildings.

3. RECOMMENDATIONS

The following recommendations have been made:

- There are numerous different battery technologies but using one consistent battery technology system for the BESS installations associated with all the Kudu developments in the De Aar area would allow for ease of training, maintenance, emergency response and could significantly reduce risks.

- Where reasonably practicable, state-of-the-art battery technology should be used with all the necessary protective features e.g., draining of cells during shutdown and standby-mode, full BMS with deviation monitoring and trips, leak detection systems.

- There are no fatal flaws associated with the proposed Kudu 4 SEF battery installation for either technology type.

- The tables in Section 4 of this report contains technical and systems suggestions for managing and reducing risks. Ensure the items listed in these tables under preventative and mitigative measures are included in the design.

- The overall design should be subject to a full Hazop prior to finalization of the design.

- For the VRFB systems an end of life (and for possible periodic purging requirements) solution for the large quantities of hazardous electrolyte should be investigated, e.g., can it be returned to the supplier for re-conditioning.

- Prior to bringing any solid-state battery containers into the country, the contractor should ensure that:
    - An Emergency Response Plan is in place that would be applicable for the full route from the ship to the site. This plan would include details of the most appropriate emergency response to fires both while the units are in transit and once they are installed and operating.
    - An End-of-Life plan is in place for the handling, repurposing or disposal of dysfunctional, severely damaged batteries, modules and containers.

- The site layout and spacing between lithium solid-state containers should be such that it mitigates the risk of a fire or explosion event spreading from one container to another.

- Under certain weather conditions, the noxious smoke from a fire in a lithium battery container could travel some distance from the unit. The smoke will most likely be acrid and could cause irritation, coughing, distress etc. Close to the source of the smoke, the concentration of toxic gases may be high

enough to cause irreversible harmful effects. Location of the facilities needs to ensure a suitable separation distance from public facilities/residences etc. The proposed BESS location is well over 500m from isolated farmhouses/development and is therefore suitable in this context.

- In order to limit the possibility of domino failures the BESS should be separated from the substation by at least 20m.

- Where there is a choice of alternative locations for the BESS, those that are further from water courses would be preferred. VRFB hazards are mostly related to possible loss of containment of electrolyte and solid-state systems may experience fires that may result in loss of containment of liquids or the use of large amounts of fire water which could be contaminated. One would not want these run-offs to enter water courses directly. The buffer distance between water bodies and the facilities containing chemicals should be set in consultation with a water specialist and is therefore not specified in this SHE RA. It is noted that there are no tributaries of the main water courses in the area within 500m of the proposed BESS location, and therefore this is not a risk of concern.

- Finally, it is suggested once the BESS technology has been chosen and more details of the final design are available, the necessary updated Risk Assessments should be in place (prior to commencement, after environmental authorisation and other necessary approvals are granted (should such be granted)).

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GLOSSARY OF SOME TERMS POSSIBLY USED IN THIS REPORT

List of units, acronyms and abbreviations used in this report	Definition
BEI	Biological Exposure Index (Refers to values in blood or urine etc as per to OHS Act)
BESS	Battery Energy Storage System
BMS	Battery Management System
dB	Decibels
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ERPG	Emergency Response Planning Guideline (a series of values in ppm or mg/m^3 that indicates various levels health effects if exposed to this concentration for more than 60 minutes)
E-stop	Emergency stop button
HAZOP	Hazard and Operability Study
HBA	Hazardous Biological Agents (Refers to pathogens, parasites, cell cultures etc - Refer to the Occupational Health and Safety Act, 1993 (Act No. 83 of 1993) (OHS Act)
HCS	Hazardous Chemical Substances (Refers to a list of hazardous chemicals - Refer to the OHS Act)
HV / MV	High Voltage / Medium Voltage
IDLH	Immediately Dangerous to Life and Health (a value in ppm or mg/m^3 that indicates serious health effects if exposed to this concentration for more than 30 minutes)
kW	Kilowatts
kPa	Kilopascal
m	Metres
m^2	Metres squared
m^3	Metres cubed
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended
NFPA	National Fire Protection Agency
NRT Act	National Road Traffic Act, 1996 (Act No. 93 of 1996) (Chapter 8 deals with transportation of dangerous goods) Note various South African National Standards (SANS) are incorporated into the regulations.
OEL	Occupational Exposure Limit (usually in ppm or mg/m3 in the air for each HCS as defined in the Hazardous Chemical Substances Regulations of the OHS Act)
OHS Act	Occupational Health and Safety Act, 1993 (Act No. 83 of 1993)
PV	Photovoltaic
RA	Risk Assessment
RQ	Reportable Quantity in terms of NEMA to DFFE
QC / QA	Quality Control or Quality Assurance
SANS	South African National Standards
SDS	Safety Data Sheet
SHE	Safety, Health and Environment
SSLB	Solid State Lithium Batteries
TWA (8 hrs)	Time weighted average of 8 hrs
VRFB	Vanadium redox flow battery
WEF	Wind Energy Facility
WBGT Index	An index in degrees Celsius composed of fractions of the Wet Bulb, Globe and Dry Bulb Temperatures (Refer to Environmental Regulations under the OHS Act)

15.1 INTRODUCTION

15.1.1 SCOPE OF ASSESSMENT

The applicant, Kudu Solar Facility 4 (Pty) Ltd, is considering a Battery Energy Storage System (BESS) to complement a solar power (Kudu 4 Photo-voltaic (PV)) generation facility near the town of De Aar in the Northern Cape.

The BESS system will have a power generation capacity of up to 500 MW and will be able to deliver up to 500 MWh. Two alternative technologies are being considered for the BESS, i.e. either Solid State (typically Lithium chemistry) (SSL) or Redox Flow (typically vanadium chemistry) (VRFB). The technology is advancing rapidly and the exact technology and chemistry will be chosen during the Engineering, Procurement and Construction (EPC) phase. For SSL batteries this would mean multiple containerised units. For VRFB, the systems can be containerized but could, in order to achieve economies of scale, be one large utility scale plant within a conventional industrial type structural steel / brick warehousing structure. In either configuration there could be large volumes of electrolyte on site either in smaller tanks inside containers or larger tanks in a building. The VRFB facilities, either containerized or as utility buildings, will be bunded to contain 110% of the largest vessel.

Supplementary infrastructure and equipment may include substations, power cables, transformers, power converters, substation buildings & offices, HV/MV switch gear, inverters and other control equipment that may be positioned within the battery containers / separate dedicated containers / the battery building / within the on-site substation complex (within which the BESS will be positioned).

The proposed BESS is subject to an Environmental Impact Assessment (S&EIA) process. In 2019, the Department of Forestry, Fisheries and the Environment (DFFE) recommended that EIA applications for BESSs, either on their own or as part of a power generation (e.g., PV or wind) application, should include a high-level Risk Assessment of the BESS considering all applicable risks (e.g., fire, explosion, contamination, end-of life disposal etc.).

This report summaries the high-level Safety Health and Environmental (SHE) Risk Assessment conducted by ISHECON for the proposed SSL or VRFB BESS at the proposed facility. Separate reports have been compiled for each of the 12 proposed Kudu Solar Facilities. This report only addresses Kudu Solar Facility 4 (hereafter referred to as the “Kudu Solar Facility” or “proposed project”).

Although this assessment is based on the best available information and expertise, ISHECON cc cannot be held liable for any incident that may occur on this installation and associated equipment which directly or indirectly relate to the work in this report.

15.1.2 EIA REGULATION SCOPE OF APPLICATION

This Risk Assessment is conducted as a technical input into the EIA process for the proposed project to comply with the requirement for a high-level SHE Assessment, and it does not necessarily comply with the requirements of a specialist study as defined in Appendix 6 of the EIA Regulations of 2014, as amended, under the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA). This was communicated since the Scoping Phase of the proposed project and in the Plan of Study for EIA.

15.1.3 RISK ASSESSMENT METHODOLOGY

This Risk Assessment will consider the technology in detail. However, considering the general risks posed by the technology, each of the possible locations will be assessed with respect to advising on preferred locations from a SHE perspective.

Risk is made up of two components:
- The probability of a certain hazardous event or incident occurring.
- The severity of the consequences of that hazardous event / incident.

Therefore, this assessment of risk comprises:

- Identification of the likely hazards and hazardous events related to the operation of the installation.
- Estimation of the likelihood/probability of these hazardous events occurring.
- Estimation of the consequences of these hazardous events.
- Estimation of the risk and comparison against certain acceptability criteria.

For the purpose of this high-level SHE Risk Assessment a desktop study of the available information, preliminary BESS locations, reports of related incidents and various literature sources was undertaken. Based on this information the facility and the project were divided into construction, operation and decommissioning (end of life) phases.

This study makes use of a qualitative risk ranking system framework[1]. The method considers the nature of what causes the effect, what will be affected and how it will be affected, as described below.

NATURE OF IMPACT	DEFINITION
Beneficial / Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Adverse / Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct	Impacts that arise directly from activities that form an integral part of the Project (e.g., new infrastructure).
Indirect	Impacts that arise indirectly from activities not explicitly forming part of the Project (e.g., noise changes due to changes in road or rail traffic resulting from the operation of Project).
Secondary	Secondary or induced impacts caused by a change in the Project environment (e.g., employment opportunities created by the supply chain requirements).
Cumulative	Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.

A Health and Safety Risk Assessment is focussed on hazards arising from the construction, operation and decommissioning of a facility and their impact on humans, either employees or members of the public outside the site. By definition the nature of the chemical and machine hazards is negative, i.e., adverse impact on health and safety. Some of the impacts are immediate and direct such as effects of fires and explosions or exposure to high concentrations of chemicals (in health and safety we refer to these as acute impacts). Other impacts are longer term such as repeated exposure to low concentrations of harmful chemicals, noise etc. (in health and safety we refer to these as chronic impacts).

[1] Adapted from a method developed by WSP to meet the combined requirements of international best practice and NEMA, Environmental Assessment Regulations, 2014, as amended (GN No.326) (the "EIA Regulations").

Using the checklist detailed in Table 15.1.3.1 the hazards in each section/phase were identified. Each identified hazard was then described by the assessor in terms of causes, consequences, preventive and mitigative measures in place.

Each hazard was qualitatively dimensioned and assessed using the method as per Table 15.1.3.2. There are five dimensioning criteria in this method:

a) The magnitude of impact on the processes of interest (i.e., human health and safety) e.g., no impact, moderate impact and will alter the operation of the process (e.g., injuries), very high impact and will destroy the process (e.g., fatalities).

b) The physical extent, e.g., will it be limited to the site or not.

c) The duration, i.e., how long will the person bear the brunt of the impact.

d) Reversibility: an impact may either be reversible or irreversible, e.g., fatalities are permanent, while it may be possible to recover from injuries.

e) The probability of occurrence of the impact.

After dimensioning these aspects, a combined overall risk / significance was calculated for each hazard, see Table 15.1.3.3.

The impact significance without design controls, preventative and mitigation measures will be assessed. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified.

The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development.

Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this Report.

There are other specialist assessments being carried out as part of the S&EIA process, for example assessments in the field of impacts on terrestrial biodiversity, including fauna and flora, aquatic biodiversity, avifauna etc. The focus of this study is on human health and safety with possible impacts from chemicals, fires, explosions etc. and on broad issues of chemical pollution, emissions and waste of resources.

TABLE 15.1.3.1 SAFETY, HEALTH AND ENVIRONMENTAL RISK ASSESSMENT CHECKLIST

NO	*RISKS*	*DESCRIPTION OF TYPICAL HAZARDS*	*TYPICAL STANDARD (OHS Act) OR KEY ISSUES*
	HEALTH RISKS		
H1	Chronic Chemical or Biological Toxic Exposure	Continuous releases of toxic materials (Chemical or biological) Long term exposure to low concentrations Unsanitary or unhygienic conditions Diseases Harmful animals/insects	Do not exceed Occupational Exposure Limits (OEL's) and Biological Exposure Indices (BEI's – OHS Act Hazardous Chemical Substances (HCS) and Hazardous Biological Agents (HBA) Regulations)) for continuous work time exposure to hazardous chemical substances and materials. Awareness of HBA.
H2	Noise	Continuous and peak exposure to high levels of noise	Continuous noise not to exceed 85dB at workstation (OHS Act Noise-Induced Hearing Loss Regulations) and 61dB at boundary of the site.
H3	Environmental	High temperatures in work areas Low temperatures in work areas High humidity in work areas	Wet Bulb Globe Temperature (WBGT) index above 30 in summer and/or very cold less than 6 deg C in winter (OHS Act Environmental Regulations for Workplaces)
H4	Psychological	Inherently dangerous tasks Monotonous tasks High production pressure	
H5	Ergonomics	Bad ergonomic design, chronic or acute impact Vibration, repetitive impact	Maximum weight to lift 20 – 25kg
	SAFETY RISKS		
S1	Fire	Internal and external fire Small fire Large fires	Upper and lower flammability limits for materials. 12.5 kW/m^2 for 1-minute leads to 1% fatalities. 37.5 kW/m^2 leads to >90% fatalities and probable structural failure.
S2	Explosion	Internal explosions inside equipment Confined explosion inside structures Unconfined explosions outside	7 kPa overpressure leads to minor structural damage. 70 kPa leads to 90 % fatalities and probable structural failure.
S3	Acute Chemical or Biological Toxic Exposure	Large releases of toxic gases Exposure to high concentrations of harmful materials Asphyxiation inside a vessel Exposure to corrosive materials, burns Ingestion of poisonous materials	Immediately Dangerous to Life and Health values (IDLH) and Emergency Response Planning Guidelines (ERPG's) for all materials. Minimum oxygen levels. Low or high pH.

NO	*RISKS*	*DESCRIPTION OF TYPICAL HAZARDS*	*TYPICAL STANDARD (OHS Act) OR KEY ISSUES*
S4	Acute physical Impact or violent release of energy	Slips and trips Working at heights Moving equipment, objects or personnel	
S5	Generation impact	Electrocution Radiation sources Lasers Static Lightning	
	ENVIRONMENTAL RISKS		
E1	Emissions	Continuous emissions	Exceeding permitted emission levels
E2	Pollution	Unplanned pollution incidents causing immediate damage	Not transporting as per legislation (SANS10228/0229 and Haz. Subs. Act – Road Tanker Regs.) Hazmat requirements Reportable spill quantities NEMA Section 30
E3	Waste of resources	Water Power Other non-renewable resources (minerals) Biodiversity	Exceeding water consumption permits Peak demand requirements
	GENERAL RISKS		
G1	Aesthetics	Tall unsightly structures Glaring glass Odours	
G2	Financial	Risks of litigation Business collapse – recovery after emergency Sustainability	Business continuity Std SANS22301
G3	Security	Theft Hi-jacking Looting	
G4	Emergencies	Emergencies originating off-site (neighbours) Natural disasters	MHI Emergency Response Planning SANS1514
G5	Legal compliance		

TABLE 15.1.3.2 – SHE QUALITATIVE RISK ASSESSMENT MATRIX

a) The magnitude of impact on human health and safety and environmental pollution, quantified on a scale from 0-5, where a score is assigned.

SCORE	DESCRIPTION
0	small and will have no effect on the environment.
1	minor and will not result in an impact on processes.
2	low and will cause a slight impact on processes.
3	moderate and will result in processes continuing but in a modified way.
4	high (processes are altered to the extent that they temporarily cease).
5	very high and results in complete destruction of patterns and permanent cessation of processes.

b) The physical extent.

SCORE	DESCRIPTION
1	the impact will be limited to the site;
2	the impact will be limited to the local area;
3	the impact will be limited to the region;
4	the impact will be national; or
5	the impact will be international.

c) The duration, wherein it is indicated whether the lifetime of the impact will be:

SCORE	DESCRIPTION
1	of a very short duration (0 to 1 years)
2	of a short duration (2 to 5 years)
3	medium term (5–15 years)
4	long term (> 15 years)
5	permanent

d) Reversibility: An impact is either reversible or irreversible. How long before impacts on receptors cease to be evident.

SCORE	DESCRIPTION
1	The impact is immediately reversible.
3	The impact is reversible within 2 years after the cause or stress is removed; or
5	The activity will lead to an impact that is in all practical terms permanent.

e) The probability of occurrence, which describes the likelihood of the impact actually occurring.

SCORE	DESCRIPTION
1	very improbable (probably will not happen).
2	improbable (some possibility, but low likelihood).
3	probable (distinct possibility).
4	highly probable (most likely).
5	definite (impact will occur regardless of any prevention measures).

TABLE 15.1.3.3 – CALCULATION AND INTERPRETATION OF RISK / SIGNIFICANCE

The final assessment of the risk, i.e., the significance, of a particular impact is determined through combination of the characteristics described above (refer formula below)

Risk	=	Consequence	x	Likelihood
Significance	=	(Extent + Duration + Reversibility + Magnitude)	x	Probability

The risk (significance) can then be assessed as very low, low, medium, high or very high as follows:

OVERALL SCORE	SIGNIFICANCE RATING (NEGATIVE)	SIGNIFICANCE RATING (POSITIVE)	DESCRIPTION
4-15	Very Low	Very Low	Where the impact in negligible
16-30	Low	Low	Where this impact would not have a direct influence on the decision to develop in the area
31-60	Moderate	Moderate	Where the impact could influence the decision to develop in the area unless it is effectively mitigated
61-80	High	High	Where the impact must have an influence on the decision process to develop in the area
81-100	Very High	Very High	Where the impact would indicate a potential fatal flaw

15.2. DESCRIPTIONS

15.2.1 ORGANISATION, SITE LOCATION AND SURROUNDING AREAS

15.2.1.1 ORGANIZATION

ABO Wind AG is an international company originating in Germany in 1996. The South African subsidiary of ABO Wind, ABO Wind renewable energies (Pty) Ltd, was founded in 2017. There is a local Cape Town Office with local employees working together with the international team. The company is currently working on a pipeline of around 5 GW of wind and solar projects as well as storage projects with batteries or hydrogen. The primary concept of the projects is to ensure social and environmental reliability / sustainability. ABO Wind acts as the project developer and project interface, coordinating the research and studies, the site identification, the project structure, BAs, EIAs, selecting the strategic partners and arranging financing.

15.2.1.2 LOCATION AND PHYSICAL ADDRESS

Kudu 4 Solar PV BESS

Affected properties for the BESS only: Remaining Extent of Portion 3 of the Farm Bas Berg No. 88 Renosterberg Local Municipality in the Pixley ka Seme District Municipality in the Northern Cape GPS co-ordinates: $30^0$16’02.01” S $24^0$18’44.66” E

15.2.1.3 DESCRIPTION OF SITE AND SURROUNDINGS

The maps below show that the BESS facilities are planned in an isolated location. Activities in the area consist of the low intensity livestock farming.

Figure 15.2.1.1 is a map of South Africa showing the location of the proposed Kudu Solar PV facility.
Figure 15.2.1.2 is the development area showing the location of the BESS facilities.
Figure 15.2.1.3 shows 500m circles (dark blue) around the proposed BESS Facilities as well as local farmsteads/developments with (red 500m circles), a nearby water courses/bodies (light blue) and aquatic sensitivity and flood plain areas (green and yellow marked area) in the immediate vicinity of the BESS.
Figure 15.2.1.4 shows the details of the development and the location of the BESS within the substation area

Figure 15.2.1.1 - Map showing the location of the proposed Kudu Solar PV Facility within the Northern Cape, South Africa.



Figure 15.2.1.2 - The general area of interest for the BESS

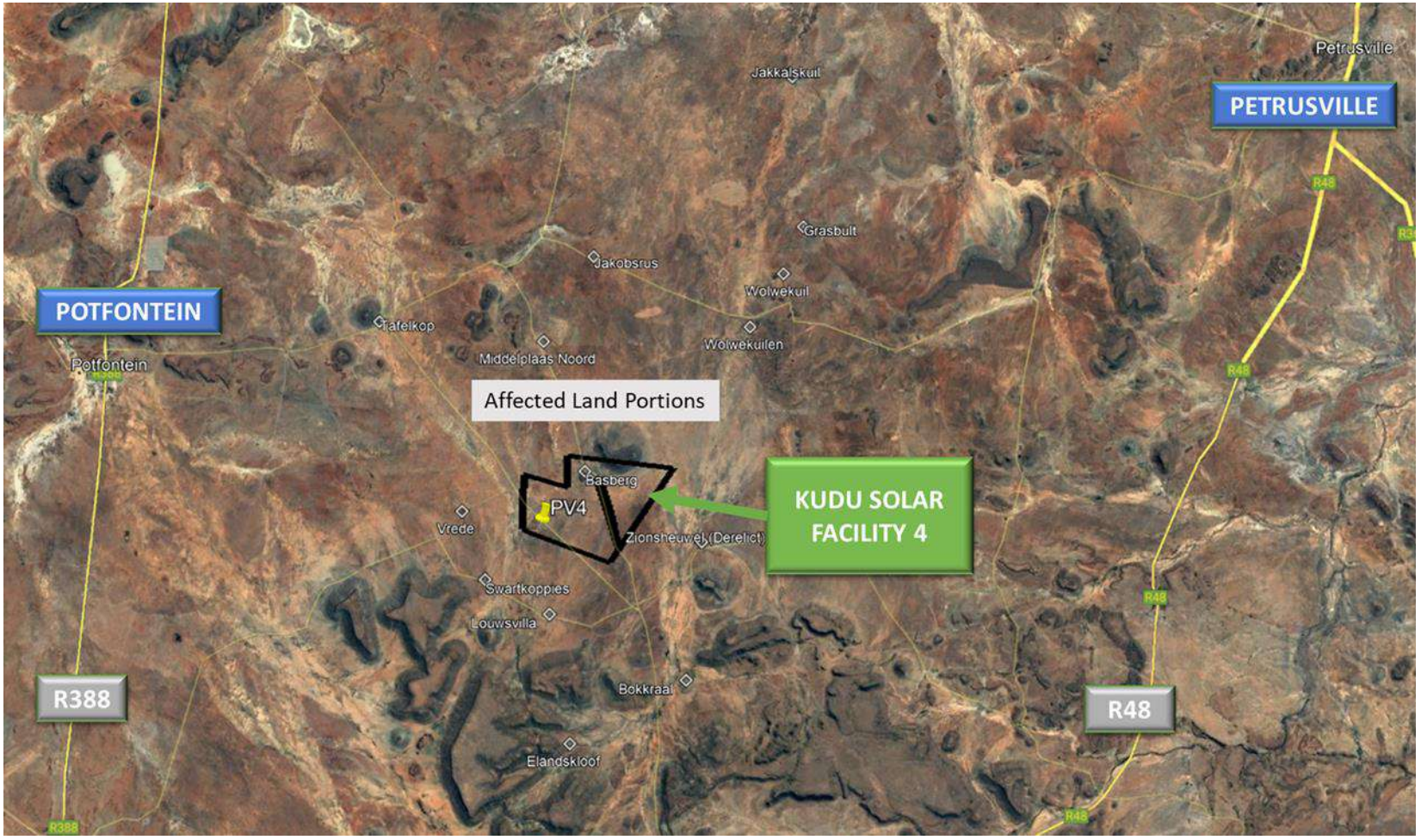


Figure 15.2.1.3 – 500m circles around the BESS Facilities (Dark Blue), Location of Developments / Farmhouses (Red), Nearby Water Courses/Bodies (Light blue) and aquatic sensitivity and floodplain areas (green and yellow) in the immediate vicinity of the BESS

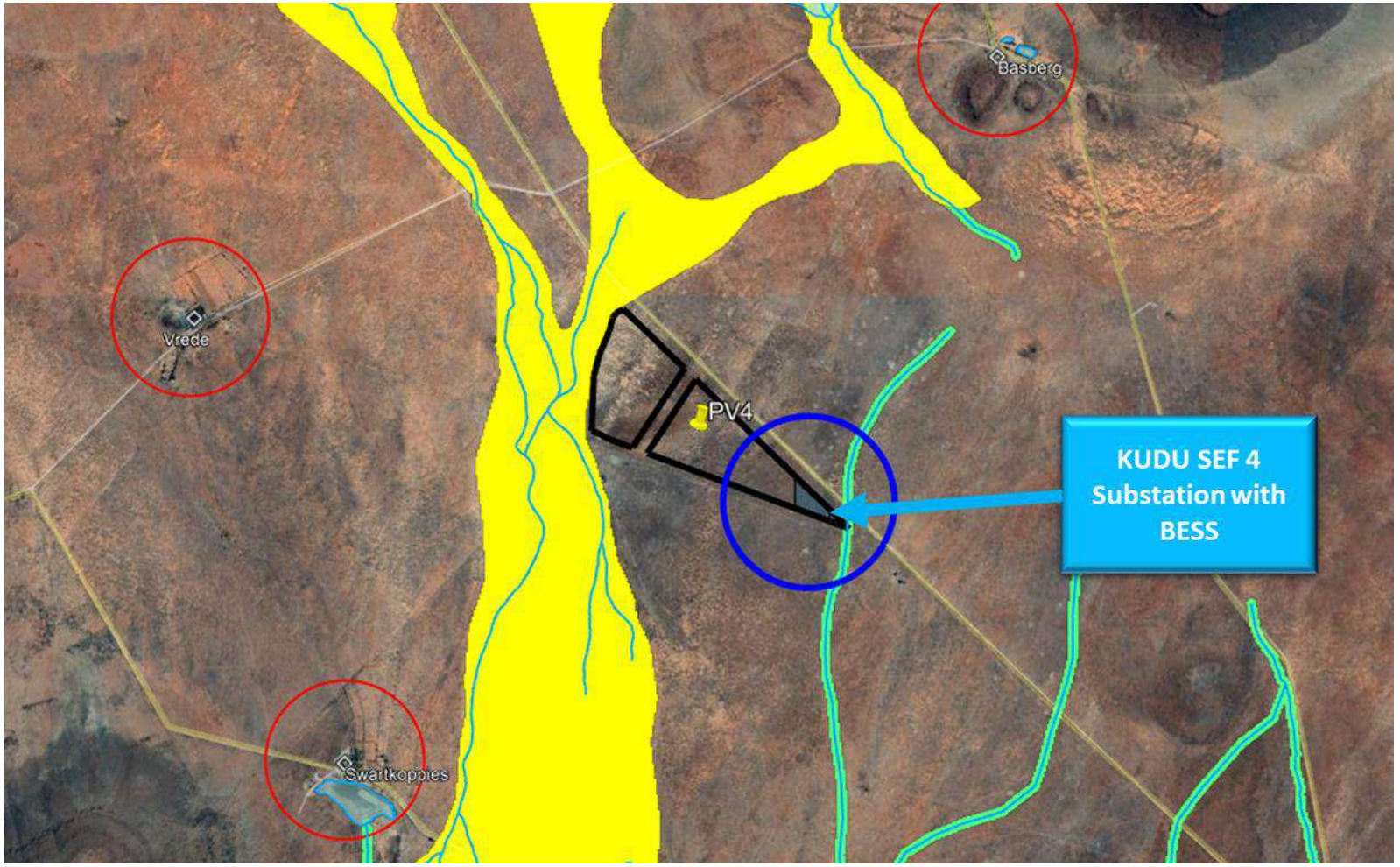
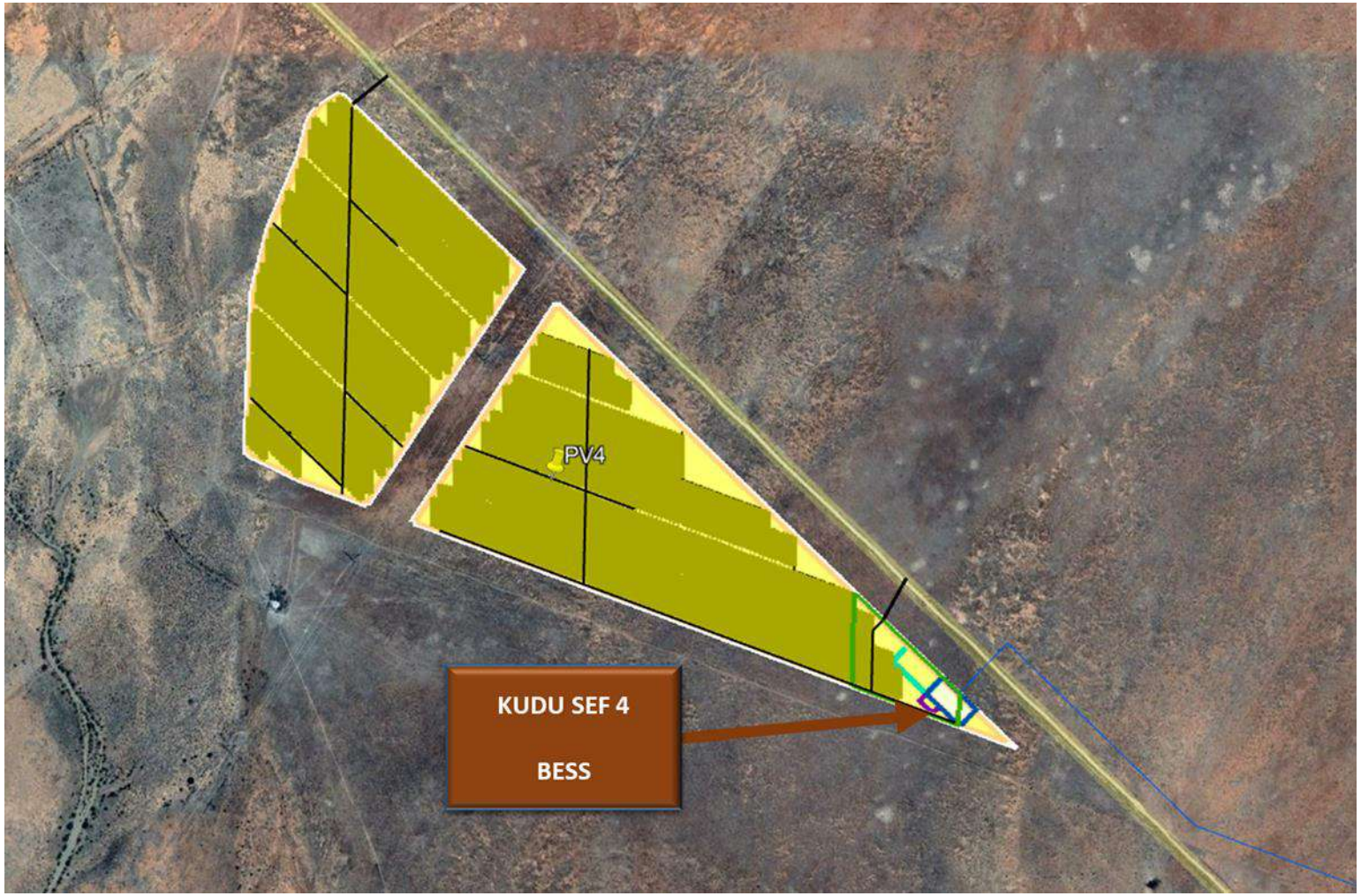


Figure 15.2.1.2 – Detailed layout of the site showing the location of the BESS within the Substation complex


PV4
KUDU SEF 4
BESS

15.2.2 TOPOGRAPHY, LAND-USE AND METEOROLOGY

15.2.2.1 TOPOGRAPHY

Refer to the relevant EIA specialist studies for details of flora and fauna as well as water resources in the area. Vegetation in the area is mostly dry scrub, grass and bushes closer to water courses.

The area is very flat ground with a few hills to the north.

There are dry (seasonal) rivers in the area around the BESS site. Due to the semi-arid nature of the area, these water sources, although seasonal, are critical.

15.2.2.2 LAND-USE

Refer to the relevant EIA specialist studies for details of the agricultural and commercial activities and cultural aspects in the area. The BESS facilities will not use large amounts of land typically < 5 ha.

The area is used very sparsely for agricultural activity, mostly livestock. There are few isolated farmstead developments in the general area but none of the dwellings in the area is within 500m of the proposed BESS location.

Across South Africa seismic activity is conceivable with Gauteng (man-made activity) and the Western Cape (natural activity) being relatively higher risk areas. However, compared with aspects such as corrosion, human error etc. seismic activity is not usually a highly likely risk factor, refer to SANS 10160:2011, part 4. [Ref 6]. The proposed area is a low seismic activity area and civil / structural design of the BESS facilities would not normally need to take major additional seismic protection into account. Refer to the Geotechnical Assessment undertaken as part of the EIA Process.

15.2.2.3 METEOROLOGY

Weather data for De Aar indicates that the wind blows predominantly from the north, north west and west. There is very little wind from the east and south. The winds vary from virtually nothing to strong winds in September/October. Given the proposed locations of the BESS facilities this means that the wind blows across the BESS facilities away from any occupied farmsteads.

The area has very little rain but long days with plenty of sunshine and summer daytime temperatures in the mid-thirties. Day night variations are typically 15 degrees Celsius or more.

Across South Africa, lightning strikes are conceivable as a source of ignition of major hazards, refer to SANS10313:2012 lightning strike density table [Ref 7]. The lightning ground flash density in De Aar is 3.3 flashes/km^2/year which is at the middle to lower end of the spectrum in South Africa, e.g. Piet Retief is 15.1 flashes/km^2/year and Boksburg as 12.1 flashes/km^2/year while areas such as Cape Town are 0.1 flashes/km^2/year. Nevertheless, ignition from on-plant sources is much more likely than lightning, but lightning cannot be ignored as a source of risk particularly for tall structures in wide open flat areas.

15.2.3 PLANT AND PROCESSES

15.2.3.1 PROPOSED DESIGN SOLID STATE BATTERIES – TYPICALLY LITHIUM

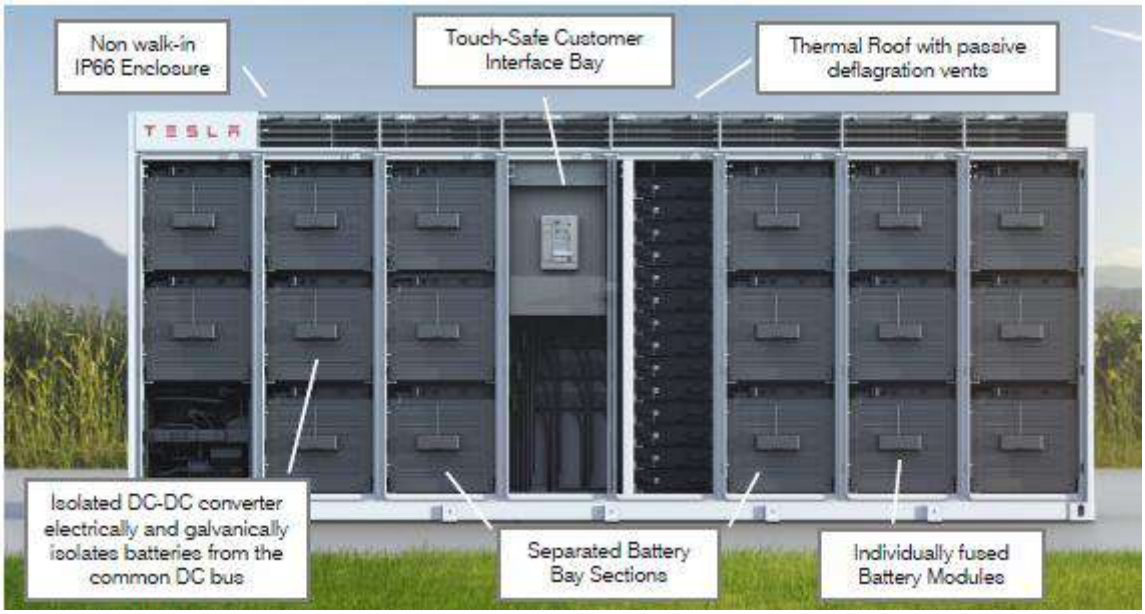
The one type of battery technology being considered for each BESS is a Solid-State Battery which consists of multiple battery cells that are assembled together to form modules. Each cell contains a positive electrode, a negative electrode and an electrolyte. The BESS will comprise of multiple battery units or modules housed in shipping containers and/or an applicable housing structure which is delivered pre-assembled to the project site. Containers are usually raised slightly off the ground and laid out in rows. They can be stacked if required although this may increase the risk of events in one container spreading to another container. Supplementary infrastructure and equipment may include substations, power cables, transformers, power converters, substation buildings and offices, HV/MV switch gear, inverters and temperature control equipment that may be positioned between, adjacent to or in the vicinity of the battery containers. The solid-state batteries that are being considered are Lithium-ion systems. The pictures in Figure 15.2.3.1.1 are typical BESS installations servicing solar power farms. Figures 15.2.3.1.2 & 15.2.3.1.3 show typical battery modules in the BESS facility.

FIGURE 15.2.3.1.1 – Images of Typical BESS Systems Servicing Solar Power Farms

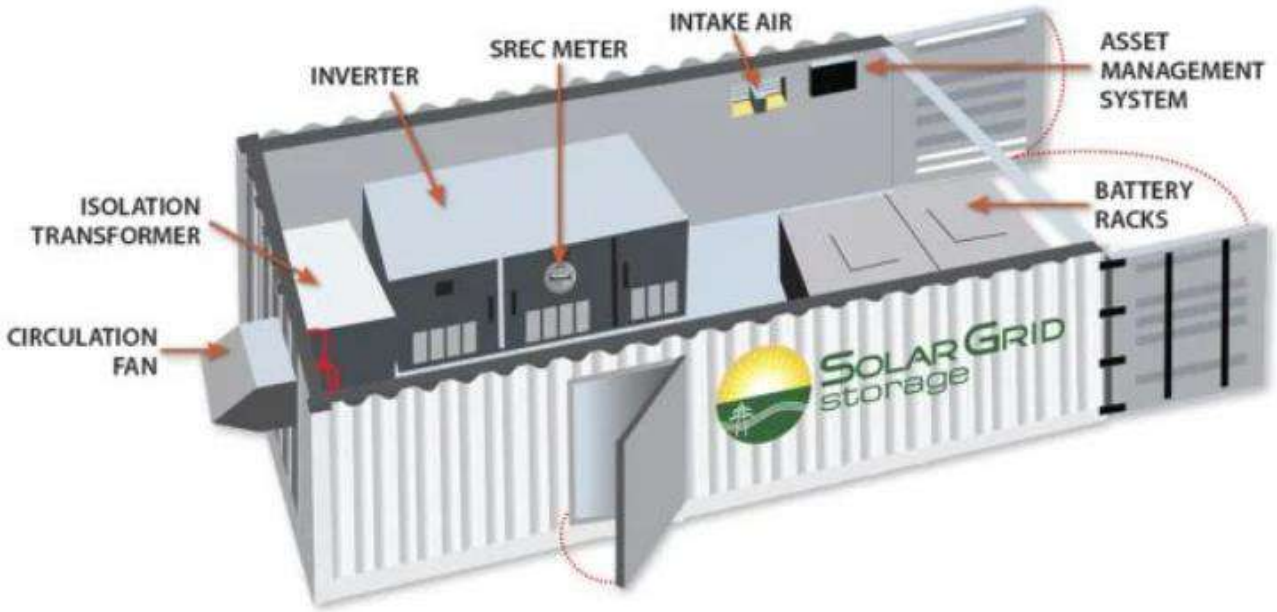


Source – computer generated artist impressions

FIGURE 15.2.3.1.2 – Typical Battery Modules in a BESS with the Separated Sections

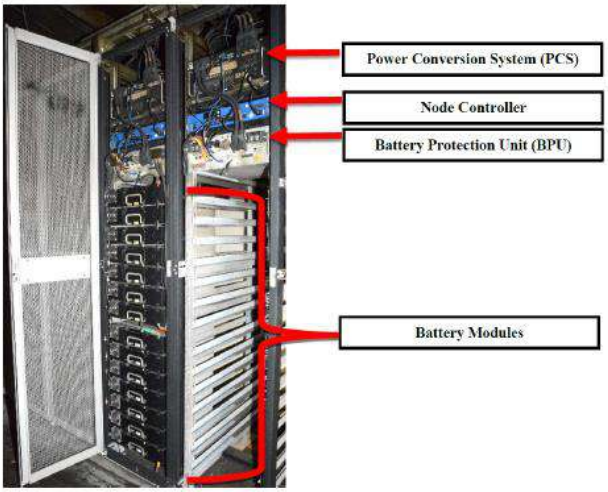


Source – Tesla MegaPack – Safety Overview



Source – Tesla MegaPack – Safety Overview

FIGURE 15.2.3.1.3 – Typical Battery Modules in a BESS with the Power Conversion Systems in with the Batteries



Source – DNV-GL McMicken Event Analysis

15.2.3.2 PROPOSED DESIGN - REDOX FLOW BATTERIES – TYPICALLY VANADIUM

One of the types of battery technology being considered for the BESS would be VRFB. These energy storage systems can be supplied either as containerized units or as a fixed installation within a building etc.

In order to present contrasting hazards with the containerized lithium batteries in the section above, this report will discuss utility scale redox flow system, i.e. not containerized redox flow batteries. Due to the proposed size of the facility (up to 500MW), and in order to highlight the possible more extreme differences between technology types, the facility can be envisioned as having redox units housed within a large battery building. If containerized systems are used, the essential hazards remain the same, but may just be slightly smaller in magnitude. For this project (up to 500 MW) there are expected to be up to 720 containers, each with six 25m3 tanks of electrolyte within the containers, hence approximately 108 000 m3 of electrolyte in the entire project. Each container acts as bund (secondary containment) able to hold at least the volume of one tank. In addition a bund mound/trench (tertiary containment primarily for any runoff) will be constructed around the entire facility. The pictures in Figure 15.2.3.2.1 and Figure 15.2.3.2.2 are typical Redox Flow BESS installations.

FIGURE 15.2.3.2.1 – Images of Some Redox Flow BESS Systems – containerized systems or buildings with tanks of electrolyte and battery systems



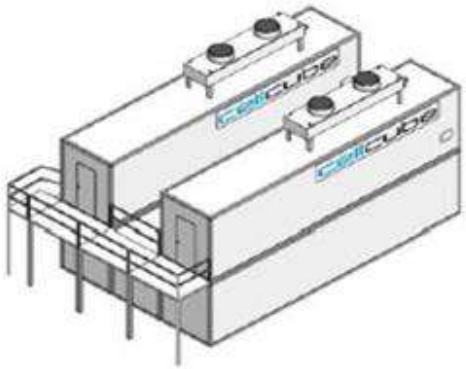
1 MW 4 MWh containerized vanadium flow battery owned by Avista Utilities and manufactured by UniEnergy Technologies



Source – Bulk Redox flow batteries for renewable energy storage, 21 Jan 2020, J Noak, N Roznyatovskaya, C Menictas, M Skyllas-Kazacos







Source – Bushveld Minerals and Energy – Energy Storage and Vanadium Redox Flow batteries 101 – 13 November 2018. And general Product Info 2023

Within each unit, battery cells are assembled together to form stacks, the image below showing a view of typical stack.

FIGURE 15.2.3.2.2 – Typical Battery Cell and Stack Set-up



Stacks of a 2MW/20MWh vanadium redox flow battery at Fraunhofer ICT. Image:

15.2.3.3 STAFF AND SHIFT ARRANGEMENT

The BESS facilities will run 7 days a week for 24 hours a day. Although the system will be largely automated with a battery management system and electronic operator interface etc, it will still require attention from operators and maintenance staff. The facility will need routine checking / preventative and breakdown maintenance / grass cutting / security etc. During normal operations there are assumed to be approximately 8 persons on site during the day depending on the activities taking place and possibly one or two operators/maintenance staff as well as security personnel at night.

15.2.3.4 OPERATIONS AT THE BESS FACILITY AND PHASES OF THE BESS PROJECT

The BESS facilities can be considered to have three main phases:

- Construction including transport to site and storage prior to installation,
- Operation including commissioning, maintenance, shutdown – restart, and
- Decommissioning including repurposing and disposal.

The main processes undertaken in each of these stages can be summarized as follows together with some details:

TABLE 15.2.3.4.1 – Project Phase with Main Processes/Activities and Some Details of Likely Elements

No	PHASE	MAIN PROCESSES	DETAILS
1.1	Construction both types of battery technology	Construction machines e.g., cranes, graders, cement trucks, diesel and oil storage	Graders to clear ground and make roads, diggers for trenches and foundations, cement mixers for civil works, cranes to place containers, diesel bowser for fuel for machines, oil for machines
1.2		Materials for the construction of the Vanadium Redox Flow Battery (VRFB) building / container plinths Equipment items for installations within the VRFB building	Building materials such as bricks, cement, re-bar, I-beams, roof sheeting etc. BESS equipment such as tanks, pumps, piping etc. Electrical equipment such as transformers, pylons, cabling.
		Equipment items for containerized installation e.g., lithium battery containers / VRFB containers	Battery containers Electrical equipment such as transformers, pylons, cabling.
1.3		Waste e.g., packaging materials, paint	Connections, transformers, switches etc will likely have protective coverings (Plastic, paper, cable ties etc) to remove during installation, paint waste (cans, brushes, solvents), and building rubble
1.4		Construction camp	Temporary offices, accommodation, ablutions
2.1	VRFB Operation	Chemical electrolyte and electrode materials in the battery cell	Tanks, pumps and pipes containing electrolyte, typically vanadium dissolved in an acidic solution.
2.2		Battery cells, stacks	The batteries will be able to generate up to 500 MW of power for four hours. The electrolyte storage will have capacity to dispatch up to 500 MWh.
2.3		Electronic equipment in building / container	Battery management system for monitoring of the batteries and control of the loading and unloading cycles
2.4		Electrical equipment inside	Power conversion system, connections, switches, cabling
2.5		Support mechanical equipment	Air conditioners, fans, coolant
2.6		Electrical equipment outside	Network interconnection equipment, switchgear, transformers
2.7		Site office and workshop	Including potable water, 220V power, kitchen, sewage, tools and parts store etc
2.8		Support services	Dirt roads, access control fences, lights inside the container and outside for general access lighting, fire suppression/fighting systems, grass cutting, communication systems
2.9		Waste	Broken parts, storm water run-off, hot air from battery and Power Conversion System (PCS) cooling systems, waste electrolyte from maintenance or other spills
2.10	Lithium Solid State Operation	Chemical electrolyte and electrode materials in the battery cell	Will be solid state batteries typically lithium-ion i.e. lithium salts dissolved in a hydrocarbon based electrolyte solution absorbed within the electrodes
2.11		Battery cells, modules and racks typically in shipping containers	The facilities are designed for up to 500 MW/500 MWh having typically ~ 700 containers. (for example, each Tesla Megapack has up to 3 megawatt hours (MWhs) of storage and 1.5 MW of inverter capacity, other units only have a power rating of just over 0.7 MW per container).

2.12		Electronic equipment in container	Battery management system for monitoring of the batteries and control of the loading and unloading cycles
2.13		Electrical equipment in container or separate container	Power conversion system, connections, switches, cabling
2.14		Mechanical equipment in container(s)	Air conditioners, fans, filters, coolant
2.15		Electrical equipment outside the containers	Network interconnection equipment, switchgear, transformers
2.16		Site office and workshop	Including potable water, 220V power, kitchen, sewage, tools and parts store etc
2.17		Support services	Dirt roads, access control fences, lights inside the container and outside for general access lighting, fire suppression/fighting systems, grass cutting, communication systems
2.18		Waste	Broken parts, storm water run-off, hot air from battery and PCS cooling systems
3.1	Decommissioning both types of battery technology	VRFB Liquid chemical waste	Waste electrolyte solution, transformer oils, coolants
		Solid State Lithium chemical waste	Batteries, air filters, transformer oils, coolants
3.2		Electronic waste	Circuit boards, HMI screens
3.3		Building rubble - non-hazardous waste	Steel, copper, cement, equipment and structures
3.4		VRFB Hazardous waste	Contaminated equipment such as pumps, pipes, bund linings
3.5		Lithium Containers	Shipping containers

15.3. HAZARD IDENTIFICATION

15.3.1 SOLID STATE LITHIUM BATTERY CHEMICAL HAZARDS

15.3.1.1 BATTERIES IN GENERAL

Lithium-ion based battery systems are becoming one of the dominant technologies for utility systems in Europe and America. For this reason, this assessment assumes that lithium-based batteries will be used in the BESS facilities. Should sodium-based batteries be used, the hazards are likely to be similar at a high level but different in their details, and therefore the Risk Assessment may need to be reviewed.

Primary (non-rechargeable) batteries use lithium metal anodes. Lithium is one of the lightest and most reactive metallic elements and is highly reactive towards water and oxygen. Exposure of lithium metal to water even as humidity can decompose exothermically to produce flammable hydrogen gas and heat. These lithium metal batteries are not used in BESS systems. However, if secondary batteries discussed below are charged at temperatures below 0 degrees Celsius, then lithium can plate out onto the anode surface and in this manner lithium metal could be present even in lithium-ion batteries.

Secondary, rechargeable lithium batteries, as used in bulk BESSs, use cathodes that contain lithium in the crystal structure of the cathode coating and/or lithium salts in an electrolyte that is in the battery. These are called lithium-ion batteries. Lithium-ion batteries operate at room temperature and have significant limitations outside the 0 – 50 degree range. The exact lithium-ion composition of the batteries can vary with suppliers. In addition, the technology allows for many combinations of chemistry to suit the particular application.

15.3.1.2 LITHIUM BATTERY CHEMISTRY

The lithium in the batteries is usually in the form of lithium salts dissolved in an electrolyte solution that is absorbed within the electrodes and/or lithium plated onto the surface of the electrode. These are referred to as solid state batteries because electrolyte liquid is not freely available in a form that can easily leak or be extracted. The electrolytes are typically ethylene carbonate or di-ethyl carbonate. The flash points of these carbonates can vary from 18 – 145 deg C which means they can be highly flammable (Flash Point FP < 60 deg C) or merely combustible if involved in an external fire (FP > 60 deg C). Some of the lithium compound in the electrolyte include lithium hexafluorophosphate, lithium perchlorate, lithium cobalt oxide etc.

15.3.1.3 HAZARD - THERMAL DECOMPOSITION

Upon heating of the contents of a battery due to shorting, contaminants, external heat or exposure to water and reaction heat, the lithium salts in batteries begin to break down exothermically to release either oxygen (oxidants) that enhances combustion, possibly leading to explosion, or fumes such as hydrogen fluoride or chlorine that are toxic.

These exothermic break down reactions are self-sustaining above a certain temperature (typically 70 deg C) and can lead to thermal run away. In this process the battery gets hotter and hotter, the decomposition reactions happen faster and faster, and excessive hot fumes are generated in the battery. Eventually the pressure in the battery builds up to the point where those gases need to be vented, usually via the weakest point in the system. These vented fumes can be flammable due to vaporization of the electrolyte and can ignite as a flash fire or fire ball (if large amounts) leading to the fire spreading to any surrounding combustible materials, e.g., plastic insulation on cables, the electrolyte, the electrodes and possibly even the plastic parts

of the battery casing etc. If the vented flammable vapours do not ignite immediately, they can accumulate within the surrounding structures. If this flammable mixture is ignited later, e.g., due to a spark, this can lead to a violent explosion of the module, cabinet, room, container etc.

In addition to being flammable the vented gases will contain toxic components. These could include:

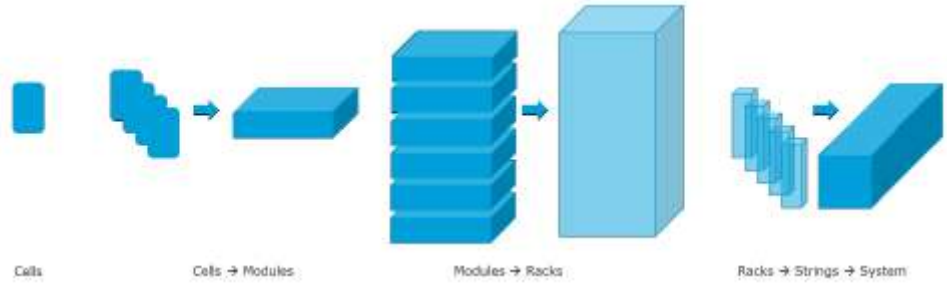
- the products of combustion such as carbon dioxide/monoxide, hydrogen cyanide,
- VOCs like benzene and ethylene, and
- decomposition products such as hydrogen fluoride, hydrogen chloride, phosphorous pentafluoride, phosphoryl fluoride and oxides of aluminium, cobalt, copper etc.

The temperature in the batteries and of these vented gases can be extremely high, e.g., > 600 deg C.

In the situation where oxygen is released internally as part of the decomposition (e.g., lithium perchlorate) the oxygen is available to react with the combustible electrolyte and if all this happens extremely fast in a self-sustaining manner within the confines of the device, an explosion of the device can occur with only localized impacts.

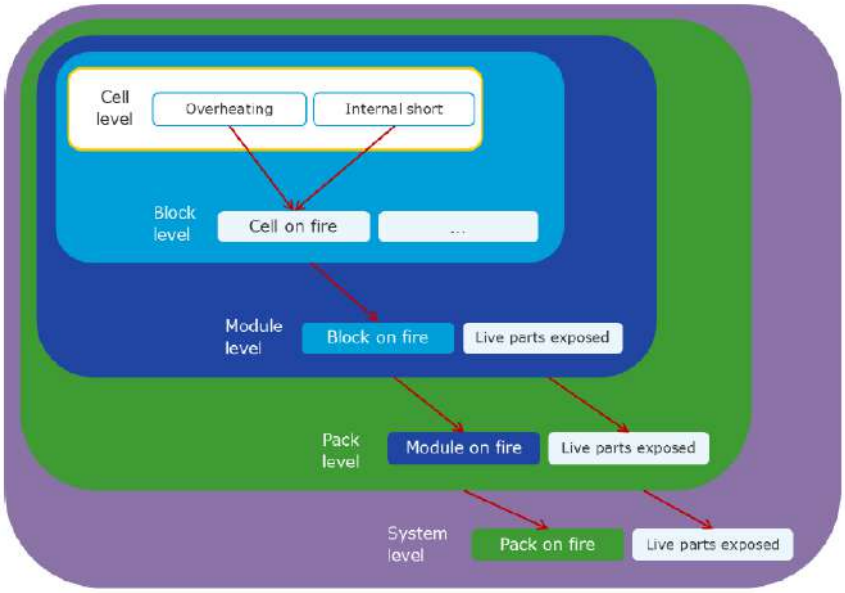
15.3.1.4 HAZARD - PROPAGATION

A BESS is composed of individual batteries which are combined into different size packs such as modules and racks, as illustrated on the diagram below.



Source DNV-GL McMicken Event Analysis

The very high temperature generated by one battery cell in thermal run away could lead to overheating of adjacent cells. This cell in turn then starts thermal decomposition and so the process propagates through the entire system, as illustrated on the diagram below.



Source – STALLION Report

In order to prevent propagation, there are separation requirements between cells, modules etc. Separation could be with physical space or insulating materials etc.

15.3.1.5 HAZARD - ELECTROLYTE LEAKS

Although extremely unlikely due to the structure of the batteries, should electrolyte liquid leak out of the batteries, it can be potentially flammable as well as corrosive etc. If ignited as fire, or explosion, the smoke would contain toxic components. If unignited it can still be extremely harmful especially if its decomposition products include hydrofluoric acid.

15.3.2 VANADIUM REDOX FLOW BATTERY HAZARDS

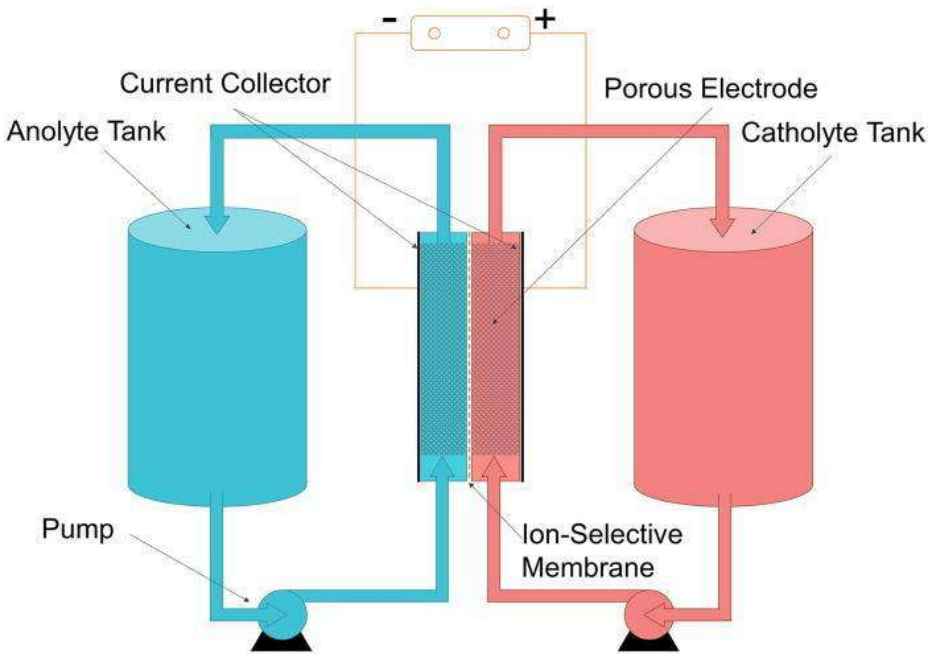
15.3.2.1 BATTERIES IN GENERAL

All electrochemical energy storage systems convert electrical energy into chemical energy when charging, and the process is reversed when discharging. With conventional batteries, the conversion and storage take place in closed cells. With redox flow batteries, however, the conversion and storage of energy are separated. Redox flow batteries differ from conventional batteries in that the energy storage material is conveyed by an energy converter. This requires the energy storage material to be in a flowable form. In redox flow batteries, charging and discharging processes can take place in the same cell. Redox flow batteries thus have the distinguishing feature that energy and power can be scaled separately. The power determines the cell size, or the number of cells and the energy is determined by the amount of the energy storage medium. In theory, there is no limit to the amount of energy that can be produced and/or stored thereby allowing for scalability of these systems.

Figure 15.3.2.1 shows the general operating principle of redox flow batteries. The energy conversion takes place in an electrochemical cell which is divided into two half cells. The half cells are separated from each other by an ion-permeable membrane or separator, so that the liquids of the half cells mix as little as possible. The separator ensures a charge balance between positive and negative half cells, ideally without the negative

and positive active materials coming into direct contact with each other. In fact, however, separators are not perfect so some cross-over of the active materials always occurs and this leads to the self-discharge effect.

FIGURE 15.3.2.1 – Schematic Diagrams of Redox Flow BESS Systems



Source – WIKIPEDIA

15.3.2.2 VANADIUM BATTERY CHEMISTRY

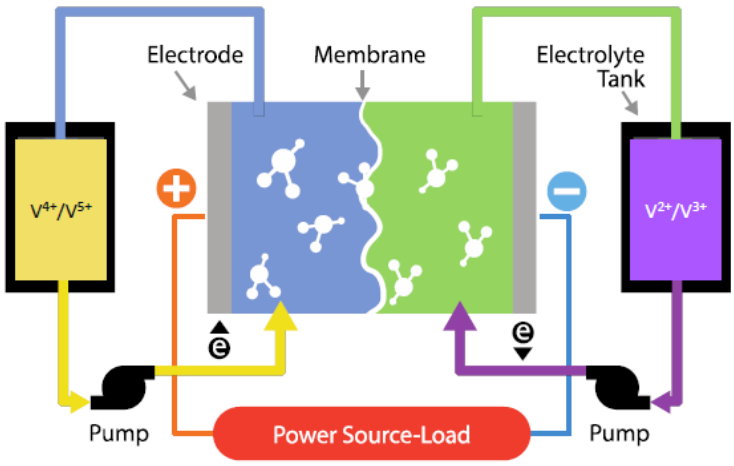
The vanadium redox battery (VRB), also known as the vanadium flow battery (VFB) or vanadium redox flow battery (VRFB), is a type of rechargeable flow battery that employs vanadium ions in different oxidation states to store chemical potential energy. The vanadium redox battery exploits the ability of vanadium to exist in solution in four different oxidation states, and uses this property to make a battery that has just one electroactive element instead of two.

The possibility of creating a vanadium flow battery was explored by Pissoort in the 1930s, NASA researchers in the 1970s, and Pellegri and Spaziante in the 1970s, but none of them were successful in demonstrating the technology. The first successful demonstration of the all-VRFB which employed vanadium in a solution of sulfuric acid in each half was by Maria Skyllas-Kazacos at the University of New South Wales in the 1980s. In redox flow batteries, the electrodes should not participate in the reactions for energy conversion and should not cause any further side reactions (e.g., undesirable gas formation). Most redox flow batteries are therefore based on carbon electrodes.

The redox pair VO2+/VO2+ are at the positive electrode and the redox pair V2+/V3+ at the negative electrode. The use of the same ions in the positive and negative electrolytes permits relatively high concentrations of active material. It also overcomes the cross-contamination degradation issues which plague other flow type batteries. The energy storage solution consists primarily of vanadium sulphate in a diluted (2mol/L) sulphuric acid (possibly containing a low concentration of phosphoric acid) and is therefore roughly comparable to the acid of lead/acid batteries. The energy density is limited by the concentration of the pentavalent + VO2.

The VRFB is without doubt the best investigated and most installed redox flow battery.

For several reasons, including their relative bulkiness, most vanadium batteries are currently used for grid energy storage, i.e., attached to power plants or electrical grids. Currently, there are over 100 VRFB installations globally with an estimated capacity of over 209,800 kWh of energy and the use of vanadium in energy storage applications has doubled to 2.1% of the global vanadium consumption in 2018.



Source: IEEE Spectrum: "It's Big and Long-Lived, and It Won't Catch Fire: The Vanadium Redox-Flow Battery", 26 October 2017

15.3.2.3 HAZARD – TOXICITY AND CORROSIVITY

The electrolyte in the VRFB system is corrosive. It is composed of a sulphuric acid-based solution similar to common automotive lead acid batteries. Unlike traditional lead-acid batteries, VRBs do not include lead. Therefore, VRBs do not have the toxicity issues of lead that conventional car batteries have. The only potential source of human toxicity in a VRB is Vanadium.

Vanadium in various physio-chemical states can have a relatively high aquatic and human toxicity. Acute oral exposure to high doses can lead to haemorrhaging, while chronic exposure leads to adverse effects on the digestive system, kidneys and blood (diarrhoea, cramps etc.).

Inhalation hazards lead to irritation of the respiratory tract, bronchospasm, and pulmonary congestion. There is little evidence that vanadium compounds are reproductive toxics or teratogens. There is also no evidence that it is carcinogenic (Source USA EPA Risk Assessment Information Systems, Toxicity Profiles, Vanadium 1998).

In the electrolyte the concentration levels of Vanadium are so low that when it is mixed into liquid form in the final product and put into operation, the VRB is deemed non-toxic. In addition, VRBs have a lower concentration of sulfuric acid than traditional lead-acid batteries. Vanadium poses a hazard when it is in powder form, i.e. when making up the electrolyte solution. The facilities will purchase the liquid electrolyte solution already made up and there will be no solid vanadium powder on site.

Toxicity or corrosion risks may be present from off-gassing produced by over-heating aqueous or vaporized electrolytes. In addition, flow batteries in fire scenarios may generate toxic gas from the combustion of hydrocarbons, plastics, or acidic electrolytes. Refer to sections on fire below for mitigation measures.

15.3.2.4 HAZARD – ELECTRICAL SHOCK/ARC

Electrical shock presents a risk to workers and emergency responders, if the energy storage system cannot be "turned off". This is referred to as "stranded energy" and presents unique hazards. Arc flash or blast is possible for systems operating above 100 V.

In the area of shock hazard, a flow battery produces voltage only when electrolytes are in a cell stack. For most designs, if the motors are turned off and fluids drained from the cell stack, then the cell stacks have no measurable voltage at the terminals. This happens not only when the battery is forcibly turned off but also in the standby mode as vanadium batteries do not include any metal plates to hold the chemical reactions / charges / voltages and can be fully drained when not in use.

If not fully drained, vanadium flow batteries are also unique in terms of short circuiting in that the internal dynamics of the battery are such that the energy discharge is limited to the fluid in the battery at any given time and the is typically less than 1% of the total stored energy. Therefore, together with the relatively low energy density of the vanadium electrolyte, the immediate release of energy, which occurs as a result of electrical shorting, is somewhat limited. The high heat capacity of the aqueous electrolyte is also beneficial in limiting the temperature rise.

Vanadium flow batteries have been tested under dead-short conditions resulting in normal operation with no danger to either equipment or personnel.

15.3.2.5 HAZARD – FIRE / DEFLAGRATION

Over 50% of the electrolyte solution is made up of water, which gives the electrolyte a non-flammable property. In the event of short circuiting, intense heat or high pressure, it is unlikely for the battery to catch fire. There is no "thermal runaway" risk when compared to other battery technologies.

Whilst some heat may be discharged from the battery, it will not be at a level that is deemed unsafe.

Like all other RFBs, VRFBs also have a battery management system. A battery management system ensures optimum and safe conditions for battery operation. Often a heat management system is integrated to avoid too high or too low temperatures.

15.3.2.6 HAZARD - HYDROGEN GENERATION

As with all other aqueous batteries, aqueous energy storage media from redox flow batteries are also subject to water limitations. In case of too high voltages or more precisely too high or too low half-cell potentials, the water is decomposed into its components, hydrogen and oxygen.

The generation of hydrogen in particular is often present as a very small but undesirable side reaction and causes a charge carrier imbalance between positive and negative half-cells, which leads to a slow loss of capacity. It also presents a fire / explosion hazard.

With VRFB, due to the flowability of the energy storage medium, the reaction products that would normally remain in the half-cell can be transported out of the cell and stored in separate tanks thus allowing the capability for a higher capacity than that attainable with conventional batteries. In addition, any deviations from safe operating parameters will trigger the shutdown of the system pumps ceasing to charge the electrolyte and thereby reducing the chances of accidental H2 generation. In addition, the thermal mass of

the electrolyte tanks can provide an additional barrier to overcharging conditions by allowing ambient temperature during the discharge times to cool the VRFB for the next charge cycle.

15.3.2.7 HAZARD – WASTE ELECTROLYTE

Unfortunately, pentavalent vanadium ions have a tendency to react with each other, which leads to the formation of larger molecules which precipitate as solids and can thus damage the system. The reaction depends on the temperature and the concentration of VO2+ (state of charge) but is also a function of the proton concentration. Temperature and concentrations therefore need to be controlled within specified ranges.

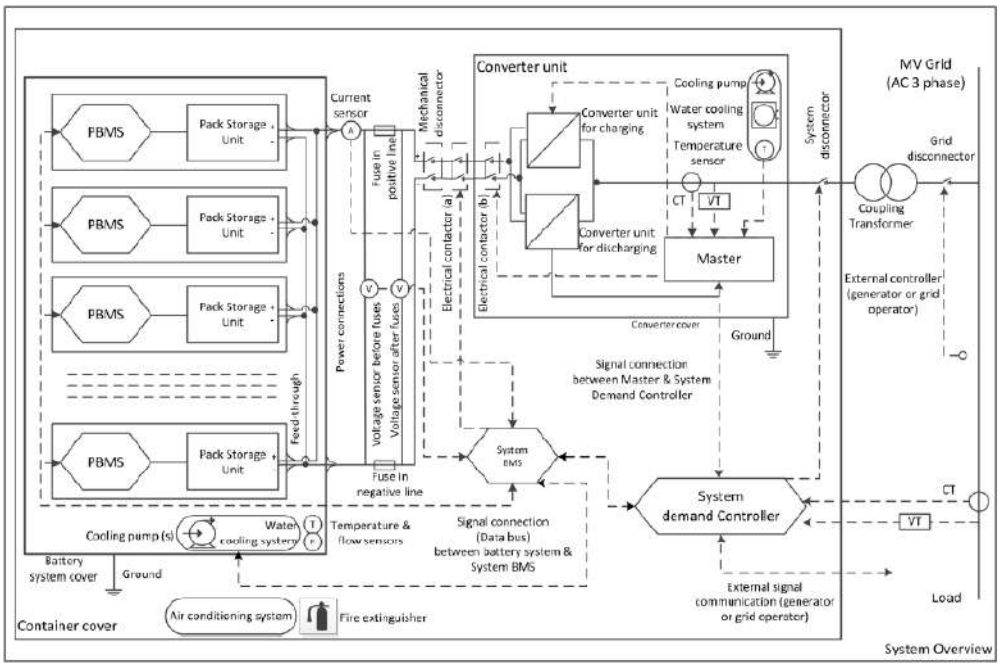
Should the concentration of undesirable components increase in the electrolyte, a part may need to be purged and replaced with fresh electrolyte. There may be facilities for regenerating purged electrolyte or it may have to be disposed of to a suitable hazardous waste facility.

15.3.2.8 HAZARD - ELECTROLYTE LEAKS

Leaks must be expected in any hazardous-fluid handling equipment. Secondary containment is typically designed into the system and standard corrosive PPE is required for handling liquid. Reliable leak detection, warning alarms, and containment is paramount. As with any chemicals plant, a suitable design with detection, alarm and trip instrumentation that has been subject to thorough Hazard and Operability Study (HAZOP) study should be in place, e.g., detection of dry running of pumps, detection of dead heading of pumps, prevention of reverse flow, detection of drop in tank levels etc.

15.3.3 OTHER CHEMICALS OR HAZARDS

The BESS is composed not only of the batteries, but also electrical connections, switches, power converters, cooling systems etc. The diagram below shows a typical complex system for a lithium solid state facility.



Source – STALLION reports

15.3.3.1 COOLING SYSTEMS

Due to the need to keep the batteries within a specified temperature range most of the containerized modular system have built-in air-conditioning systems while the VRFB building systems may have cooling water systems. Some have only fans for air cooling with filters to remove dust prior to cooling. Others, particularly those in hot environments requiring more cooling, may have refrigerant-based systems. These would have a refrigerant circuit usually containing non-flammable non-toxic refrigerant such as R134a (simple asphyxiant) etc as well as a low hazard circulating medium such as an ethylene glycol-based coolant. At high temperatures above 250 deg C R134 may decompose and may generate hydrogen fluoride and other toxic gases. Ethylene glycol is really only harmful if swallowed. In the environment it breaks down quickly and at low concentrations that would typically occur from occasional small spills, it has no toxicity.

15.3.3.2 FIRE SUPPRESSION SYSTEMS

Although these are only effective for some fire scenarios, some of the solid-state containerized systems come fitted with “Clean agent” fire suppressant systems. These are pressurized containers of powder/gases that are released into the container to snuff a fire and do not leave a residue on the equipment. Some containers have water sprinkler systems installed to quench thermal run-away reactions.

In general fire fighters may respond with water cannons/hydrants, foam systems etc. Such responses may generate large amount of contaminated and hazardous water runoff. A system to contain as much of this as possible should be in place.

15.3.3.3 GENERAL ELECTRICAL AND ELECTRONIC EQUIPMENT

Whatever the configuration of the battery containers/ buildings there will be electrical and electronic equipment in the battery compartment, the battery building as well as outside. In some installations the main electrical equipment such as the power conversion system is in a separate compartment separated by a fire wall. In others it can be in a separate container.

Wherever there is electrical equipment there is a possibility of shorting and overheating and fire.

15.3.4 PAST ACCIDENTS AND INCIDENTS RELEVANT TO BESS

The following events occurred with various types of batteries, e.g., solid state, and are included for the purpose of possible ideas on how things may go wrong with equipment around the batteries themselves:

1. There have been sodium-sulphur fires in Japanese installations. One such event was at the Tsukuba Plant, (Joso City, Ibaraki Prefecture) of Mitsubishi Materials Corporation where molten material leaked from a battery cell causing a short between battery cells in an adjoining block. As there was no fuse between cells the current continued to flow, with the whole battery module catching fire. Hot molten material melted the battery cell casings inside the battery overflowing to the modules below, causing the fire to spread further.
2. There have been exploding, melting Samsung smartphone lithium batteries.
3. A tesla electric battery powered car caught fire, see image below. Initially, a metal object penetrated the battery causing damage leading to short circuiting and thermal runaway. There was an alarm and the driver warned by on-board computer to park car safely and exit. The runaway did not propagate

to the other battery compartment due to separation measures installed. Fire fighters actually made the fire worse by their action to open the battery system to try and get water into it. This allowed air in and the flames to spread to the rest of the car. By way of comparison the American National Fire Protection Agency (NFPA) has stated that there are approximately 90 fires per billion kilometres driven with internal combustion engine cars as compared to the Tesla electric car with only 2 fires per billion driven kilometres.



Source STALLION Report

4. In 2010 a UPS Airlines cargo plane from Dubai crashed after a fire started in a large undeclared lithium battery shipment. Since not declared the batteries were not handled in any special manner as would be required if they were a declared hazardous load. There have been two other fires on flights containing lithium battery cargos. In all cases the fire went from small to uncontrolled in less than 30 minutes.
5. In 2013 the lithium batteries installed in two separate Air Japan Boeing 787 Dreamliners ignited resulting in fires, while on the ground in one case and in-flight in the other.
6. In August 2012, there was a fire at night at the Kahuku wind farm in Hawaii with an advanced lead-acid battery system installed indoors. The fire department were called several hours later and attempted, unsuccessfully to extinguish the fire with dry powder. The fire fighters faced thick smoke and could not enter the building for several hours because it was unclear whether the batteries were emitting toxic fumes.
7. In February 2012 during commission of a solar BESS in Arizona USA a fire started. The cause is unknown but the fire did not spread beyond the shipping container.
8. On 10 August 2016 in Wisconsin USA a fire started in the DC power control compartment of a BESS under construction. Fire department arrived and applied alcohol resistant foam to extinguish the fire. The fire did not spread to the batteries. As the system was in commissioning the fire suppression system in the PCS was not yet functional.
9. On 11 November 2017, a Lithium based BESS in Belgium caught fire during commissioning. Fitted fire detection and extinguishing system failed to contain the fire. The fire department were called and rapidly extinguished the fire preventing spreading to adjacent containers.



A fire engulfs a lithium-ion battery system at an Engie test site in Belgium, Nov. 11.

Photo Credit: MrJoostvant / YouTube

10. On 19 April 2019 there was an explosion at utility company Arizona Public Service's (APS) solar battery facility in Surprise, Arizona. The incident on April 19, 2019, started when there were reports at around 17:00 of smoke from the building housing the BESS. A few hours later, at approximately 20:04, an explosion occurred from inside the BESS. Nine people were injured. The factual conclusions reached by the investigation into the incident were:
    - The suspected fire was actually an extensive cascading thermal runaway event, initiated by an internal cell failure within one battery cell in the BESS: cell pair 7, module 2, rack 15.
    - It is believed to a reasonable degree of scientific certainty that this internal failure was caused by an internal cell defect, specifically abnormal Lithium metal deposition and dendritic growth within the cell.
    - The total flooding clean agent fire suppression system installed in the BESS operated early in the incident and in accordance with its design. However, clean agent fire suppression systems are designed to extinguish incipient fires in ordinary combustibles. Such systems are not capable of preventing or stopping cascading thermal runaway in a BESS.
    - As a result, thermal runaway cascaded and propagated from cell 7-2 through every cell and module in Rack 15, via heat transfer. This propagation was facilitated by the absence of adequate thermal barrier protections between battery cells, which may have stopped or slowed the propagation of thermal runaway.
    - The uncontrolled cascading of thermal runaway from cell-to-cell and then module-to-module in Rack 15 led to the production of a large quantity of flammable gases within the BESS. Analysis and modelling from experts in this investigation confirmed that these gases were sufficient to create a flammable atmosphere within the BESS container.
    - Approximately three hours after thermal runaway began, the BESS door was opened by firefighters, agitating the remaining flammable gases, and allowing the gases to make contact with a heat source or spark. This led to the explosion.



Arizona utility APS has grounded its energy storage operations while the investigation continues.



Posted Tuesday, April 30, 2019 9:44 am

By **Jason Stone & Matt Roy,** Independent Newsmedia

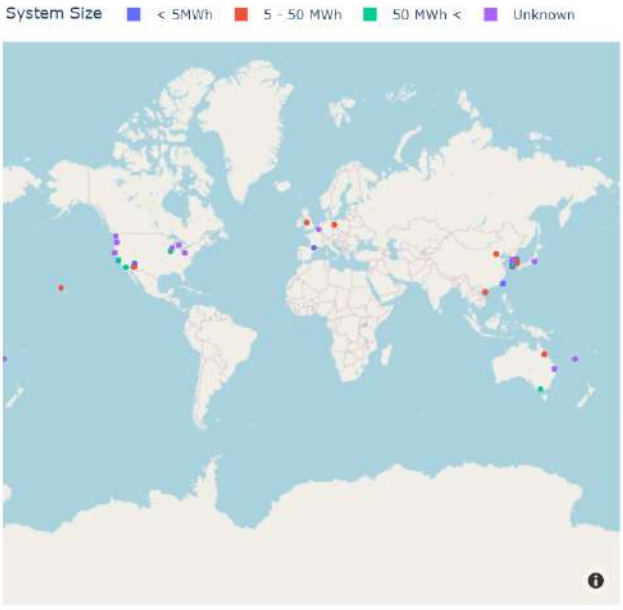


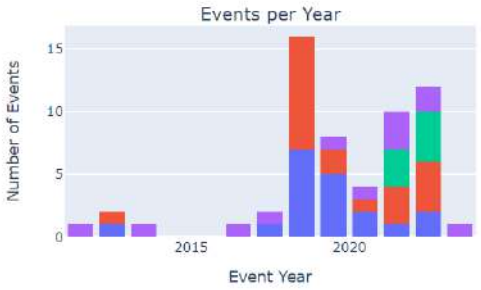
Source DNV-GL McMicken Event Analysis

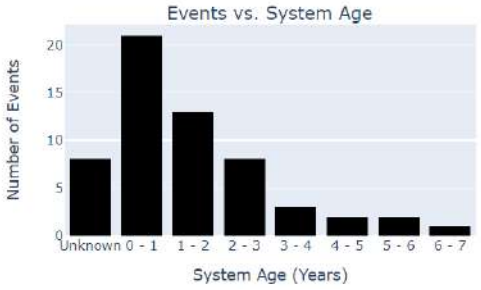
11. Records (By WoodMac) indicate that there are approximately 200 BESS systems in the USA and there have been 2 - 3 fires in the last 5 -10 years. This is an event frequency of 0.001 - 0.003 events per unit per year. DNV-GL in their quantitative risk analysis of BESS sites found that considering all the latest (2019) safety features the theoretical event frequency should be as low as 0.00001 events/unit/year i.e., 2 orders of magnitude lower than the actual values.

12. Korea has installed over 1200 energy storage systems as part of the clean energy programs. In December 2018 a lithium BESS caught fire at a cement plant in Jecheon. It was the 15th fire in 2018 in Korea. As of June 2019, there had been 23 fires at Korean facilities. The faults are reported to be with the incorrect installation of battery management systems, electrical systems and not due to the batteries themselves. Assuming these BESS systems have on average been in place for 5 years then the event frequency is approximately 0.004 events per unit per year. This correlates to the high value estimated for the USA data. This data is also two orders of magnitude higher than the DNV theoretical prediction on 0.00001 events/unit/year.

13. The Electric Power Research Institute (EPRI) of California USA maintains a list of Battery released accidents on its Wiki-Storage Page. The EPRI is an independent non-profit energy research, development and deployment organization that is funded by organizations around the world including the energy sector, academia and governments. The graphs and lists below summarize some of the incidents and the three accidents described in more below the table are typical of the types of accidents recorded.







Location	Energy (MWh)	Power (MW)	Application	Installation	Event Date	System Age (yr)	State During Accident	Source
US, PA, Millvale			Solar Integration	Urban	30 January 2023		Operational	WTAE
South Korea, Jeollanam-do, Yeongam-gun, Geumjeong-myeon	251		Solar Integration	Rural	27 December 2022	1.8	Operational	E2News.com
South Korea, Jeollanam-do, Damyang-gun, Mujeong-myeon, Deokgok-ri	9.1	2.5	Solar Integration	Rural	8 December 2022	5.5	Operational	E2News.com
China, Hainan	50	25	Solar Integration		20 October 2022	0	Commissioning	china5e.com
US, CA, Moss Landing	730	182.5	Energy Shifting, Ancillary Services	Substation	20 September 2022	0.5	Operational	KSBW News
South Korea, Incheon		103	Energy Shifting	Factory	6 September 2022		Operational	Teller Report
US, CA, Rio Dell			Solar Integration / Backup	Rural	3 August 2022	4	Operational	KRCR
US, AZ, Chandler	40	10		Substation	18 April 2022	3	Operational	AZ Central
US, CA, Valley Center	560	140		Substation	5 April 2022	0.2	Operational	Valley Road Runner
Longjing, Taichung City, Taiwan	1	1	Solar Integration	Power Plant	30 March 2022	2	Operational	Economic Daily
US, CA, Moss Landing	400	100	LG Energy Solution	Solar Integration	Power Plant	13 February 2022	1	Operational	KSBW News
South Korea, Gunwi-gun, Gyeongsangbuk-do	1.5	0.45	LG Energy Solution	Solar integration	Rural	17 January 2022	3	Operation. Fully charged	E2News
South Korea, Nam-gu, Ulsan	50	10	SK Innovation	Peak Load Reduction	Urban	12 January 2022	2	Operational	E2News
US, CA, Moss Landing	1,200	300	LG Energy Solution	Solar Integration	Power Plant	4 September 2021	0.8		Vistra
Australia, Victoria, Geelong	450	300	Tesla	Grid Stability	Rural	30 July 2021	0	Construction, Commissioning	ABC News
US, IL, LaSalle	72	72	LFP	Frequency Regulation	Rural	19 July 2021	1.6		The Times
Germany, Neuhardenberg	5	5	[LFP]	Solar Integration and Frequency Regulation	Indoor/Hangar	18 July 2021	5		RBB 24
Boulouparis, New Caledonia, France				Solar Integration	Rural	13 July 2021			FranceTVInfo.fr
US, MI, Standish				Demand Charge Mgmt	Substation	19 April 2021	0	Installation	WSGW
China, Beijing	25		Gotion High-Tech [LFP]	Solar Integration	Commerce Area	16 April 2021	2	Construction, Commissioning	CTIF Accident Analysis

a) There have been three incidents at the Moss Landing Power plants PG&E battery storage facility in the USA where there are 256 TESLA Mega Packs installed. The latest involved one pack which caught alight and burned out five hours later. Firefighting approach was to let the pack burn out. Near-by communities were warned to shelter-in-place and the adjacent highway shutdown due to possible toxic smoke. Only one mega pack burned out and the fire did not spread.





b) There was a small fire at the new Terra-Gen battery storage facility on Valley Centre Road USA. A small electrical failure produced some smoke which triggered the protection systems. Those worked exactly as planned and the failure was contained to a single battery module (meaning literally a single battery which is about the size of a DVD case). The safety systems worked exactly as planned and in addition the enclosure next to the one with the problem shut down because it also detected the smoke.

c) The fire broke out during testing of a 13-tonne Tesla lithium megapack at the Victorian Big Battery site near Geelong Australia. A 13-tonne lithium battery was engulfed in flames, which then spread to an adjacent battery bank. This event indicates that if the battery pack units are not suitably separated the heat from one fire can set off an adjacent unit.





15.4. RISK ASSESSMENT

An analysis was undertaken to identify the failure events, their causes, consequences, as well as the preventative and mitigative measures in place on the proposed installation for all three phases of a typical project.

15.4.1 SOLID STATE LITHIUM-ION BATTERY ENERGY STORAGE SYSTEMS

TABLE 15.4.1.1 - CONSTRUCTION PHASE (Excluding commissioning which involves starting and testing the installed equipment, i.e. powering up the batteries)

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 1:	Human Health - chronic exposure to toxic chemical or biological agents	Causes - Construction materials such as cement, paints, solvents, welding fumes, truck fumes etc. Consequences - Employee / contractor illness.	Construction	Negative	The construction phase will be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. SHEQ policy in place. A detailed construction Risk Assessment to be undertaken prior to work. SHE procedure in place. PPE to be specified. SHE appointees in place. Contractor's safety files in place and up to date. All necessary health controls/ practices to be in place, e.g., ventilation of welding and painting areas. SHE monitoring and reporting programs in place. Emergency response plan to be in place prior to beginning construction and to include aspects such as appointment of emergency controller, provision of first aid, first responder contact numbers.	Moderate	3	1	3	4	4	**44**	1	1	3	4	2	**18**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 2:	Human Health - exposure to noise	Causes - Drilling, piling, generators, air compressors. Consequences - Adverse impact on hearing of workers. Possible nuisance factor in near-by areas.	Construction	Negative	OHS Act Noise Induced Hearing Loss Regulations. Health Risk Assessment to determine if equipment noise exceeds 85dB at workstation and 61dB at boundary of the site. Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.	Easy	3	1	5	5	4	**56**	2	1	5	5	2	**26**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 3:	Human Health - exposure to temperature extremes and/or humidity	Causes - Heat during the day. Cold in winter. Consequence - Heat stroke. Hypothermia.	Construction	Negative	Construction site facilities to comply with Occupational Health and Safety Act 85 of 1993, specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. Adequate potable water for employees to be provided during all phases of the project. Bore hole, bowser and tank or small water treatment plant may be required to provide potable water for the BESS installation staff during all phases of the project. Geohydrology Assessment has been conducted during the EIA Phase to assess the impact of the use of groundwater.	Easy	3	2	3	1	2	**18**	2	2	3	1	1	**8**
						Significance	**N2 - Low**						**N1 - Very Low**					
Impact 4:	Human Health - exposure to psychological stress	Causes - Large projects bring many contractor workers into a small, isolated community. Consequences – Lack of sufficient accommodation, entertainment etc. Increase in alcohol abuse, violence	Construction	Negative	Refer to the Socio-Economic Specialist Study undertaken as part of the EIA for this project.	Easy	2	3	3	2	2	**20**	2	3	3	2	2	**20**
						Significance	**N2 – Low**						**N2 – Low**					
Impact 5:	Human Health – exposure to ergonomic stress	Causes – Lifting heavy equipment. Awkward angles during construction. Consequences – Back and other injuries.	Construction	Negative	Training in lifting techniques. Ensure that despite the isolated location all the necessary equipment is available (and well maintained) during construction. Otherwise, employees may revert to unsafe practices. Ensure this is in place prior to project commencement Ensure first aid provision on site.	Moderate	4	1	3	2	3	**30**	4	1	3	2	2	**20**
						Significance	**N2 - Low**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 6a:	Human and Equipment Safety - exposure to fire radiation	Causes – Involvement in an external fire. Fire involving fuels used in construction vehicles or vehicles themselves (e.g., tyre fire). Fire due to uncontrolled welding or other hot-work Consequences - Injuries due to radiation especially amongst first responders and bystanders. Fatalities unlikely from the heat radiation as not highly flammable nor massive fire.	Construction	Negative	Fuels stored on site in dedicated, demarcated and bunded areas. Suitable fire-fighting equipment on site near source of fuel, e.g., diesel tank, generators, mess, workshops etc. The company responsible for the facility at this stage is to have: 1. Emergency plan to be in place prior to commencement of construction. 2. Fuel spill containment procedures and equipment to be in place. 3. Hot-work permit and management system to be in place.	Complex	4	2	3	5	4	**56**	4	2	3	5	2	**28**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 6b:	Human and Equipment Safety - exposure to fire radiation	Causes - Solid state battery containers damaged on route e.g., dropped in port (drops do happen about 1/2000 containers) and importing possibly up to 700 containers for the site. With this it is possible, although unlikely, that one will be dropped, traffic accident on-route. Involvement in an external fire e.g., at the port or on route. Data indicates installed facility events are 0.001/year. Transport of 700 units per installation assumed to take 4 weeks each so f= 0.05 - once in 20 years so likelihood is moderate. Consequences – Injuries due to radiation especially amongst first responders and bystanders. Fatalities unlikely from the heat radiation as not highly flammable nor massive fire (refer to noxious smoke in	Construction	Negative	Solid state battery design includes abuse tests such as drop test, impact, rapid discharge etc. Propagation tests for systems, e.g., heat insulating materials between cells/modules. Factory acceptance test prior to prior to leaving manufacture. Batteries are usually stored at 50% charge to prolong life but may be shipped fully discharged. This level of detail should be understood so as to assess the risk during transport and storage. The company responsible for the battery installation should ensure suitably competent transport companies are appointed. The company responsible for transportation should ensure: - Compliance with National Road Traffic Act regulation 8 – dangerous goods. - Port Authorities should be alerted to the overall project and the hazardous nature of the contents of battery containers being imported. Note. If, as per one of the typical suppliers (Tesla) indications, the containers are classified as IMDG Class 9 – the containers will not receive any special care in the ports and may be stored next to flammables. Port emergency response in particular need training on mitigating battery hazards. Prior to bringing any containers into the country, the company responsible for the battery installation (possibly via appointed contractors) should ensure that an Emergency response plan is in place for the full route from the ship to the site. Drivers trained in the hazards of containerized batteries. The Emergency response plan must determine and address: - What gases would be released in a fire and are there inhalation hazards. - Extinguishing has two important elements, put out fire and to provide cooling. Different approaches may be needed for small fire – e.g., put out, and for large fires e.g., cool with copious quantities of water. Note inert gases and foam may put out the initial fire but fail to control thermal runaway or to cool the batteries	Complex	5	2	5	5	4	**68**	5	2	5	5	1	**17**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
		APPENDIX A below for the major impact).			resulting in reignition. - What initial fire extinguishing medium should be used. - Whether there are any secondary gases or residues from use of extinguishers. - If water is appropriate, determine if the system needs outside connections to sprinklers inside the container. - First responders need to know what media to use, especially if water totally unsuitable and if there are no connection points for water etc. - Must the container be left unopened or opened. - PPE to be specified including possible exposure to chemicals and fumes as well as radiate heat. - Containment of residues/water/damaged equipment. - Suitable safe making and disposal plan for after the event i.e. how do responders deal with partially charged damage units, contaminated surfaces (e.g., HF residues).													
						Significance	**N4 - High**						**N2 - Low**					
Impact 7:	Human and Equipment Safety - exposure to explosion over pressures	Causes - With solid state lithium containers, flammable gases generated by thermal run away reach explosive limits. Ignition on hot surfaces, static. Consequences - Potential fatalities amongst first responders. Damage to container, transport truck or other nearby items, e.g., other container in the port.	Construction	Negative	During transport this is only likely to happen due to possible inappropriate emergency response, e.g., opening containers when they may be the type that should be left to burn out. For simplicity one transport route would be preferable. The route needs to be assessed in terms of responding local services, rest places for drivers, refuelling if required, break down services available etc. Once an import route has been chosen, e.g., N10 from Port of Ngqura, then the appointed transport company should ensure key emergency services on route could be given awareness training in battery fire/accident response. Emergency response planning and training referred to above may be important for key locations such as the mountain passes / tunnels.	N/A	5	4	5	5	3	**57**	5	4	5	5	1	**19**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 8a:	Human and Equipment Safety - exposure to acute toxic chemical and biological agents	Causes Human pathogens and diseases, sewage, food waste. Snakes, insects, wild and domesticated animals and harmful plants. Consequences - Illness and at worst without mitigation, possibly extending to fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc.	Construction	Negative	All necessary good hygiene practices to be in place, e.g., provision of sanitation facilities, eating areas, infectious disease controls. Policies and practice for dealing with known vectors of disease such as AIDS, TB, COVID 19 and others. Awareness training for persons on site, safety induction to include animal hazards. First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. Due to isolated locations some distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts.	Complex	4	2	3	2	3	**33**	3	2	3	2	2	**20**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 8b:	Human and Equipment Safety - exposure to acute toxic chemical and biological agents	Causes - Damaged solid-state batteries release fumes, leak electrolyte, are completely broken exposing hazardous chemicals. Thermal runaway and hazardous fumes released. Consequences - Impacts can vary from mild skin irritation from exposure to small leaks to serious corrosive burns or lung damage.	Construction	Negative	Appointed transport company to ensure transport in accordance with Regulation 8 of the National Road Traffic Act 93 of 1996, Dangerous Goods. Not permitted to transport prescribed goods in manner not consistent with the prescriptions, e.g., consignor and consignee responsibilities. Prescription found in SANS 10228/29 and international codes for battery transport etc. Transportation of BESS components in sealed packages that are kept upright, protected from movement damage etc. Also packaged to ensure no short-circuiting during transport. Transport to prevent excessive vibration considerations as battery internal components may be damaged leading to thermal run-away during commissioning. Pre-assembled containers will most likely be supplied. These will be fitted with the necessary protective measures by the supplier considering marine and road transport as well as lifting, setting down etc. Route selection to consider possible incidents along the way and suitable response, e.g., satellite tracking, mobile communication, 24/7 helpline response. Standard dangerous goods requirements for Hazmat labels, Transport Emergency Data i.e. Trem cards, driver trained in the hazards of the load. Likelihood similar to fire above.	Complex	4	3	3	5	3	**45**	4	3	3	5	2	**30**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 9:	Human and Equipment Safety - exposure to violent release of kinetic or potential energy	Causes - Construction moving equipment, heavy loaded, elevated loads, working at heights Consequences - Injury or possibly fatality. Damage to equipment. Delays in starting the project, financial losses	Construction	Negative	The construction phase will be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. SHEQ policy in place. A detailed construction Risk Assessment to be undertaken prior to work. SHE procedure in place. PPE to be specified. SHE appointees in place. Contractors safety files in place and up to date. SHE monitoring and reporting programs in place. Standard construction site rules regarding traffic, reversing sirens, rigging controls, cordoning off excavations etc. Civil and building structures to comply with the National Building Regulations and building Standards Act 103 of 1977, SANS 10400 and other relevant codes. Other constructions such as roads, sewers etc also to comply with relevant SANS standards. All normal procedures for working at heights, hot work permits, confined space entry, cordon off excavations etc to be in place before construction begins. Emergency response plan to be in place before construction begins.	Complex	5	1	5	5	4	**64**	5	1	5	5	1	**16**
							N4 - High						**N2 - Low**					
Impact 10:	Human and Equipment Safety - exposure to electromagnetic waves	Causes - Use of electrical machines, generators etc. Hot dry area static generation is highly likely. Lightning strike. Consequences - Electrocution. Ignition and burns. Injury and death. Damage to electrical equipment.	Construction	Negative	Standard maintenance of condition of electrical equipment and safe operating instructions. Ability to shut off power to systems in use on site. If persons are decanting fuels or dealing with other highly flammable materials care should be taken regarding possible static discharge, and installations to be suitably designed and maintained. Lightning strike rate in the study area is moderately low. Outside work must be stopped during thunderstorms.	Complex	5	2	5	5	3	**51**	5	2	5	5	1	**17**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
					Lighting conductors may be required for the final installation, to be confirmed during design phase.													
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 11:	Environment - emissions to air	Causes - Dust from construction and generally hot dry area. Consequences - Adverse impact on employee health.	Construction	Negative	May need to use dampening on roads etc. as per normal construction practices. May need PPE (dust masks) for specific construction workers.	Easy	3	2	1	1	4	**28**	2	2	1	1	2	**12**
						Significance	**N2 - Low**						**N1 - Very Low**					
Impact 12:	Environment - emissions to water	Causes - Diesel for equipment, paints and solvents. Transformer oil spills. Sewage and kitchen/mess area wastewater. Consequences - Environmental damage, particularly to the surface and underground water in the area.	Construction	Negative	Normal construction site practices for preventing and containing fuels/paint/oil etc spills. Bunding under any temporary tanks, curbing under truck offloading areas and sealed surfaces (e.g., concrete) under truck parking area is particularly important. Spill clean-up procedures to be in place before commencing construction. Sewage and any kitchen liquids - containment and suitable treatment/disposal	Moderate	2	2	3	2	3	**27**	2	2	3	2	2	**18**
						Significance	**N2 - Low**						**N2 - Low**					
Impact 13:	Environment - emissions to earth	Causes - Mess area and other solid waste. Consequences - Environmental damage.	Construction	Negative	There will be packaging materials that will need to be disposed of after the entire system is connected and commissioned as well as after regular maintenance. There will need to be waste segregation (e.g., electronic equipment, chemicals) and management on the site.	Easy	2	2	3	3	3	**30**	1	2	3	3	2	**18**
						Significance	**N2 - Low**						**N2 - Low**					
Impact 14:	Environment - waste of resources e.g., water, power etc	Causes - Water usage not controlled. Battery containers damaged.	Construction	Negative	Water usage to be monitored on site during construction. Handling protocols to be provided by battery supplier. End of Life plan needs to be in place before any battery containers enter the country as there may be	Easy	1	1	1	2	4	**20**	1	1	1	2	2	**10**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
		Consequences - Delays.			damaged battery unit from day 1. Water management plan and spill containment plans to be in place.													
							N2 - Low						N1 - Very Low					
Impact 15:	Public - Aesthetics	Causes - Bright surfaces reflecting light. Tall structures in a flat area. Consequences - Irritation.	Construction	Negative	Refer to the visual impact assessment undertaken as part of the EIA.	Moderate	2	2	3	3	3	**30**	2	2	3	3	3	**30**
						Significance	N2 - Low						N2 - Low					
Impact 16:	Investors - Financial	Causes - Defective technology. Extreme project delays. Consequences - Financial loss	Construction	Negative	Design by experienced contractors using internationally recognized and proven technology. Project management with deviation monitoring.	Moderate	5	1	3	4	3	**39**	3	1	3	4	2	**22**
						Significance	N3 - Moderate						N2 - Low					
Impact 17:	Employees and investors - Security	Causes - On route, potential hi-jacking of valuable but hazardous load. On site, theft of construction equipment and battery installation facilities. Civil unrest or violent strike by employees. Consequences - Theft. Injury to burglars. Damage to equipment possibly setting off thermal runaway.	Construction	Negative	Fencing around electrical infrastructure to SANS standard and Eskom Guidelines. The hazardous nature of the electrical and battery equipment should be clearly indicated – e.g., Skull and Cross Bones or other signs. Isolated location both helps and hinders security. Night lighting to be provided both indoors and outdoors where necessary.	Complex	4	1	3	2	4	**40**	3	1	3	2	3	**27**
						Significance	N3 - Moderate						N2 - Low					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 18:	Emergencies	Causes - Fires, explosions, toxic smoke, large spills, traffic accidents, equipment/structural collapse. Inadequate emergency response to small event leads to escalation. Consequences - Injuries turn to fatalities, small losses become extended down time.	Construction	Negative	All safety measures listed above. Emergency procedures need to be practiced prior to commencement of construction. If batteries are stored at 50% charge, thermal run away can happen while in storage on site waiting for installation. In addition, if involved in an external fire thermal run away can happen even with uncharged batteries. Except during shipping, ideally the units should not be stored any closer to each other than they would be in the final installation so that propagation is prevented, i.e. laydown area needs to be considered. The company in charge of the containers at each stage in the transport process needs to be very clear so that responsibility for the integrity of the load and protection of the persons involved in transfer and coordination of emergency response on-route. E.g., if purchased from Tesla where does hand over occur to the South African contractor / owner, at the factory door in USA, at the port in RSA, at the site fence. For example, who will be accountable if there's thermal runway event on a truck with a container that stops in a small town for driver refreshments.	Complex	4	2	3	5	4	**56**	4	2	3	5	2	**28**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 19:	Investors - Legal	Causes - Battery field is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. Consequences - Unknown hazards manifest due to using "cheaper supplier or less developed technology".	Construction	Negative	Use only internationally reputable battery suppliers who comply with all known regulations/guideline at the time of purchasing. Where reasonably practicable ensure only "state of the art" battery systems are used and not old technologies prone to fires/explosions etc.	Moderate	3	1	3	3	4	**40**	2	1	3	3	2	**18**
						Significance	**N3 - Moderate**						**N2 - Low**					

The above Risk Assessment shows that provided the preventative and mitigative measures are incorporated, the construction phase of the project does not present any high risks nor any fatal flaws. The average raw risk significance is rated as moderate, and the average residual risk is rated as low.

TABLE 15.4.1.2 - OPERATIONAL PHASE (Including Commissioning – i.e. initial testing of the systems and first powerup of batteries)

From the details of accidents that have happened both with BESS installations and chemical plants in general, it is clear that many potential problems manifest during the commissioning phase when units are first powered up to test functionality. This phase is critical and all controls, procedures, mitigation measures etc that would be in place for full operation should be in place before commissioning commences.

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 1a:	Human Health - chronic exposure to toxic chemical or biological agents	Causes - Operation and maintenance materials spare parts, paints, solvents, welding fumes, transformers oils, lubricating oils and greases etc. Consequences - Occupational illness.	Operation	Negative	The operation and maintenance phase will be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993. SHEQ policy in place. A detailed Risk Assessment of all normal operating and maintenance activities on site to be compiled, and form the basis of operating instructions, prior to commencing commissioning. SHE procedure in place, e.g., PPE specified, management of change, integrity monitoring. SHE appointees in place. Training of staff in general hazards on site. All necessary health controls/ practices to be in place, e.g., ventilation of confined areas, occupational health monitoring if required and reporting programs in place. Emergency response plan for full operation and maintenance phase to be in place prior to beginning commissioning and to include aspects such as: - appointment of emergency controller, - emergency isolation systems for electricity, - -emergency isolation and containment systems for electrolyte, - provision of PPE for hazardous materials response, - provision of emergency facilities for staff at the main office building, - provision of first aid facilities, - first responder contact numbers etc.	Easy	2	1	3	4	5	**50**	1	1	3	4	2	**18**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 1b:	Human Health - chronic exposure to toxic chemical or biological agents	Causes - Compromised battery compartments vapours accumulate in the containers, solids/liquids on surfaces. Maintenance of battery components, corrosive and mildly toxic liquid on surfaces. Consequences - Dermatitis, skin /eye/lung irritation.	Operation	Negative	Solid state batteries sealed, individual batteries in modules which are also sealed, pre-packed in the container. Maintenance procedures will be in place should equipment need to be opened, e.g., pumps drained and decontaminated prior to repair in workshop etc. PPE will be specified for handling battery parts and other equipment on site. Training of staff in hazards of chemicals on site. Possible detectors with local alarms if regulated occupational exposure limits are exceeded etc prior to entry for inspection of battery containers. Labelling of all equipment. Confined space entry procedures if entering tanks. There needs to be careful thought given to procedures to be adopted before entering into the BESS or a container particularly after a Battery management System (BMS) shut down where there may be flammable or toxic gases present, a fire etc. Safety Data Sheets (SDSs) to be available on site. Operating manuals to be provided including start-up, shut-down, steady state, monitoring requirements. Maintenance manuals with make safe, decontamination and repair procedures. Proposed maintenance schedules e.g., checklists for weekly, monthly, annual etc. Provided portable equipment for calibration and for testing/verification of defective equipment, e.g., volt/current meters, infrared camera	Complex	3	1	3	5	4	**48**	1	1	3	5	2	**20**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 2:	Human Health - exposure to noise	Causes - Moving parts inside containers, buildings, pumps, compressors, cooling systems etc. Consequences - Adverse impact on hearing of workers. Nuisance factor at	Operation	Negative	Design to ensure continuous noise does not exceed 85dB within the facilities or at any other location on site or 61 dB at the site boundary, e.g., emergency generator, air compressor etc. Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.	Easy	2	1	5	5	4	**52**	2	1	5	5	2	**26**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
		near-by residences or other activities.																
						Significance	N3 - Moderate						N2 - Low					
Impact 3:	Human Health - exposure to temperature extremes and/or humidity	Causes - Heat during the day. Batteries generate heat within enclosed building / containers. Cold in winter. Night work requires lighting. Consequences - Heat stroke. Hypothermia.	Operation	Negative	Building and container facilities to comply with Occupational Health and Safety Act 85 of 1993 specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. Ensure containers are temperature controlled as required to remain within the optimal battery operating temperature range. Lighting to be provided inside any buildings, inside the containers, possibly linked to the door opening and outdoors where necessary. Adequate potable water to be provided during all phases of the project. Suitable lighting to be provided including emergency lighting for safe building exit in the event of power failure. PPE for operations and maintenance staff to be suitable for the weather conditions.	Easy	4	2	3	1	2	**20**	3	2	3	1	1	**9**
						Significance	N2 - Low						N1 - Very Low					
Impact 4:	Human Health - exposure to psychological stress	Causes - Isolated workstation and monotonous repetitive work. Consequences - Low performance, system productivity suffers.	Operation	Negative	Staff rotation to other activities within the site may be necessary. Performance monitoring of inspections / maintenance tasks in particular will be necessary.	Easy	2	3	3	2	2	**20**	1	3	3	2	1	**9**
						Significance	N2 - Low						N1 - Very Low					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 5:	Human Health - exposure to ergonomic stress	Causes - Lifting heavy equipment. Awkward angles during maintenance, stretching reaching to high level and bending to low level. Working at height if equipment located on top of roofs or elevated electrical equipment (e.g., pylons). Consequences - Back and other injuries.	Operation	Negative	Training in lifting techniques. Training in working at heights. If equipment is at height (see OHS Act General Safety Regulation 6), ensure suitable safe (electrically and physically) ladders / harnesses etc. are available. Working at height procedure to be in place.	Easy	5	1	3	2	3	**33**	4	1	3	2	2	**20**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 6a:	Human and Equipment Safety - exposure to fire radiation	Causes – Involvement in an external fire e.g., veld fire, maintenance vehicle fire, electrical systems fire. Manufacturing defects or damage to battery leading to shorting and heating. High humidity condensation of water or ingress of water or flooding leading to shorting. Dust accumulation on electrical parts leading to overheating. Excessive electrical loads - surges Operator abuse BMS failure or software failure. Incorrect extinguishing medium, escalate the fire. Consequences - Contaminated run off. Radiation burns unlikely to be severe as no highly flammable materials on site. Damaged equipment. Fire spreads to other	Operation	Negative	Grass cutting and fire breaks around the BESS installations to prevent veld fires. No combustible materials to be stored in or near the batteries or electrical infrastructure. Separation of site diesel tank, transformers from BESS and vice versa. Suggested minimum separation from substation is 20m. There are BESS design codes from the USA and standards of practice that can be used e.g., UL9540, NFPA 855 and DNV GL RP 43. Detailed Failure Modes and Effect Analysis (FMEA)/Hazop/Bowtie to be done during design at the component level and system levels. Safety integrity level rating of equipment (failure probably) with suitable redundancy if required. Site Acceptance Testing as part of commissioning of each unit and the overall system. Abuse tests conducted by supplier. BMS should be checking individual cell voltage as well as stack, module, container, system voltages/current etc. BMS tripping the cell and possibly the stack/ building unit or module/rack/container, if variations in voltage. Diagnostics easily accessible. Diagnostics able to distinguish cell from stack or cell from module faults. Protective systems are only as good as their reliability and functionality testing is important, e.g., testing that all battery trips actually work. Fire resistant barrier between the batteries and the PCS side if in the same container, or separate containers. Suitable ingress protection level provided for electrical equipment, e.g., IP55 - 66. If air cooling into container, suitable dust filters to be provided. Smoke detectors linked to BMS & alerts in control room. Effects of battery aging to be considered. Solid state battery life starts to be impacted above 40 deg C and significant impacts above 50 deg C with thermal run away starting at 65-70 deg C. BMS trips system at 50 deg C. Temperature monitoring to be in place. Regular infrared scanning. Data needs to be stored for trend analysis. Data indicates an event frequency of 0.001 per	Complex	5	1	5	5	4	**64**	5	1	5	5	1	**16**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
		units or offsite if grass/vegetation not controlled.			installation and with up to 700 units this would mean an event once 2 years, i.e. a high probability event. Most events will be small not resulting in injuries, but this is possible if the event is not controlled. Prior to commencement of cold commissioning, emergency plan from transport and construction phase to be extended to operational phase and to include the hazards of the electrically live system. Procedure to address solid state container fires – extinguishing, ventilating, entering as appropriate or not. PPE for container firefighting include fire retardant, chemically resistant, nitrile gloves, antistatic acid resistant boots, fill face shields, BA sets. A planned fire response to prevent escalation to an explosion or an environmental event. Suitable supply of fire extinguishing medium and cooling medium Consider fire water for cooling adjacent equipment – BESS units. Can use fogging nozzles to direct smoke. Ensure procedures in place for clean up after event Lingering HF and other toxic residues in the soil and on adjacent structures. Procedures to be in place for Infra-red (IR) scanning (or other suitable method) to determine if batteries are still smouldering / are sufficient cooled to handle as batteries may still be active some weeks after an event. Smoke or gas detector systems that are not part of the original battery container package, need to be linked to the main control panel for the entire system so that issues can be detected and responded to rapidly.													
						Significance	**N4 - High**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 6b:	Human and Equipment Safety - exposure to fire radiation	Causes - Power Conversion System (PCS – DC to AC) cooling failure, electrical fire. Consequences - Fire starts in PCS or another section or room and spreads to battery area.	Operation	Negative	Modern lithium container design places the PCS in another part of the container with a fire rated wall separating it from the battery. Alternately the PCS in another container altogether.	Moderate	5	2	5	5	4	**68**	5	2	5	5	1	**17**
						Significance	**N4 - High**						**N2 - Low**					
Impact 7:	Human and Equipment Safety - exposure to explosion over pressures	Cause 1 - Transformer shorting / overheating / explosion. Cause 2 - Flammable gases generated by thermal run away reach explosive limits. Ignition on hot surfaces, static. Lithium Cobalt Oxide generates O2 during decomposition – escalation. Consequences - Potential fatalities amongst first responders. Damage to container or other nearby items, e.g., other container.	Operation	Negative	Electrical equipment will be specified to suit application. Emergency response plan and employee training referred to above is to be in place. This is only really likely to happen due to possible inappropriate emergency response, e.g., opening containers when they may be the type that should be left to burn out. Modern state of the art containers have ventilation systems for vapours. Undertake a hazardous area classification of the inside of the container to confirm the rating of electrical equipment, due to possible leaks of electrolyte or generation of flammable gases under thermal run away. Emergency response plan and employee training referred to above is critical. Suitable training of selected emergency responders who may be called out to the facilities is critical. NOTE. Refer to Appendix A for an initial approximation of worst-case possible explosion impact zones.	Moderate	5	1	5	5	2	**32**	5	1	5	5	1	**16**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 8a:	Human and Equipment Safety - exposure to acute toxic chemical and biological agents	Causes Human pathogens and diseases, sewage, food waste. Snakes, insects, wild and domesticated animals and harmful plants. Consequences - Illness and at worst without mitigation, possibly extending to fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc	Operation	Negative	All necessary good hygiene practices to be in place, e.g., provision of sanitation facilities, eating areas, infectious disease controls. Policies and practice for dealing with known vectors of disease such as AIDS, TB, COVID 19 and others. Awareness training for persons on site, safety induction to include animal hazards. First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. Due to isolated locations some distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts	Moderate	4	1	3	2	3	**30**	3	1	2	2	2	**16**
						Significance	**N2 - Low**						**N2 - Low**					
Impact 8b:	Human and Equipment Safety - exposure to acute toxic chemical and biological agents	Causes - Damaged batteries components, leak electrolyte, are completely broken exposing hazardous chemicals. Hazardous fumes released on thermal run away see fire above. Consequences - Impacts can vary from mild skin irritation from exposure to small leaks to serious corrosive burns for large exposure.	Operation	Negative	Acid resistant PPE (e.g., overalls, gloves, eyeglasses) to be specified for all operations in electrolyte areas. PPE to be increased (e.g., full-face shield, aprons, chemical suits) for operations that involve opening equipment and potential exposure, e.g., sampling, maintenance. All operators/maintenance staff trained in the hazards of chemicals on site. Batteries contained, modules contained and all inside a container that acts as bund. Refer to fire above as all the protective measures apply to prevent toxic smoke. Refer to fire above as all the measures apply to mitigate toxic smoke. 24/7 helpline response. Standard dangerous goods requirements for Hazmat labels. All operators/maintenance staff trained in the	Moderate	4	3	3	5	3	**45**	3	3	3	5	2	**28**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
		In the case of toxic fumes, serious lung damage.			hazards. NOTE Refer to Appendix A for an initial approximation of worst case possible noxious smoke impact zones.													
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 9:	Human and Equipment Safety - exposure to violent release of kinetic or potential energy	Causes - Moving equipment, pumps, heavy equipment at elevation, nip points, working at heights. Traffic accidents. Earthquake / tremor. Consequences - Injury. Fatality in unlikely worst case, e.g., traffic accidents or fall from heights. Damage to equipment, spills, environment pollution	Operation	Negative	Apart from pumps, no major moving parts during operation. Maintenance equipment to be serviced and personnel suitably trained in the use thereof. Normally just small vehicles on site, bakkies, grass cutting, cherry-pickers etc. Possibly large cranes if large equipment or elevated structure removed/replaced. Traffic signs, rules etc in place on site. All normal working at heights, hot work permits, confined space entry, cordon off unsafe areas/works etc to be in place. Emergency response plan. Civil design to take seismic activity into account.	Moderate	5	1	5	5	3	**48**	5	1	5	5	1	**16**
							N3 - Moderate						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 10:	Human and Equipment Safety - exposure to electromagnetic waves	Causes - Use of electrical machines, generators etc. Hot dry area static generation is highly likely. Lightning strike. Consequences - Electrocution. Ignition and burns. Injury and death. Damage electrical equipment.	Operation	Negative	Codes and guidelines for electrical insulation. Suitable PPE to be specified. Low voltage equipment (e.g., batteries) separated from high voltage equipment (e.g. transmission lines), minimum is 20m. Ensure trained personnel and refer to guideline – IEE 1657 – 2018. Ensure compliance with Eskom Operating Regulations for high voltage systems including access control, permit to work, safe work procedures, live work, abnormal and emergency situations, keeping records. Electromagnetic fields, impact on other equipment e.g., testing devices, mobile phones – malfunction, permanent damage. Software also need to be kept as update to date as reasonably practicable. Consider suitably located Emergency stop buttons for the facility and the other equipment on site. PPE to consider static accumulation for entering the facility, and particularly the battery containers especially after a high temperature shut down where there could possibly be flammable materials. The procedures for responding to alarm and auto shut down on containers, needs to consider that there may be a dangerous environment inside and how to protect personnel who may enter to respond. Lightning strike rate in proposed development area is moderate. All outside work must be stopped during thunder storms. Lighting conductors may be required for the installation, to be confirmed during design	Complex	5	2	5	5	3	**51**	5	2	5	5	1	**17**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 11:	Environment - emissions to air	Not expected on a normal basis. Refrigerant may be an asphyxiant if accidentally released	Operation	Negative	Especially after any warning alarms have gone off, but possibly even normally the container could be treated as entering a confined space and similar procedures could be in place, e.g., do not enter	Easy	3	1	1	1	3	**18**	3	1	1	1	1	**6**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
		indoors it can accumulate and displace oxygen.			alone, gas testing prior to entering, ensure adequate ventilation.													
						Significance	**N2 - Low**						**N1 - Very Low**					
Impact 12:	Environment - emissions to water	Causes - Cooling water blow-down. Laboratory waste (if included in the design). Maintenance waste, e.g., oils. Spills from batteries, coolant system, diesel trucks, transformers. Parked vehicles – oil drips. Fire water runoff control. Kitchen waste and sewage. Refrigerant release. Consequences - Pollution if not contained. Excessive disposal costs if emissions not limited.	Operation	Negative	Bunding under any outdoors tanks, curbing under truck offloading areas and sealed surfaces (e.g., concrete) under truck parking area is particularly important. Sewage and any kitchen liquids - containment and suitable treatment/disposal. Procedures for dealing with damaged/leaking equipment as well as clean-up of spills. Normal site practices for preventing and containing diesel/paint etc spills. Waste management plan to be in place e.g., liquid waste treatment or suitable removal and disposal will be provided. Spill clean-up procedures to be in place before bringing container on site, including spill kits – non-combustible materials, hazmat disposal. The National Environment Management Act (NEMA) Section 30, the DEA Guidelines have a list of hazard categories with Reportable spill Quantities, ensure compliance with this by listing all materials on site, their hazard categories and determining the spill thresholds for reporting.	Moderate	2	2	3	2	3	**27**	2	2	3	2	2	**18**
						Significance	**N2 - Low**						**N2 - Low**					
Impact 13:	Environment - emissions to earth	Causes - Mess area and other solid waste. Disposal of solid-state batteries. Consequences - Environmental damage.	Operation	Negative	Implement waste segregation (e.g., electronic equipment, chemicals, domestic) and management on the site.	Easy	2	2	3	3	3	**30**	2	2	3	3	1	**10**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
						Significance	N2 - Low						N1 - Very Low					
Impact 14:	Environment - waste of resources e.g., water, power etc	Causes - Similar to construction phase. Disposal of batteries or components. Disposal of containers. Water usage not controlled. Consequences - Delays. Excessive costs and disposal of large volumes of hazardous waste.	Operation	Negative	Water usage to be monitored on site. Handling protocols to be provided by supplier of batteries. Water management plan and spill containment plans to be in place. Investigate end of Life plan for solid state batteries - reuse / recovery / reconditioning. Similarly, for decommissioned containers – reuse / recovery / repurpose	Easy	1	1	1	2	4	**20**	1	1	1	2	2	**10**
							N2 - Low						N1 - Very Low					
Impact 15:	Public - Aesthetics	Causes - Bright surfaces reflecting light. Tall structures in a flat area. Consequences - Irritation.	Operation	Negative	Refer to the Visual Impact Assessment undertaken as part of the EIA.	Easy	1	2	4	4	2	**22**	1	2	4	4	2	**22**
						Significance	N2 - Low						N2 - Low					
Impact 16:	Investors - Financial	Causes - Defective technology. Extreme project delays. Consequences - Financial loss	Operation	Negative	Operation by experienced personnel using internationally recognized and proven technology operating procedures. Operations management with deviation monitoring.	Easy	5	1	3	4	3	**39**	3	1	3	4	2	**22**
						Significance	N3 - Moderate						N2 - Low					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 17a:	Employees and investors - Security	Causes - On route, potential hi-jacking of valuable but hazardous load. On site, theft of construction equipment and battery installation facilities. Civil unrest or violent strike by employees. Consequences - Theft. Injury to burglars. Damage to equipment possibly setting off thermal runaway.	Operation	Negative	Fencing around electrical infrastructure to SANS standard and Eskom Guidelines. Consider motion detection lights and CCTV. The hazardous nature of the electrical and battery equipment should be clearly indicated – e.g., Skull and Cross Bones or other signs. Isolated location both helps and hinders security. Night lighting to be provided both indoors and outdoors where necessary.	Moderate	3	1	3	2	4	**36**	3	1	3	2	2	**18**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 17b:	Employees and investors - Security	Causes - Cyber security attacks aimed at the National Electricity Grid. Consequences - Ransom of the National Electricity Grid.	Operation	Negative	Cyber security needs monitoring. Remote access to system needs to be negotiated and controlled e.g. Password controls, levels of authority etc.to ensure protection of the National Electricity Grid from Cyber-attacks accessing through the BESS. Cyber emergency procedures – should be in place prior to commissioning.	Complex	4	4	3	1	4	**48**	4	4	3	1	2	**24**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 18:	Emergencies	Causes - Fires, explosions, toxic smoke, large spills, traffic accidents, equipment/structural collapse. Inadequate emergency response to small event leads to escalation. Consequences - Injuries turn to fatalities, small losses become extended down time.	Operation	Negative	All safety measures listed above. Emergency procedures need to be practiced prior to commencement of operations. Escape doors should swing open outwards and not into the container. Doors should be able to be hooked open when persons are inside the container, i.e. they should not be automatically self-closing. More than one exit from buildings. Storage of spare batteries (e.g., in stores on site or elsewhere) also needs to consider possible thermal run away.	Complex	4	2	3	4	3	**39**	4	2	3	4	2	**26**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 19:	Investors - Legal	Causes Battery field is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. Consequences - Unknown hazards manifest due to using "cheaper supplier or less developed technology".	Operation	Negative	Use only internationally reputable battery suppliers who comply with all known regulations/guideline at the time of purchasing. Where reasonably practicable ensure only "state of the art" battery systems are used and not old technologies prone to fires/explosions etc.	Moderate	3	1	3	3	4	**40**	3	1	3	3	2	**20**
						Significance	**N3 - Moderate**						**N2 - Low**					

The above Risk Assessment shows that, provided the preventative and mitigative measures are incorporated, the operational phase of the project does not present any high risks nor any fatal flaws. The average raw risk significance is rated as moderate, and the average residual risk is rated as low.

TABLE 15.4.1.3 - DECOMMISSIONING PHASE

Battery components may have a limited lifespan, there are damaged equipment etc. There could already be "waste" on the first day of commissioning and plans should be in place to deal with this. Ideally an End-of-Life plan needs to be in place before the first BESS container / equipment is brought on site.

All decommissioning activities must comply with the relevant regulations at the time. Decommissioning will ultimately need to be informed by the regulatory requirements at the time, which may be different to present requirements. The exact risk ratings are not possible to determine now given the uncertainties in mitigations applicable at that time. Except for the actual physical disposal to ground and its legal aspects the ratings for all other hazards have been left as neural and the mitigation measures applied to the hazards during the construction and operational phases would also be applicable during de-commissioning.

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 1:	Human Health - chronic exposure to toxic chemical or biological agents	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 2:	Human Health - exposure to noise	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 3:	Human Health - exposure to temperature extremes and/or humidity	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 4:	Human Health - exposure to psychological stress	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
						Significance	#N/A						#N/A					
Impact 5:	Human Health - exposure to ergonomic stress	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 6:	Human and Equipment Safety - exposure to fire radiation	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 7:	Human and Equipment Safety - exposure to explosion over pressures	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 8:	Human and Equipment Safety - exposure to acute toxic chemical and biological agents	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 9:	Human and Equipment Safety - exposure to violent release of kinetic or potential energy	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
							#N/A						#N/A					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 10:	Human and Equipment Safety - exposure to electromagnetic waves	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 11:	Environment - emissions to air	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 12:	Environment - emissions to water	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 13:	Environment - emissions to earth	Causes - Batteries / equipment reached end of life and may leak. Consequences - Environment damage from heavy metal ions.	De-commission	Negative	End of Life shutdown procedure including a Risk Assessment of the specific activities involved. Where possible re-purpose the solid-state batteries / containers and equipment with associated environmental impact considered. Disposal according to local regulations and other directives such as the European Batteries Directive, where relevant. End of life, which is affected by temperature and time, cycles etc, should be predefined and the monitoring should be in place to determine if it has been reached.	Complex	4	3	3	5	4	**60**	4	3	3	5	2	**30**
						Significance	N3 - Moderate						N2 - Low					
Impact 14:	Environment - waste of resources e.g., water, power etc	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 15:	Public - Aesthetics	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 16:	Investors - Financial	Similar to the construction n and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 17:	Employees and investors - Security	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 18:	Emergencies	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 19:	Investors - Legal	Disposal of hazardous “waste” is rife with difficulties and numerous regulations that need to be complied with.	De-commission	Negative	Applicants should seek the opinion from a waste consultant on how to correctly dispose of hazardous waste.	Complex	3	1	3	3	4	**40**	3	1	3	3	3	**30**
						Significance	**N3 - Moderate**						**N2 - Low**					

As noted above, it is not possible to provide exact ratings for most impacts predicted during the decommissioning phase based on various factors. However, from an emissions and leakage perspective, recommended mitigation measures and a preliminary significance rating has been provided, which have a raw risk rating as moderate and residual risk as low.

15.4.2 VANADIUM REDOX FLOW BATTERY ENERGY STORAGE SYSTEMS

TABLE 15.4.2.1 - CONSTRUCTION PHASE (Excluding commissioning i.e. filling the system with electrolyte, testing and initial powerup of the batteries)

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 1:	Human Health - chronic exposure to toxic chemical or biological agents	Causes - Construction materials such as cement, paints, solvents, welding fumes, truck fumes etc. Consequences - Employee / contractor illness.	Construction	Negative	The construction phase will be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. SHEQ policy in place. A detailed construction Risk Assessment to be undertaken prior to work. SHE procedure in place. PPE to be specified. SHE appointees in place. Contractor's safety files in place and up to date. All necessary health controls/ practices to be in place, e.g., ventilation of welding and painting areas. SHE monitoring and reporting programs in place. Emergency response plan to be in place prior to beginning construction and to include aspects such as appointment of emergency controller, provision of first aid, first responder contact numbers.	Moderate	3	1	3	4	4	**44**	1	1	3	4	2	**18**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 2:	Human Health - exposure to noise	Causes - Drilling, piling, generators, air compressors. Consequences - Adverse impact on hearing of workers. Possible nuisance factor in near-by areas.	Construction	Negative	OHS Act Noise Induced Hearing Loss Regulations. Health Risk Assessment to determine if equipment noise exceeds 85dB at workstation and 61dB at boundary of the site Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.	Easy	3	1	5	5	4	**56**	2	1	5	5	2	**26**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 3:	Human Health - exposure to temperature extremes and/or humidity	Causes - Heat during the day. Cold in winter. Consequence - Heat stroke. Hypothermia.	Construction	Negative	Construction site facilities to comply with Occupational Health and Safety Act 85 of 1993, specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. Adequate potable water for employees to be provided during all phases of the project. Bore hole, bowser and tank or small water treatment plant may be required to provide potable water for the employees during all phases of the project. Geohydrology Assessment has been conducted during the EIA Phase to assess the impact of the use of groundwater.	Easy	3	2	3	1	2	**18**	2	2	3	1	1	**8**
						Significance	**N2 - Low**						**N1 - Very Low**					
Impact 4:	Human Health - exposure to psychological stress	Causes - Large projects bring many contractor workers into a small, isolated community. Consequences – Lack of sufficient accommodation, entertainment etc. Increase in alcohol abuse, violence	Construction	Negative	Refer to the Socio-Economic Specialist Study undertaken as part of the EIA for this project.	Easy	2	3	3	2	2	**20**	2	3	3	2	2	**20**
						Significance	**N2 - Low**						**N2 - Low**					
Impact 5:	Human Health - exposure to ergonomic stress	Causes - Lifting heavy equipment. Awkward angles during construction. Consequences - Back and other injuries.	Construction	Negative	Training in lifting techniques. Ensure that despite the isolated location all the necessary equipment is available (and well maintained) during construction. Otherwise, employees may revert to unsafe practices. Ensure this is in place prior to project commencement Ensure first aid provision on site.	Moderate	4	1	3	2	3	**30**	4	1	3	2	2	**20**
						Significance	**N2 - Low**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 6:	Human and Equipment Safety - exposure to fire radiation	Causes – Involvement in an external fire. Fire involving fuels used in construction vehicles or vehicles themselves (e.g., tyre fire). Fire due to uncontrolled welding or other hot-work Consequences - Injuries due to radiation especially amongst first responders and bystanders. Fatalities unlikely from the heat radiation as not highly flammable nor massive fire.	Construction	Negative	Fuels stored on site in dedicated, demarcated and bunded areas. Suitable fire-fighting equipment on site near source of fuel, e.g., diesel tank, generators, mess, workshops etc. The company responsible for the facility at this stage is to have: 1. Emergency plan to be in place prior to commencement of construction. 2. Fuel spill containment procedures and equipment to be in place. 3. Hot-work permit and management system to be in place.	Complex	4	2	3	5	4	**56**	4	2	3	5	2	**28**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 7:	Human and Equipment Safety - exposure to explosion over pressures	No credible causes	Construction	Negative	None identified due to no credible causes.	N/A	1	1	1	1	1	**4**	1	1	1	1	1	**4**
						Significance	**#N/A**						**#N/A**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 8:	Human and Equipment Safety - exposure to acute toxic chemical and biological agents	Causes Human pathogens and diseases, sewage, food waste. Snakes, insects, wild and domesticated animals and harmful plants. Consequences - Illness and at worst without mitigation, possibly extending to fatalities. Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc.	Construction	Negative	All necessary good hygiene practices to be in place, e.g., provision of sanitation facilities, eating areas, infectious disease controls. Policies and practice for dealing with known vectors of disease such as AIDS, TB, COVID 19 and others. Awareness training for persons on site, safety induction to include animal hazards. First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. Due to isolated locations some distance from town, the ability to treat with anti-venom and extreme allergic reactions on site is critical to mitigate the impacts.	Complex	4	2	3	2	3	**33**	3	2	3	2	2	**20**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 9:	Human and Equipment Safety - exposure to violent release of kinetic or potential energy	Causes - Construction moving equipment, heavy loaded, elevated loads, working at heights Consequences - Injury or possibly fatality. Damage to equipment. Delays in starting the project, financial losses	Construction	Negative	The construction phase will be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993 specifically the Construction Regulations. SHEQ policy in place. A detailed construction Risk Assessment to be undertaken prior to work. SHE procedure in place. PPE to be specified. SHE appointees in place. Contractors safety files in place and up to date. SHE monitoring and reporting programs in place. Standard construction site rules regarding traffic, reversing sirens, rigging controls, cordoning off excavations etc. Civil and building structures to comply with the National Building Regulations and building Standards Act 103 of 1977, SANS 10400 and other relevant codes. Other constructions such as roads, sewers etc also to comply with relevant SANS standards. All normal procedures for working at heights, hot work permits, confined space entry, cordon off excavations etc to be in place before construction begins. Emergency response plan to be in place before construction begins.	Complex	5	1	5	5	4	**64**	5	1	5	5	1	**16**
							N4 - High						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 10:	Human and Equipment Safety - exposure to electromagnetic waves	Causes - Use of electrical machines, generators etc. Hot dry area static generation is highly likely. Lightning strike. Consequences - Electrocution. Ignition and burns. Injury and death. Damage electrical equipment.	Construction	Negative	Standard maintenance of condition of electrical equipment and safe operating instructions. Ability to shut off power to systems in use on site. If persons are decanting fuels or dealing with other highly flammable materials care should be taken regarding possible static discharge, and installations to be suitably designed and maintained. Lightning strike rate in the study area is moderately low. Outside work must be stopped during thunderstorms. Lighting conductors may be required for the final installation, to be confirmed during design phase. Risk to and from electricity transmission pylons, suggest separation at least the pylon fall height, e.g. >10m for 10m tall pylons.	Complex	5	2	5	5	3	**51**	5	2	5	5	1	**17**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 11:	Environment - emissions to air	Causes - Dust from construction and generally hot dry area. Consequences - Adverse impact on employee health.	Construction	Negative	May need to use dampening on roads etc. as per normal construction practices. May need PPE (dust masks) for specific construction workers.	Easy	3	2	1	1	4	**28**	2	2	1	1	2	**12**
						Significance	**N2 - Low**						**N1 - Very Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 12:	Environment - emissions to water	Causes - Diesel for equipment, paints and solvents. Transformer oil spills. Sewage and kitchen/mess area wastewater. Consequences - Environmental damage, particularly to the surface and underground water in the area.	Construction	Negative	Normal construction site practices for preventing and containing fuels/paint/oil etc spills. Bunding under any temporary tanks, curbing under truck offloading areas and sealed surfaces (e.g., concrete) under truck parking area is particularly important. Spill clean-up procedures to be in place before commencing construction. Sewage and any kitchen liquids - containment and suitable treatment/disposal	Moderate	2	2	3	2	3	**27**	2	2	3	2	2	**18**
						Significance	**N2 - Low**						**N2 - Low**					
Impact 13:	Environment - emissions to earth	Causes - Mess area and other solid waste. Consequences - Environmental damage.	Construction	Negative	There will be packaging materials that will need to be disposed of after the entire system is connected and commissioned as well as after regular maintenance. There will need to be waste segregation (e.g., electronic equipment, chemicals) and management on the site.	Easy	2	2	3	3	3	**30**	1	2	3	3	2	**18**
						Significance	**N2 - Low**						**N2 - Low**					
Impact 14:	Environment - waste of resources e.g., water, power etc	Causes - Water usage not controlled. Battery equipment damaged. Consequences - Delays.	Construction	Negative	Water usage to be monitored on site during construction. Handling protocols to be provided by battery supplier. Water management plan and spill containment plans to be in place.	Easy	1	1	1	2	4	**20**	1	1	1	2	2	**10**
							N2 - Low						**N1 - Very Low**					
Impact 15:	Public - Aesthetics	Causes - Bright surfaces reflecting light. Tall structures in a flat area. Consequences - Irritation.	Construction	Negative	Refer to the visual impact assessment undertaken as part of the EIA.	Moderate	3	2	3	4	4	**48**	1	2	3	4	2	**20**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 16:	Investors - Financial	Causes - Defective technology. Extreme project delays. Consequences - Financial loss	Construction	Negative	Design by experienced contractors using internationally recognized and proven technology. Project management with deviation monitoring.	Moderate	5	1	3	4	3	**39**	3	1	3	4	2	**22**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 17:	Employees and investors - Security	Causes - On route, potential hi-jacking of valuable but hazardous load. On site, theft of construction equipment and battery installation facilities. Civil unrest or violent strike by employees. Consequences - Theft. Injury to burglars. Damage to equipment possibly setting off thermal runaway.	Construction	Negative	Fencing around electrical infrastructure to SANS standard and Eskom Guidelines. The hazardous nature of the electrical and battery equipment should be clearly indicated – e.g., Skull and Cross Bones or other signs. Isolated location both helps and hinders security. Night lighting to be provided both indoors and outdoors where necessary.	Complex	4	1	3	2	4	**40**	3	1	3	2	3	**27**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 18:	Emergencies	Causes - Fires, explosions, toxic smoke, large spills, traffic accidents, equipment/structural collapse. Inadequate emergency response to small event leads to escalation. Consequences - Injuries turn to fatalities, small losses become extended down time.	Construction	Negative	All safety measures listed above. Emergency procedures need to be practiced prior to commencement of construction.	Complex	4	2	3	4	3	**39**	4	2	3	4	2	**26**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 19:	Investors - Legal	Causes Battery field is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. Consequences - Unknown hazards manifest due to using "cheaper supplier or less developed technology".	Construction	Negative	Use only internationally reputable battery suppliers who comply with all known regulations/guideline at the time of purchasing. Where reasonably practicable ensure only "state of the art" battery systems are used and not old technologies prone to fires/explosions etc.	Moderate	3	1	3	3	4	**40**	2	1	3	3	2	**18**
						Significance	**N3 - Moderate**						**N2 - Low**					

The above Risk Assessment shows that provided the preventative and mitigative measures are incorporated, the construction phase of the project does not present any high risks nor any fatal flaws. The average raw risk significance is rated as moderate, and the average residual risk is rated as low.

TABLE 15.4.2.2 - OPERATIONAL PHASE (Including Commissioning, e.g. filling the electrolyte into the tanks, testing the electrics, powering up the battery systems)

From the details of accidents that have happened both with BESS installations and chemical plants in general, it is clear that many potential problems manifest during the commissioning phase when units are first powered up to test functionality. This phase is critical and all controls, procedures, mitigation measures etc that would be in place for full operation should be in place before commissioning commences.

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 1a:	Human Health - chronic exposure to toxic chemical or biological agents	Causes - Operation and maintenance materials spare parts, paints, solvents, welding fumes, transformers oils, lubricating oils and greases etc. Consequences - Occupational illness.	Operation	Negative	The operation and maintenance phase will be managed according to all the requirements of the Occupational Health and Safety Act 85 of 1993. SHEQ policy in place. A detailed Risk Assessment of all normal operating and maintenance activities on site to be compiled, and form the basis of operating instructions, prior to commencing commissioning. SHE procedure in place, e.g., PPE specified, management of change, integrity monitoring. SHE appointees in place. Training of staff in general hazards on site. All necessary health controls/ practices to be in place, e.g., ventilation of confined areas, occupational health monitoring if required and reporting programs in place. Emergency response plan for full operation and maintenance phase to be in place prior to beginning commissioning and to include aspects such as: - appointment of emergency controller, - emergency isolation systems for electricity, - -emergency isolation and containment systems for electrolyte, - provision of PPE for hazardous materials response, - provision of emergency facilities for staff at the main office building, - provision of first aid facilities, - first responder contact numbers etc.	Easy	2	1	3	4	5	**50**	1	1	3	4	2	**18**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 1b:	Human Health - chronic exposure to toxic chemical or biological agents	Causes - Compromised battery compartments vapours accumulate in the containers, solids/liquids on surfaces. Maintenance of battery components, corrosive and mildly toxic liquid on surfaces. Consequences - Dermatitis, skin /eye/lung irritation.	Operation	Negative	VRFB Batteries facilities normally within buildings but may be containerized. Maintenance procedures will be in place should equipment need to be opened, e.g., pumps drained and decontaminated prior to repair in workshop etc. PPE will be specified for handling battery parts and other equipment on site. Training of staff in hazards of chemicals on site. Labelling of all equipment. Confined space entry procedures if entering tanks. Safety Data Sheets (SDSs) to be available on site. Operating manuals to be provided including start-up, shut-down, steady state, monitoring requirements. Maintenance manuals with make safe, decontamination and repair procedures. Proposed maintenance schedules e.g., checklists for weekly, monthly, annual etc. Provided portable equipment for calibration and for testing/verification of defective equipment, e.g., volt/current meters, infrared camera	Complex	2	1	3	5	4	**44**	1	1	3	5	2	**20**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 2:	Human Health - exposure to noise	Causes - Moving parts inside containers, buildings, pumps, compressors, cooling systems etc. Consequences - Adverse impact on hearing of workers. Nuisance factor at near -by residences or other activities.	Operation	Negative	Design to ensure continuous noise does not exceed 85dB within the facilities or at any other location on site or 61 dB at the site boundary, e.g., emergency generator, air compressor etc. Employees to be provided with hearing protection if working near equipment that exceeds the noise limits.	Easy	2	1	5	5	4	**52**	2	1	5	5	2	**26**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 3:	Human Health - exposure to temperature extremes and/or humidity	Causes - Heat during the day. Batteries generate heat within enclosed building / containers. Cold in winter. Night work requires lighting. Consequences - Heat stroke. Hypothermia.	Operation	Negative	Building and container facilities to comply with Occupational Health and Safety Act 85 of 1993 specifically the thermal, humidity, lighting and ventilation requirements of the Environmental Regulations for Workplaces. Night work is likely for VRFB. Suitable lighting to be provided including emergency lighting for safe building exit in the event of power failure. Adequate potable water to be provided during all phases of the project. PPE for operations and maintenance staff to be suitable for the weather conditions.	Easy	4	2	3	1	2	**20**	3	2	3	1	1	**9**
						Significance	**N2 - Low**						**N1 - Very Low**					
Impact 4:	Human Health - exposure to psychological stress	Causes - Isolated workstation and monotonous repetitive work. Consequences - Low performance, system productivity suffers.	Operation	Negative	Staff rotation to other activities within the site may be necessary. Performance monitoring of inspections / maintenance tasks in particular will be necessary.	Easy	2	3	3	2	2	**20**	1	3	3	2	1	**9**
						Significance	**N2 - Low**						**N1 - Very Low**					
Impact 5:	Human Health - exposure to ergonomic stress	Causes - Lifting heavy equipment. Awkward angles during maintenance, stretching reaching to high level and bending to low level. Working ta height if equipment located on top of electrolyte tanks, roofs or elevated electrical equipment (e.g., pylons). Consequences - Back and other injuries.	Operation	Negative	Training in lifting techniques. Training in working at heights. If equipment is at height (see OHS Act General Safety Regulation 6), ensure suitable safe (electrically and physically) ladders / harnesses etc. are available. Working at height procedure to be in place.	Easy	5	1	3	2	3	**33**	4	1	3	2	2	**20**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 6a:	Human and Equipment Safety - exposure to fire radiation	Causes – Involvement in an external fire e.g., veld fire, maintenance vehicle fire, electrical systems fire. Manufacturing defects or damage to battery leading to shorting and heating. High humidity condensation of water or ingress of water or flooding leading to shorting. Dust accumulation on electrical parts leading to overheating. Excessive electrical loads - surges Operator abuse BMS failure or software failure. Incorrect extinguishing medium, escalate the fire. Consequences - Contaminated run off. Radiation burns. No affected bystanders. Damaged equipment. Fire spreads to other units or offsite if grass/vegetation not controlled.	Operation	Negative	Grass cutting and fire breaks around the BESS installations. No combustible materials to be stored in or near the batteries or electrical infrastructure, e.g., separation of site diesel tank and separation from substations. In this case the risk is from the substation to the BESS and not vice versa. Apply normal electrical separation distances of substation to other independent infrastructure Fire resistant barrier between the batteries and the PCS side if in the same container. Design codes from USA and standards of practice UL9540, NFPA 855 and DNV GL RP 43. Detailed Failure Mode and Effect Analysis FMEA/Hazop/Bowtie to done during design at the component level and system levels. Safety integrity level rating of equipment (failure probably) with suitable redundancy if required. Site Acceptance Testing as part of commissioning of each unit and the overall system. BMS should be checking individual cell voltage as well as stack, module, container, system voltages/current etc. BMS tripping the cell and possibly the stack/ building unit or module/rack/container, if variations in voltage. Diagnostics easily accessible. Diagnostics able to distinguish cell from stack or cell from module faults. As per SANS Standards, suitable ingress protection (IP) level provided for electrical equipment, e.g., IP55 - 66. If air cooling into container / building, suitable dust filters to be provided if needed. Smoke detectors may be needed linked to BMS and alerts in the main control room. Effects of battery aging to be considered. Temperature monitoring, regular infrared scanning. Data stored for trend analysis. Protective systems functionality testing. Prior to commencement of cold commissioning, emergency plan from transport and construction phase to extended to operational phase and to include the hazards of the electrically live system. Procedure to address suitable extinguishing media, ventilating, entering container as appropriate or not. PPE for firefighting may need to include fire retardant, chemically resistant, nitrile gloves, antistatic acid resistant boots, fill face shields, BA sets. A planned fire response to prevent escalation to an environmental event is critical. Suitable fire extinguishing medium, cooling medium and adequate supply of both is critical e.g., cooling adjacent equipment and can use fogging nozzles to direct smoke. Ensure procedures in place to clean up after event Lingering toxic residues in the soil and on adjacent structures.	Complex	5	1	5	5	3	**48**	5	1	5	5	1	**16**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 6b:	Human and Equipment Safety - exposure to fire radiation	Causes - Power Conversion System (PCS – DC to AC) cooling failure electrical fire. Consequences - Fire starts in PCS or another section or room and spreads to battery area.	Operation	Negative	VRFB building systems PCS in another area separating it from the batteries and other equipment	Moderate	5	2	5	5	3	**51**	5	2	5	5	1	**17**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 7:	Human and Equipment Safety - exposure to explosion over pressures	Transformer shorting / overheating / explosion. Consequences - Potential fatalities, e.g., amongst first responders. Damage to nearby equipment.	Operation	Negative	Electrical equipment will be specified to suit application. Emergency response plan and employee training referred to above is to be in place.	Moderate	5	1	5	5	2	**32**	5	1	5	5	1	**16**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 8a:	Human and Equipment Safety - exposure to acute toxic chemical and biological agents	Causes Human pathogens and diseases, sewage, food waste. Snakes, insects, wild and domesticated animals and harmful plants. Consequences - Illness and at worst without mitigation, possibly extending to fatalities.	Operation	Negative	All necessary good hygiene practices to be in place, e.g., provision of sanitation facilities, eating areas, infectious disease controls. Policies and practice for dealing with known vectors of disease such as AIDS, TB, COVID 19 and others. Awareness training for persons on site, safety induction to include animal hazards. First aid and emergency response to consider the necessary anti-venom, anti-histamines, topical medicines etc. Due to isolated locations some distance from town, the ability to treat with anti-venom and extreme	Moderate	4	1	3	2	3	**30**	3	1	2	2	2	**16**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
		Effects can vary from discomfort to fatalities for venomous snakes or bee swarms etc			allergic reactions on site is critical to mitigate the impacts													
						Significance	**N2 - Low**						**N2 - Low**					
Impact 8b:	Human and Equipment Safety - exposure to acute toxic chemical and biological agents	Causes - Damaged batteries components, leak electrolyte, are completely broken exposing hazardous chemicals. Consequences - Impacts can vary from mild skin irritation from exposure to small leaks to serious corrosive burns for large exposure.	Operation	Negative	Corrosion resistant PPE (e.g., overalls, gloves, eyeglasses) to be specified for all operations in electrolyte areas. PPE to be increased (e.g., full-face shield, aprons, chemical suits) for operations that involve opening equipment and potential exposure, e.g., sampling, maintenance. All operators/maintenance staff trained in the hazards of chemicals on site. Electrolyte contained, modules contained inside a building that is bunded. 24/7 helpline response. Standard dangerous goods requirements for Hazmat labels. All operators/maintenance staff trained in the hazards.	Moderate	4	3	3	5	3	**45**	3	3	3	5	2	**28**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 9:	Human and Equipment Safety - exposure to violent release of kinetic or potential energy	Causes - Moving equipment, pumps, heavy equipment at elevation, nip points, working at heights. Traffic accidents. Earthquake / tremor. Consequences - Injury. Fatality in unlikely worst case, e.g., traffic accidents or fall from heights. Damage to equipment, spills, environment pollution	Operation	Negative	Apart from pumps, no major moving parts during operation. Maintenance equipment to be serviced and personnel suitably trained in the use thereof. Normally just small vehicles on site, bakkies, grass cutting, cherry-pickers etc. Possibly large cranes if large equipment or elevated structure removed/replaced. Traffic signs, rules etc in place on site. All normal working at heights, hot work permits, confined space entry, cordon off unsafe areas/works etc to be in place. Emergency response plan. Civil design to take seismic activity into account.	Moderate	5	1	5	5	3	**48**	5	1	5	5	1	**16**
							N3 - Moderate						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 10:	Human and Equipment Safety - exposure to electromagnetic waves	Causes - Use of electrical machines, generators etc. Hot dry area static generation is highly likely. Lightning strike. Consequences - Electrocution. Ignition and burns. Injury and death. Damage electrical equipment.	Operation	Negative	Codes and guidelines for electrical insulation. PPE to suit. Low voltage equipment (e.g., batteries) separated from high voltage (e.g., transmission to grid). Risk of pylons to BESS, suggest at least the pylon fall height, e.g. >10m for 10m tall pylons. Ensure trained personnel and refer to guideline – IEE 1657 – 2018. Ensure compliance with Eskom Operating Regulations for high voltage systems including access control, permit to work, safe work procedures, live work, abnormal and emergency situations, keeping records. Electromagnetic fields, impact on other equipment e.g., testing devices, mobile phones – malfunction, permanent damage. Software also need to be kept as update to date as reasonably practicable. Consider suitably located Emergency stop buttons for the facility and the other equipment on site. PPE to consider static accumulation for entering the facilities, and particularly the battery containers especially after a high temperature shut down where there could possibly be flammable materials. The procedures for responding to alarm and auto shut down on containers, needs to consider that there may be a dangerous environment inside and how to protect personnel who may enter to respond. Lightning strike rate in proposed development area is moderate. All outside work must be stopped during thunder storms. Lighting conductors may be required for the installation, to be confirmed during design	Complex	5	2	5	5	3	**51**	5	2	5	5	1	**17**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 11:	Environment - emissions to air	Not expected on a normal basis. Refrigerant may be an asphyxiant if	Operation	Negative	Especially after any warning alarms have gone off, but possibly even normally the container could be treated as entering a confined space and similar procedures could be in place, e.g., do not enter	Easy	3	1	1	1	3	**18**	3	1	1	1	1	**6**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
		accidentally released indoors it can accumulate and displace oxygen.			alone, gas testing prior to entering, ensure adequate ventilation													
						Significance	**N2 - Low**						**N1 - Very Low**					
Impact 12:	Environment - emissions to water	Causes - Cooling water blow-down. Laboratory waste (if included in the design). Maintenance waste, e.g., oils. Spills from batteries, coolant system, diesel trucks, transformers. Parked vehicles – oil drips. Fire water runoff control. Kitchen waste and sewage. Refrigerant release. VRFB electrolyte purging. Consequences - Pollution if not contained. Excessive disposal costs if emissions not limited.	Operation	Negative	Electrolyte areas fully bunded to 110% of largest tank, or more. Bunding under any outdoors tanks, curbing under truck offloading areas and sealed surfaces (e.g., concrete) under truck parking area is particularly important. Sewage and any kitchen liquids - containment and suitable treatment/disposal. Procedures for dealing with damaged/leaking equipment as well as clean-up of spills. Normal site practices for preventing and containing diesel/paint etc spills. Waste management plan to be in place e.g., liquid waste treatment or suitable removal and disposal will be provided. Spill clean-up procedures to be in place before bringing container on site, including spill kits – non-combustible materials, hazmat disposal. The National Environment Management Act (NEMA) Section 30, the DEA Guidelines have a list of hazard categories with Reportable spill Quantities, ensure compliance with this by listing all materials on site, their hazard categories and determining the spill thresholds for reporting. This is particularly relevant for liquid filled systems such as RFB. Process controls in place to prevent contamination and deterioration of electrolyte leading to excessive purging. Ensure proposed locations of the BESS facilities are a suitable distance from the closest water course. Relevant recommendations have been made by the Aquatic Specialist and Groundwater Specialists, and this has been factored into the layout. Refer to the	Moderate	3	2	3	2	3	**30**	3	2	3	2	2	**20**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
					relevant studies for additional information. In the event of a major spill if this is too close it may not allow time for mitigation to be taken. Adequate secondary and possibly tertiary containment systems may then be needed on site.													
						Significance	**N2 - Low**						**N2 - Low**					
Impact 13:	Environment - emissions to earth	Causes - Mess area and other solid waste. Disposal of battery components. Consequences - Environmental damage.	Operation	Negative	Implement waste segregation (e.g., electronic equipment, chemicals, domestic) and management on the site. During commissioning there will be a need for bulk transport of electrolyte to site and transfer of electrolyte into the tanks within the containers. Suitable secondary containment of possible spills / overfills etc. during this transfer process will need to be in place.	Easy	2	2	3	3	4	**40**	2	2	3	3	2	**20**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 14:	Environment - waste of resources e.g., water, power etc	Causes - Similar to construction phase. Disposal of batteries or components. Disposal of containers. Water usage not controlled. Excessive purging of deteriorated or contaminated electrolyte. Consequences - Delays. Excessive costs and disposal of large volumes of hazardous waste.	Operation	Negative	Water usage to be monitored on site. Handling protocols to be provided by supplier of electrolyte. Water management plan and spill containment plans to be in place. Investigate End of Life plan for electrolyte - reuse / recovery / reconditioning. Similarly, for decommissioned containers / equipment – reuse / recovery / repurpose	Easy	2	1	1	2	4	**24**	2	1	1	2	2	**12**
							N2 - Low						**N1 - Very Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 15:	Public - Aesthetics	Causes - Bright surfaces reflecting light. Tall structures in a flat area. Consequences - Irritation.	Construction	Negative	Refer to the Visual Impact Assessment undertaken as part of the EIA.	Moderate	3	2	3	4	4	**48**	1	2	3	4	2	**20**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 16:	Investors - Financial	Causes - Defective technology. Extreme project delays. Consequences - Financial loss	Operation	Negative	Operation by experienced personnel using internationally recognized and proven technology operating procedures. Operations management with deviation monitoring	Easy	5	1	3	4	3	**39**	3	1	3	4	2	**22**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 17a:	Employees and investors - Security	Causes - On route, potential hi-jacking of valuable but hazardous load. On site, theft of construction equipment and battery installation facilities. Civil unrest or violent strike by employees. Consequences - Theft. Injury to burglars. Damage to equipment possibly setting off thermal runaway.	Operation	Negative	Fencing around electrical infrastructure to SANS standard and Eskom Guidelines. Consider motion detection lights and CCTV. The hazardous nature of the electrical and battery equipment should be clearly indicated – e.g., Skull and Cross Bones or other signs. Isolated location both helps and hinders security. Night lighting to be provided both indoors and outdoors where necessary.	Moderate	3	1	3	2	4	**36**	3	1	3	2	2	**18**
						Significance	**N3 - Moderate**						**N2 - Low**					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 17b:	Employees and investors - Security	Causes - Cyber security attacks aimed at the National Electricity Grid. Consequences - Ransom of the National Electricity Grid.	Operation	Negative	Cyber security needs monitoring. Remote access to system needs to be negotiated and controlled e.g. password controls, levels of authority etc.to ensure protection of the National Electricity Grid from Cyber-attacks accessing through the BESS. Cyber emergency procedures – should be in place prior to commissioning	Complex	4	4	3	1	4	**48**	4	4	3	1	2	**24**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 18:	Emergencies	Causes - Fires, explosions, toxic smoke, large spills, traffic accidents, equipment/structural collapse. Inadequate emergency response to small event leads to escalation. Consequences - Injuries turn to fatalities, small losses become extended down time.	Operation	Negative	All safety measures listed above. Emergency procedures need to be practiced prior to commencement of operations. Escape doors should swing open outwards and not into the building/container. More than one exit from buildings.	Complex	4	2	3	4	3	**39**	4	2	3	4	2	**26**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 19:	Investors - Legal	Causes Battery field is evolving quickly with new guides, codes and regulations happening at the same time as evolving technology. Consequences - Unknown hazards manifest due to using "cheaper supplier or	Operation	Negative	Use only internationally reputable battery suppliers who comply with all known regulations/guideline at the time of purchasing. Where reasonably practicable ensure only "state of the art" battery systems are used and not old technologies prone to fires/explosions etc.	Moderate	3	1	3	3	4	**40**	3	1	3	3	2	**20**

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
		less developed technology".																
						Significance	N3 - Moderate						N2 - Low					

The above Risk Assessment shows that, provided the preventative and mitigative measures are incorporated, the operational phase of the project does not present any high risks nor any fatal flaws. The average raw risk significance is rated as moderate, and the average residual risk is rated as low.

TABLE 15.4.2.3 - DECOMMISSIONING PHASE

Battery components may have a limited lifespan, there are damaged equipment, waste electrolyte etc. There could already be "waste" on the first day of commissioning and plans should be in place to deal with this. Ideally an End-of-Life plan needs to be in place before the first electrolyte / container / equipment is brought on site.

All decommissioning activities must comply with the relevant regulations at the time. Decommissioning will ultimately need to be informed by the regulatory requirements at the time, which may be different to present requirements. The exact risk ratings are not possible to determine now given the uncertainties in mitigations applicable at that time. Except for the actual physical disposal to ground and its legal aspects the ratings for all other hazards have been left as neural and the mitigation measures applied to the hazards during the construction and operational phases would also be applicable during de-commissioning.

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 1:	Human Health - chronic exposure to toxic chemical or biological agents	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 2:	Human Health - exposure to noise	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 3:	Human Health - exposure to temperature extremes and/or humidity	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 4:	Human Health - exposure to psychological stress	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
						Significance	#N/A						#N/A					
Impact 5:	Human Health - exposure to ergonomic stress	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 6:	Human and Equipment Safety - exposure to fire radiation	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 7:	Human and Equipment Safety - exposure to explosion over pressures	Similar to the construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 8:	Human and Equipment Safety - exposure to acute toxic chemical and biological agents	Similar to the Construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 9:	Human and Equipment Safety - exposure to violent release of kinetic or potential energy	Similar to the Construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
							#N/A						#N/A					

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
Impact 10:	Human and Equipment Safety - exposure to electromagnetic waves	Similar to the Construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 11:	Environment - emissions to air	Similar to the Construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 12:	Environment - emissions to water	Similar to the Construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 13:	Environment - emissions to earth	Causes - Batteries / electrolyte / equipment reached end of life and may leak. Consequences - Environment damage from heavy metal ions.	Construction	Negative	End of Life shutdown procedure including a Risk Assessment of the specific activities involved. Where possible re-purpose the solid-state batteries / containers and equipment with associated Environmental impact considered. Disposal according to local regulations and other directives such as the European Batteries Directive. End of life, which is affected by temperature and time, cycles etc, should be predefined and the monitoring should be in place to determine if it has been reached.	Complex	4	3	3	5	4	**60**	4	3	3	5	2	**30**
						Significance	**N3 - Moderate**						**N2 - Low**					
Impact 14:	Environment - waste of resources e.g., water, power etc	Similar to the Construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 15:	Public - Aesthetics	Similar to the Construction and	De-commission	Negative	As per construction and operational phases.	Easy												

Impact number	Receptor	Description	Stage	Character	Preventative and Mitigative Measures	Ease of Mitigation	(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
							Raw Risk						Residual Risk					
		operational phases - no new hazards.																
						Significance	#N/A						#N/A					
Impact 16:	Investors - Financial	Similar to the Construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 17:	Employees and investors - Security	Similar to the Construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 18:	Emergencies	Similar to the Construction and operational phases - no new hazards.	De-commission	Negative	As per construction and operational phases.	Easy												
						Significance	#N/A						#N/A					
Impact 19:	Investors - Legal	Disposal of hazardous "waste" is rife with difficulties and numerous regulations that need to be complied with.	De-commission	Negative	Applicants should seek the opinion from a waste consultant on how to correctly dispose of hazardous waste.	Complex	3	1	3	3	4	**40**	3	1	3	3	3	**30**
						Significance	**N3 - Moderate**						**N2 - Low**					

The above Risk Assessment shows that, provided the preventative and mitigative measures are incorporated, the de-commissioning phase of the project does not present any high risks nor any fatal flaws.

15.5. CONCLUSIONS AND RECOMMENDATIONS

The tables in Section 15.4 contain all the recommended preventative and mitigative measures necessary to ensure risks are not unacceptably high.

Below are a few extracted items that are possibly of highest risks and therefore a priority.

15.5.1 CONCLUSIONS

GENERAL

- This Risk Assessment has found that with suitable preventative and mitigative measures in place, none of the identified potential risks are excessively high, i.e., from a SHE perspective no fatal flaws were found with either type of technology for the proposed BESS installation at the proposed Kudu Solar Facility near De Aar.

- At a large facility, without installation of the "state-of-the-art" battery technology that includes protective features, there can be significant risks to employees and first responders. The latest battery designs include many preventative and mitigative measures to reduce these risks to tolerable levels. (Refer to tables in section 15.4 under preventative and mitigative measures). Where reasonably practicable, state-of-the-art technology should be used, i.e., not old technology that may have been prone to fire and explosion risks.

- The design should be subject to a full Hazard and Operability Study (HAZOP) prior to commencement of procurement. A HAZOP is a detailed technical systematic study that looks at the intricacies of the design, the control system, the emergency system etc. and how these may fail under abnormal operating conditions. Additional safeguards may be suggested by the team doing the study.

LITHIUM SOLID STATE CONTAINERIZED BATTERIES

- With lithium solid-state batteries, the most significant hazard with battery units is the possibility of thermal runaway and the generation of toxic and flammable gases. There have been numerous such incidents around the world with batteries at all scales and modern technology providers include many preventative and mitigative features in their designs. This type of event also generates heat which may possibly propagate the thermal runaway event to neighbouring batteries if suitable "state of the art" technology is not employed.

- The flammable gases generated may ignite leading to a fire which accelerates the runaway process and may spread the fire to other parts of the BESS or other equipment located near-by.

- If the flammable gases accumulate within the container before they ignite, they may eventually ignite with explosive force. This type of event is unusual but has happened with an older technology container installed at McMicken in the USA in 2019.

- Due to a variety of causes, thermal runaway could happen at any point during transport of the BESS to the facility, during construction or operation / maintenance at the facility or during decommissioning and safe making for disposal.

- Due to the containerized approach as well as the usual good practice of separation between containers, which should be applied on this project, and therefore the likely restriction of events to one container at a time, the main risks are close to the containers i.e., to transport drivers, employees at the facilities and first responders to incidents.

- In terms of a worst conceivable case container fires, the significant impact zone is likely to be limited to within 10m of the container and mild impacts to 20m. Based on the current proposed layouts, impacts at the closest isolated farmhouses are not expected.

- In terms of a worst conceivable case explosion, the significant impact zone is likely to be limited to with 10m of the container and minor impacts such as debris within 50m. Based on the current proposed layouts, impacts at the closest isolated farmhouses are not expected.

- In terms of a worst reasonably conceivable toxic smoke scenario, provided the units are placed suitably far apart to prevent propagation from one unit to another and large external fires are prevented, the amount of material burning should be limited to one container at any one time. In this case, beyond the immediate vicinity of the fire, the concentrations of harmful gases within the smoke should be low. The proposed BESS installation's location should ideally be over 500m from any occupied development / farmhouse. The BESS is well over 500m from the closest facility to the east, and therefore the risks posed by BESS are acceptably low.

- Based on the above it is suggested that if the substation were over 20m from the closest BESS container there should be limited direct impacts of any fire or explosion on the substation. Fires at the substation are also not likely to lead to domino failures of the BESS.

VANADIUM REDOX FLOW BATTERY INSTALLATIONS

- The most significant hazard with VRFB units is the possibility of spills of corrosive and environmentally toxic electrolyte. Many preventative and mitigative features should be included in the design and operation, e.g., full secondary containment, level control on tanks, leak detection on equipment etc. (Refer to tables in section 15.4 under preventative and mitigative measures).

- VRFB units do not present significant fire and electrical arcing hazards provided they are correctly designed, operated, maintained and managed. Suitable Battery Management System (BMS), safety procedures, operating instructions, maintenance procedures, trips, alarms and interlocks should be in place. (Refer to tables in section 15.4 under preventative and mitigative measures).

TECHNOLOGY AND LOCATION OF BESS FACILITIES

- From a safety and health point of view, the above Risk Assessment shows that risks posed by VRFB systems may be slightly lower than those of SSL facilities, particularly with respect to fire and explosion risks. From an environmental spill and pollution point of view the VRFB systems present higher short-term risks than the SSL systems. However, the above conclusions may be due to the fact that the VRFB technology is not as mature as SSL technology and therefore there is not as much operating experience and accident information available for the VRFB. From an overall SHE RA point of view, there is no specific preference for a type of technology.

- From a SHE risk assessment point of view, where there is a choice of location that is further from public roads, water courses or isolated farmhouses/occupied developments, this would be preferred. VRFB hazards are mostly related to possible loss of containment of electrolyte and SSL batteries to fires producing toxic smoke and fire fighting which may result in contaminated of firewater runoff. One would not want these liquids to enter water courses nor the smoke to pass close to houses / public traffic. The current chosen location meets these separation requirements, and the relevant specialists such as aquatic and geohydrology have provided inputs on setback distances.

- Changes to the detailed layouts post Environmental Authorisation (should such be granted) are deemed acceptable if the changes remain within the approved buildable areas / development footprints, and area assessed during this Scoping and EIA Process (with the avoidance of no-go sensitive areas) and any solid state (e.g. lithium) BESS is located over 500m from farm buildings.

15.5.2 RECOMMENDATIONS

The following recommendations have been made:

- There are numerous different battery technologies but using one consistent battery technology system for the BESS installations associated with all the Kudu developments in the De Aar area would allow for ease of training, maintenance, emergency response and could significantly reduce risks.

- Where reasonably practicable, state-of-the-art battery technology should be used with all the necessary protective features e.g., draining of cells during shutdown and standby-mode, full BMS with deviation monitoring and trips, leak detection systems.

- There are no fatal flaws associated with the proposed Kudu Solar Facility battery installation for either technology type.

- The tables in Section 4 of this report contains technical and systems suggestions for managing and reducing risks. Ensure the items listed in these tables under preventative and mitigative measures are included in the design.

- The overall design should be subject to a full HAZOP prior to finalization of the design.

- For the VRFB systems an end of life (and for possible periodic purging requirements) solution for the large quantities of hazardous electrolyte should be investigated, e.g., can it be returned to the supplier for re-conditioning.

- Prior to bringing any solid-state battery containers into the country, the contractor should ensure that:
    - An Emergency Response Plan is in place that would be applicable for the full route from the ship to the site. This plan would include details of the most appropriate emergency response to fires both while the units are in transit and once they are installed and operating.
    - An End-of-Life plan is in place for the handling, repurposing or disposal of dysfunctional, severely damaged batteries, modules and containers.

- The site layout and spacing between lithium solid-state containers should be such that it mitigates the risk of a fire or explosion event spreading from one container to another.

- Under certain weather conditions, the noxious smoke from a fire in a lithium battery container could

travel some distance from the unit. The smoke will most likely be acrid and could cause irritation, coughing, distress etc. Close to the source of the smoke, the concentration of toxic gases may be high enough to cause irreversible harmful effects. Location of the facilities needs to ensure a suitable separation distance from public facilities/residences etc. The proposed BESS location is well over 500m from isolated farmhouses/development and is therefore suitable in this context.

- In order to limit the possibility of domino failures the BESS should be separated from the substation by at least 20m.

- Where there is a choice of alternative locations for the BESS, those that are further from water courses would be preferred. VRFB hazards are mostly related to possible loss of containment of electrolyte and solid-state systems may experience fires that may result in loss of containment of liquids or the use of large amounts of fire water which could be contaminated. One would not want these run-offs to enter water courses directly. The buffer distance between water bodies and the facilities containing chemicals should be set in consultation with a water specialist and is therefore not specified in this SHE RA. It is noted that there are no tributaries of the main water courses in the area within 500m of the proposed BESS location, and therefore this is not a risk of concern.

- Finally, it is suggested once the BESS technology has been chosen and more details of the final design are available, the necessary updated Risk Assessments should be in place (prior to commencement, after environmental authorisation and other necessary approvals are granted (should such be granted)).

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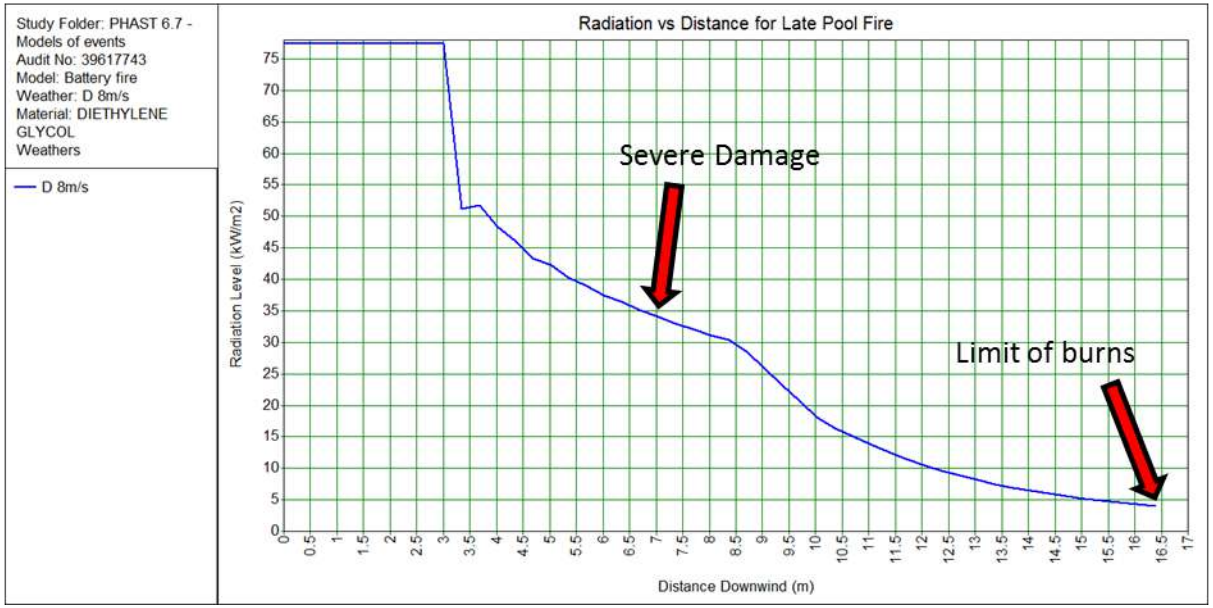
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APPENDIX A

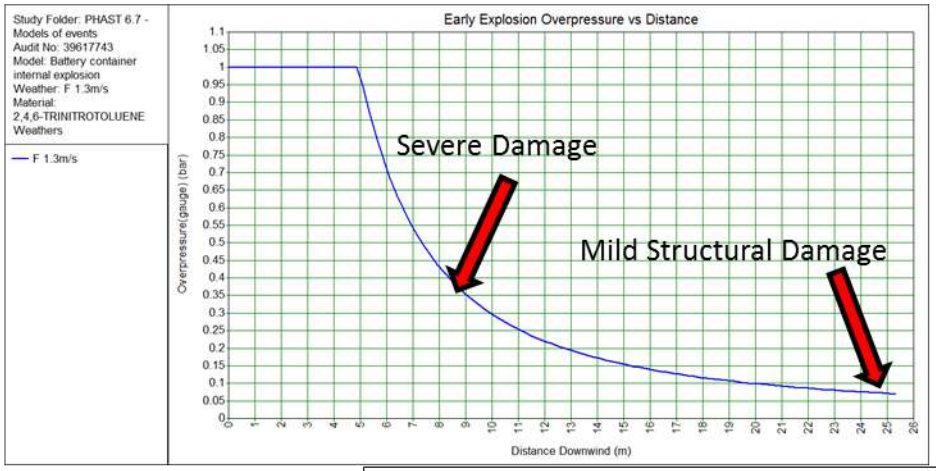
Preliminary Approximations of Absolute WORST-CASE Consequence and Risk Modelling (Modelling done using DNV-GL software PHAST RISK 6.7)

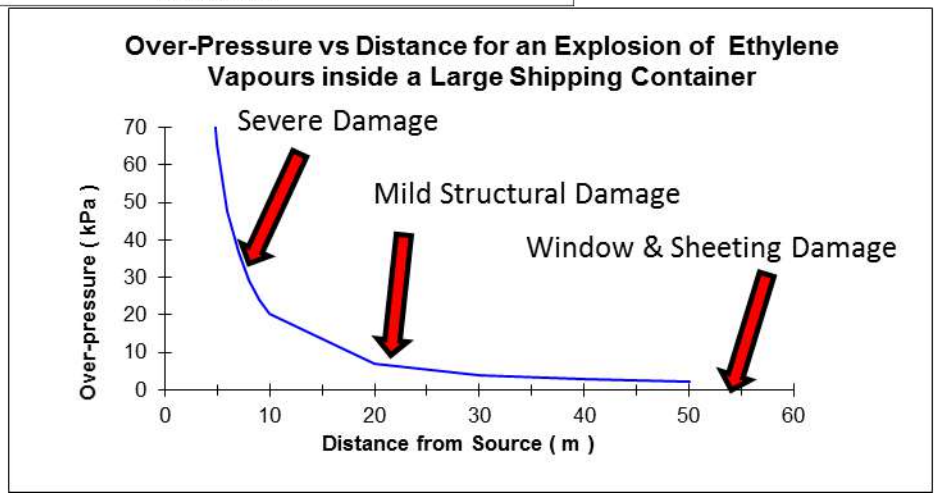
PLEASE NOTE – the modelling, especially the noxious smoke modelling, is an approximation.

Approximation of WORST-CASE Radiation Levels from an Entire Container on Fire

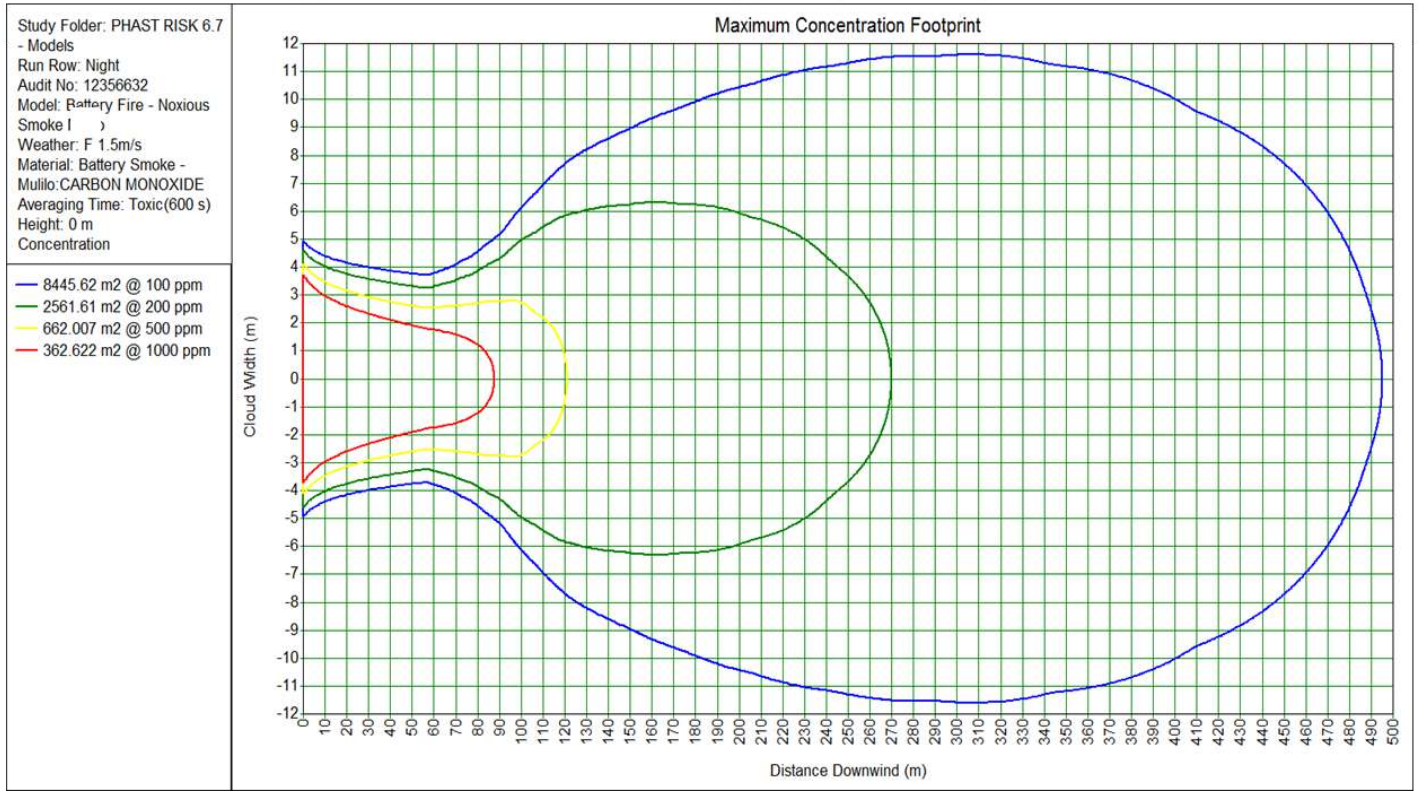


Approximation of WORST-CASE Explosion Over pressures from an Entire Container Explosion





Approximation of Maximum Concentration of Carbon Monoxide in Noxious Smoke Cloud from Lithium Container Fire
200ppm is the Nuisance Level, 500ppm is potentially harmful



APPENDIX B: SPECIALIST STATEMENT OF INDEPENDENCE

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 - 12), near De Aar, Northern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

Details of Specialist, Declaration and Undertaking Under Oath

Page 1 of 3

1. SPECIALIST INFORMATION

Specialist Company Name:	ISHECONcc			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	
Specialist name:	Debra Catherine Mitchell			
Specialist Qualifications:	MSc Chem Eng			
Professional affiliation/registration:	ECSA Professional Engineer			
Physical address:	Building H4, Pinelands Office Park, Maxwell Drv, Moddefontein			
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E-mail:	mitchelld@isheocn.co.za			

2. DECLARATION BY THE SPECIALIST

I, ___DEBRA CATHERINE MITCHELL____, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

ISHECONcc

Name of Company:

12 JUNE 2023

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, ___DEBRA CATHERINE MITCHELL___, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

ISHECONcc

Name of Company

12 JUNE 2023

Date

Signature of the Commissioner of Oaths

12 JUNE 2023

Date

Dennis Richard Diamond
COMMISSIONER OF OATHS
9/1/8/2 Randburg (A15) 14 March 2001
Fish Eagle 2 Office Park
Unit 12 Kingfisher Crescent
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Details of Specialist, Declaration and Undertaking Under Oath

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CHAPTER 16:

Geohydrology Assessment



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GEOHYDROLOGY ASSESSMENT:

Scoping and Environmental Impact Assessment (EIA) Process for the Proposed Development of a Solar Photovoltaic Facility (Kudu Solar Facility 4) and associated infrastructure, near De Aar, Northern Cape Province

Report prepared for:	*Report prepared by:*
CSIR – Environmental Management Services P O Box 320 Stellenbosch 7599 South Africa	Christel van Staden; Dale Barrow; Shane Teek & Louis Jonk GEOSS South Africa (Pty) Ltd P.O. Box 12412 Die Boord, Stellenbosch 7613 South Africa Stellenbosch 7600 South Africa

Version 0: 22 March 2023
Version 1: July 2023



GEOSS South Arica (Pty) Ltd was appointed to complete a geohydrology impact assessment for the proposed Kudu Solar Facilities project located approximately 60 km to the northeast of De Aar in the Northern Cape Province. This geohydrological assessment is aimed at determining the potential for groundwater to be used for construction and operational purposes, as well as the risks to nearby groundwater users which are mainly livestock and occupants on the farms.

The proposed site is directly underlain by three main lithologies (rock/soil types):

- Various shales and combinations of purple, red, green and grey, mudstone or sandstones of the Tierberg Formation (Pt) and undifferentiated sediments of the Adelaide Subgroup (predominantly horizontal layers).
- Large dolerite sill structures, which have intruded into the mudstone and sandstone layers in the area (Jd), (including associated dyke structures).
- Locally developed areas of alluvial and/or other quaternary deposits.

The Kudu Solar Facility 4 and surrounding area is underlain by two aquifers with regional groundwater electrical conductivity (EC) ranges between 70 and 300 mS/m.

- A fractured aquifer with an average borehole yield potential of 0.5 – 2.0 L/s.
- An intergranular and fractured aquifer, although there is currently no known information on this aquifer.

The water requirements for the proposed Kudu Solar Facility 4 are as follows:

- Construction phase: 9 000 m^3/a (0.29 L/s)
- Operational phase: 1 000 m^3/a (0.03 L/s).

The assessment identified the following main impacts along with the significance of each phase pre and post mitigation shown in the table below.

Construction Phase

- Potential impact 1: Potential lowering of the groundwater level.
- Potential impact 2: Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages.

Operational Phase

- Potential impact 3: Potential lowering of the groundwater level.
- Potential impact 4: Potential impact on groundwater quality as a result of using cleaning agents for cleaning the solar panels.

- Potential impact 5: Groundwater quality deterioration as a result of electrolyte that will be used for the Battery Energy Storage System (BESS).

Decommissioning Phase

- Potential impact 6: Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages.
- Potential impact 7: Potential lowering of the groundwater level.

Cumulative impacts identified were identical to the individual impacts of the individual Kudu Solar Facility 4, with the only changes occurring in the duration, scale, and likelihood of the impacts occurring.

Phase	Overall Impact Significance (Pre-Mitigation)	Overall Impact Significance (Post Mitigation)
Construction	Moderate to Very Low	Low-Very Low
Operational	Moderate to Very Low	Low-Very Low
Decommissioning	Very Low	Very Low
Cumulative - Construction	Moderate to Very Low	Low-Very Low
Cumulative - Operational	Moderate to Very Low	Low-Very Low
Cumulative - Decommissioning	Very Low	Very Low

A summary of the main mitigation measures identified for the developments include:

- Inclusion of a borehole monitoring program
- Adherence to the safe borehole yield values
- The use of environmentally friendly cleaning agents
- Construction of BESS with a 50-meter buffer from any boreholes
- The addition of effective bunding and secondary containment around BESS facilities
- Vehicles must be regularly serviced and maintained.
- Inclusion of drip trays for long standing vehicles.
- Diesel fuel storage tanks should be above ground on an impermeable concrete surface in a bunded area.
- Construction vehicles and equipment should also be refuelled on an impermeable surface. Spillages are to be removed with correct disposal procedures.
- Proof of disposal retained on file for auditing purposes.

The distribution of boreholes across the proposed area have been assessed in relation to the farm portions with special reference to the allowable General Authorisation volumes for the constituent farm portion that comprise the proposed Kudu Solar Facility 4 and surrounds. Furthermore, the hydrocensus has confirmed there are several boreholes on site and/or on neighbouring properties, with HBH1 and HBH24 representing potentially viable sources of groundwater for the development of Solar Facility 4. The use of this/these borehole/s would/will depend on the operational requirements of the facility, negotiations with the landowners and proximity to the facility.

Considering that the required peak (construction) water supply is 9 000 m^3/a (0.29 L/s) for the proposed Kudu Solar Facility 4, the required water volumes should be readily available and could be supplied by the regional aquifer yield (0.5 – 2.0 L/s).

The demand for the facility could potentially be met by abstraction from Farm 3/88. However, if Solar Facilities 2, 3, 4 and 5 are constructed simultaneously, the water demands during the construction period will exceed the available GA volume of the farm portion. Furthermore, the cumulative demands of construction (~4.6 L/s) for all twelve planned Kudu Solar Facilities (if developed simultaneously) exceeds the regional yield potential of the underlying aquifer (0.5 – 2.0 L/s). Therefore, groundwater exploration (including hydrocensus, lineament mapping and geophysics) on adjacent properties should be undertaken for additional supply to meet the demands. Alternatively, to source all the water from this farm portion, a Water Use License Application will be required to meet the demands of the construction period.

Given the findings of this assessment, an overall significance rating post mitigation is given as **Low to Very Low** and the development of the proposed Kudu Solar Facility is authorised to continue on condition the following recommendations are adhered to:

- In the case that multiple projects are constructed simultaneously, adherence to recommended mitigation measures should be strictly followed to prevent over abstraction. In the event that groundwater is to be used in the project, the proposed monitoring plan should be followed with a special focus on groundwater level monitoring to ensure that the aquifer is not over abstracted and falls to levels below historic borehole depths.
- All proposed impact mitigation measures are to be implemented during the development of the project. These include the use of environmentally safe cleaning agents, the construction of BESS facilities 50m from any boreholes along with appropriate bunding and secondary containment, and the recommended precautionary approaches aimed at preventing oil spills and fuel leaks.



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Abbreviations	
BH	Borehole
CGS	Council for Geoscience
DHSWS	Department of Human Settlements, Water and Sanitation
DWA	Department of Water Affairs (used to be Department of Water Affairs and Forestry)
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EC	electrical conductivity
GIS	Geographic Information System
L/s	litres per second
m	metres
mbch	meters below collar height
mbgl	metres below ground level
mm	millimetre
mS/m	milli-Siemens per metre
NGA	National Groundwater Archive
WARMS	Water Authorisation and Registration Management System



Definitions	
Aquifer	A geological formation, which has structures or textures that hold water or permit appreciable water movement through them [from National Water Act (Act No. 36 of 1998)].
Borehole	Includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer [from National Water Act (Act No. 36 of 1998)].
DRASTIC	An acronym for a groundwater vulnerability assessment methodology: D = depth to groundwater / R = recharge / A = aquifer media type / S = soil type / T = topography / I = impact of the unsaturated zone / C = hydraulic conductivity. The methodology uses a rating and weighting approach and was developed by the Environmental Protection Agency (USA)
Electrical Conductivity	The ability of groundwater to conduct electrical current, due to the presence of charged ionic species in solution (Freeze and Cherry, 1979).
Fractured aquifer	Fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly within fissures and fractures.
Groundwater	Water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems.
Inferred	Where a geological contact or fault is believed to exist however is not confirmed.
Intergranular aquifer	Generally unconsolidated but occasionally semi-consolidated aquifers. Groundwater occurs within intergranular interstices in porous medium. Typically occur as alluvial deposits along river terraces.
Intergranular and fractured aquifers	Largely medium to coarse grained granite, weathered to varying thicknesses, with groundwater contained in intergranular interstices in the saturated zone, and in jointed and occasionally fractured bedrock.
Vulnerability	The tendency or likelihood for contaminants to reach a specified position in the ground-water system after introduction at some location above the uppermost aquifer (National Research Council, 1993).

16. GEOHYDROLOGY ASSESSMENT

This report serves as the Groundwater Impact Assessment that was prepared as part of the Environmental Impact Assessment (EIA) Processes for the proposed development of 12 Solar Photovoltaic (PV) Facilities (Kudu Solar Facilities 1 - 12) and associated infrastructure, near De-Aar, Northern Cape Province (Map 16-1).

16.1 Introduction

GEOSS South Arica (Pty) Ltd was appointed to complete a geohydrology impact assessment for the proposed Kudu Solar Facilities project. This geohydrological assessment includes a review of groundwater characteristics and users in the area, with the aim of determining the potential for groundwater to be used for construction and operational purposes, as well as risk to nearby groundwater users.

The generation capacity of each proposed solar PV facility will range from 50 MWac to 350 MWac. Four PV facilities each have a capacity of more than 150 MWac but up to 350 MWac. Eight PV facilities each have an estimated capacity of up to 150 MWac. Generally, the water requirements are as follows:

For the facilities (i.e. eight) with an estimated capacity of up to 150 MWac:

- Construction Phase: The total water requirement is estimated to be 9 000 m^3/a per solar facility thus a total 72 000 m^3/a. The construction phase should last approximately 18 months.
- Operational Phase: The total water requirement is estimated to be 1 000 m^3/a per solar facility thus a total of 8 000 m^3/a for the operational phase which should last approximately 20 years.

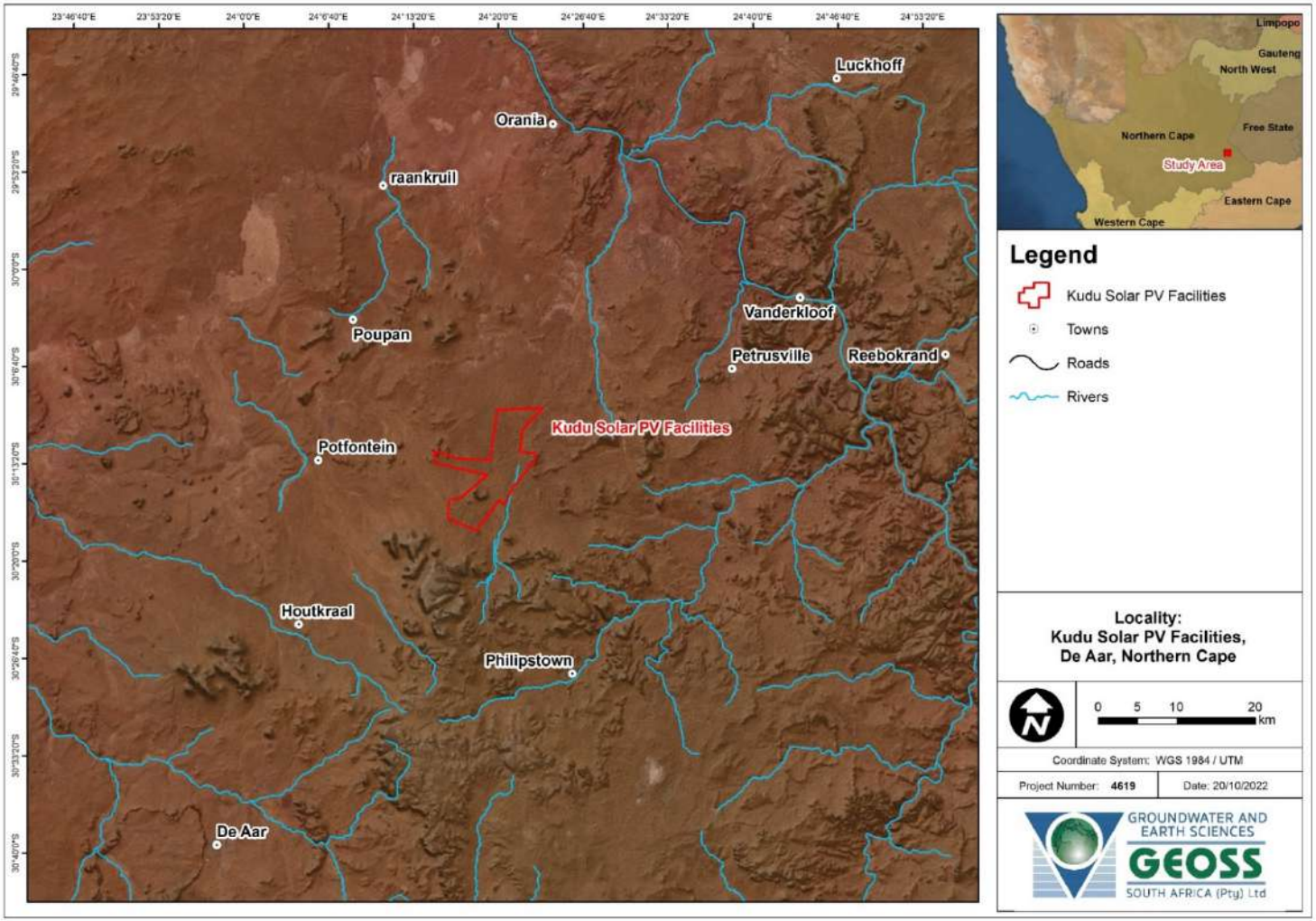
For the facilities (i.e. four) with an estimated capacity of more than 150 MWac but up to 350 MWac:

- Construction Phase: The total water requirement is estimated to be 18 000 m^3/a per solar facility thus a total 72 000 m^3/a. The construction phase should last approximately 18 months.
- Operational Phase: The total water requirement is estimated to be 2 000 m^3/a per solar facility thus a total of 8 000 m^3/a for the operational phase which should last approximately 20 years.

For the capacity and water requirement of this facility see Table 16-10. The water requirements differ depending on the capacity of the facility, and this is elaborated upon for this specific facility in subsequent sections (Section 16.5 – 16.9).

This report outlines the work completed to assess the likelihood of using groundwater for the proposed Kudu Solar Facility development, including the potential impact the development may have on groundwater resources in the area.

Separate reports have been compiled for each PV facility. This report only covers the Kudu Solar Facility 4 and associated infrastructure (hereafter referred to as the “Kudu Solar Facility” or “proposed project”).



Map 16-1: Locality of the proposed Kudu Solar Facility development, near De Aar, Northern Cape.

16.1.1 Scope, Purpose and Objectives of this Specialist Report

The scope of work is to provide groundwater specialist services with regard to the tasks outlined below:

- Assessment for groundwater to be used for construction and operational purposes for the proposed project, including solar panel cleaning.
- Assessment of the impact on geohydrological resources as a result of the proposed development.
- Provide recommendations to minimize or mitigate impacts.
- Confirm what type of authorisation is required to make use of the groundwater.

The results of the investigation are presented in this report along with the data analysis and interpretation.

16.1.2 Details of Specialist

This specialist assessment has been undertaken by Dale Barrow, Christel van Staden, Shane Teek and Louis Jonk of GEOSS South Africa. Dale Barrow is registered with the South African Council for Natural and Scientific Professions (SACNASP), as a Professional Natural Scientist, with Registration Number 400289/13 in the field of Earth Sciences. Christel van Staden is registered as a candidate with the SACNASP, with Registration Number 122591. Shane Teek is registered as a candidate with the SACNASP, with Registration Number 126397. Louis Jonk is registered as a Professional Natural Scientist with the SACNASP, with Registration Number 121278. A curriculum vitae is included for all parties in Appendix A of this Specialist Assessment.

In addition, a signed specialist statement of independence is included in Appendix B of this specialist input report.

16.1.3 Terms of Reference

The procedure adopted for this Impact Assessment Level study involved an initial desktop study of all available data and databases. The study involved obtaining and reviewing all relevant data to the proposed projects. This included analysing data from the National Groundwater Archive (NGA), Water Authorisation and Registration Management System (WARMS) and GEOSS's internal database, as well as groundwater yield, groundwater chemistry and geological maps of the area. A site visit was also carried out on the 23rd and 24th of March 2022 to conduct a hydrocensus to obtain further groundwater use information. The hydrocensus data was also analysed using geohydrological and spatial analysis methods to address the project objectives. A summary of the sensitivities and high-level impacts was also included.

The following terms of reference applies to the assessment:

- Obtain data for all the PV sites (i.e. obtain data from the NGA (and associated groundwater use databases) and internal GEOSS database (which includes information relevant to the site). Obtain data from the local Department of Water and Sanitation (DWS) monitoring boreholes. Obtain relevant geological maps and geohydrological maps, as well as relevant groundwater reports.

- Undertake a site visit in order to identify the level of sensitivity relating to geohydrology, and to complete a hydrocensus.
- Analyse the hydrocensus data using geohydrological and spatial analysis methods to address the project objectives.
- Compile a Geohydrology Impact Assessment in compliance with Appendix 6 of the 2014 National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations (as amended) and Part A of the Assessment Protocols published in GN 320. The Specialist Assessment must also be in adherence to any additional relevant legislation and guidelines that may be deemed necessary, as applicable.
- Determination, description and mapping of the baseline environmental condition and sensitivity of the study area relating to geohydrology (including hydrogeological characterisation of aquifers (types, sensitivity, vulnerability)), and groundwater (quality, quantity, use, potential for industrial or domestic use) in the area surrounding the proposed development. Specify set-backs or buffers, and provide clear reasons for these recommendations.
- Provide review input on the preferred infrastructure layout following the sensitivity analysis and layout identification.
- Identify relevant permits that may be required and additional protocols and/or licensing requirements that are relevant to the project and the implications thereof, if any.
- A description of assumptions and limitations used.
- Identify significant features or disturbances within the proposed project study area and define any environmental risks in terms of geohydrology and the proposed project infrastructure.
- Confirm what type of authorisation or licence is required to make use of the groundwater.
- Identify and assess the potential direct, indirect and cumulative impacts of the proposed development geohydrology.
- Provide recommendations with regards to potential monitoring programmes.
- Determine mitigation and/or management measures for inclusion in the Environmental Management Programme (EMPr) which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts. Also identify best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts for inclusion in the EMPr.
- Review the Generic EMPr for Substations (GN 435) and confirm if there are any specific environmental sensitivities or attributes present on the site and any resultant site-specific impact management outcomes and actions that need to be included.
- Provide a reasoned opinion indicating the acceptability of the proposed development and a recommendation if the development should go ahead or not.

16.2 Approach and Methodology

The specialist study was completed as follows:

Task 1: Obtain all relevant data to the proposed projects (i.e. obtain data from NGA and associated groundwater use databases, e.g. WARMS, GEOSS internal database). Obtain any data from local DWS monitoring boreholes. Obtain relevant geological maps and geohydrological maps. Obtain relevant groundwater reports. Compile a project Geographic Information System (GIS).

Task 2: Complete a site visit and a hydrocensus (i.e. visit boreholes and land owners to obtain information such as yields and to measure the field chemistry to assess the groundwater quality (pH, Electrical Conductivity (EC) and total dissolved solids (TDS)). The representative hydrocensus extends for a radius of 1 km from the study area.

Task 3: Analyse the data, using geohydrological methods and address the questions raised in the project objectives.

Task 4: Document the results in a report.

16.2.1 Information Sources

The information sources used in this study are listed in Table 16-1.

Table 16-1: Information sources used to assess the Groundwater for the proposed Kudu Solar Facility project.

Data / Information	Source	Date	Type	Description
Geological Map	Council for Geosciences	1997	Spatial	1:250 000 scale Geological Map Series of 3024 Colesberg
Climatology and Geohydrology	Cape Farm Mapper	2009	Database	SA Atlas of Climatology and Geohydrology; obtained from Western Cape Government Agriculture
Groundwater recharge and vulnerability mapping	Conrad J. and Munch Z.	2007	Spatial	A National scale approach to groundwater recharge and vulnerability mapping
Hydrogeological map series	Department of Water Affairs and Forestry	2005	Spatial	Hydrogeological map series of the republic of South Africa
NGA Database	NGA	14 April 2022	Database and Spatial	Spatial delineation of NGA registered boreholes

16.2.2 Assumptions, Knowledge Gaps and Limitations

The following assumptions and limitations apply:

- A limitation experienced during this investigation was the fact that the area received extensive rainfall prior to and during the site visit. Due to the rain the roads were extremely wet and made progress in the field slow and also difficult. Some farmers did not give GEOSS permission to drive on certain roads on their properties as it would damage the roads and there was a high risk of the

vehicle getting stuck. Despite this, the field work conducted is deemed suitable for the study and meets the objectives of the study.

- The investigation was conducted during the rainfall season of the region. The data, therefore, does not reflect conditions that prevail during the drier portion of the year. It is not expected that this would affect the outcome of the assessment.
- The geohydrological assessment is based on available literature for the study area. This includes regional scale GIS datasets based on 1: 1 000 000.
- No drill records or yield test data exists for production or wind pump boreholes to clarify yields and geological logs.
- The acquisition of accurate groundwater levels proved to be difficult, therefore data was limited to information obtained from local parties. Nonetheless these limitations have not negatively impacted the conclusions of the study.
- The NGA data is available at a local scale, although is known to sometimes contain false information.
- Since the area earmarked for the development of PV 8 falls across the Remaining Extent of the Farm Annex Wolve Kuil No. 41 and Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41, the water requirement for PV 8 was calculated based on a ratio of 25:75 split between the two mentioned portions.
- Since the area earmarked for the development of PV 1 falls across the Remaining Extent of the Farm Bas Berg No. 88 and Remaining Extent of Portion 3 of the Farm Bas Berg No. 88, the water requirement for PV 1 was calculated based on a ratio of 75:25 split between the two mentioned portions.
- Since the area earmarked for the development of PV 2 falls across the Remaining Extent of the Farm Bas Berg No. 88 and Remaining Extent of Portion 3 of the Farm Bas Berg No. 88, the water requirement for PV 2 was calculated based on a ratio of 50:50 split between the two mentioned portions.
- Since the area earmarked for the development of PV 11 falls across the Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41 and Portion 2 of the Farm Wolve Kuil No. 43, the water requirement for PV 11 was calculated based on a ratio of 75:25 split between the two mentioned portions.

The information obtained was sufficient to provide comprehensive geohydrological characterization of the regional setting.

It must be noted that there are no areas on site that should be avoided from a groundwater sensitivity perspective.

16.2.3 Consultation Processes Undertaken

During the undertaking of the geohydrological and geotechnical[1] site verification process, all landowners were contacted to ensure that GEOSS was able to locate their boreholes and inspect the landforms across their properties. This was mainly to ensure consent was granted; this was achieved telephonically by Christel Van Staden of GEOSS South Africa.

[1] Note that a separate Geotechnical Assessment is included in Chapter 17 of this EIA Report.

16.3 Description of Project Aspects relevant to Hydrogeological Specialist Study

The Project Applicant intends to source water from the existing boreholes or to drill new boreholes to source groundwater (if available and if suitable) for the construction, operational and decommissioning phases (i.e. general construction use, concrete batching, cleaning of panels, drinking water, and domestic use). As a result, water pipelines may need to be constructed to transfer groundwater from identified waterpoints. Alternatively water may be transported by trucks from the identified water points to the sites (Map 16-2) Groundwater may also need to be stored on site in suitable, closed containers or reservoir tanks during the construction and operational phases. The compliance requirements in terms of the National Water Act (Act 36 of 1998) (NWA) are also assessed in terms of groundwater use. It must be noted that in terms of water supply options, the use of existing boreholes is the third option and drilling of new boreholes is the fourth option. The first option is to source water from the local municipality and the second is to source water from a third party.

Generally, groundwater can be impacted negatively in two manners, namely:

- Over-abstraction (where groundwater abstraction exceeds recharge rates) which can result in the alteration of groundwater flow directions and gradients, as well as quality.
- Quality deterioration (i.e. from anthropogenic activities negatively impacting groundwater quality).

There is currently limited groundwater abstraction taking place in relation to the size of the study area (based on regional datasets). Groundwater use volumes are generally low, and water is mostly used for drinking and livestock watering. The low rainfall and high evapotranspiration rates within the study area are a limiting factor for the recharge of the aquifer underlying the study area.

The groundwater requirement for the project can be met by using the existing boreholes. However, agreements will have to be put in place with the current land owners for the use of groundwater. These agreements will have to be legally valid documents and the necessary endorsements will be required from the DWS.

If no such agreements can be put in place, then additional new boreholes will need to be drilled on the relevant farm portions/developments, followed by complete geohydrological testing and an assessment, including yield and water quality testing, and then authorisation from DWS to use the groundwater will be required, as well as the necessary Environmental Assessment process (if required). This will be undertaken as a separate process, once more detailed information becomes available, outside of the current Application for Environmental Authorisation for the Solar PV Facility and associated infrastructure. This Geohydrology Assessment focuses on the third option, which is the use of existing boreholes within the study area. Some information is provided on the permitting requirements for new boreholes, where possible, but this is not the focus of this assessment.

The proposed project will also entail the development of a Battery Energy Storage System (BESS) at the PV Facility. Lithium Ion and Redox Flow BESS technologies were considered during this EIA Process. With any chemical storage (e.g. for the electrolyte needed for the Redox Flow BESS) there is always a risk of contamination to soils and groundwater. Additional information is provided in the impact assessment section of this report.

16.4 Baseline Environmental Description

16.4.1 Study Area Definition

The study area for all the proposed Kudu Solar Facilities 1 to 12 is the full extent of the eight affected farm properties on which the proposed PV Facilities will be constructed. The full extent of these properties has been assessed in this study in order to identify environmental sensitivities and no-go areas. The total study area for all the Kudu Solar Facilities 1 to 12 is approximately 8 150 hectares (ha).

At the commencement of this Scoping and EIA Process, the **Original Scoping Buildable Areas** which fall within the study area were identified by the Project Developer following the completion of high-level environmental screening based on the Screening Tool.

Following the identification of sensitivities during the Scoping Phase, the Project Developer considered such sensitivities and formulated the **Revised Scoping Buildable Areas**. The **Revised Scoping Buildable Areas** were used to inform the design of the layout, and further assessed during this EIA Phase of the project in order to identify the preferred development footprint of the proposed project on the approved site as contemplated in the accepted Scoping Report. The development footprint is where the actual development will be located, i.e. the footprint containing the PV solar arrays and associated infrastructure.

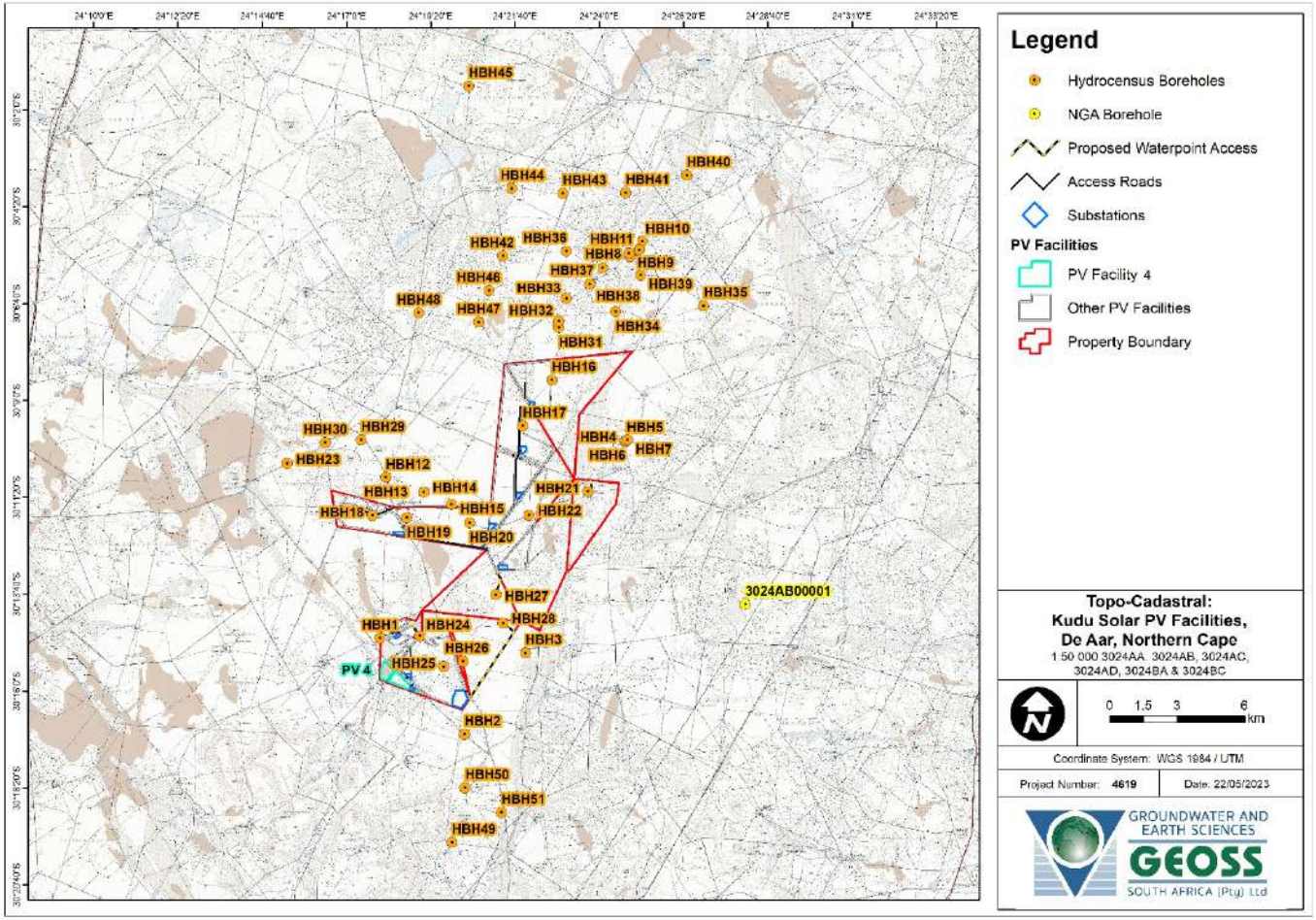
16.4.2 General Description

The nearest town to the proposed project is De Aar, approximately 60 km to the southwest. The landscape in the surrounding area is arid, with transported sands occurring widely along plains with dolerite sills (generally northwest of the study area) and mudstone, shale and sandstones (generally southeast of the study area) outcropping in areas of higher elevation. It is understood that the farms in the area are mainly used for livestock farming purposes. The major impact within the area is, therefore, the abstraction of ground water for livestock-focused agriculture.

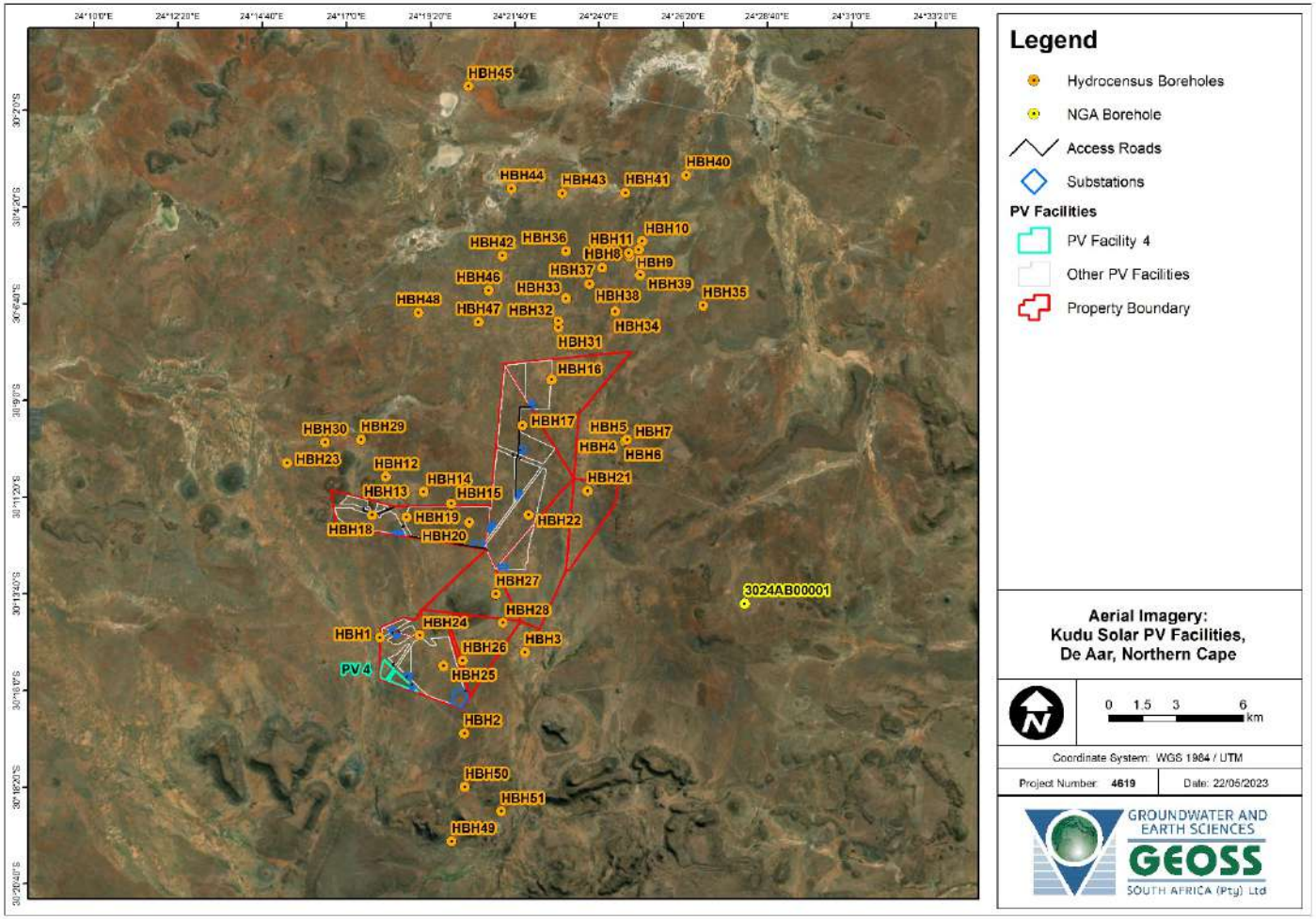
The receptors that could be impacted due to groundwater abstraction or groundwater quality deterioration are the livestock and occupants on the farms within the study area.

Acceptable levels of change in terms of geohydrology conditions would generally be characterised by small to negligible changes in water table depth up until depth of historic boreholes and small changes in chemistry such that there is no level of deterioration in groundwater quality.

Map 16-2 and Map 16-3 present existing boreholes used for livestock and drinking water on and around the study area with detailed views of the Kudu Solar Facility 4 superimposed on a 1:50 000 topo-cadastral map and aerial image respectively.



Map 16-2: The study area delineating the study area for the 12 Kudu Solar Facilities, property boundaries, hydrocensus boreholes and the NGA borehole on a 1:50 000 scale topocadastral map (3024AA, 3024AB, 3024AC, 3024AD, 3024BA, 3024BC). Note that this report is focused on Kudu Solar Facility 4.



Map 16-3: Aerial view delineating the study area of the 12 Kudu Solar Facilities, hydrocensus boreholes and the NGA borehole. Note that this report is focused on Kudu Solar Facility 4.

16.4.3 Project Specific Description

16.4.3.1 Climate

The study area experiences a semi-arid climate, with most of the rainfall occurring during February to March. Figure 16-1 shows the monthly average minimum and maximum air temperature distribution and Figure 16-2 shows the monthly median rainfall and evaporation distribution for the study area (Schulze, 2009). The long term (1950 – 2000) mean annual precipitation for the study area is 281 mm/a. The rainfall does not exceed evaporation during the course of the year.

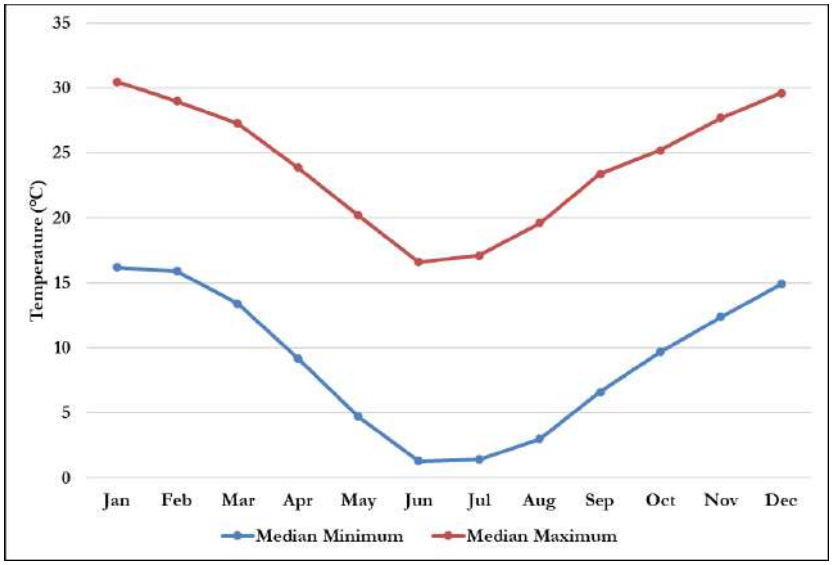


Figure 16-1: Monthly average air temperature for the Kudu Solar Facility study area (Schulze, 2009).

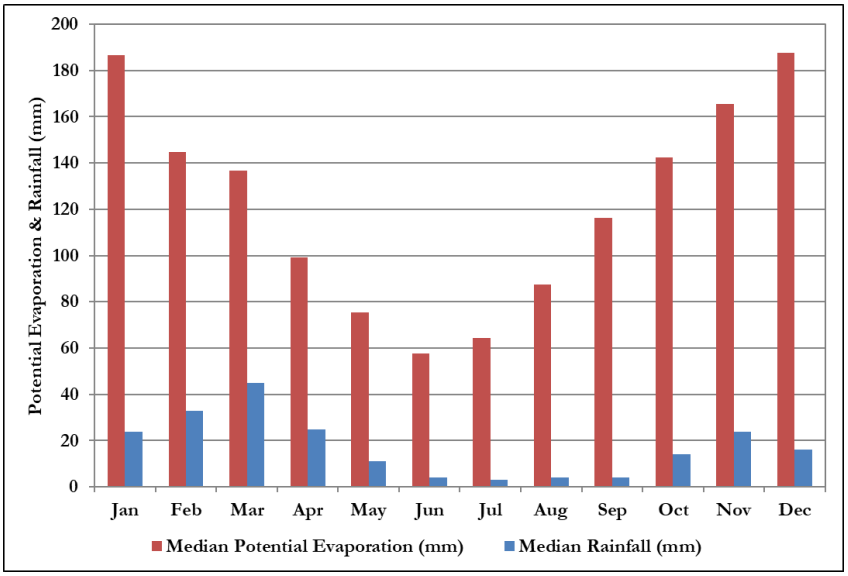


Figure 16-2: Monthly median rainfall and evaporation distribution for the Kudu Solar Facility study area (Schulze, 2009).

16.4.3.2 Regional Geology

The Geological Survey of South Africa (now the Council for Geoscience) has mapped the area at 1:250 000 scale (3024, Colesberg). The geological setting is shown in Map 16-4. The main geology of the area is listed in Table 16-2.

Table 16-2: Geological formations within the study area listed in order of relative age.

Symbol	Formation/Subgroup	Group	Lithology
	Quaternary Deposit		Alluvium / Terrace Gravel
Qc			Calcrete
Jd	Jurassic Intrusion		Dolerite
Pa	Adelaide Subgroup	Beaufort Group	Blue-grey silty mudstone, subordinate brownish-red mudstone; sandstone
Pt	Tierberg Formation	Ecca Group	Blue-grey to black shale with carbonate-rich concretions; subordinate siltstone and sandstone in upper part

The Kudu Solar Facility 4 is mainly underlain by and well-developed calcretes, with a small portion to the west underlain by Quaternary alluvium deposits. These quaternary deposits, in turn, overly either dolerite sills and dykes, (Jd) or undifferentiated sediments of the Adelaide Subgroup (Pa) and/or Tierberg Formation (Pt). The Adelaide Subgroup (Pa) comprises interbedded mudstones, siltstones and sandstone, whilst the Tierberg Formation (Pt) consists primarily of shale and sandstone. Both of these units were deposited within a braided river to deltaic setting within the Karoo basin during the Permian Period some 268 to 247 Million years ago (Johnson et al., 2006). These sediments were subsequently intruded during the Jurassic Period by dolerite sills and dykes of the Karoo Dolerite Suite. There are no known large structural geological features in the surrounding area of the proposed project; however, the dolerite sills in the area commonly show extensive jointing as a result of cooling and exhumation (Senger et al., 2015).

16.4.3.3 Regional Hydrogeology

The regional aquifer directly underlying the proposed project study area is classified by the Department of Water Affairs and Forestry (DWAF) (DWAF, 2005) as a fractured aquifer with an average yield potential of 0.5 – 2.0 L/s **(**Map 16-5). A fractured aquifer describes an aquifer where groundwater only occurs in narrow fractures within the bedrock. However, based on the geological map and the site-specific information it is known that the Quaternary deposits of alluvium and calcrete form an intergranular aquifer on top of the fractured bedrock. There is no known information about this aquifer. An intergranular aquifer is a primary aquifer and is described as an aquifer in which groundwater is stored within, and flows through open pore spaces in the unconsolidated Quaternary deposits.

Based on the DWAF (2005) mapping of the regional groundwater quality, as indicated by electrical conductivity (EC), the groundwater underlying the Kudu Solar Facility and the surrounding area is in the range of 70 – 300 mS/m. This is considered to be “good to marginal” quality for water (Map 16-6) with respect to drinking water standards.

Both these classifications are based on regional datasets, and therefore only provide an indication of conditions to be expected.

According to research done by Harkness et al. (2018), there is evidence in the southern portion of the Karoo basin that there are several variable aged sources of ground water at different depths. They found that the deeper groundwater was typically more saline, older according to isotope data, and had chemical signatures indicating both ancient meteoric and marine sources. Although separated by confining fine grained units throughout, fracture and joint sets within dolerite sills and dykes potentially act as a conduit for mixing between younger freshwater, and ancient saline aquifers.

16.4.3.4 Aquifer Vulnerability (DRASTIC)

Based on the regional datasets the proposed project overlies a fractured aquifer that possesses water bearing properties due to fracturing. Several methods have been developed to classify an aquifer's vulnerability with The DRASTIC method being applied to this study.

Groundwater vulnerability can be defined as the "tendency for contaminants to reach a specified position in the groundwater system after introduction at some location" (Vrba and Zaporozec, 1994). Key physical parameters which determine groundwater vulnerability include lithology, thickness, effective porosity, groundwater flow direction, age and residence time of water. Generally, the residence time of contaminants in groundwater and the distance that it travels in the aquifer are considered important measures of vulnerability.

There are two main groups of methods for assessing groundwater vulnerability, namely:

- Index or subjective rating methods, and
- Statistical or process-based methods.

The "index or subjective rating method" is relatively easily addressed within a GIS framework. The cell-based layer approach facilitates the assignment of ratings and weights, and rapid achievement of a final result of relative groundwater vulnerability. This approach also means that the algorithm can easily be repeated as new or more detailed data sets are obtained or if ratings and weightings need to be adjusted as a result of a sensitivity analysis for example. The most well-known "index or subjective rating method" is the "DRASTIC" method (Aller et al., 1987). The DRASTIC method of Aller et al. (1987) uses the typical overlay technique often applied in subjective rating methods. The DRASTIC approach is based on four major assumptions:

- The contaminant is introduced at ground surface;
- The contaminant is flushed into the groundwater by precipitation;
- The contaminant has the mobility of water; and
- The area evaluated using DRASTIC is 40.5 ha or larger.

The implication of these assumptions is that DRASTIC should not be used for contaminants that do not have the mobility of water or for point assessment (such as storage tanks). In addition, groundwater conditions in South Africa are dominated by secondary/fracture-controlled flow conditions. The DRASTIC method does not consider local preferential flow paths of fractured aquifer systems particularly well. The DRASTIC method takes into account the following factors:

D	=	depth to groundwater	(9)
R	=	recharge	(8)
A	=	aquifer media	(8)
S	=	soil type	(4-5)
T	=	topography	(10)
I	=	impact of the vadose zone	(9)
C	=	conductivity (hydraulic)	(6)

The number indicated in parenthesis at the end of each factor description is the weighting or relative importance at that factor.

Groundwater vulnerability maps developed using the DRASTIC method have been produced in many parts of the world. In spite of the widespread use of DRASTIC, the effectiveness of the method has been met with mixed success due to hydrogeological heterogeneity and the many assumptions that need to be made in determining groundwater vulnerability. In addition, the use of a generic vulnerability map only gives a broad indication of relative vulnerability and in many instances detailed scale, contaminant specific vulnerability assessments are required.

As part of the Groundwater Resources Assessment Project (DWAF, 2005), numerous data sets were produced and this enabled the mapping of groundwater vulnerability at the national scale on a 1 km by 1 km cell (pixel) size basis (Conrad and Munch, 2007). This national scale map indicates the relative vulnerability of groundwater resources throughout the country and provides project planners a clear idea of what level of groundwater protection is required.

The groundwater vulnerability for the study area is shown in Map 16-7. The development area for the Kudu Solar Facility 4 has a **Low to Medium** groundwater vulnerability. It is assumed that the regional data maps relate to the underlying fractured aquifer and not the intergranular aquifer. The intergranular aquifer on top of the fractured aquifer has no protection and therefore any contamination that is introduced on the surface of the intergranular aquifer will infiltrate into the subsurface and can cause contamination of the intergranular aquifer. Therefore, the vulnerability specifically for the intergranular aquifer is considered to be **medium**.

16.4.4 Site Specific and Existing Groundwater Information

16.4.4.1 NGA Database

A desktop assessment was initially carried out within and around the study area to determine if there were any groundwater users in the area. The NGA database provides data on borehole positions, groundwater chemistry and yield, where available. The NGA indicated there is one borehole surrounding the study area (Map 16-2 and Map 16-3). The NGA site is summarized in Table 16-3.

Table 16-3: Summary of NGA borehole.

NGA Label	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Yield (L/s)	Depth (m)	Lithology
3024AB00001	-30.23333	24.46667	0.18	0-39.93 39.93-73.46	Shale Sandstone

The NGA site indicates a borehole has a yield of 0.18 L/s, depth of 73.46 m with a lithology of shale followed by sandstone.

16.4.4.2 Hydrocensus

A representative hydrocensus was conducted on 23 and 24 March 2022 on the farm portions on which the Kudu Solar Facilities 1 - 12 are located (i.e. the study area) and the surrounding farm portions. The hydrocensus boreholes are shown on Map 16-2 and Map 16-3. These boreholes are summarised in Table 16-4. During the hydrocensus data such as borehole depth, water level (WL), pH, total dissolved solids (TDS) and EC were measured.

Table 16-4 : Summary of Boreholes in the study area.

Borehole Name	Latitude (DD, WGS84)	Longitude (DD, WGS84)	pH	EC (mS/m)	TDS (mg/L)	WL (mbgl)	Depth (m)
HBH1	-30.2463968	24.2971598	7.4	76	370	-	-
HBH2	-30.2851593	24.3358956	-	-	-	-	-
HBH3	-30.2526869	24.3643247	7.5	91	440	17.75	-
HBH4	-30.1679489	24.4109898	7.1	102	500	8.7	-
HBH5	-30.1675761	24.4118524	-	-	-	8.7	-
HBH6	-30.1676747	24.4112416	-	-	-	-	-
HBH7	-30.1673778	24.4120952	7.5	95	460	9.2	-
HBH8	-30.0936932	24.4136653	6.8	126	1260	6.4	10
HBH9	-30.092446	24.413403	7.5	104	510	8.4	-
HBH10	-30.0875905	24.4194914	7.3	80	390	-	-
HBH11	-30.091018	24.4180866	-	-	-	8.1	-
HBH12	-30.1818617	24.3003232	7.5	94	460	10.1	-
HBH13	-30.181802	24.3002685	-	-	-	-	-
HBH14	-30.1879078	24.3179014	-	-	-	-	-
HBH15	-30.1927376	24.3305225	-	-	-	-	-
HBH16	-30.1431559	24.377371	7.4	100	490	11	-
HBH17	-30.1614565	24.3636659	9.1	64	310	7.25	17
HBH18	-30.1971676	24.2939657	8.4	107	520	11.1	-
HBH19	-30.1980902	24.3098031	7.5	86	420	10.95	-
HBH20	-30.200251	24.33882	9.6	104	520	-	-
HBH21	-30.187906	24.393707	8	58	270	-	-
HBH22	-30.197459	24.366364	7.7	57	280	-	-

Borehole Name	Latitude (DD, WGS84)	Longitude (DD, WGS84)	pH	EC (mS/m)	TDS (mg/L)	WL (mbgl)	Depth (m)
*HBH23	-30.175992	24.2547534	-	-	-	-	-
*HBH24	-30.245532	24.315637	-	-	-	-	-
*HBH25	-30.258001	24.326557	-	-	-	-	-
*HBH26	-30.255856	24.335565	-	-	-	-	-
*HBH27	-30.229251	24.35097	-	-	-	-	-
*HBH28	-30.240724	24.35404	-	-	-	-	-
*HBH29	-30.166797	24.288983	-	-	-	-	-
*HBH30	-30.167743	24.272326	-	-	-	-	-
*HBH31	-30.122051	24.380559	-	-	-	-	-
*HBH32	-30.119526	24.380652	-	-	-	-	-
*HBH33	-30.110477	24.384284	-	-	-	-	-
*HBH34	-30.115827	24.406987	-	-	-	-	-
*HBH35	-30.113626	24.447559	-	-	-	-	-
*HBH36	-30.09143	24.384297	-	-	-	-	-
*HBH37	-30.098216	24.401043	-	-	-	-	-
*HBH38	-30.104676	24.395147	-	-	-	-	-
*HBH39	-30.101161	24.418577	-	-	-	-	-
*HBH40	-30.061157	24.440153	-	-	-	-	-
*HBH41	-30.068085	24.411932	-	-	-	-	-
*HBH42	-30.093241	24.354924	-	-	-	-	-
*HBH43	-30.068237	24.382791	-	-	-	-	-
*HBH44	-30.06616	24.359238	-	-	-	-	-
*HBH45	-30.024899	24.339597	-	-	-	-	-
*HBH46	-30.107118	24.348457	-	-	-	-	-
*HBH47	-30.119755	24.343665	-	-	-	-	-
*HBH48	-30.115915	24.315975	-	-	-	-	-
*HBH49	-30.328537	24.329885	-	-	-	-	-
*HBH50	-30.306722	24.336103	-	-	-	-	-
*HBH51	-30.316574	24.352879	-	-	-	-	-

* Could not gain access to borehole due to wet conditions. Farmer indicated location of borehole on a map.

- Data could not be obtained due to base plate that covered the whole borehole or the information was unavailable.

From the information obtained during the hydrocensus it is clear that the boreholes are shallow in the area as all of them were wind pumps. The water is mainly used for domestic use and livestock watering. The boreholes had an EC that ranged from 57 mS/m to 126 mS/m and all of the boreholes were only drilled into the alluvium as the farmers reported that they only drill until they intersect the “ysterklip” which can be assumed to be the shales or dolerites underlying the alluvium.

16.4.4.3 Groundwater Quality

The groundwater quality obtained during the hydrocensus was assessed to establish if it is suitable for the following uses:

- Potable water
- Domestic use which will include washing of dishes and toilet flushing
- Washing of panels
- General construction and concrete batching

16.4.4.3.1 SANS241-1:2015: Drinking water standards

The field parameters that were obtained from boreholes that were tested during the hydrocensus have been classified according to the South African National Standard (SANS) SANS241-1: 2015 standards for domestic water in **(**Table 16-5**).** Table 16-6 presents the field chemistry results, colour coded according to the SANS241-1: 2015 drinking water assessment standards.

Table 16-5: Classification table for specific limits for domestic water standards

Acute Health	Chronic Health	Aesthetic	Operational	Acceptable

The limits and associated risks for domestic water as determined by the SANS 241:2015 are as follows, where:

- Health risks: parameters falling outside these limits may cause acute or chronic health problems in individuals.
- Aesthetic risks: parameters falling outside these limits indicate that water is visually, aromatically or palatably unacceptable.
- Operational risks: parameters falling outside these limits may indicate that operational procedures to ensure water quality standards are met may have failed.

Table 16-6: Production borehole results classified according the SANS241-1:2015

	Borehole Name	pH	EC (mS/m)	TDS (mg/L)
	HBH1	7.4	76	370
	HBH3	7.5	91	440
	HBH4	7.1	102	500
	HBH7	7.5	95	460
	HBH8	6.8	126	1260
	HBH9	7.5	104	510
	HBH10	7.3	80	390
	HBH12	7.5	94	460
	HBH16	7.4	100	490
	HBH17	9.1	64	310

	Borehole Name	pH	EC (mS/m)	TDS (mg/L)
	HBH18	8.4	107	520
	HBH19	7.5	86	420
	HBH20	9.6	104	520
	HBH21	8	58	270
	HBH22	7.7	57	280
SANS241-1:2015		5-9.5	≤170 Aesthetic	≤1200 Aesthetic

16.4.4.3.2 DWA (1998): Drinking Water Assessment Guide

The field parameters that were obtained have also been classified according to the DWAF (1998) standards for domestic water (as they a little easier to understand). Table 16-7 enables an evaluation of the water quality with regards to the various parameters measured (DWAF, 1998). Table 16-8 presents the water chemistry analysis results colour coded according to the DWAF drinking water assessment standards.

Table 16-7: Classification table for the groundwater results (DWAF, 1998)

Blue	**(Class 0)**	**Ideal water quality** - suitable for lifetime use.
Green	**(Class I)**	**Good water quality** - suitable for use, rare instances of negative effects.
Yellow	**(Class II)**	**Marginal water quality** - conditionally acceptable. Negative effects may occur.
Red	**(Class III)**	**Poor water quality** - unsuitable for use without treatment. Chronic effects may occur.
Purple	**(Class IV)**	**Dangerous water quality** - totally unsuitable for use. Acute effects may occur.

Table 16-8: Classified production borehole results according to DWAF 1998.

	Borehole Name	pH	EC (mS/m)	TDS (mg/L)
	HBH1	7.4	76	370
	HBH3	7.5	91	440
	HBH4	7.1	102	500
	HBH7	7.5	95	460
	HBH8	6.8	126	1260
	HBH9	7.5	104	510
	HBH10	7.3	80	390
	HBH12	7.5	94	460
	HBH16	7.4	100	490
	HBH17	9.1	64	310

	Borehole Name	pH	EC (mS/m)	TDS (mg/L)
	HBH18	8.4	107	520
	HBH19	7.5	86	420
	HBH20	9.6	104	520
	HBH21	8	58	270
	HBH22	7.7	57	280
DWAF (1998) Drinking Water Assessment Guide	Class 0	5-9.5	<70	<450
	Class I	4.5-5&9.5-10	70-150	450-1000
	Class II	4-4.5&10-10.5	150-370	1000-2400
	Class III	3-4&10.5-11	370-520	2400-3400
	Class IV	<3&>11	>520	>3400

The available chemistry results (pH, EC and TDS) have been compared SANS241-1: 2015 standards and the DWAF (1998) standards in Table 16-6 and Table 16-8. From this it is seen that the groundwater quality is generally of good quality in terms of pH, EC and TDS. It is possible that the groundwater can be used for potable and domestic purposes with only minor treatment however a full laboratory analysis will be required.

With regards to the cleaning of panels it is understood that a very clean water is required to clean the panels otherwise salts will deposit on the panels. The electric conductivity for the groundwater ranges from 57 to 126 mS/m which is considered to be good to marginal. Although this water quality is relatively good it will not be suitable for panel washing as it will result in salts precipitating on the panels. The salts could be removed from the groundwater by thermal distillation (i.e. boiling since salt has a much higher boiling point than water) or by membrane separation (commonly reverse osmosis). Both of these techniques are possible but financial viability would have to be determined before commissioning as both techniques are costly on a large scale.

In terms of using groundwater for construction purposes and mixing of concrete the SANS 51008:2006 (*Mixing water for concrete document)* was referred to. Both the composition of the water and the application of the concrete needs to be considered. Potable water is considered to be suitable for concrete batching with no testing required. Groundwater is also considered to potentially be suitable for concrete batching; however, it requires testing as some groundwater can be very saline which is not considered to be suitable. Furthermore, the SANS 51008 standards do specify maximum limits for chlorides, sulphates, alkalinity, phosphates, nitrates, lead and zinc. Most of these parameters are currently unknown and therefore it is unclear if the groundwater is suitable for construction and concrete batching.

16.4.4.4 Water level elevation maps

The water level elevations obtained during the hydrocensus were interpolated[2] to determine the groundwater flow direction. The data is presented in Figure 16-3, and indicates a 99.44% correlation between surface topography (elevation (mamsl)) and groundwater level elevation. Bayesian interpolation is therefore considered an acceptable interpolation technique. The water level elevation map for March 2022 is presented in Map 16-8. From this it is seen that the groundwater flow direction is in a general north westerly direction.

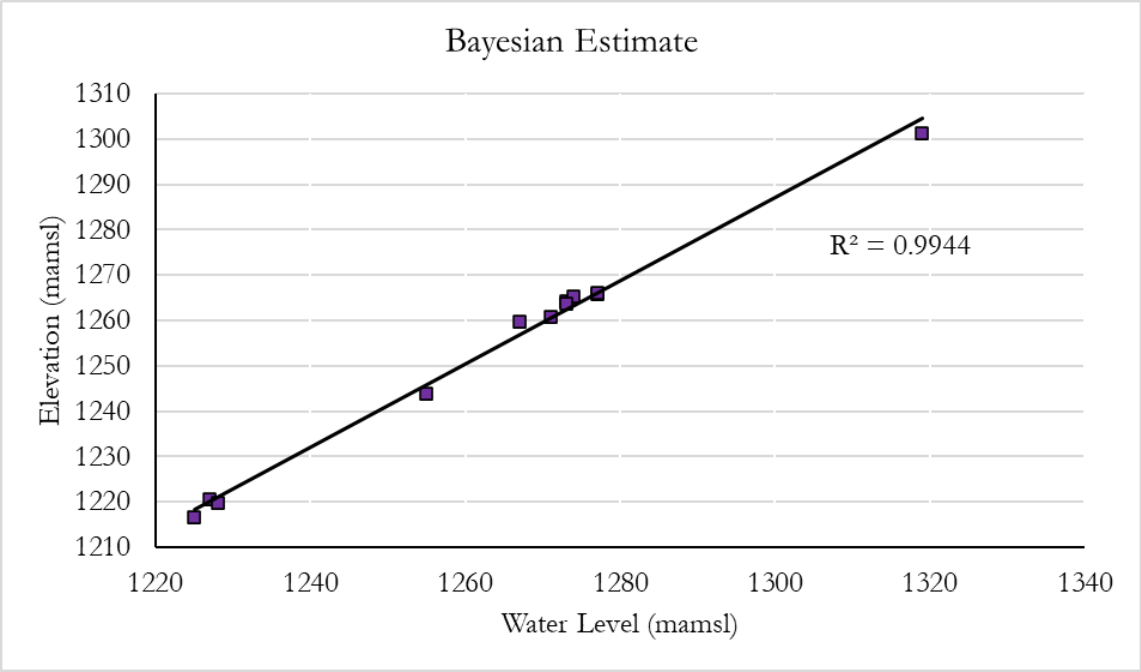
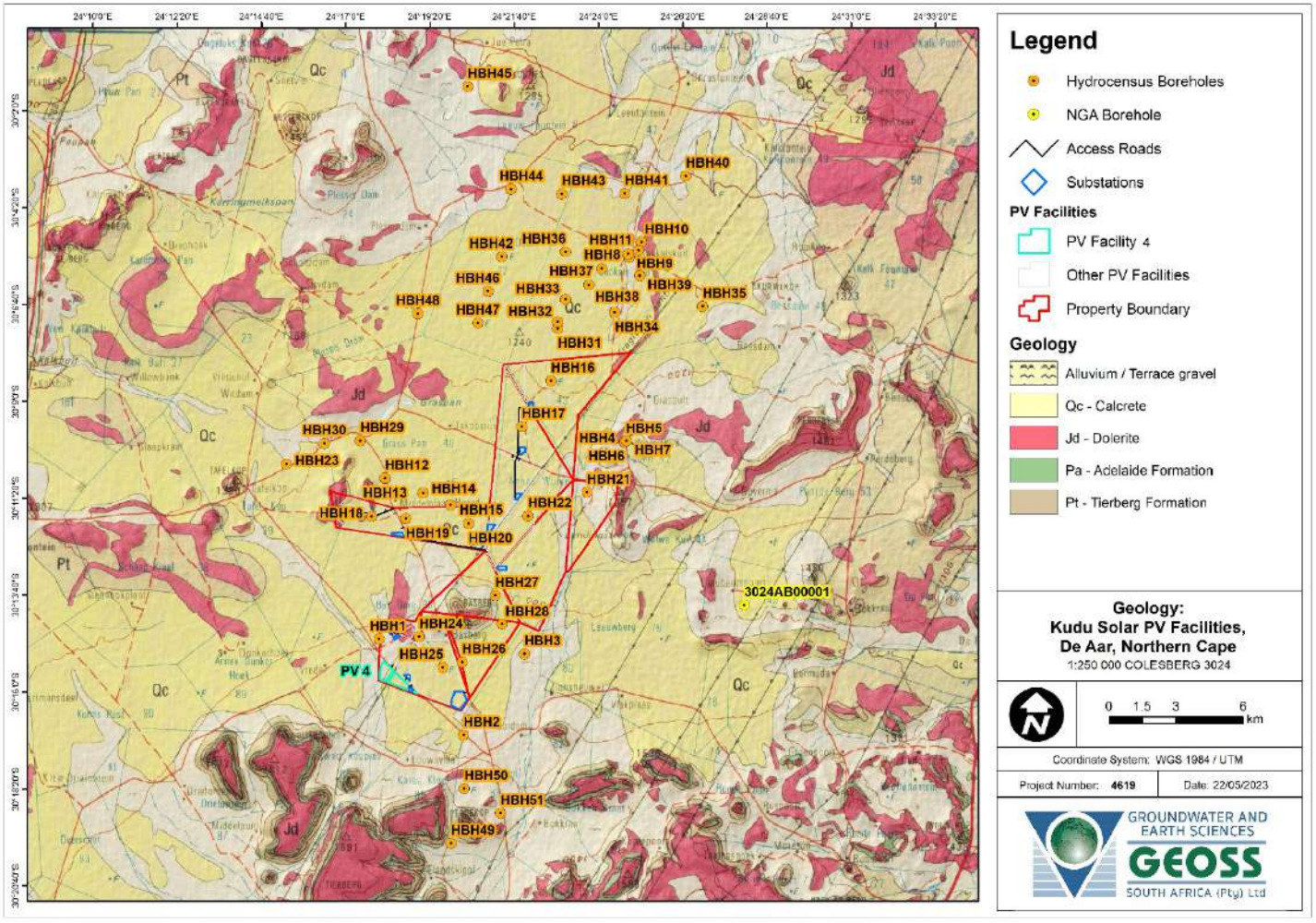
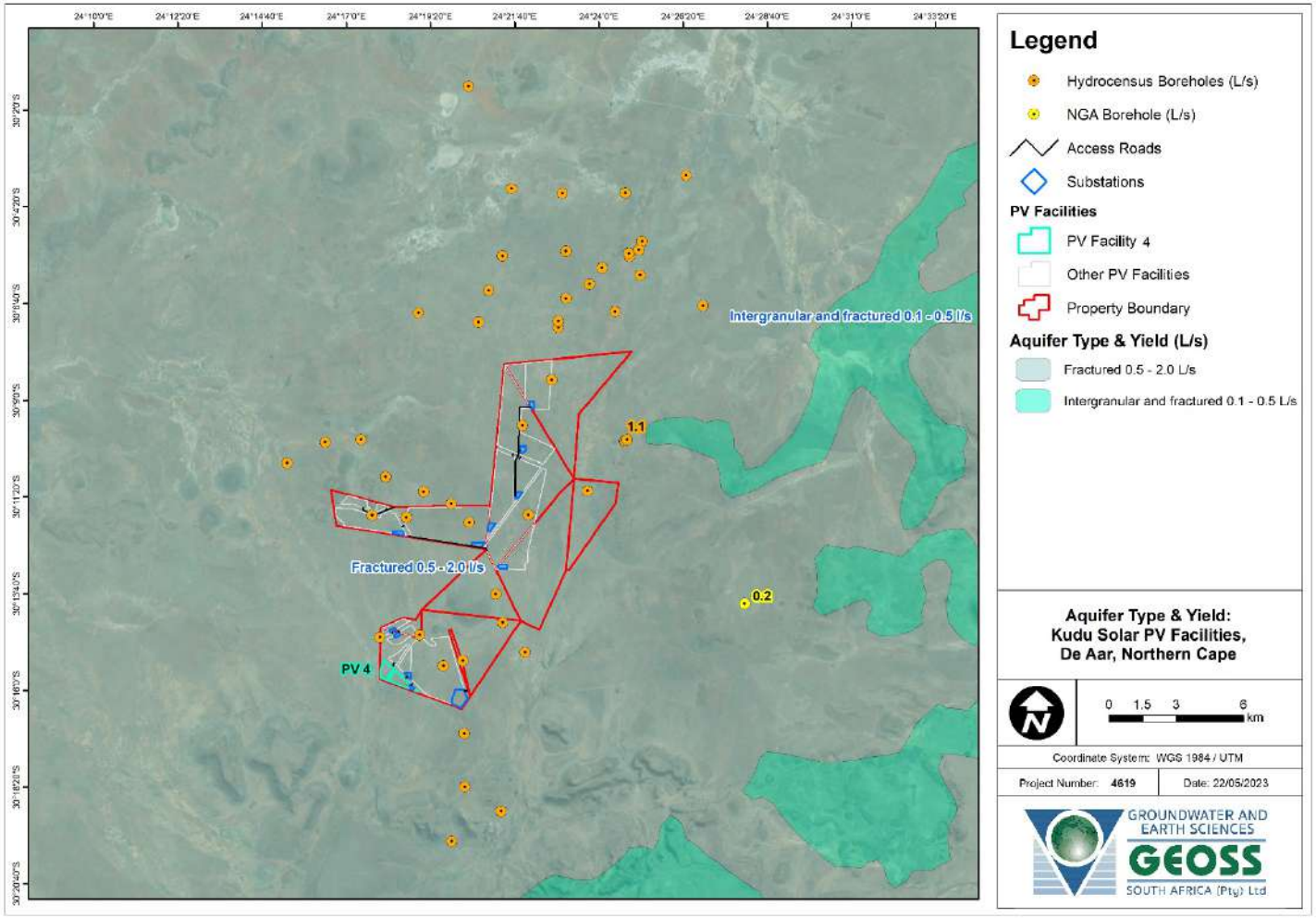


Figure 16-3: Correlation between surface topography and groundwater elevation.

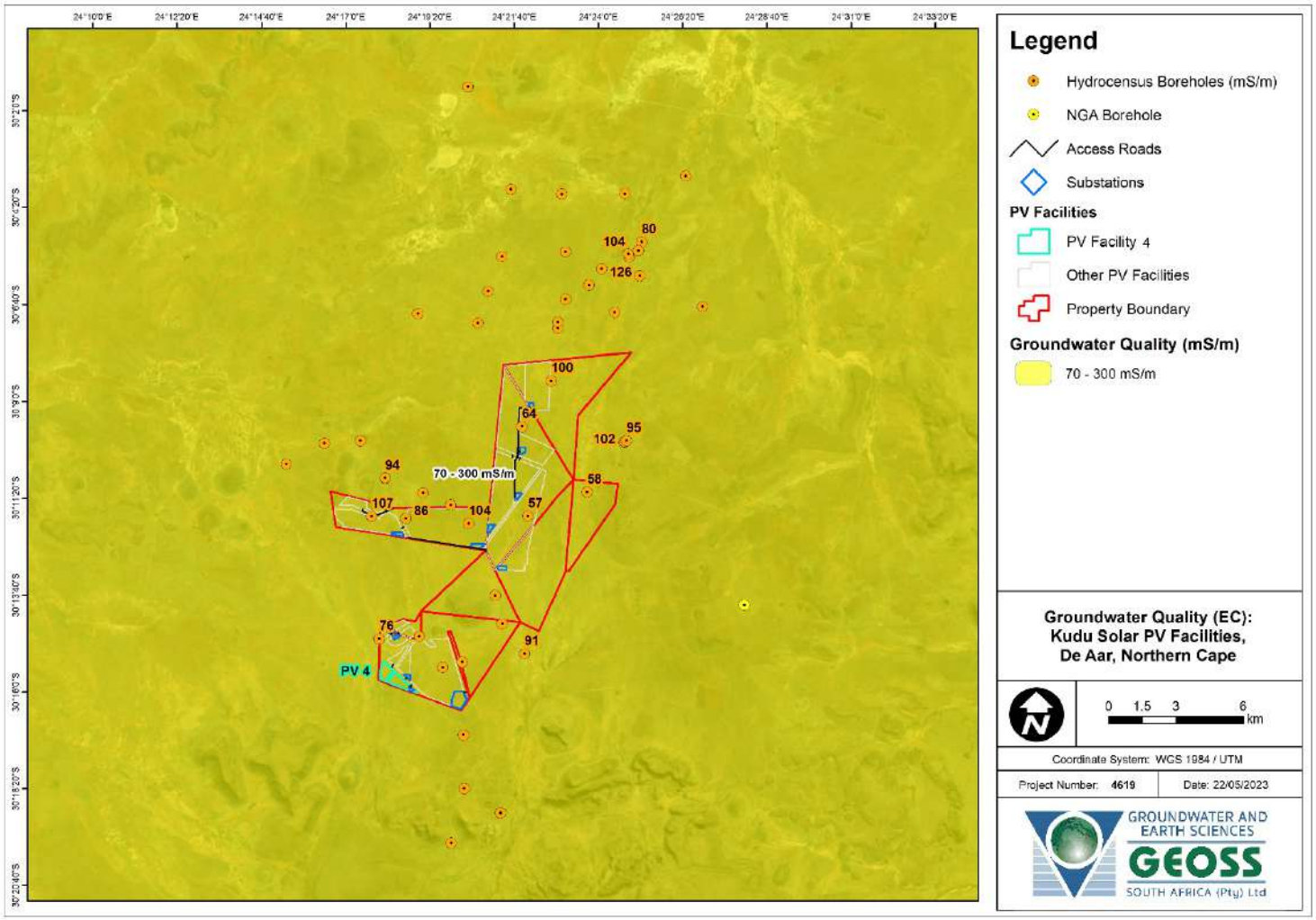
[2] Bayesian interpolation was used and the output generated was a point grid, which was interpolated in ArcGIS software to create the groundwater elevation surface.



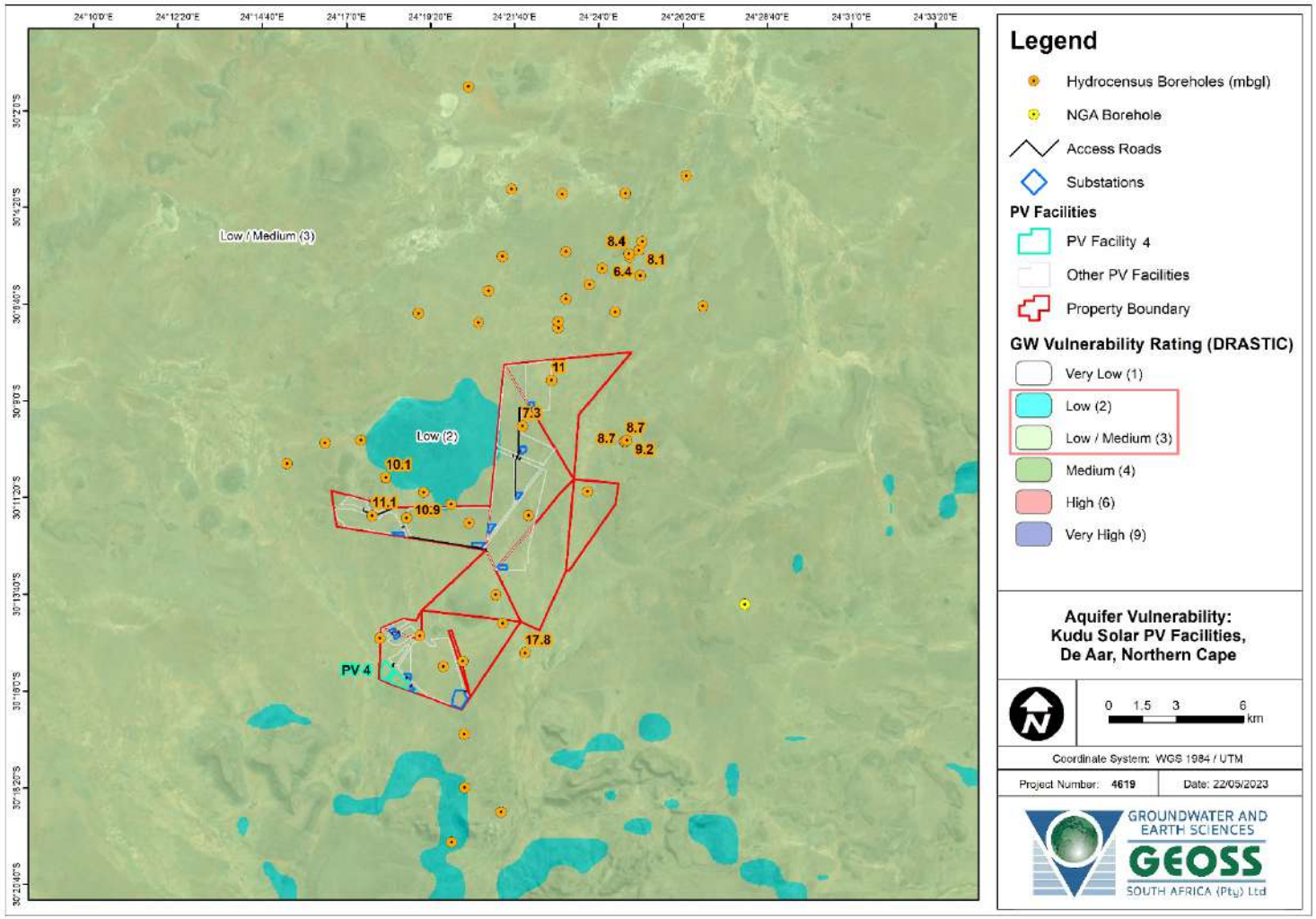
Map 16-4: Geological setting of the study area for the Kudu Solar Facilities. (CGS (1997) map: 1:250 000 scale Colesberg). Note that this report is focused on Kudu Solar Facility 4.



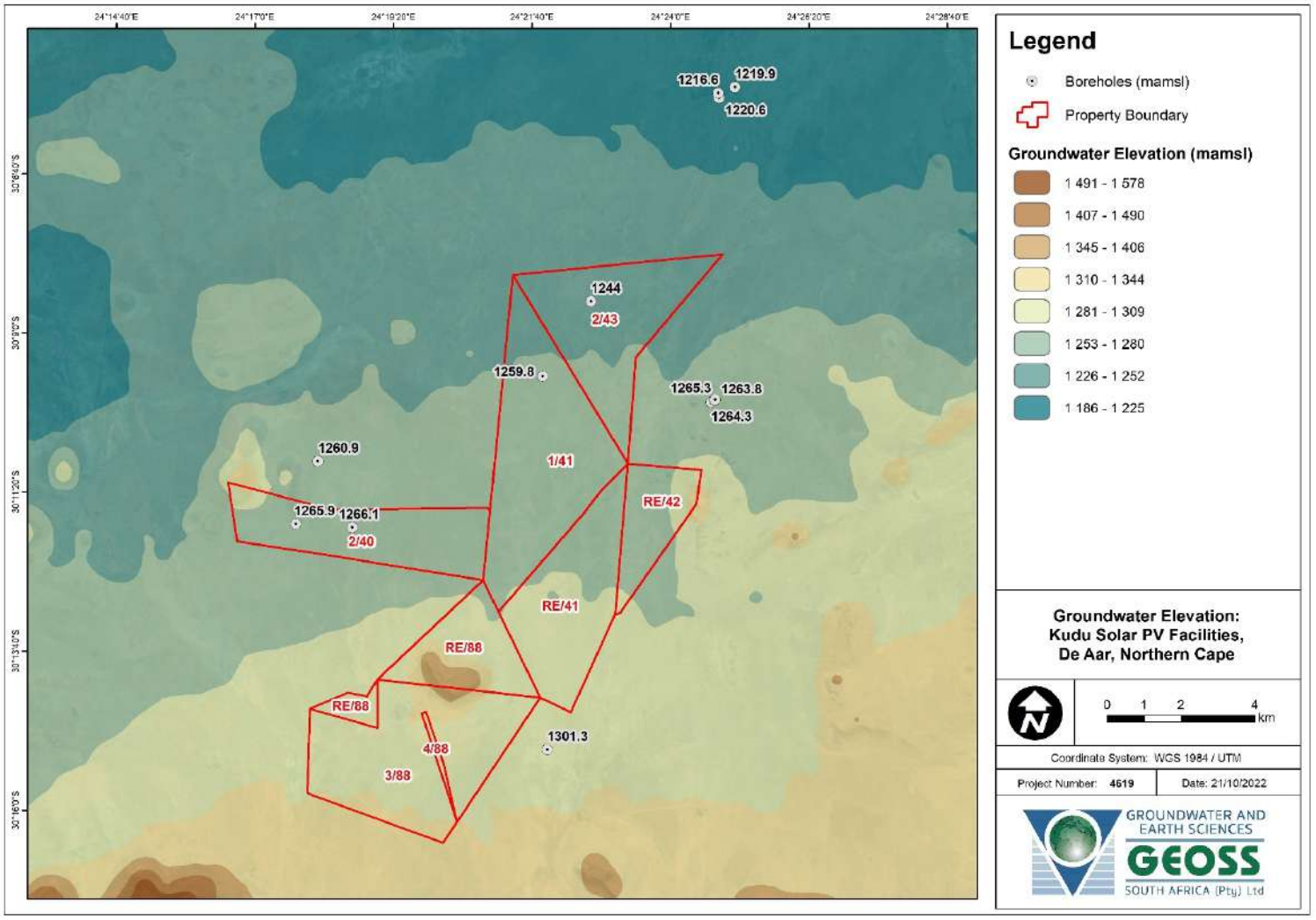
Map 16-5: Regional aquifer yield (DWAF, 2005) and borehole yields (L/s) in the study area for the Kudu Solar Facilities. Note that this report is focused on Kudu Solar Facility 4.



Map 16-6: Regional groundwater quality (mS/m) from DWAF (2005) and borehole groundwater quality (EC in mS/m) in the study area for the Kudu Solar Facilities. Note that this report is focused on Kudu Solar Facility 4.



Map 16-7: Vulnerability rating (DWAF, 2005) and groundwater depths (mbgl) in the study area for the Kudu Solar Facilities. Note that this report is focused on Kudu Solar Facility 4.



Map 16-8: Groundwater contour map based on the March 2022 field measurements in the study area. Note that this report is focused on Kudu Solar Facility 4.

16.4.5 Identification of Environmental Sensitivities

16.4.5.1 Sensitivities identified by the National Web-Based Environmental Screening Tool

Part of the terms of reference for the Kudu Solar Facility was to identify sensitivities by the National Web-Based Environmental Screening Tool. However, it is important to note that there are no dedicated Geohydrology or Groundwater themes on the National Web-based Environmental Screening Tool (Screening Tool) (as of May 2023), therefore the environmental sensitivity of the proposed project area as identified by the Screening Tool is not applicable. As such, no site sensitivity verification report is required. Furthermore, there is no dedicated assessment protocol prescribed for Geohydrology or Groundwater. Therefore, the specialist assessment has been undertaken in compliance with Appendix 6 of the NEMA EIA Regulations of 2014.

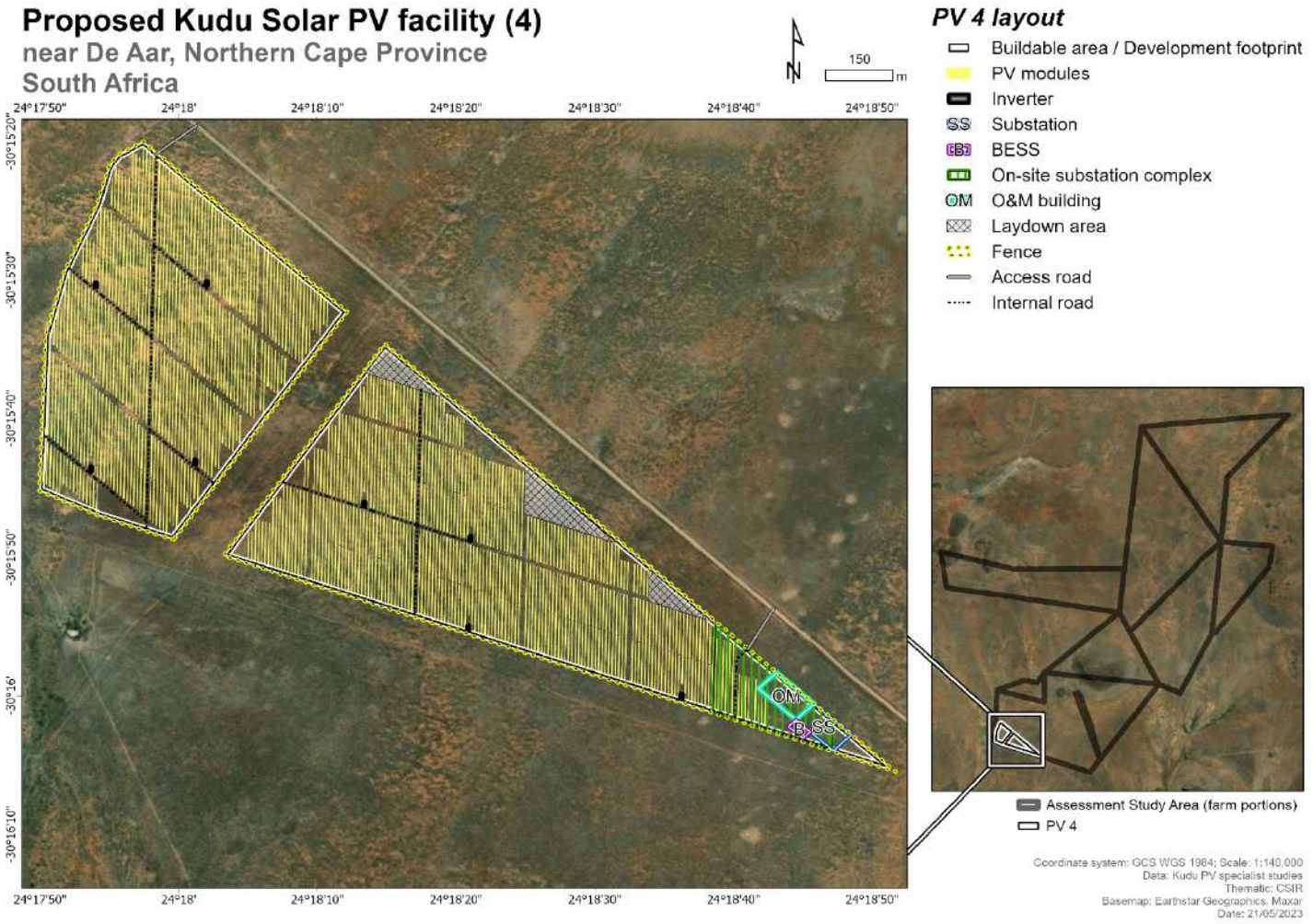
16.4.5.2 Specialist Sensitivity Analysis and Verification

As there is no sensitivity assessment protocol for Groundwater or Geohydrology, the following sensitivity analysis is based primarily on the results from the DRASTIC approach outlined in section 16.4.2. From this analysis a geospatial model was created, which shows that the entire site sits within a low/medium ground water vulnerability rating, with the overlying alluvium being tentatively given a medium vulnerability rating. Furthermore, the site is situated above a fractured aquifer with relatively low yield of 0.5 to 2.0 l/s. Overlying the fractured aquifer is an intergranular aquifer made up of Cenozoic alluvium and carbonate palaeosols. This aquifer has no protection, with the result that any contamination introduced on the surface can infiltrate into the subsurface and potentially contaminate this aquifer. However, this is coupled with a low permeability of the unsaturated layer, which allows for a significant attenuation capacity. The sensitivity across the entire development is, therefore, similarly classified as “medium” with respect to all activities associated with the proposed development. This classification as “medium” sensitivity does not represent a constraint and does not represent an area to be avoided from a groundwater sensitivity perspective. Accordingly, no buffer areas have been identified save for a 50m buffer around borehole sites with respect to BESS construction/installation. Additional information on the impacts associated with the BESS are discussed in the following sections. Currently no site alternatives have been identified as these would be located within a similarly classed sensitivity area.

The major receptors with respect to ground water within the region are limited to livestock and the occupants of the surrounding farms. The principal activity within the region is the farming of livestock, which relies almost completely on the underground water resource. Any deterioration in either groundwater quality or groundwater level will negatively impact on these receptors.

16.4.5.3 Sensitivity Analysis Summary Statement

As indicated above, following the identification of sensitivities during the Scoping Phase, the Project Developer considered such sensitivities and formulated the Revised Scoping Buildable Areas. The Revised Scoping Buildable Areas led to the identification of the development footprints and detailed layouts in the EIA Phase. The development footprint and detailed layout are considered suitable from a Geohydrological perspective, as the sensitivities identified above (i.e. BESS placement to be outside of 50 m from identified boreholes) have been taken into consideration. The development footprint and detailed layout are shown in Map 16.9. Changes to the detailed layouts are deemed acceptable if the changes remain within the approved buildable areas / development footprints and area assessed during the Scoping and EIA Process with no-go sensitive areas avoided.



Map 16-9: Detailed Layout of Kudu Solar Facility 4

16.5 Issues, Risks and Impacts

16.5.1 Identification of Potential Impacts/Risks

The potential impacts on groundwater due to the proposed project activities are listed below:

- Lowering of the groundwater level due to abstraction during the construction and operational phases (9 000 m^3/a for the Construction Phase and 1 000 m^3/a for the Operational Phase for this PV project).
- Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages during the construction and decommissioning phases.
- Potential impact on groundwater quality as a result of cleaning agents used for cleaning the solar panels during the operational phase.
- Potential impact on groundwater quality as a result of electrolyte that will be used for the BESS.

Any construction activities such as the excavation and installation of foundations and piling (narrow diameter holes for foundation purposes) will have minimal to no impact on the groundwater of the site or region, as the groundwater level is approximately >5 mbgl.

The potential impacts identified during the Scoping and EIA are:

Construction Phase

- Potential impact 1: Potential lowering of the groundwater level from construction requirements.
- Potential impact 2: Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages.

Operational Phase

- Potential impact 3: Potential lowering of the groundwater level from operational requirements.
- Potential impact 4: Potential impact on groundwater quality as a result of using cleaning agents for cleaning the solar panels.
- Potential impact 5: Groundwater quality deterioration as a result of electrolyte that will be used for the BESS.

Decommissioning Phase

- Potential impact 6: Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages.
- Potential impact 7: Potential lowering of the groundwater level from decommissioning requirements.

Although the project description does not state the anticipated water use during decommissioning phase, from previous experience on similar projects it is unlikely that water use for the decommissioning phase will exceed that of the construction phase. This impact is,

therefore, assessed according to anticipated water usages similar to that of the construction phase.

Cumulative Impacts

- Cumulative Impact 1: Potential lowering of groundwater level during the construction, operational and decommissioning phase for all 12 of the Kudu PV facilities.
- Cumulative Impact 2: Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages from the construction and the decommissioning phase for all 12 Kudu facilities.
- Cumulative Impact 3: Potential of impact on groundwater quality as a result of using cleaning agents for cleaning the solar panels during the operational phase for all the 12 Kudu facilities.
- Cumulative Impact 4: Potential impact on groundwater quality as a result of electrolyte that will be used for the BESS.
- Cumulative Impact 5: Other wind and solar, and EGI projects within a 30 km radius.

No indirect impacts are identified.

16.5.2 Summary of Issues identified during the Public Consultation Phase

The following represents a summary of the main issues identified during the Public Consultation Phase during Scoping. Many of the stakeholders shared the same concerns including:

- Increased abstraction of groundwater due to the proposed development may deplete the groundwater resources in the area.
- Increased abstraction may lower the groundwater table to depths lower than the average windpump depth of 50 to 80 meters.
- Whether the cumulative water requirements are serviceable by the aquifer and does not exceed the potential recharge.
- What the Water Use Licence Requirements are for groundwater uses related to the proposed project.

Table 16-9 shows a more detailed representation of these concerns with reference to specific comments made by stakeholders. All of these comments are addressed in the subsequent sections of this assessment.

Table 16-9: Table showing a summary of the main comments received from stakeholders during the Public Consultation Phase during Scoping with key responses

Comment	Commenter	Response
Queries on the water usage of the project.	Adjacent and/or nearby landowners and Interested and Affected Parties (I&APs)	Note that **each** Kudu Solar Facility will require the following water volumes. This specifically applies to Kudu Solar Facility 1, 2, 3, 4, 6, 9, 10, and 12. Each facility listed here will require the amount of water below: ▪ Approximately 9 000 m^3 of water is estimated to be required per year for the construction phase. ▪ Approximately 1 000 m^3 of water is estimated to be required per year for the operational phase. The following water usage applies to Kudu Solar Facilities 5, 7, 8 and 11 each (i.e. each facility listed here will require the amount of water below): ▪ Approximately 18 000 m^3 of water is estimated to be required per year for the construction phase. ▪ Approximately 2 000 m^3 of water is estimated to be required per year for the operational phase. For all the proposed Kudu Solar Facilities, water requirements during the decommissioning phase are unknown at this stage, however it is unlikely to exceed the water requirements of the construction phase. Water required for the construction, operational and decommissioning phases will either be sourced from the following sources (**in order of priority and likelihood**): ▪ Local municipality i.e. most likely trucked in or made available for collection at the Local Municipal Water Treatment Plant via a metered standpipe; ▪ Investigation into a third-party water supplier which may include private services companies. This would most likely be trucked in; ▪ Existing boreholes on site to source groundwater (if available and if suitable); or

Comment	Commenter	Response
		▪ New boreholes that will be drilled on site to source groundwater (if available and if suitable), which will be subject to complete geohydrological testing and an assessment, as well as a Water Use Licence Application process, as well as the necessary Environmental Assessment process (if required). This will be undertaken as a separate process, once more detailed information becomes available, outside of the current Application for EA for the Solar PV Facility and associated infrastructure. Therefore the use of existing boreholes on site to source groundwater (if available and if suitable) is only one of the potential water sources (and it is only the third most likely option, as noted above. Water from the municipality is the first option in terms of viability but consideration of other options is vital). A hydrocensus was undertaken as part of this Geohydrology Assessment in order to visit selected boreholes and landowners to obtain information such as yields and to measure the field chemistry to assess the groundwater quality (pH, total dissolved solids (TDS) and electrical conductivity (EC)). An analysis of the hydrocensus chemistry results was also undertaken in terms of the SANS 241-1: 2015 and the Department of Water Affairs and Forestry (DWAF) (1998) Standards. Based on this, the groundwater quality in the study area is generally of good quality in terms of pH, TDS and EC. It is possible that the groundwater can be used for potable and domestic purposes with only minor treatment however a full laboratory analysis will be required. With regards to the cleaning of panels, salts could be removed from the groundwater by thermal distillation (i.e. boiling since salt has a much higher boiling point than water) or by membrane separation (commonly reverse osmosis). Both of these techniques are possible but financial viability would have to be determined before commissioning as both techniques are costly on a large scale. Water pipelines may need to be constructed to transfer groundwater from existing boreholes or they may be transported by trucks from the boreholes to the site. Groundwater may also need to be stored on site in suitable containers or reservoir tanks during the construction and operational phases. Ground water storage may trigger the need for a Water Use Licence if there is more than 2000 m^3 stored on the site per year in an open container.

Comment	Commenter	Response
		These responses are expanded within Section 16.3 and Section 16.6 of this chapter.
Requests for information on the measures in place to test the availability of water resources.	▪ Adjacent and/or nearby landowners and I&APs	As noted above, a hydrocensus was conducted to confirm the quality of various existing boreholes in the region. However, no drill records or yield test data exists for production or wind pump boreholes to clarify yields and geological logs. Therefore, estimations for groundwater supply capacity for the area are based on regional datasets. For each PV Facility, the anticipated demands are less than the regional yield potential of the underlying aquifer (0.5 – 2.0 L/s). This is considered appropriate for a study undertaken as part of an EIA Process. The study area is located mainly within quaternary catchment D33B with small sections within quaternary catchment D62F. Both of these quaternary catchments form part of the Lower Orange Water Management Area in the Northern Cape. The groundwater General Authorisation (GA) for both of the catchments is 45 m^3/ha/a (published on 2 September 2016, in GG 40243, GN 538 (i.e. Revision of GA for the taking and storing of water). If the proposed projects are timed and planned appropriately with regards to groundwater use, all the water can be obtained from groundwater, with the use being Generally Authorised. The impact of the proposed abstraction on groundwater is predicted to be of low significance, with effective implementation of mitigation actions (i.e. to adhere to the borehole's safe yield and to monitor water levels and flow). These responses are expanded on in Section 16.4, Section 16.8 and Section 16.6 of this chapter.
Requests for information regarding Water Use Licence Requirements for boreholes.	Adjacent and/or nearby landowners and I&APs	As noted above, for all the proposed Kudu Solar Facilities, the potential sources of water, in order of priority and likelihood, include the: Local municipality, third-party water supplier, existing boreholes or drilled boreholes on site. Therefore, the use of existing boreholes on site to source groundwater is only one of the potential water sources (and it is only the third most likely option, as noted above. Water from the municipality is the first option in terms of viability but consideration of other options is vital).

Comment	Commenter	Response
		In terms of measurements, the Geohydrology Assessment undertook a hydrocensus of the existing boreholes in the area and an analysis of the data, and based on this, the groundwater quality in the study area is generally of good quality in terms of pH, TDS and EC. The study area is located mainly within quaternary catchment D33B with small sections within quaternary catchment D62F. Both of these quaternary catchments form part of the Lower Orange Water Management Area in the Northern Cape. The groundwater GA for both of the catchments is 45 m^3/ha/a (published on 2 September 2016, in GG 40243, GN 538 (i.e. Revision of GA for the taking and storing of water)). If the proposed projects are timed and planned appropriately with regards to groundwater use, all the water can be obtained from groundwater, with the use being Generally Authorised. Registration of the usage in terms of the GA with the Department of Water and Sanitation (DWS) would be required. These responses are expanded on in Section 16.3, Section 16.4, Section 16.6, and Section 16.8 of this chapter.
Requests for information regarding the impact of the development on groundwater resources.	Adjacent and/or nearby landowners and I&APs and I&APs	This Geohydrology Assessment provides feedback on the suitability of the groundwater for usage during the construction and operational phases of the project, and also identifies various potential impacts of the proposed project on the geohydrology, as noted below: Construction Phase: ○ Potential lowering of the groundwater level. ○ Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages. Operational Phase ○ Potential lowering of the groundwater level. ○ Potential impact on groundwater quality as a result of using cleaning agents for cleaning the solar panels. ○ Potential impact on groundwater quality as a result of electrolyte that will be used for the BESS.

Comment	Commenter	Response
		Decommissioning Phase o Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages. All the impacts have been rated with a low to very low significance with the implementation of mitigation measures. All mitigation measures have been captured in the Environmental Management Programme (EMPr). These responses are expanded on in Section 16.3, Section 16.6, and Section 16.9 of this chapter.
Queries on the sustainability of groundwater withdrawal for the maintenance of the development.	Adjacent and/or nearby landowners and I&APs and I&APs	The impact of the usage of the ground water during the relevant project phases is addressed in this Geohydrology Assessment, along with the identification of various management actions to address such usage of water, which have been carried over to the EMPr, which is legally binding once approved. Any historical groundwater monitoring by the DWS should be sourced and assessed during all phases of development (once Environmental Authorisation is obtained, should it be granted), and a monitoring program should be instated (water level, chemistry and volumes abstracted). This has been included in the EMPr. These responses are expanded on in Section 16.9 of this chapter.
Queries on the effect of windpump/ boreholes on the supply of drinking water to sheep, cattle, and game farm activities.	Adjacent and/or nearby landowners and I&APs and I&APs	This Geohydrology Assessment assessed the impact of the water required for the proposed development on the environment. With appropriate sighting and management measures groundwater impact on existing users can be entirely mitigated. The assessment has identified the lowering of groundwater levels as a result of over-abstraction as a potential impact, of low significance, with the implementation of recommended mitigation measures (i.e. adhere to the borehole's safe yield and to monitor water levels and flow; and boreholes must be correctly yield tested according to the National Standard (SANS 10299-4:2003, Part 4 – Test pumping of water boreholes). This includes a Step Test, Constant Discharge Test and recovery monitoring). This has been included as a requirement in the EMPr. In addition, an appropriate monitoring program will need to be instated to ensure over abstraction of groundwater is not taking place, and/or to ensure that no contamination

Comment	Commenter	Response
		of groundwater is taking place. This will allow the Environmental Control Officer / Environmental Manager of the proposed project (appointed post EA should authorisation be granted, and the proposed project progresses to the commencement phase) to determine the observed effect on the groundwater resources in the area. These responses are expanded on within Section 16.9 within this chapter.
Comment regarding the majority of existing windpumps and boreholes being just adequate for sheep; and the impact on water levels due to the drought season.	Adjacent and/or nearby landowners and I&APs	Testing of boreholes, that are planned to be used, will be required to determine if the yields can actually deliver the required volumes. In addition, droughts are seasonal and will occur. The more information that is collected (e.g. monitoring prior to construction) the more certainty there will be on the actual observed effect on the proposed development on the groundwater resources. Therefore, groundwater monitoring is crucial for the protection of the regional groundwater resources. These responses are expanded on within Section 16.9 within this chapter.
Comment regarding the ground water being slow running.	▪ Adjacent and/or nearby landowners and I&APs	As noted above, this will need to be scientifically yield tested. The impact of the usage of groundwater has been assessed in this Geohydrology Assessment. These responses are expanded on within Section 16.9 within this chapter.
Comments regarding groundwater moving from south to north.	▪ Adjacent and/or nearby landowners and I&APs	The comment is agreed with, based on the available information. Groundwater movement is driven by gravity and (generally speaking) flows from high elevations to low elevations. These responses are expanded on within Section 16.4 within this chapter.
Comments regarding the depth of the water surface in this area, and its gradual sinking over time and as drought seasons approach.	▪ Adjacent and/or nearby landowners and I&APs	This can only be confirmed by instatement of an appropriate monitoring program. The requirements for such a program have been documented in the EMPr. These responses are expanded on within Section 16.9 within this chapter.
Feedback on the depth of the borehole (and link to the dolerite bank) and the history around the boreholes.	▪ Adjacent and/or nearby landowners and I&APs	Anecdotal evidence suggests that many of the boreholes were drilled using ‘stamper boor’ apparatus. It appears this is the average depth of the boreholes (50 – 80 m) in the region. It is agreed that boreholes are typically shallow in the region. This is not to say there is absolutely no water deeper than the average depth of the boreholes in the region. Only several deep boreholes could prove this.

Comment	Commenter	Response
		These responses are expanded on within Section 16.4 within this document
Comment regarding status of the ground water (i.e. fossil water and stored underground for many years).	▪ Adjacent and/or nearby landowners and I&APs	This could be confirmed by isotopic dating of the ground water. There is evidence in the southern portion of the Karoo basin that there are several sources of ground water at variable depths, with variable ages. Deeper groundwater was typically found to be saline, and older (Harkness et al., 2018). However, this is not within the scope of the current assessment, nor is it required in order to assess the overall impacts of ground water usage associated with the proposed project. These responses are expanded on within Section 16.4 within this chapter.
Comment regarding the supplement of ground water (i.e. slow and occurs only once every few years).	▪ Adjacent and/or nearby landowners and I&APs	This can be confirmed by yield testing boreholes in the area and implementing monitoring to observe actual effects of groundwater removal/abstraction. The impact of the usage of groundwater has been assessed in this Geohydrology Assessment These responses are expanded on within Section 16.9 within this chapter.

Comments related to geohydrology impacts associated with the proposed project were raised by Interested and Affected Parties during the review period of the Draft EIA Report. These comments are similar to those submitted and considered during the Scoping Phase, and therefore similar responses apply. Comments were raised in terms of recommendations for groundwater monitoring and in terms of water use licence applications and general authorisations; queries on the water use licence requirements for the project, the amount of groundwater to be used, water availability and drought related concerns, sustainability of groundwater usage, concerns around not distributing the development over a larger area thereby distributing the impact of groundwater abstraction and increasing sustainable abstraction, groundwater flow, and chemical pollution of grazing land. Responses have been provided in Appendix H.7 of the Final EIA Report.

16.6 Impact Assessment

16.6.1 Potential Impacts during the Construction Phase

The impact table for the Construction Phase is presented in Table 16-11.

16.6.1.1 Impact 1: Groundwater impact as a result of over-abstraction from construction requirements

During the construction phase the project plans to use 9 000 m^3/a (0.29 L/s) (Table 16-10). This requirement is within the expected capacity of the aquifer (0.5-2.0 L/s) therefore the risk associated to this impact is considered to be low. It must be noted that the study area is known to experience extreme droughts and therefore even though the construction groundwater demand is within the yield potential of the aquifer, adherence to the mitigation measures during the construction phase is vital.

The status of this impact is rated as negative with a local spatial extent and a short-term duration (i.e. for the construction phase). The consequence and probability of the impact are respectively rated as substantial and likely. The reversibility of the impact is rated as high and the irreplaceability is rated low. The significance of the impact without the implementation of mitigation measures is rated as moderate. With effective implementation of prevention / mitigation actions (i.e. to adhere to the borehole's safe yield and to monitor water levels and flow etc.), the impact of the proposed abstraction on groundwater is predicted to be of low significance.

Table 16-10: Extent and water requirements of the Kudu Solar Facility 4

Solar Facility	Size (MWac)	Construction Requirement (m^3)	Operational Requirement (m^3)
4	50	9000	1000

Impact 2: Potential Impact on Groundwater Quality as a result of Accidental Oil Spillages or Fuel Leakages

If there is an accidental oil spill or fuel leakage during the construction phase, then the low permeability of the unsaturated zone will provide significant attenuation capacity. The status of this impact (for the construction phase) is rated as negative with a site-specific spatial extent and short-term duration. The consequence and probability of the impact are respectively rated as slight and extremely unlikely. The reversibility of the impact is rated as high and the irreplaceability is rated as low. The significance of the impact without the implementation of mitigation measures is rated as very low.

A precautionary approach must be implemented and reasonable measures must be undertaken to prevent oil spillages and fuel leakages from occurring. During the construction phase, vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks, if required, should be above ground on an impermeable concrete surface in a bunded area. Construction vehicles and equipment should also be refuelled on an impermeable surface. A designated area should be established at the construction site camp for this purpose, if

off-site refuelling is not possible. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, and reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.

With effective implementation of these prevention / mitigation actions, the impact of the project on groundwater as a consequence of accidental oil spillages and fuel leakages is predicted to be of very low significance.

Table 16-11: Impact Summary Tables: Construction Phase

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Lowering of groundwater levels as a result of over-abstraction	***Status***	*Negative*	*Moderate*	▪ *Adhere to the borehole's safe yield and to monitor water levels and flow.* ▪ *Boreholes must be correctly yield tested according to the National Standard (SANS 10299-4:2003, Part 4 – Test pumping of water boreholes). This includes a Step Test, Constant Discharge Test and recovery monitoring.*	*Low*	*High*
	Spatial Extent	*Local*				
	Duration	*Short Term*				
	Consequence	*Substantial*				
	Probability	*Likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				
Accidental oil spillage / fuel leakage	***Status***	*Negative*	*Very Low*	▪ *Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks, if required, should be above ground on an impermeable surface in a bunded area. Vehicles and equipment should also be refuelled on an impermeable surface. A designated area should be established at the construction site camp for this purpose, if off-site refuelling is not possible. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, and reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes*	*Very Low*	*High*
	Spatial Extent	*Site Specific*				
	Duration	*Short Term*				
	Consequence	*Slight*				
	Probability	*Extremely Unlikely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				

16.6.2 Potential Impacts during the Operational Phase

The impact table for the Operational Phase is presented in Table 16-12.

16.6.2.1 Impact 1: Groundwater impact as a result of over-abstraction from operational requirements

During the operational phase the peak requirement is estimated to be 1 000 m^3/a (0.032 L/s) for the PV Facility (Table 16-10). Therefore, the groundwater requirement for the operational phase is within the yield potential of the underlying aquifer (0.5 – 2.0 L/s). It must be noted that the study area is known to experience extreme droughts and therefore even though the operational groundwater demand is within the yield potential of the aquifer, adherence to the mitigation measures during the operational phase is vital.

The status of this impact is rated as negative with a local spatial extent and a long-term duration (i.e. for the life of the project). The consequence and probability of the impact are respectively rated as substantial and likely. The reversibility of the impact is rated as high and the irreplaceability is rated low. The significance of the impact without the implementation of mitigation measures is rated as moderate. With effective implementation of prevention / mitigation actions (i.e. to adhere to the borehole's safe yield and to monitor water levels and flow), the impact of the proposed abstraction on groundwater is predicted to be of low significance.

16.6.2.2 Impact 2: Potential impact on groundwater quality as a result of using cleaning agents

The low permeability of the unsaturated zone will provide significant attenuation capacity. The status of this impact (for the operational phase) is rated as negative with a site-specific spatial extent and long-term duration (i.e. for the life of the project). The consequence and probability of the impact are respectively rated as slight and extremely unlikely. The reversibility of the impact is rated as high and the irreplaceability is rated as low. The significance of the impact without the implementation of mitigation measures is rated as very low. Recommended mitigation measures include using environmentally safe cleaning agents that breakdown naturally and do not cause adverse effects. With adherence to the proposed mitigation measures the significance of this impact would also be rated as very low.

16.6.2.3 Impact 3: Potential impact on groundwater quality as a result of electrolyte that will be used for the BESS

The proposed development will require a BESS at the facility. There are usually electrolytes of an environmentally harmful chemical composition that are used within the BESS, especially for Redox Flow BESS (whereas Lithium Ion BESS are solid state containerized systems). With any chemical storage there is always a risk of contamination to soils and groundwater. The status of this impact (for the operational phase) is rated as negative with a site-specific spatial extent and long-term duration (i.e. for the life of the project). The consequence and probability of the impact are respectively rated as substantial and very unlikely. The reversibility of the impact is rated as high and the irreplaceability is rated as low. The significance of the impact without the implementation of mitigation measures is rated as low. It is recommended that all BESS's are placed a minimum of 50m from any borehole and include effective bunding and secondary containment structures. With adherence to the proposed mitigation measures the significance of this impact would be rated as very low.

Table 16-12: Impact Summary Tables: Operational Phase

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
OPERATIONAL PHASE						
Lowering of groundwater levels as a result of over-abstraction	***Status***	*Negative*	*Moderate*	▪ *Adhere to the borehole's safe yield and to monitor water levels and flow.* ▪ *Boreholes must be correctly yield tested according to the National Standard (SANS 10299-4:2003, Part 4 – Test pumping of water boreholes). This includes a Step Test, Constant Discharge Test and recovery monitoring.*	*Low*	*High*
	Spatial Extent	*Local*				
	Duration	*Long Term*				
	Consequence	*Substantial*				
	Probability	*Likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				
Potential impact on groundwater quality as a result of using cleaning agents	***Status***	*Negative*	*Very Low*	▪ *Use environmentally safe cleaning agents that breakdown naturally and do not cause adverse effects.*	*Very Low*	*High*
	Spatial Extent	*Site Specific*				
	Duration	*Long Term*				
	Consequence	*Slight*				
	Probability	*Extremely Unlikely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				
Potential impact on groundwater quality as a result of electrolyte that will be used for the BESS	***Status***	*Negative*	*Low*	▪ *Ensure that all electrolyte or chemicals stored or used on site have secondary containment systems in place with reliable leak detection, annunciation in place. Ensure that all chemicals are handled on concrete bunded surfaces and not on bare soil.* ▪ *Any waste products produced from the BESS systems should be removed and disposed of appropriately.*	*Very Low*	*High*
	Spatial Extent	*Site Specific*				
	Duration	*Long Term*				
	Consequence	*Substantial*				
	Probability	*Very Unlikely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
OPERATIONAL PHASE						
				▪ *Waste water produced by fire hydrants should not be allowed to runoff into the environment. It is recommended that all BESS's are placed a minimum of 50m from any borehole.*		

16.6.3 Potential Impacts during the Decommissioning Phase

The impact table for the Decommissioning Phase is presented in Table 16-13.

16.6.3.1 Impact 1: Potential Impact on Groundwater Quality as a result of Accidental Oil Spillages or Fuel Leakages

During the decommissioning phase the main impact is linked to the potential for accidental oil spillages due to the machinery that will be used to decommission the site. The same applies as in the construction phase, therefore, if there is an accidental oil spill or fuel leakage during the decommissioning phase the low permeability of the unsaturated zone will provide significant attenuation capacity. The status of this impact (for the decommissioning phase) is rated as negative with a site-specific spatial extent and short-term duration. The consequence and probability of the impact are respectively rated as slight and extremely unlikely. The reversibility of the impact is rated as high and the irreplaceability is rated as low. The significance of the impact without the implementation of mitigation measures is rated as very low. A precautionary approach must be implemented and reasonable measures must be undertaken to prevent oil spillages and fuel leakages from occurring. During the decommissioning phase, vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks, if required, should be above ground on an impermeable concrete surface in a bunded area. Vehicles and equipment should also be refuelled on an impermeable surface. A designated area should be established at the site camp for this purpose, if off-site refuelling is not possible. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, and reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes. With effective implementation of these prevention / mitigation actions, the impact of the project on groundwater as a consequence of accidental oil spillages and fuel leakages is predicted to be of very low significance.

16.6.3.2 Impact 2: Groundwater impact as a result of over-abstraction from decommissioning requirements

Although water requirements during the decommissioning phase were not specificized, it is unlikely that they will exceed the water requirements of the construction phase. As such, this potential impact has been evaluated at a potential maximum requirement of 9 000 m^3/a (0.29 L/s). This requirement is within the expected capacity of the aquifer (0.5-2.0 L/s) therefore the risk associated to this impact is considered to be low. It must be noted that the study area is known to experience extreme droughts and therefore even though the construction groundwater demand is within the yield potential of the aquifer, adherence to the mitigation measures during the decommissioning phase is vital.

The status of this impact is rated as negative with a local spatial extent and a short-term duration (i.e. for the decommissioning phase). The consequence and probability of the impact are respectively rated as substantial and likely. The reversibility of the impact is rated as high and the irreplaceability is rated low. The significance of the impact without the implementation of mitigation measures is rated as moderate. With effective implementation of prevention / mitigation actions (i.e. to adhere to the borehole's safe yield and to monitor water levels and flow etc.), the impact of the proposed abstraction on groundwater is predicted to be of low significance.

Table 16-13: Impact Summary Tables: Decommissioning Phase

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
DECOMMISSIONING PHASE						
Accidental oil spillage / fuel leakage	***Status***	*Negative*	*Very Low*	▪ *Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks, if required, should be above ground on an impermeable surface in a bunded area. Vehicles and equipment should also be refuelled on an impermeable surface. A designated area should be established at the site camp for this purpose, if off-site refuelling is not possible. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, and reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.*	*Very Low*	*High*
	Spatial Extent	*Site Specific*				
	Duration	*Short Term*				
	Consequence	*Slight*				
	Probability	*Extremely Unlikely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				
Lowering of groundwater levels as a result of over-abstraction	***Status***	*Negative*	*Moderate*	▪ *Adhere to the borehole's safe yield and to monitor water levels and flow.* ▪ *Boreholes must be correctly yield tested according to the National Standard (SANS 10299-4:2003, Part 4 – Test pumping of water boreholes). This includes a Step Test, Constant Discharge Test and recovery monitoring.*	*Low*	*High*
	Spatial Extent	*Local*				
	Duration	*Short Term*				
	Consequence	*Substantial*				
	Probability	*Likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				

16.6.4 Potential Cumulative Impacts

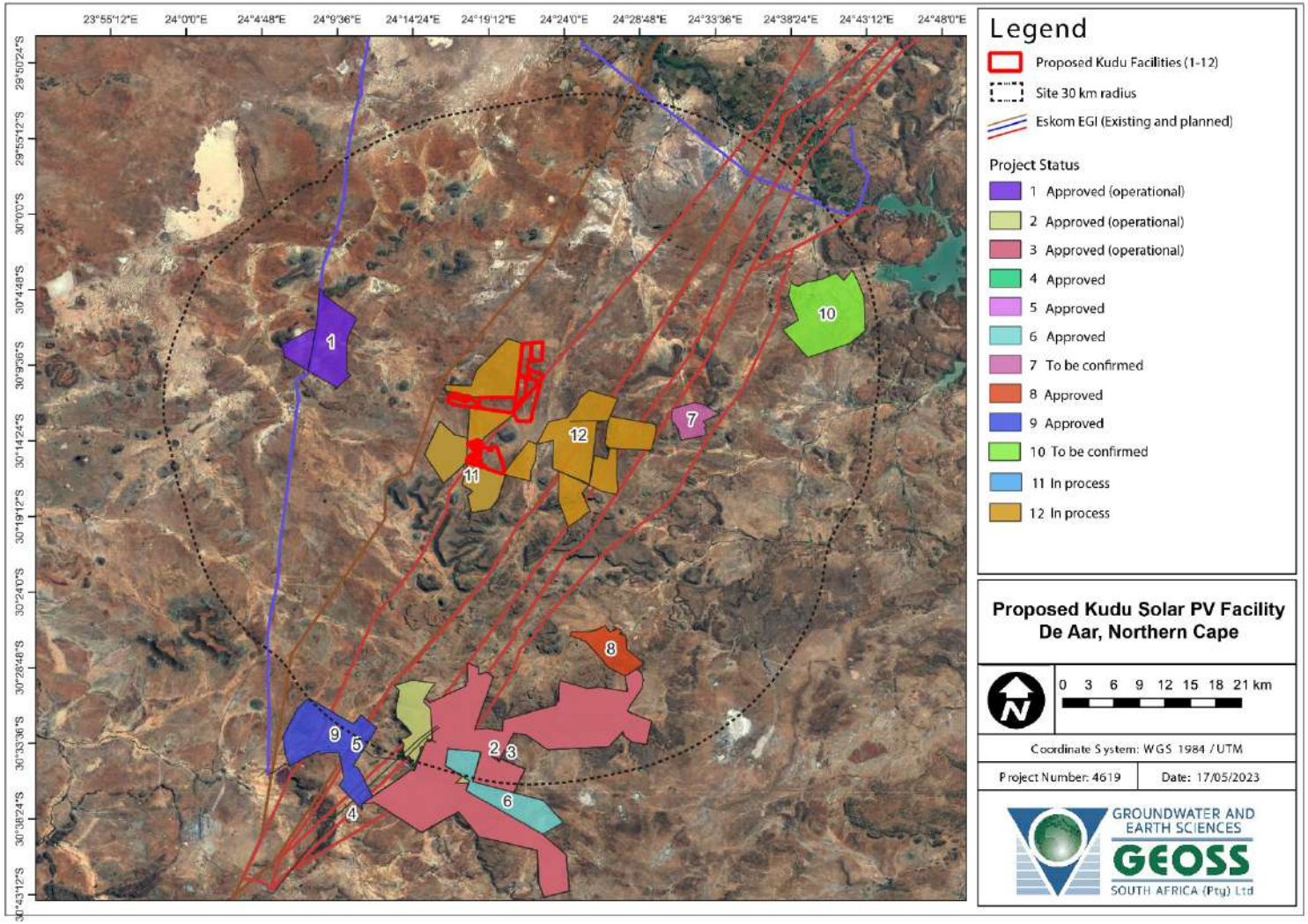
The cumulative impacts of the proposed Kudu Solar Facility and other approved and in process renewable energy facilities and electricity grid infrastructure (EGI) within a 30 km radius from the study area are presented in this section. The cumulative impacts identified include the impacts related to the construction, operational and decommissioning phases across proposed Kudu Solar Facility. In general, the impacts during the different phases of the project are quite similar, therefore, their intensities increase as the project progresses resulting in a higher probability for the impact to occur.

According to information collected by the CSIR from the Renewable Energy EIA Database and the South African Heritage Resources Information System (SAHRIS) (~February 2023), 12 other renewable energy facilities and EGI have been approved, or in the process of approval in terms of the NEMA EIA Regulations, that are located with a 30 km radius from the Kudu Solar Facilities (Map 16-10). Three of these renewable energy facilities are already existing and operational. In addition, approximately 10 existing Eskom power lines fall within the 30 km radius of the proposed project, with three Eskom planned power line projects, as shown in Map 16-10. Failing to implement effective mitigation measures throughout the lifespan of projects might cause the intensity of different identified impacts to increase. Appendix F of this chapter contains Table 16-19 covering the details of approved projects within a 30 km radius of the proposed Kudu Solar Facility as provided by the CSIR.

The types of impacts of these developments are nearly identical to each other, with the main cumulative effect being an increase in impact duration and likelihood for the construction, operational, and decommissioning phase. These increases are especially exacerbated for the construction phase, in the case that construction of all the proposed developments within a 30km radius occurs simultaneously. Of special concern is the cumulative effect of the proposed Odyssey and Crossroads Green Energy Cluster projects which fall within a 10 km radius of the Kudu Project. It must be reiterated that these projects are still in their Environmental Assessment Phases. The cumulative impact of all these developments during the operational phase should be quite low as long as the proposed mitigation measures and appropriate ground water monitoring is implemented.

The cumulative impacts include all the potential impacts discussed in section 16.6.1, 16.6.2, 16.6.3 and the potential impacts of other wind and solar, and EGI projects within a 30km radius, see Map 16-10 and Appendix F of this chapter. As such, the cumulative impacts are:

- Potential lowering of groundwater level during the construction and operational phase for all 12 of the proposed Kudu Solar PV facilities, Odyssey, and Crossroads projects.
- Potential of impact on groundwater quality as a result of accidental oil spillages or fuel leakages from the construction and the decommissioning phases for the proposed 12 Kudu Solar PV facilities, Keren Energy Odyssey, and Crossroads projects.
- Potential of impact on groundwater quality as a result of using cleaning agents for cleaning the solar panels during the operational phases for all 12 proposed Kudu Solar PV facilities, Keren Energy Odyssey, and Crossroads projects
- Potential impact on groundwater quality as a result of electrolyte that will be used for the BESS).
- Other wind and solar, and EGI projects within a 30 km radius.



Map 16-10: Map showing the proposed Kudu Solar PV Facility in relation to other local authorised, in process or operational renewable projects

16.6.4.1 Impact 1: Groundwater impact as a result of over-abstraction from construction, operation, and decommissioning requirements

As an overview and as noted above, water requirements for individual facilities divided based on their capacities (MWac) are as follows (Table 16-14):

- Kudu Solar Facilities 1, 2, 3, 4, 6, 9, 10 and 12 (i.e. those projects up to 150 MWac):
  - Construction Phase: 9 000 m^3/a/facility (~0.29 L/s/facility).
  - Operational Phase: 1 000 m^3/a/facility (~0.03 L/s/facility.
- Kudu Solar Facility 5, 7, 8 and 11 (i.e. those projects with a capacity of more than 150 MWac but up to 350 MWac):
  - Construction Phase: 18 000 m^3/a/facility (~0.60 L/s/facility).
  - Operational Phase: 2 000 m^3/a/facility (~0.06 L/s/facility).

During the construction phase, cumulatively across all facilities (1 to 12) this equates to 144 000 m^3/a (~4.6 L/s) (Table 16-14). Thus, if all facilities are developed during the same year the proposed groundwater abstraction is higher than the yield potential of the underlying aquifer (0.5 – 2.0 L/s). However, it is unlikely that all 12 facilities will be developed in the same year and additionally, the extent over which the water will be required (and likely abstracted), is expected to reduce the volume required from any single borehole. Adherence to mitigation measures during the construction phase is vital. As mentioned earlier in the report, the use of existing boreholes to source groundwater (if available and suitable) is only the third most likely water use option. Water sourced from the municipality is the first option in terms of viability, but consideration of other options is vital.

During the operational phase, cumulatively across all facilities (1 to 12) this equates to 16 000 m^3/a (~0.5 L/s) (Table 16-14). Therefore, the groundwater requirement for the operational phase of all 12 projects is within the yield potential of the underlying aquifer (0.5 – 2.0 L/s). It must be noted that the study area is known to experience extreme droughts and therefore even though the operational groundwater demand is within the yield potential of the aquifer, adherence to the mitigation measures during the operational phase is vital.

Due to the large spatial extent (30 km radius), most of the other authorised facilities are more than 10 km from the Kudu Solar Facilities and will likely have little influence on the Kudu Solar Facility. This includes the associated power lines which have a low enough water requirement as to not greatly impact the geohydrological conditions of the region.

Of special concern would be the cumulative impact of the adjacent Odyssey and Crossroads Green Energy Cluster projects which, although still in the EIA phase, are within a 10 km radius of the Kudu Solar Project. Although no data on the expected water usage of the Crossroads and Odyssey projects was interrogated, generalised water requirements for Solar PV projects suggest that there is a much higher risk of over abstraction should all these projects be constructed simultaneously, as opposed to one at a time. In the event that construction of the Keren Energy Odyssey, Crossroads, and Kudu projects occurs simultaneously the cumulative impact is regarded as moderate significance without the implementation of mitigation measures. This impact has a variable duration dependent on whether the proposed sites are constructed simultaneously (short

term) or in several phases (medium term). In the event of multiple projects being constructed at the same time, the monitoring program needs to be strictly adhered to so as to prevent over abstraction. By adhering to the proposed mitigation measures the impact can be regarded as low significance.

During the operational phases the cumulative water use should still be below the regional groundwater yield; however, this interpretation is only based on generalised water requirements for Solar PV facilities.

For the operational phase, the impact is also rated as moderate significance before mitigation and low significance with mitigation, with the same mitigation measures discussed above.

Similar impact ratings have been provided for the decommissioning phase as for the operational phase.

Table 16-14: Summary of anticipated water requirements of solar facilities during construction and operational phases.

Facility	Size (MWac)	Construction (m3/a)	Operational (m3/a)	Construction (L/s)	Operational (L/s)
1	50	9000	1000	0,285	0,032
2	50	9000	1000	0,285	0,032
3	50	9000	1000	0,285	0,032
4	50	9000	1000	0,285	0,032
6	150	9000	1000	0,285	0,032
9	150	9000	1000	0,285	0,032
10	150	9000	1000	0,285	0,032
12	150	9000	1000	0,285	0,032
Cumulative <150 MWac		*72000*	*8000*	*2,283*	*0,254*
5	350	18000	2000	0,571	0,063
7	350	18000	2000	0,571	0,063
8	350	18000	2000	0,571	0,063
11	330	18000	2000	0,571	0,063
Cumulative >150 <350 MWac		*72000*	*8000*	*2,283*	*0,254*
Cumulative		*144000*	*16000*	*4,566*	*0,507*

16.6.4.2 Impact 2: Potential Impact on Groundwater Quality as a result of Accidental Oil Spillages or Fuel Leakages during the construction and decommissioning phases

If there is an accidental oil spill or fuel leakage during any of the project phases, then the low permeability of the unsaturated zone will provide significant attenuation capacity. This potential cumulative impact is mainly limited to the construction and decommissioning phase of the development. The status of this impact is rated as negative with a site-specific spatial extent and a variable duration dependent on whether the proposed sites are constructed and decommissioned simultaneously (short term) or in several phases (medium term). The consequence and probability of the impact are respectively rated as slight and unlikely (phased construction/decommissioning)

to likely (simultaneous construction/decommissioning). The reversibility of the impact is rated as high and the irreplaceability is rated as low. The significance of the impact without the implementation of mitigation measures is rated as very low.

The mitigation measures for this impact are the same as that discussed above for the construction and decommissioning phases.

With effective implementation of these prevention / mitigation actions, the impact of the project on groundwater as a consequence of accidental oil spillages and fuel leakages is predicted to be of very low significance.

16.6.4.3 Impact 3: Potential impact on groundwater quality as a result of using cleaning agents during the operational phase

The low permeability of the unsaturated zone will provide significant attenuation capacity. The status of this impact is limited mostly to the operational phase, and is rated as negative with a site-specific spatial extent and long-term duration (i.e. for the life of the project). The consequence and probability of the impact are respectively rated as slight and unlikely. The reversibility of the impact is rated as high and the irreplaceability is rated as low. The significance of the impact without the implementation of mitigation measures is rated as very low. Recommended mitigation includes using an environmentally safe cleaning agent that breakdown naturally and do not cause adverse effects. With adherence to the proposed mitigation measures the significance of this impact would also be rated as very low.

16.6.4.4 Impact 4: Potential impact on groundwater quality as a result of electrolyte that will be used for the BESS during the operational phase

The status of this impact is limited primarily to the operational phase, and is rated as negative with a site-specific spatial extent and long-term duration (i.e. for the life of the project). The consequence and probability of the impact are respectively rated as substantial and unlikely. The reversibility of the impact is rated as high and the irreplaceability is rated as low. The significance of the impact without the implementation of mitigation measures is rated as moderate. It is recommended that all BESS's are placed a minimum of 50m from any borehole and include effective bunding and secondary containment structures. With adherence to the proposed mitigation measures the significance of this impact would be rated as low.

16.6.4.5 Concluding Cumulative Summary: Potential impacts during the construction, operational, and decommissioning phases of other wind and solar, and EGI projects within a 30 km radius.

When including each of the Kudu PV clusters as separate entities, a total of 22 renewable power projects are either operational, proposed, or in the environmental approval phase within a 30 km radius of the Kudu Solar PV 4 (see Appendix F). Of these only the Cross Roads Green Energy Cluster and Keren Energy Odyssey Solar PV Facilities (environmental approval in process for both) are within 10 km radius of the Kudu Solar Facility (should Environmental Authorisations be granted). Accordingly, only these projects would be considered to have an appreciable cumulative impact on the underlying aquifer. Both these projects are solar PV projects and, therefore, have very similar impacts to those of the Kudu Solar Facility, namely over abstractions of groundwater, and potential aquifer contamination from oil spills, solar panel cleaning agents, and electrolytes from associated BESS infrastructure. The mitigations for each of these impacts is discussed in the subsections above.

16.6.4.6 Impact Summary Tables: Cumulative Impacts

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Lowering of groundwater levels as a result of over-abstraction	***Status***	*Negative*	*Moderate*	▪ *Adhere to the borehole's safe yield and to monitor water levels and flow. Boreholes must be correctly yield tested according to the National Standard (SANS 10299-4:2003, Part 4 – Test pumping of water boreholes). This includes a Step Test, Constant Discharge Test and recovery monitoring.* ▪ *A monitoring program needs to be adhered to so as to determine and remain below safe abstraction rates.*	*Low*	*High*
	Spatial Extent	*Local*				
	Duration	*Short Term to Medium Term*				
	Consequence	*Substantial*				
	Probability	*Likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				
Accidental oil spillage / fuel leakage	***Status***	*Negative*	*Very Low*	▪ *Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks, if required, should be above ground on an impermeable surface in a bunded area. Vehicles and equipment should also be refuelled on an impermeable surface. A designated area should be established at the construction site camp for this purpose, if off-site refuelling is not possible. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, and reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.*	*Very Low*	*High*
	Spatial Extent	*Site Specific*				
	Duration	*Short term to Medium Term*				
	Consequence	*Slight*				
	Probability	*Unlikely to Likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
OPERATIONAL PHASE						
Lowering of groundwater levels as a result of over-abstraction	**Status**	*Negative*	*Moderate*	▪ *Adhere to the borehole's safe yield and to monitor water levels and flow. Boreholes must be correctly yield tested according to the National Standard (SANS 10299-4:2003, Part 4 – Test pumping of water boreholes). This includes a Step Test, Constant Discharge Test and recovery monitoring.* ▪ *A monitoring program needs to be adhered to so as to determine and remain below safe abstraction rates.*	*Low*	*High*
	Spatial Extent	*Local*				
	Duration	*Long Term*				
	Consequence	*Substantial*				
	Probability	*Likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				
Potential impact on groundwater quality as a result of using cleaning agents	**Status**	*Negative*	*Very Low*	▪ *Use environmentally safe cleaning agents that breakdown naturally and do not cause adverse effects.*	*Very Low*	*High*
	Spatial Extent	*Site Specific*				
	Duration	*Long Term*				
	Consequence	*Slight*				
	Probability	*Unlikely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				
Potential impact on groundwater quality as a result of electrolyte that will be used for the BESS	**Status**	*Negative*	*Moderate*	▪ *Ensure that all electrolyte or chemicals stored or used on site have secondary containment systems in place with reliable leak detection, annunciation in place. Ensure that all chemicals are handled on concrete bunded surfaces and not on bare soil. Any waste products produced from the BESS systems should be removed and disposed of appropriately.* *Waste water produced by fire hydrants should not be allowed to runoff into the environment. It is recommended that all BESS's are placed a minimum of 50m from any borehole.*	*Low*	*High*
	Spatial Extent	*Site Specific*				
	Duration	*Long Term*				
	Consequence	*Substantial*				
	Probability	*Unlikely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
DECOMMISSIONING PHASE						
Accidental oil spillage / fuel leakage	**Status**	*Negative*	*Very Low*	▪ *Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks, if required, should be above ground on an impermeable surface in a bunded area. Vehicles and equipment should also be refuelled on an impermeable surface. A designated area should be established at the site camp for this purpose, if off-site refuelling is not possible. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, and reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.*	*Very Low*	*High*
	Spatial Extent	*Site Specific*				
	Duration	*Short to Medium Term*				
	Consequence	*Slight*				
	Probability	*Unlikely to Likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				
Lowering of groundwater levels as a result of over-abstraction	**Status**	*Negative*	*Moderate*	▪ *Adhere to the borehole's safe yield and to monitor water levels and flow. Boreholes must be correctly yield tested according to the National Standard (SANS 10299-4:2003, Part 4 – Test pumping of water boreholes). This includes a Step Test, Constant Discharge Test and recovery monitoring.* ▪ *A monitoring program needs to be adhered to so as to determine and remain below safe abstraction rates.*	*Low*	*High*
	Spatial Extent	*Local*				
	Duration	*Short Term to Medium Term*				
	Consequence	*Substantial*				
	Probability	*Likely*				
	Reversibility	*High*				
	Irreplaceability	*Low*				

16.6.5 No-go Alternatives

The potential groundwater impacts of the No-go alternative for the proposed Kudu PV Solar Facility 4 are also considered. Presently, the sites proposed for development is used mainly for agricultural purposes, i.e. open fields for grazing of various types of livestock. In the scenario that the PV facility did not go ahead it would be expected that these activities would continue and represents the baseline against which other impacts can be compared.

The farm portions where Kudu PV Solar Facility 4 is proposed does not currently utilize significant volumes of groundwater and small-scale abstraction is predominantly for domestic purposes. As such the No-go alternative does not represent a risk to groundwater or aquifer depletion.

However, as noted above, there is a low water demand in the study area and a large spatial extent; and the impacts relating to the use of ground water are not considered to be very significant, especially if the projects are planned and phased suitably.

16.6.6 Battery Energy Storage System

As noted above, Lithium-Ion BESS and Redox Flow BESS were both considered for the proposed project. For Redox Flow BESS, various chemical compositions are likely, such as Vanadium. Refer to Chapter 15 of this EIA Report for a High-Level Safety, Health and Environment Risk Assessment, which provides high level information on the safety, health and environmental risks of the BESS technologies.

Both BESS technologies have been considered in this assessment. The risks associated with each individual technology is such that, with strict adherence to the appropriate mitigation measures, both technologies will have little risk to the local hydrogeological system. Furthermore, no fatal flaws of either technology with respect to the geohydrological system have been identified. Considering this, both Lithium Ion BESS and Redox Flow BESS are considered suitable and no preference is given to either one.

16.7 Impact Assessment Summary

The overall impact significance findings, following the implementation of the proposed mitigation measures are shown in Table 16-15.

Table 16-15: Overall Impact Significance

Phase	**Overall Impact Significance (Pre-Mitigation)**	**Overall Impact Significance (Post Mitigation)**
Construction	Moderate to Very Low	Low-Very Low
Operational	Moderate to Very Low	Low-Very Low
Decommissioning	Very Low	Very Low
Nature of Impact	**Overall Impact Significance (Pre-Mitigation)**	**Overall Impact Significance (Post Mitigation)**
Cumulative - Construction	Moderate to Very Low	Low-Very Low
Cumulative - Operational	Moderate to Very Low	Low-Very Low
Cumulative - Decommissioning	Very Low	Very Low

The cumulative demands of simultaneous construction (~4.6 L/s) for all twelve planned Kudu Solar Facilities exceeds the regional yield potential of the underlying aquifer (0.5 – 2.0 L/s). The will also likely be the case should construction of the surrounding Keren Energy Odyssey Solar PV Facilities and the Crossroads Green Energy Cluster occur at the same time as construction of the Kudu Solar Facilities. In the event that construction of the above-mentioned projects occurs at the same time, adherence to the recommended mitigation measures should be strictly followed to prevent over abstraction.

The cumulative impacts on groundwater quality due to the construction and operation of the PV facilities for the Kudu Solar Facility are considered Low to Very Low, provided that responsible construction practices are adopted, and the proposed mitigation measures are utilized; for example, use of environmentally cleaning agents.

16.8 Legislative and Permit Requirements

The NWA is administered by the DWS and is the main legislation for managing water resources in South Africa. The purpose of the NWA is to provide a framework for the equitable allocation and sustainable management of water resources. Both surface and groundwater sources are redefined by the Act as national resources which cannot be owned by any individual, and rights to which are not automatically coupled to land rights, but for which prospective users must apply for authorization and register as users. The NWA also provides for measures to prevent, control and remedy the pollution of surface and groundwater sources.

The proposed project is located mainly within quaternary catchment D33B with small sections within quaternary catchment D62F. Both of these quaternary catchments from part of the Lower Orange Water Management Area in the Northern Cape. The groundwater General Authorisation (GA) for both of the catchments is 45 m^3/ha/a (published on 2 September 2016, in Government Gazette 40243, Government Notice (GN) 538 (i.e. Revision of General authorisation for the taking and storing of water)). The farm portions with the associated hectares and allowable abstraction under GA is presented in Table 16-16**.** The allowable abstraction under the GA is capped at 40 000

m^3/a per farm portion and therefore the majority of the farm portions are capped at 40 000 m^3/a due to the size.

The total allowable volume of groundwater the project can abstract within the GA is 234 650 m^3/a which is higher than the peak requirement during the construction phase of 144 000 m^3/a for all 12 Kudu Solar Facilities (Table 16-16). Therefore, if the project is planned appropriately with regards to groundwater use, all the water can be obtained from groundwater, with the use being Generally Authorised. Registration of the usage in terms of the GA with DWS would be required. Alternatively, to source all the water from the Remaining Extent of Portion 3 of the Farm Bas Berg No. 88, a Water Use License Application will be required to meet the demands of the construction period. In the case of water storage, a total of 2000 m^3/a can be stored on the property in an open container.

Table 16-16: Farm portions affected by the proposed Kudu Solar Facilities; relevant portion highlighted in blue.

Farm Portion Name	Size (ha)	Kudu Solar 1	Kudu Solar 2	Kudu Solar 3	Kudu Solar 4	Kudu Solar 5	Kudu Solar 6	Kudu Solar 7	Kudu Solar 8	Kudu Solar 9	Kudu Solar 10	Kudu Solar 11	Kudu Solar 12	Allowable abstraction under GA (m3/a)	Anticipated requirement during construction m3/a
Remaining Extent of Farm Bas Berg No. 88 (Two Sections)	770	(75%) of 9000 m^3/a	50% of 9000 m^3/a											34 650	11 250
Remaining Extent of Portion 3 of the Farm Bas Berg No. 88	7687	25% of 9000 m^3/a	50% of 9000 m^3/a	100% of 9000 m^3/a	100% of 9000 m^3/a	100% of 18000 m^3/a								40 000	42 750
Remaining extent of Portion 2 (Middel Plaats) (a portion of Portion 1) of the farm Grasspan No. 40	1054						100% of 9000 m^3/a	100% of 18000 m^3/a						40 000	27 000
Portion 1 (Wolve Kuil West) of the farm Annex Wolve Kuil No. 41	1707								75% of 18000 m^3/a	100% of 9000 m^3/a	100% of 9000 m^3/a	75% of 18000 m^3/a		40 000	45 000
Remaining extent of the farm Annex Wolve Kuil No. 41	1128								25% of 18000 m^3/a					40 000	4 500
Portion 2 of the farm Wolve Kuil No. 43	1238											25% of 18000 m^3/a	100% of 9000 m^3/a	40 000	13 500
													Total	**234 650**	**144 000**

16.9 Environmental Management Programme Inputs

Potential environmental impacts pertaining to local groundwater resources have been considered in this EIA. In order to ensure safe and sustainable management of the groundwater resources in the area, several management inputs will be required. These inputs are, however, not required as part of the EIA phase and will only be required once the final operational conditions of the project are confirmed post environmental authorisation. Phase 1 will be required to determine if the groundwater is of a suitable quality and quantity; and Phase 2 will only be required if the groundwater quality and quantity are confirmed suitable for use. Additional information is provided below.

Phase 1: Determining if the groundwater is of a suitable quality and quantity:

1. Undertake a full laboratory analysis to confirm that the groundwater can be used for potable and domestic purposes, and determine the treatment required. This Geohydrology Assessment has confirmed that the groundwater is generally of good quality in terms of pH, EC and TDS.
2. The water quality is not considered suitable for panel washing as it will result in salts precipitating on the panels. The salts could be removed from the groundwater by thermal distillation (i.e. boiling since salt has a much higher boiling point than water) or by membrane separation (commonly reverse osmosis). Confirm what mechanisms could be used to remove the salts from the groundwater for panel cleaning. This will entail undertaking a financial viability investigation / feasibility study.
3. Undertake necessary tests to confirm if the groundwater is suitable for construction and concrete batching.
4. Conduct scientific yield tests to determine sustainable abstraction volumes from boreholes that are to be utilised.

Phase 2: Once the groundwater quality and quantity are determined more accurately and confirmed it is suitable for use the follow steps are required for sustainable management:

1. Acquire any historical monitoring data for the region.
2. Determine the volume of groundwater abstracted by farmers annually prior to construction by flow meters.
3. Ensure water saving techniques are instated and adhered to.
4. Ensure that proper bunding and secondary containment measures are in place for BESS facilities and are designed by an appropriate competent person.
5. Ensure that environmentally safe cleaning agents that breakdown naturally and do not cause adverse effects are used.
6. In the event that the entire Kudu Solar Facility development is constructed simultaneously, adherence to the recommended mitigation measures should be strictly followed to prevent over-abstraction.
7. Instate an appropriate monitoring program including monitoring of groundwater quality, water levels (ideally by water level loggers and hand readings using a dip meter), and abstracted volumes. These data should be reported on at the least biannually.

8. Yield test all monitoring boreholes according to SANS 10299-4:2003, Part 4 – Test pumping of water boreholes. This includes a Step Test, Constant Discharge Test and recovery monitoring.

16.9.1 Proposed Monitoring Plan:

It is recommended that at least three boreholes in the vicinity of each cluster of projects be allocated for monitoring purposes. These can either be existing boreholes, or newly drilled monitoring boreholes as this will allow for monitoring of the groundwater quality and groundwater levels across the affected area. The optimum position of the monitoring boreholes should be based on availability of open space surrounding the planned buildable area; however, it is recommended that one borehole be located up-gradient of the affected area to monitor background values and the other two boreholes be down-gradient of the affected area. Three general monitoring sites are presented in Table 16-17, however these are in an idealised scenario and any existing boreholes in the vicinity of the proposed sites can be utilised for monitoring purposes. Furthermore, one or more monitoring boreholes should present within 100 meters of notable contamination points (i.e. BESS and refuelling stations) as well as near project specific groundwater abstraction points. The borehole water level (if present) and the groundwater quality should be monitored on a monthly basis during construction phase and then on a quarterly basis during operational phase, so as to determine seasonal fluctuation. The implementation of the groundwater monitoring programme will be important for assessing any impacts of the Kudu Solar Facility on groundwater and the environment.

It is recommended that groundwater monitoring be undertaken at the proposed site in accordance with guidelines set out in the publication by DWAF (1998). The various aspects of the monitoring are presented in this section, along with relevant recommendations.

Table 16-17: General locations for proposed monitoring points.

Site_ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)
K1M_01	-30,23785	24,30997
K1M_02	-30,26389	24,29734
K1M_03	-30,27589	24,33460

In the case that new monitoring boreholes are drilled, the drilling should be supervised by a geohydrologist and drill samples should be collected every 1 metre and logged. Additional information should also be collected such as the depth of water strikes, associated water strike yields and groundwater quality. This is crucial information for the optimal design of the boreholes. The driller should be supervised to ensure all site requirements are met. A graphical representation of a proposed borehole construction is presented in Figure 16-4; the exact construction will, however, be unique for the borehole. It is not anticipated that multiple aquifers will be present in the bedrock. The inner diameter of the uPVC casing must not be less than 110 mm.

A gravel pack should be installed with an annulus of about 12 mm. The boreholes should be developed with compressed air for at least two hours upon completion along with an airlift test to

estimate the yield of the borehole. Each borehole must be protected with a concrete block or a protected manhole if there is traffic in the area. Each borehole also needs a permanent plate glued to the lid containing the details pertaining to the borehole. A bentonite plug of at least 500 mm needs to be installed at the top of the hole to prevent ingress of surface water.

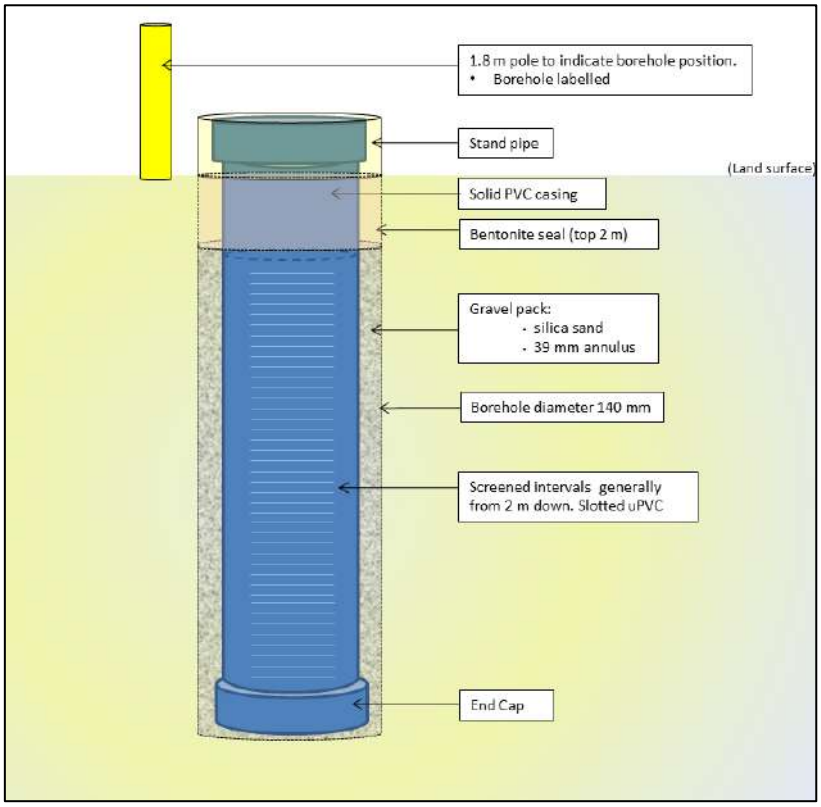


Figure 16-4: Schematic representation of the proposed general borehole construction.

16.9.1.1 Groundwater Level Monitoring

Groundwater level measurements are recommended for the monitoring boreholes at the study site. A dip meter can be used to measure the water level below the top of the borehole collar/casing height (mbch). The height of the collar/casing height must then also be measured (m). The water level (metres below ground level (mbgl)) can then be calculated by subtracting the collar/casing height from the water level (mbch). The value must be recorded along with the date and time of measurement. An interface meter can be used during monitoring to detect the presence of non-aqueous phase liquids (if present).

16.9.1.2 Groundwater Quality Monitoring

It is preferable to use a low volume sampling pump in most monitoring boreholes. Prior to sampling, the groundwater should be pumped through a flow-through cell until field chemistry parameters have stabilised.

16.9.1.3 Sample Collection, Preservation and Submission

Sample bottles must be labelled with the site name, borehole name and date. At the time of sampling, field chemistry parameters must be measured and recorded. These include electrical conductivity (EC), oxidation reduction potential (ORP), pH, temperature and dissolved oxygen (DO). During sampling, disposable nitrile gloves should be worn to minimise the transfer of any potential contaminants. Nitrile gloves should be dedicated to a sampling location and disposed of after use. Samples must be collected in an appropriate sampling container and preserved in the correct manner prior to submission to an accredited laboratory for the analysis parameters. The sample method and preservation must be discussed with the laboratory prior to sampling.

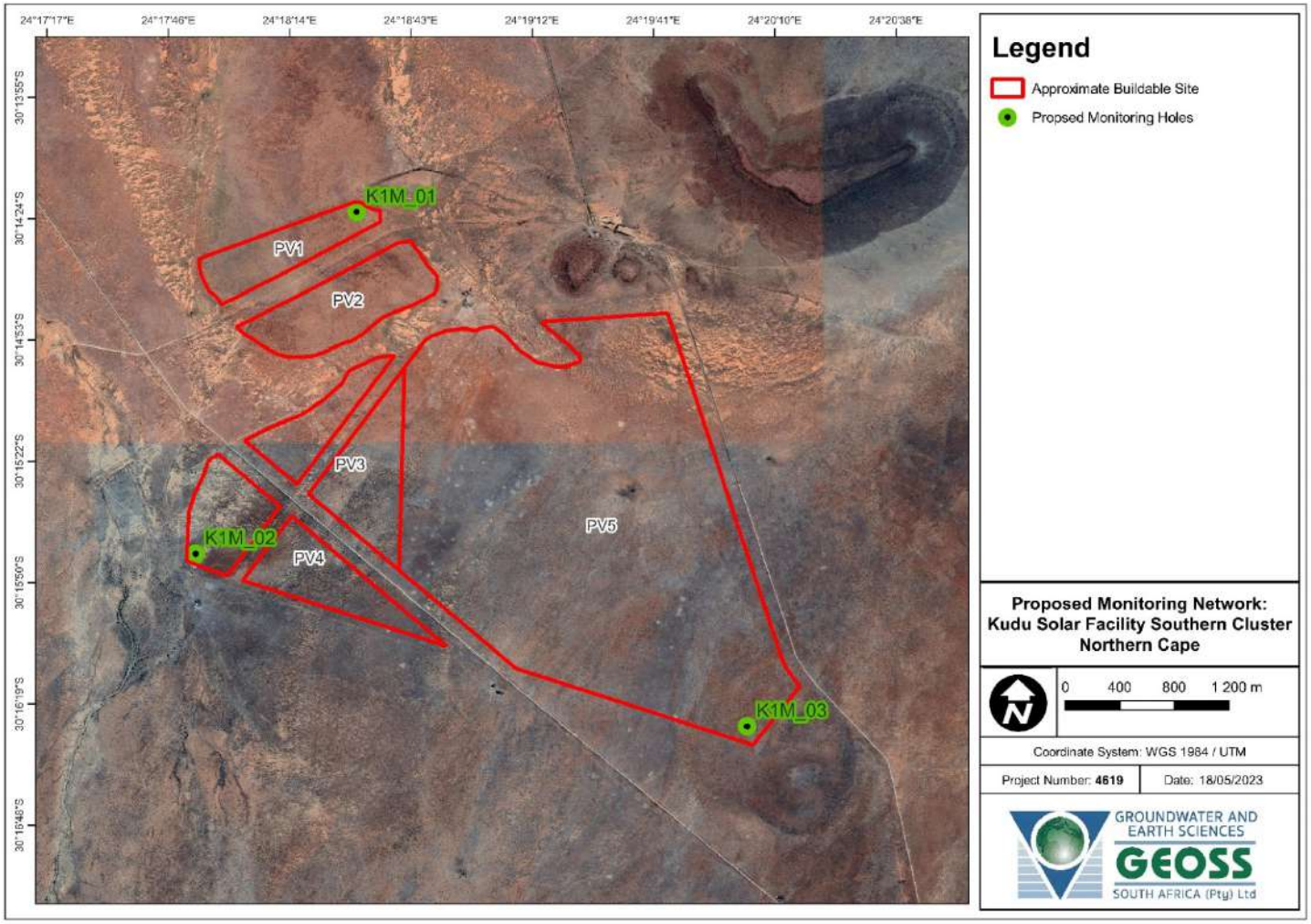
16.9.1.4 Monitoring Frequency and Parameter Analysis

In order to best understand and monitor the site, it is recommended that monthly water level measurements be taken to determine seasonal fluctuation during the construction period, after which water level measurements can be taken at quarterly intervals during the operational phase. Further to this, water quality measurements should be taken on a quarterly basis during the construction phase, after which water quality measurement can be taken on a bi-annual basis during the operational phase. The monitoring schedule can be reviewed and revised upon the start of the decommissioning phase. Table 16-18 indicates the potential parameters for the analysis.

Table 16-18: Proposed groundwater monitoring parameters and their recommended frequency.

Parameter	Frequency		
	K1M_01	K1M_02	K1M_03
Groundwater Level	Monthly (Construction Phase) Quarterly (Operational Phase)	Monthly (Construction Phase) Quarterly (Operational Phase)	Monthly (Construction Phase) Quarterly (Operational Phase)
pH	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Electrical conductivity (EC)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Total Dissolved Solids (TDS)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Alkalinity	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Total Organic Carbon (TOC)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Benzene	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Toulene	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Ethylene	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Xylene	Quarterly (Construction Phase)	Quarterly (Construction Phase)	Quarterly (Construction Phase)

Parameter	Frequency		
	K1M_01	K1M_02	K1M_03
	Bi-annually (Operational Phase)	Bi-annually (Operational Phase)	Bi-annually (Operational Phase)
Gasoline Range Organics (GRO)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Extractible Petroleum Hydrocarbons (EPH)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Volatile Organic Compounds (VOC)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Cd	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Cr	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Cu	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Fe	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Ni	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
Zn	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)
V	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)	Quarterly (Construction Phase) Bi-annually (Operational Phase)



Map 16-11: Proposed monitoring borehole locations from an aerial view.

16.10 Final Specialist Statement and Authorisation Recommendation

16.10.1 Statement and Reasoned Opinion

The Geohydrology Assessment conducted for the Kudu Solar PV4 facility came to the following main conclusions:

- The anticipated demands of this facility are less than the regional yield potential of the underlying aquifer (0.5 – 2.0 L/s).
- HBH1 and HBH24 are potentially viable sources of groundwater for the development of Solar Facility 4. The use of this/these borehole/s would/will depend on the operational requirements of the facility, negotiations with the landowners and proximity to the facility.
- The demand for the facility could potentially be met by abstraction from Remaining Extent of Portion 3 of the Farm Bas Berg No. 88 under General Authorisation. However, if Solar Facilities 2, 3, 4 and 5 are constructed at the same time, cumulatively, the water demands during the construction period will exceed the available GA volume of the farm portion. Therefore, groundwater exploration (including hydrocensus, lineament mapping and geophysics) on adjacent properties should be undertaken for additional supply to meet the demands. Alternatively, to source all the water from this farm portion, a Water Use License Application will be required to meet the demands of the construction period.
- The cumulative demands of construction (~4.6 L/s) for all twelve planned Kudu Solar Facilities (if developed simultaneously) exceeds the regional yield potential of the underlying aquifer (0.5 – 2.0 L/s). Since yield information was not available during the undertaking of the hydrocensus, estimations for groundwater supply capacity for the area are based on regional datasets.
- The study site has been classified as overlying low yielding aquifer with a groundwater vulnerability classification of “low/medium” to medium and a sensitivity rating of “medium” with no areas that need to be avoided.
- Both the potential individual and cumulative impacts from the construction, operation, and decommissioning phases for of the development are considered as Low to Very Low with appropriate mitigation.

Given these conclusions it is the opinion of the specialist that development of the proposed Kudu Solar Facility be authorised to proceed given that proper mitigation measures highlighted within this document are implemented during each phase of the project to suppress the intensity of identified impacts.

16.10.2 EA Condition Recommendations

From the impact assessment it is evident that the development will have a very low to low impact on the local geohydrological system as long as the recommended mitigation measures are adhered to.

As such, the project is authorised to continue from a geohydrological perspective on condition of implementation of the following recommendations:

- In the case that multiple projects are constructed simultaneously, adherence to recommended mitigation measures should be strictly followed to prevent over abstraction.
- Phase two of the monitoring plan is to be discussed and evaluated in the event that groundwater is to be used in the project.
- The proposed monitoring plan should be followed with a special focus on groundwater level monitoring to ensure that the aquifer is not over abstracted and falls to levels below historic borehole depths.
- All proposed impact mitigation measures are to be implemented during the development of the project. These include the use of environmentally safe cleaning agents, the construction of BESS facilities 50m from any boreholes along with appropriate bunding and secondary containment, and the recommended precautionary approaches aimed at preventing oil spills and fuel leaks.

16.11 References

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APPENDICES

APPENDIX A - SPECIALIST EXPERTISE

CURRICULUM VITAE – LOUIS JONK

GENERAL

Nationality:	South African
Profession:	Geotechnical Specialist
Specialization:	Soil classification for engineering purposes. Groundwater exploration and sampling.
Position in firm:	Geotechnical Geologist at GEOSS – South Africa (Pty) Ltd.
Date commenced:	09 January 2023
Year of birth & ID #:	1993 – 9307215060088
Language skills:	English (good – speaking, reading, and writing) Afrikaans (good - speaking, reading, and writing).

KEY SKILLS

- Geotechnical investigations
- Compilation of factual reports.
- Field mapping.
- Soil and rock profiling.
- Material classification and material use determination.
- Supervision of geotechnical contractors.
- ArcGIS, QGIS, Python, FLAC/SLOPE; HotPlot

EDUCATIONAL AND PROFESSIONAL STATUS

Qualifications

2018	M.Sc. (Geology – Cum Laude)	University of the Stellenbosch, South Africa
2015	B.Sc. Hons. (Earth Science)	University of the Stellenbosch, South Africa
2014	B.Sc. (Geology: Earth Science)	University of the Stellenbosch, South Africa

EMPLOYMENT RECORD

Jan 2023 to present	GEOSS South Africa (Pty) Ltd, South Africa
April 2020 to Dec 2022	Council for Geoscience South Africa
April 2018 to March 2020	Iziko Museums of South Africa

CURRICULUM VITAE – SHANE TEEK

GENERAL

Nationality:	South African
Profession:	Geotechnical Specialist & Hydrogeologist
Specialization:	Soil classification for engineering purposes. Groundwater exploration and sampling.
Position in firm:	Geotechnical Geologist & Hydrogeologist at GEOSS – South Africa (Pty) Ltd.
Date commenced:	17 July 2021
Year of birth & ID #:	1994 – 9404135162084
Language skills:	English (good – speaking, reading, and writing) Afrikaans (good - speaking, reading, and writing).

KEY SKILLS

- Geotechnical investigations
- Compilation of factual reports.
- Field mapping.
- Soil and rock profiling.
- Material classification and material use determination.
- Supervision of geotechnical contractors.
- Groundwater geophysics and conducting hydrocensus studies.
- Groundwater development - borehole drilling and test pumping supervision and analysis.
- Groundwater monitoring - development and analysis of groundwater level and quality data.
- Groundwater management - sustainable aquifer development and management.
- Groundwater contamination assessments.
- ArcGIS, QGIS, Python, FLAC/SLOPE, Midas GTS NX.

EDUCATIONAL AND PROFESSIONAL STATUS

Qualifications

2021	M.Eng. (Civil Engineering – Cum Laude)	University of the Stellenbosch, South Africa
2016	B.Sc. Hons. (Earth Science)	University of the Stellenbosch, South Africa
2015	B.Sc. (Geology: Earth Science)	University of the Stellenbosch, South Africa

Memberships

- Geological Society of South Africa – Member No. 970413
- South African Council for National Scientific Professions (SACNASP) Mem. No. 126397/20
- Founding member of the UNESCO Groundwater Youth Network (GWYN)

EMPLOYMENT RECORD

July 2021 to present	GEOSS South Africa (Pty) Ltd, South Africa
Jan 2020 to June 2021	Geotechnics Africa Western Cape, South Africa
Feb 2019 to July 2019	Polytechnique Montréal, Canada
Jan 2017 to Dec 2017	Remote Exploration Services, South Africa.

CURRICULUM VITAE – DALE BARROW

GENERAL

Nationality:	South African
Profession:	Hydrogeologist
Firm:	GEOSS South Africa (Pty) Ltd
Position:	Director and Hydrogeologist
Specialization:	Groundwater exploration, development, management and monitoring including numerical modelling. Hydrogeological impact studies and assessment of groundwater – surface water interaction.
Date commenced:	February 2008
Year of birth & ID #:	1985 – 851205 5227 082
Language skills:	English (mother tongue), Afrikaans (average)

KEY SKILLS

- Project Management
- Hydrogeological technical input on projects
- Groundwater surface water interaction assessment
- Groundwater exploration - (aerial photo interpretation, resistivity, magnetic and EM34 geophysical surveys for borehole siting purposes, geological conceptualization)
- Groundwater development - borehole drilling and test pumping supervision and analysis.
- Groundwater monitoring –development and analysis of groundwater level and quality data.
- Groundwater management – sustainable aquifer development and management.
- Numerical modelling of groundwater flow and mass transport.
- Groundwater component of Catchment Management Strategies and other Groundwater Resource Directed Measures.
- Groundwater contamination assessments.
- GIS / WISH and GW Vistas and typical software skills.

EDUCATIONAL AND PROFESSIONAL STATUS

Qualifications

2017	MBA (Cum Laude)	University of Stellenbosch, South Africa
2010	M.Sc. (Geohydrology)	University of the Free State, South Africa
2007	B.Sc. (Hons) Structural Geology	University of Stellenbosch, South Africa
2006	B.Sc. Geology – Applied Earth Science	University of Stellenbosch, South Africa

Courses

2019 Water Governance in South Africa: IWRM, the NWA, and water use authorizations, focusing on WULAs and IWWMPs. WISA accredited. Carin Bosman (CBSS)
2016 SPRING Software Modelling Course
2015 European Management Residency in Economics and Business (Maastricht University School of Business and Economics)
2013 Aquifer Firm Yield; Wellfield Design; Wellfield costing
2010 Introduction to QGIS (GISSA)
2010 Presentation Skills (Elsabé Daneel productions cc)
2009 Introduction to Isotope Hydrology in Southern Africa (GSSA)
2009 Aquifer Mechanics (IGS-UOFS)

2009 Groundwater Chemistry (IGS-UOFS)
2009 Groundwater Geophysics (IGS-UOFS)
2009 Groundwater Modelling (IGS-UOFS)
2009 Groundwater Management (IGS-UOFS)

Memberships

- Groundwater Division of the Geological Society of South Africa
- South African Council for National Scientific Professions (SACNASP) Mem. No. 400289/13

EMPLOYMENT RECORD

1 February 2008 to present:	GEOSS – Geohydrological and Spatial Solutions International (Pty) Ltd, Stellenbosch
23 July 2018 - November 2019	Design and part time lecturing of the Hydrogeology course for 3rd year students at Stellenbosch University

APPENDIX B - SPECIALIST STATEMENT OF INDEPENDENCE

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 - 12), near De Aar, Northern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
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5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

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Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

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Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

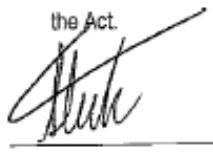
1. SPECIALIST INFORMATION

Specialist Company Name:	GEOSS SOUTH AFRICA (PTY) LTD			
B-BBEE	Contribution level (Indicate 1 to 8 or non-compliant)	3	Percentage Procurement recognition	110%
Specialist name:	SHANE TEEK			
Specialist Qualifications:	MEng – Civil Engineering			
Professional affiliation/registration:	SACNASP: 126397			
Physical address:	Unit 12, Techno Stell Bldg, 09 Quantum Street, Techno Park, Stellenbosch			
Postal address:	PO Bo12412, Die Boord, Stellenbosch			
Postal code:	7613	Cell:	079 183 7782	
Telephone:	021 880 1079	Fax:	n/a	
E-mail:				

2. DECLARATION BY THE SPECIALIST

I, SHANE TEEK, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

GEOSS SOUTH AFRICA (PTY) LTD

Name of Company:

28 November 2022

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, SHANE TEEK, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

GEOSS SOUTH AFRICA (PTY) LTD

Name of Company

28 November 222

Date

Samantha Schoeman
ACMA 1-7 Fluwen
17 Schoongezicht Str, Heldervue, 7130

Signature of the Commissioner of Oaths

29/11/2022

Date

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

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PROJECT TITLE

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0001

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Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	**GEOSS SOUTH AFRICA (PTY) LTD**			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	**3**	Percentage Procurement recognition	**110%**
Specialist name:	**DALE BARROW**			
Specialist Qualifications:	MSc in Hydrogeology			
Professional affiliation/registration:	SACNASP: 400289/13			
Physical address:	Unit 12, Techno Stell Bldg, 09 Quantum Street, Techno Park, Stellenbosch			
Postal address:	PO Box 12412, Die Boord, Stellenbosch			
Postal code:	7613	Cell:	074 172 2862	
Telephone:	021 880 1079	Fax:	n/a	
E-mail:	dbarrow@geoss.co.za			

2. DECLARATION BY THE SPECIALIST

I, **Dale Barrow,** declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

GEOSS SOUTH AFRICA (PTY) LTD

Name of Company:

07 July 2023

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Dale Barrow, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

GEOSS SOUTH AFRICA (PTY) LTD

Name of Company

07 July 2023

Date

Signature of the Commissioner of Oaths

07 July 2023

Date

Ex officio COMMISSIONER OF OATHS (RSA)
Samantha Schoeman ACMA - 1-7FUWGN
The Boulevard Office Park, Block B
Ground Floor, Searle Street, Woodstock, 7925

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

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Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

Details of Specialist, Declaration and Undertaking Under Oath

Page 1 of 3

1. SPECIALIST INFORMATION

Specialist Company Name:	GEOSS South Africa (Pty) Ltd.			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	3	Percentage Procurement recognition	110%
Specialist name:	**Louis Jonk**			
Specialist Qualifications:	B.Sc. (Hons) – Earth Sciences; M.Sc - Geology			
Professional affiliation/registration:	SACNASP 121278; GSSA 969970; PSSA			
Physical address:	Unit 12, Techno Stell Bldg, 09 Quantum Street, Techno Park, Stellenbosch			
Postal address:	PO Box 12412, Die Boord, Stellenbosch			
Postal code:	7613	Cell:	078 802 8447	
Telephone:	021 880 1079	Fax:	n/a	
E-mail:	ljonk@geoss.co.za			

2. DECLARATION BY THE SPECIALIST

I, **Louis Jonk**, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

GEOSS SOUTH AFRICA (PTY) LTD

Name of Company:

07 July 2023

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, **Louis Jonk**, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

GEOSS SOUTH AFRICA (PTY) LTD

Name of Company

07 July 2023

Date

Signature of the Commissioner of Oaths

07 July 2023

Date

7/7/23

Ex officio COMMISSIONER OF OATHS (RSA)
Samantha Schoeman ACMA – 1-7FUWGN
The Boulevard Office Park, Block B
Ground Floor, Searle Street, Woodstock, 7925

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

APPENDIX C - SITE SENSITIVITY VERIFICATION

Geohydrology themes do not exist on the National Web-based Environmental Screening Tool (Screening Tool) (as of May 2023); therefore, the environmental sensitivity of the proposed project area as identified by the Screening Tool is not applicable. For this reason, no site sensitivity verification report is required. Furthermore, there is no dedicated assessment protocol prescribed for conducting a Geohydrological Assessment. Therefore, this specialist assessment has been undertaken in compliance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014. Details of the site visit are indicated below:

Date of Site Visit	23-24 March 2022
Specialist Name	Christel van Staden and Dale Barrow
Professional Registration Number	Cand.Sci.Nat: 122591 and Pr.Sci.Nat: 400289/13
Specialist Affiliation / Company	GEOSS

All relevant desktop information, consultation with landowners, and previous assessments undertaken by the author in the study area have been taken into consideration during the undertaking of this specialist assessment.

The site sensitivity verification was undertaken using the following means:

(a) desk top analysis, using satellite imagery; geological maps and hydrogeological and geotechnical reports and databases where possible and applicable.

(b) preliminary on-site inspection; and drive over.

(c) collected water samples, field chemistry and water levels where possible and relevant; assessed site conditions to determine whether literature information is generally confirmed.

APPENDIX D - IMPACT ASSESSMENT METHODOLOGY

The impact assessment includes:

- *the nature, status, significance and consequences of the impact and risk;*
- *the extent and duration of the impact and risk;*
- *the probability of the impact and risk occurring;*
- *the degree to which impacts and risks can be mitigated;*
- *the degree to which the impacts and risks can be reversed; and*
- *the degree to which the impacts and risks can cause loss of irreplaceable resources.*

Terminology used in impact assessment can overlap. To avoid ambiguity, please note the following clarifications (that are based on NEMA and the EIA Regulations):

- *The term environment is understood to have a broad interpretation that includes both the natural (biophysical) environment and the socio-economic environment. The term socio-ecological system is also used to describe the natural and socio-economic environment and the interactions amongst these components.*
- *Significance = Consequence x Probability, which means that significance is equivalent to risk.*
- *The impact can have a positive or negative status. The significance of a negative impact may be called a risk, and the significance of a positive impact may be called an opportunity.*

The following principles are to underpin the application of this methodology:

- *Transparent and repeatable process - specialists are to describe the thresholds and limits they apply in their assessment, wherever possible.*
- *Adapt parameters to context (where justified) – the methodology proposes some thresholds (e.g. for spatial extent, in Step 3 below), however, if the nature of the impact requires a different definition of the categories of spatial extent, then this can be provided and described.*
- *Combination of a quantitative and qualitative assessment – where possible, specialists are to provide quantitative assessments (e.g. areas of habitat affected, decibels of noise, number of jobs), however, it is recognised that not all impacts can be quantified, and then qualitative assessments are to be provided.*

As per the DFFE Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect and cumulative:

- *Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.*
- *Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.*
- *Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective*

impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

The impact assessment methodology includes the aspects described below.

- ***Step 1**: **Nature** of impact/risk - The type of effect that a proposed activity will have on the environment.*

- ***Step 2**: **Status** - Whether the impact/risk on the overall environment will be:*
  - *Positive - environment overall will benefit from the impact/risk;*
  - *Negative - environment overall will be adversely affected by the impact/risk; or*
  - *Neutral - environment overall not be affected.*

- ***Step 3**: **Qualitatively** determine the **consequence** of the impact/risk by identifying the **a) SPATIAL EXTENT; b) DURATION; c) REVERSIBILITY; AND d) IRREPLACEABILITY**.*

  - ***A) Spatial extent** – The size of the area that will be affected by the impact/risk:*
    - *Site specific;*
    - *Local (<10 km from site);*
    - *Regional (<100 km of site);*
    - *National; or*
    - *International (e.g. Greenhouse Gas emissions or migrant birds).*

  - ***B) Duration** – The timeframe during which the impact/risk will be experienced:*
    - *Very short term (instantaneous);*
    - *Short term (less than 1 year);*
    - *Medium term (1 to 10 years);*
    - *Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration)); or*
    - *Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).*

  - ***C) Reversibility** of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):*
    - *High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);*
    - *Moderate reversibility of impacts;*
    - *Low reversibility of impacts; or*
    - *Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).*

  - ***D) Irreplaceability** of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):*

- *High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);*
- *Moderate irreplaceability of resources;*
- *Low irreplaceability of resources; or*
- *Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).*

Some of the criteria are quantitative (e.g. spatial extent and duration) and some may be described in a quantitative or qualitative manner (e.g. reversibility and irreplaceability). The specialist then combines these criteria in a qualitative manner to determine the ***consequence****.*

The consequence terms ranging from slight to extreme must be calibrated per Specialist Study so that there is transparency and consistency in the way a risk/impact is measured. For example, from a biodiversity and ecology perspective, the consequence ratings could be defined according to a reduction in population or occupied area in relation to Species of Conservation Concern (SCC) status, ranging from slight consequence for defined areas of Least Concern, to extreme consequence for defined areas that are Critically Endangered. For example, from a social perspective, a slight consequence could refer to small and manageable impacts, or impacts on small sections of the community; a moderate consequence could refer to impacts which affect the bulk of the local population negatively or may produce a net negative impact on the community; and an extreme consequence could refer to impacts which could result in social or political violence or institutional collapse.

- ***Consequence*** *– The anticipated consequence of the risk/impact is generally defined as follows:*
  - *Extreme (extreme alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they permanently cease);*
  - *Severe (severe alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease);*
  - *Substantial (substantial alteration of natural or socio-economic systems, patterns or processes, i.e. where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease;*
  - *Moderate (notable alteration of natural or socio-economic systems, patterns or processes, i.e. where the natural or socio-economic environment continues to function but in a modified manner; or*
  - *Slight (negligible and transient alteration of natural or socio-economic systems, patterns or processes, i.e. where natural systems/environmental or socio-economic functions, patterns, or processes are not affected in a measurable manner, or if affected, that effect is transient and the system recovers).*

- ***Step 4****: Rate the* ***probability*** *of the impact/risk using the criteria below:*

  - ***Probability*** *– The probability of the impact/risk occurring:*
    - *Extremely unlikely (little to no chance of occurring);*
    - *Very unlikely (<30% chance of occurring);*

- *Unlikely (30-50% chance of occurring)*
- *Likely (51 – 90% chance of occurring); or*
- *Very Likely (>90% chance of occurring regardless of prevention measures).*

- ***Step 5**: Use both the **consequence** and **probability** to determine the **significance** of the identified impact/risk (qualitatively as shown in Figure 16.5). Significance definitions and rankings are provided below:*

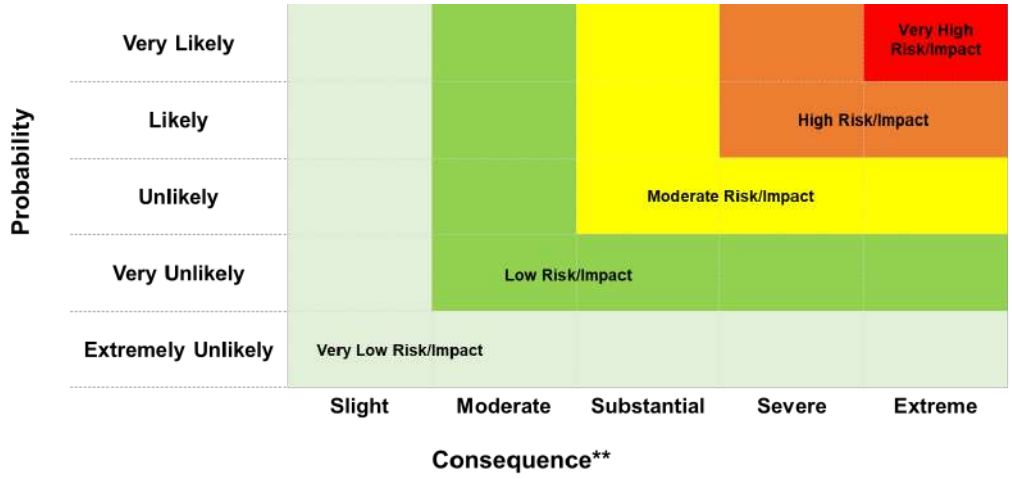


Figure 16-5: Guide to assessing risk/impact significance as a result of consequence and probability.

- ***Significance** – Will the impact cause a notable alteration of the environment?*
  - *Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
  - *Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
  - *Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);*
  - *High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and*
  - *Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).*

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- *Very low = 5;*
- *Low = 4;*
- *Moderate = 3;*
- *High = 2; and*
- *Very high = 1.*

The specialists must provide a written supporting motivation of the assessment ratings provided.

- ***Step 6**: Determine the **Confidence Level** – The degree of confidence in predictions based on available information and specialist knowledge:*
    - *Low;*
    - *Medium; or*
    - *High.*

APPENDIX E - COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

Requirements of Appendix 6 (Specialist Reports) of Government Notice R326 (Environmental Impact Assessment (EIA) Regulations of 2014, as amended)	***Section where this has been addressed in the Specialist Report***
1. (1) A specialist report prepared in terms of these Regulations must contain - *a) details of -* *i. the specialist who prepared the report; and* *ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;*	*Appendix A.*
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	*Appendix B*
c) an indication of the scope of, and the purpose for which, the report was prepared;	*Section 16.1.1*
(cA) an indication of the quality and age of base data used for the specialist report;	*Sections 16.2.1 and 16.2.2*
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	*Section 16.4 and Section 16.6.4*
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	*Section 16.2.2*
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	*Section 16.2*
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	*Section 16.4.3 and Section 16.4.6*
g) an identification of any areas to be avoided, including buffers;	*Section 16.4.6*
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	*Section 16.4.6*
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	*Section 16.2.2*
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	*Section 16,4 and 16,5*
k) any mitigation measures for inclusion in the EMPr;	*Section 16.9*
l) any conditions for inclusion in the environmental authorisation;	*Section 16.10.2*
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	*Section 16.10.2*
n) a reasoned opinion- *i. whether the proposed activity, activities or portions thereof should be authorised;* *(iA) regarding the acceptability of the proposed activity or activities; and* *ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;*	*Section 16.10.1*
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	*Section 16.2.3*
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	*Section 16.5.2*
q) any other information requested by the competent authority.	

Requirements of Appendix 6 (Specialist Reports) of Government Notice R326 (Environmental Impact Assessment (EIA) Regulations of 2014, as amended)	***Section where this has been addressed in the Specialist Report***
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	*Note: Part A of the Assessment Protocols published in GN 320 on 20 March 2020 are not applicable as there are no dedicated Geohydrology or Groundwater themes on the National Web-based Environmental Screening Tool (Screening Tool) (as at May 2023).* *Section 16.4.5 and Appendix C*

APPENDIX F - OTHER RENEWABLE ENERGY PROJECTS WITHIN 30 KM OF THE KUDU SOLAR PV FACILITY

Table 16-19: Approved renewable energy projects, located within 30 km of the proposed Kudu Solar Facility.

CSIR No.	DFFE REFERENCE	TECHNO-LOGY	MW/ KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
1	• 12/12/20/2258 • 12/12/20/2258/1	Solar PV	75	Approved and Preferred Bidder (Operational)	• The Proposed Establishment of Photovoltaic (Solar Power) Farms in the Northern Cape Province - Kalkbult	2010	Scoping and EIA	Scatec Solar SA Pty Ltd	Sustainable Development Projects cc
2	• 12/12/20/2463/1 • 12/12/20/2463/1/2 • 12/12/20/2463/1/A2 • 12/12/20/2463/1/AM3 • 12/12/20/2463/1/AM4 • 12/12/20/2463/1/AM5	Onshore Wind	140	Approved and Preferred Bidder (Operational)	• Longyuan Mulilo De Aar 2 North Wind Energy Facility • Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility • The Wind Energy Facility (North and South) situated on the Plateau Near De Aar, Northern Cape Province	2010 and 2014	Scoping and EIA and Amendment	Longyuan Mulilo De Aar 2 South (Pty)	Aurecon South Africa (Pty) Ltd and Holland and Associates Environmental Consultants
3	• 12/12/20/2463/2 • 12/12/20/2463/2/AM2	Onshore Wind	100	Approved and Preferred Bidder (Operational)	• Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility • The Wind Energy Facility (North and South) Situated On The Plateau Near De Aar, Northern Cape Province	2010 and 2014	Scoping and EIA and Amendment	Mulilo Renewable Energy (Pty) Ltd	Aurecon South Africa (Pty) Ltd
4	• 14/12/16/3/3/1/1166 14/12/16/3/3/1/1166/AM3 14/12/16/3/3/1/1166/AM4	Transmission line	132	Approved	• Basic Assessment for the proposed construction of a 132 kV transmission line	2010 and 2014	Basic Assessment	Longyuan Mulilo De Aar 2 North (Pty) Ltd	Aurecon South Africa (Pty) Ltd

CSIR No.	DFFE REFERENCE	TECHNO-LOGY	MW/ KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
					corridor adjacent to the existing Eskom transmission line from Longyuan Mulilo De Aar 2 North Wind Energy Facility (WEF) to the Hydra Substation in De Aar, Northern Cape				
5	• 14/12/16/3/3/1/785	Transmis sion line	132	Approved	• Proposed construction of two 132kV transmission lines from the South & North Wind Energy Facilities on the Eastern Plateau (De Aar 2) near De Aar, Northern Cape.	2010	Basic Assessment	Mulilo Renewable Energy (Pty) Ltd	Aurecon South Africa (Pty) Ltd
6	• 14/12/16/3/3/2/278 • 14/12/16/3/3/2/278/1 • 14/12/16/3/3/2/278/2	Onshore Wind	118	Approved	• Proposed Castle Wind Energy Facility Project, located near De Aar, Northern Cape	2010 and 2014	Scoping and EIA	Castle Wind Farm (Pty) Ltd	Aurecon South Africa (Pty) Ltd; and Savannah Environmental Consultants (Pty) Ltd
7	• 14/12/16/3/3/2/564 • 14/12/16/3/3/2/564/AM1 • 14/12/16/3/3/2/564/AM2	Solar PV	75	To be confirmed	• Proposed Swartwater 75MW solar PV power facility in Petrusville within Renosterburg Local Municipality, Northern Cape	2010 and 2014	Scoping and EIA and Amendment	AE-AMD Renewable Energy (Pty) Ltd	USK Environmental and Waste Engineering (Pty) Ltd
8	• 14/12/16/3/3/2/740	Solar PV	300	Approved	• Proposed 300MW Solar Power Plant in Phillipstown area in Renosterberg Local Municipality	2010	Scoping and EIA	To be confirmed	Tshikovha Environmental and Communication Consultants

CSIR No.	DFFE REFERENCE	TECHNO-LOGY	MW/ KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
9	• 14/12/16/3/3/2/744	Solar PV	0	Approved	• Proposed PV facility on farm Jakhalsfontein near De Aar	2010	Scoping and EIA	Solar Capital (Pty) Ltd	Eco Compliance (Pty) Ltd
10	• 14/12/16/3/3/2/739	Solar PV	70 - 100	To be confirmed	• Proposed 70 - 100 MW Solar Power Plant in Petrusville	2010	Scoping and EIA	To be confirmed	Tshikovha Environmental and Communication Consultants
11	• Not issued yet (it is understood that the project is still within the pre-application stage)	Solar PV	800 (Maximum)	Pre-Application	• The Proposed Keren Energy Odyssey Solar PV Facilities (Odyssey Solar 1, Odyssey Solar 2, Odyssey Solar 3, Odyssey Solar 4, Odyssey Solar 5, Odyssey Solar 6, Odyssey Solar 7 And Odyssey Solar 8)	2014	Scoping and EIA	Keren Energy Group Holdings	EnviroAfrica cc
12	• To be confirmed	Solar PV	3050	Scoping	• The Proposed Development of the Crossroads (formally referred to as the Hydra B) Green Energy Cluster of Renewable Energy Facilities and Grid Connection Infrastructure, Pixley Ka Seme District Municipality, Northern Cape Province. The Cluster entails the development of up to 21 solar energy facilities, with the Scoping and EIA Processes consisting of three phases. Phases 1, 2 and 3 consist of	2014	Scoping and EIA	Akuo Energy Afrique	Savannah Environmental Consultants (Pty) Ltd

CSIR No.	DFFE REFERENCE	TECHNO-LOGY	MW/ KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
					9, 6 and 6 solar facilities, respectively. The Phase 1 Scoping and EIA Processes were launched in January 2023.				
Study area shown on map	• 14/12/16/3/3/2/2244 • 14/12/16/3/3/2/2245 • 14/12/16/3/3/2/2246 • 14/12/16/3/3/2/2247 • 14/12/16/3/3/2/2248 • 14/12/16/3/3/2/2249 • 14/12/16/3/3/2/2250 • 14/12/16/3/3/2/2251 • 14/12/16/3/3/2/2252 • 14/12/16/3/3/2/2253 • 14/12/16/3/3/2/2254 • 14/12/16/3/3/2/2255	Solar PV	2180	Scoping and EIA Process underway	• Proposed Development of 12 Solar Photovoltaic (PV) Facilities (Kudu Solar Facility 1 to 12) and associated infrastructure, near De Aar, Northern Cape Province	2014	Scoping and EIA	Kudu Solar Facility 1 (Pty) Ltd to Kudu Solar Facility 12 (Pty) Ltd	CSIR
Shown on map as Existing HV Lines	• N/A	Transmis sion Line	220	Existing Power Line	• HYDRA ROODEKUIL 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmis sion Line	132	Existing Power Line	• HYDRA ROODEKUIL 1	-	-	-	-
Shown on map as	• N/A	Transmis sion Line	765	Existing Power Line	• BETA HYDRA 2	-	-	-	-

CSIR No.	DFFE REFERENCE	TECHNO-LOGY	MW/ KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
Existing HV Lines									
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• HYDRA PERSEUS 3	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• VAN DER KLOOF ROODEKUIL 2	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	220	Existing Power Line	• VAN DER KLOOF ROODEKUIL 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• BETA HYDRA 1	-	-	-	-
Shown on map as Existing HV Lines	• N/A	Transmission Line	400	Existing Power Line	• HYDRA PERSEUS 2	-	-	-	-
Shown on map as	• N/A	Transmission Line	132	Existing Power Line	• KALKBULT/KAREEBOSCHPAN 1	-	-	-	-

CSIR No.	DFFE REFERENCE	TECHNO-LOGY	MW/ KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
Existing HV Lines									
Shown on map as Existing HV Lines	• N/A	Transmission Line	132	Existing Power Line	• ROODEKUIL/ORANIA 1	-	-	-	-
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Perseus to Gamma 2nd 765 kV line • Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line	-	-	-	-
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Relocate Beta-Hydra 765kV line to form Perseus-Hydra 1st 765kV line • Cape Corridor Phase 2: Zeus - Hydra 765kV Integration	-	-	-	-
Shown on map as Planned HV Lines	• N/A	Transmission Line	765	Planned Power Line	• Perseus to Gamma 2nd 765 kV line • Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line	-	-	-	-



CHAPTER 17:

Geotechnical Assessment



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GEOTECHNICAL ASSESSMENT:

Scoping and Environmental Impact Assessment (EIA) Process for the Proposed Development of a Solar Photovoltaic Facility (Kudu Solar Facility 4) and associated infrastructure, near De Aar, Northern Cape Province

Report prepared for:	*Report prepared by:*
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This report summarises the results from a desktop specialist study which aimed to project a high-level overview of envisaged risks from a geotechnical standpoint, and provide broad recommendations for high-level designs. The following conclusions can be drawn from the investigation:

1. Based on the findings of this geotechnical desktop study, development should proceed provided the mitigation measures are implemented.
2. Increased soil erosion and contamination may transpire as an impact of the proposed development, and this may persist for the life of the project. However, the impact of this is expected to be very low to low significance during all phases of the development (i.e., construction, operation and decommissioning).
3. Published data for the area, e.g., geological map, is generally confirmed by fieldwork undertaken by GEOSS in the area. However, variable soil and rock conditions will exist across the site, broadly these have been divided as follows:
    a. Zone A – Karoo Sandstones and mudstones
    b. Zone B – Karoo dolerite
    c. Zone C – Areas of thicker soil cover (generally within drainage channels)
4. It is anticipated that conventional foundations can be employed for all structures. Karoo mudrock and sandstone should be avoided when selecting aggregates for concrete mixes.
5. The footprint of each proposed structure would have to be investigated prior to compilation of final design.
6. Owing to the variable geologic and soil conditions across the proposed development area, the subgrade conditions will vary across the site. Dolerite has been proven to perform well as an aggregate for wearing courses in other areas of the Karoo. Dolerite has also been incorporated as an aggregate in concrete mixes.
7. The excavatability of the stratum on site are anticipated to be variable, based on material composition and texture, the degree of weathering, and the nature of discontinuities within the rock and/or soil mass.
8. The seismicity in the region should be considered during design.
9. Road cuttings and drainage systems should be designed by an appropriately qualified professional.
10. Detailed geotechnical investigations will need to be undertaken prior to construction. Such investigations would not be required to fulfil the requirements of the EIA process. However, it would be necessary prior to construction.

11. GEOSS has endeavoured to highlight and characterise all potential geotechnical risks that are presented by the site that has been proposed for development. However, due to the anisotropic (variable) nature of earth materials, each point on the site will present results that differ. For this reason, it is considered of the utmost importance that the foundation excavations be inspected prior to casting to ensure that soil with an adequate bearing capacity is obtained beneath each footing, and/or piling conditions be assessed. These works should be carried out by an appropriately qualified individual, during construction of the facility.



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Abbreviations	
AASHTO	American Association of State Highway and Transportation Officials
BH	Borehole
CBR	California bearing ratio
CGS	Council for Geoscience
CSIR	Council for Scientific and Industrial Research
DWS	Department of Water Affairs and Sanitation
EAM	Engineering and Asset Management
EC	electrical conductivity
EOH	End of Hole
g	Gravity
L/s	litres per second
LL	Liquid Limit
LS	Linear Shrinkage
LSSG	Lower selected sub-grade
m	metres
MCCSSO	Moisture content, colour, consistency, structure, soil type, and origin.
MDD	Maximum Dry Density
mm	millimetre
MOD	Modified AASHTO
mS/m	milli-Siemens per metre
NGA	National Groundwater Archive
NHBRC	National Home Builders Registration Council
OMC	Optimum moisture content
PI	Plasticity Index
TLB	Tractor loader backhoe
UFST	Underground Fuel Storage Tanks
USSG	Upper selected sub-grade



Definitions	
Aquifer	a geological formation, which has structures or textures that hold water or permit appreciable water movement through them [from National Water Act (Act No. 36 of 1998)]
Electrical conductivity	the ability of groundwater to conduct electrical current due to the presence of charged ionic species in solution (Freeze and Cherry, 1979)
Fractured aquifer	Describes an aquifer where groundwater only occurs in narrow fractures within the bedrock
Geologic materials	Primarily rock and soil (synonymous with Geological)
Geotechnical zone	Region where similar geotechnical conditions are anticipated.
Groundwater	Water found in the subsurface in the saturated zone below the water table or piezometric surface, i.e., the water table marks the upper surface of groundwater systems.
Intergranular aquifer (or primary aquifer)	An aquifer in which groundwater is stored within and flows through open pore spaces in the unconsolidated granular Quaternary deposits
Lithology/lithologies	A specific rock type, e.g., sandstone, shale or granite etc.
Pedocrete	Superficial deposits, not of sedimentary origin, which have formed through either weathering residues, or cementation or replacement of existing soils (by precipitates derived from soil-water and or groundwater), or a combination of such processes. Several chemical agents replace or cement, e.g., calcium carbonates (calcrete) and/or iron oxides (ferricrete)

17. GEOTECHNICAL ASSESSMENT

This chapter includes the Geotechnical Specialist Assessment that was prepared by GEOSS South Africa, as part of the Scoping and Environmental Impact Assessment (EIA) Process for the proposed development of the Kudu Solar Facility 4 and associated infrastructure, near De-Aar, Northern Cape Province (Map 17-1). Kudu Solar Facility 4 forms part of a cluster of 12 Solar Photovoltaic (PV) projects proposed by the Project Developer.

17.1 Introduction

17.1.1 Scope, Purpose and Objectives of this Specialist Report

The primary objective of the desktop assessment is to summarise the area's geology, including the likely distribution of potential geotechnical challenges related to the underlying geology. Provide geotechnical impact assessment of the proposed development on the receiving environment, e.g., providing mitigation measures to limit impacts of concentrated runoff generated by hard surfaces resulting in increased soil erosion.

This chapter only addresses Kudu Solar Facility 4 (hereafter referred to as the "Kudu Solar Facility" or "proposed project").

17.1.2 Details of Specialist

This specialist assessment has been undertaken by Hardy Luttig, Shane Teek, and Dale Barrow of GEOSS South Africa. Hardy Luttig obtained a Bachelor degree in Earth Science and a Masters in Geotechnical Engineering at the University of Stellenbosch. Shane Teek is registered as a candidate with the SACNASP, with Registration Number 126397. Dale Barrow is registered as a professional with the SACNASP, with Registration Number 400829/13. A curriculum vitae is included for all parties in Appendix A of this Specialist Assessment.

In addition, a signed specialist statement of independence is included in Appendix B of this Specialist Assessment.

17.1.3 Terms of Reference

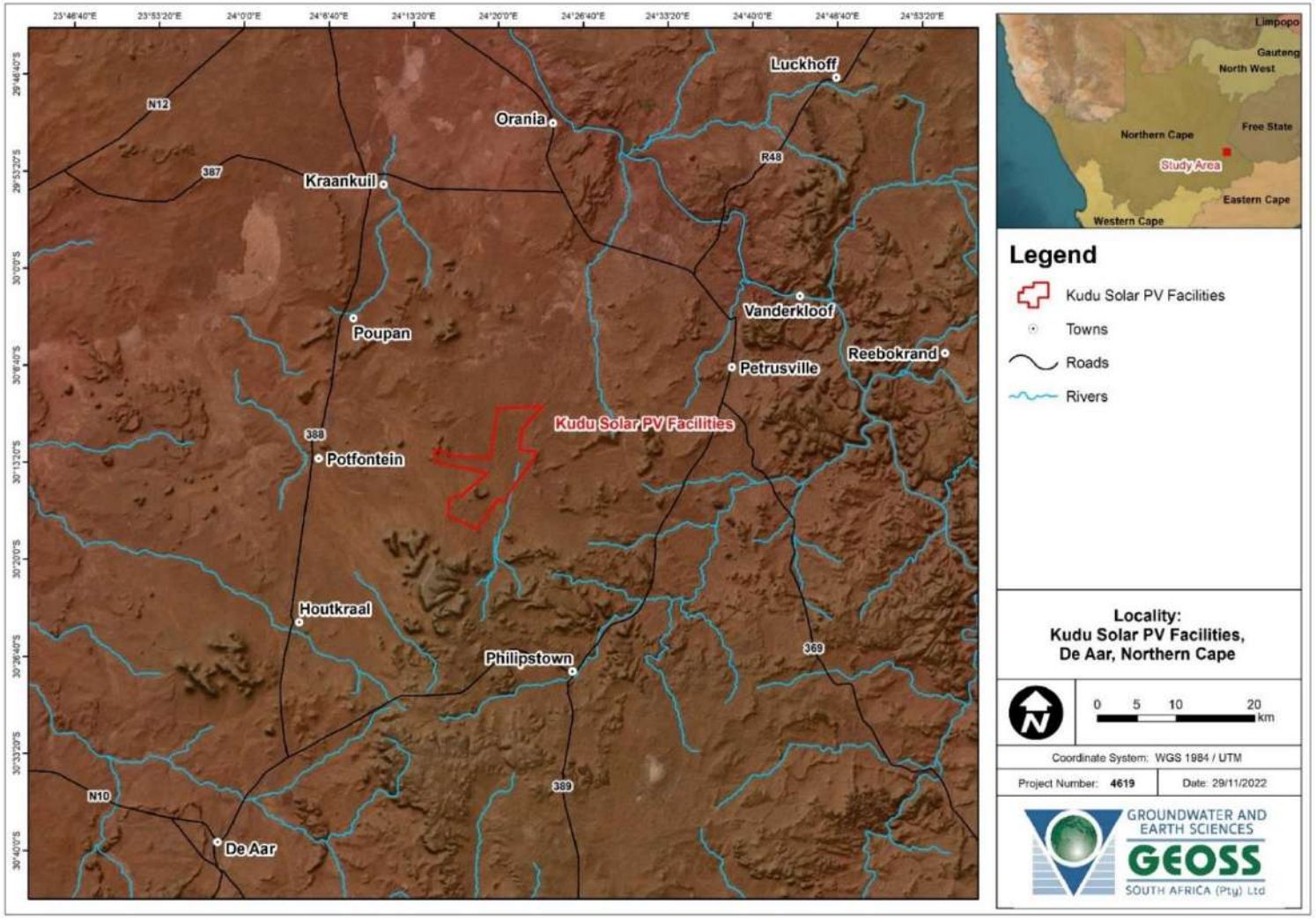
The Terms of Reference for the geotechnical desktop specialist study are as follows:

- Compile and review available geological and geotechnical information for the region, including the anticipated soil conditions.
- Determine whether problem soils are likely to be encountered within the study area.
- A general discussion of possible and likely engineering characteristics of the respective geological materials.
- Identify possible development constraints that may be present across the study area, e.g., topographical constraints, major discontinuities, or shallow groundwater conditions (permanent or non-permanent).

- An evaluation of the seismic potential of the area based on available published literature.
- Provide commentary on any potentially sensitive areas across the site, such as ridges, outcrops and exposures.
- Provide broad recommendations that may be used to guide the geotechnical design and plan future investigations within the study area.
- Specification of set-backs or buffers (if any), and provide clear reasons for these recommendations.
- Provide review input on the preferred infrastructure layout following the sensitivity analysis and layout identification.
- Summarise, classify and categorise geotechnical risks that may arise due to the development and provide relevant mitigation measures to manage said risks.
- Provide spatial mapping of geotechnical zones where similar environmental conditions are expected.
- Provide spatial mapping of slope classification, where development is most to least favourable, based on Stiff et al. (1996).
- Identify and assess the potential direct, indirect and cumulative impacts of the proposed development on the receiving environment from a geotechnical perspective.
- A description of assumptions and limitations used.
- Identification of additional protocols, licensing and/or permitting requirements that are relevant to the project and the implications thereof, if any.
- Provide recommendations with regards to potential monitoring programmes.
- Determine mitigation and/or management measures, which could be implemented to as far as possible, reduce the effect of negative impacts and enhance the effect of positive impacts. Also, identify best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts, for inclusion in the Environmental Management Programme (EMPr).
- Review the Generic EMPr for Substations (GN 435) and confirm if there are any specific environmental sensitivities or attributes present on the site and any resultant site-specific impact management outcomes and actions that need to be included.
- Provide a reasoned opinion indicating the acceptability of the proposed development and a recommendation if the development should go ahead or not.

17.1.4 Proposed Development

The proposed development includes all components of the Kudu Solar Facility, e.g., the erection of PV tables for the generation of solar power, associated electrical infrastructure (above and/or below the surface), ancillary structures for site security and/or transformers, battery energy storage system(s) (BESS), as well as access tracks/roads and boundary fences.



Map 17-1: Locality map showing the location of the proposed Kudu Solar Facility and surrounds.

17.2 Approach and Methodology

The following approach and methodology were followed for this desktop geotechnical assessment:

Task 1: Obtain all data relevant to the project (i.e., previous geotechnical reports), and search the internal GEOSS database (including relevant information pertinent to the study area). Review/acquire geological, geotechnical, and hydrogeological maps for the area. Review any reports that have been compiled for the study area. Compile a project GIS.

Task 2: Conduct a literature review. Compile geotechnical impact assessment using the methodology presented in Appendix D of this assessment chapter. Draw from data gathered during the site visit undertaken by GEOSS during the separate Hydrogeological study (Chapter 16 of this EIA Report), during which time the geotechnical and geological conditions were generally confirmed visually.

Task 3: Compile and analyse the data using geotechnical methods and address the questions raised in the project objectives. Document findings in the desktop geotechnical report.

17.2.1 Information Sources

The information sources used in this study are listed in Table 17-1.

Table 17-1: Information sources used to assess the Geotechnical conditions for the proposed Kudu Solar Facility.

Data / Information	Source	Date	Type	Description
Geological Map	Council for Geosciences	1997	Spatial	1:250 000 scale Geological Map Series of 3024 Colesberg
[Geotechnical] Engineering Geology of Southern Africa: The Karoo Sequence Volume 3	A. B. A. Brink	1983	Literature	Engineering properties of rocks and soils of the Karoo Supergroup
Climatology and Geohydrology	Cape Farm Mapper	2009	Database	SA Atlas of Climatology and Geohydrology; obtained from Western Cape Government Agriculture
Groundwater recharge and vulnerability mapping	Conrad J. and Munch Z.	2007	Spatial	A National scale approach to groundwater recharge and vulnerability mapping
Hydrogeological map series	Department of Water Affairs and Forestry	2005	Spatial	Hydrogeological map series of the republic of South Africa
NGA Database	NGA	14 April 2022	Database and Spatial	Spatial delineation of NGA registered boreholes

17.2.2 Assumptions, Knowledge Gaps and Limitations

The following is important to note regarding the completion of this project:

- A site visit was not undertaken during the geotechnical desktop study. However, the services performed by GEOSS South Africa (Pty) Ltd are consistent with the level of care and skill ordinarily exercised by the geotechnical unit and/or members of the geotechnical profession practising under similar conditions in the locality of the project. This report is therefore considered to fulfil the scope of the present investigation, and third party information has been utilised in good faith in compilation of this report.
- The duration of the construction phase and decommissioning phase is assumed to be approximately one and a half years, and one year respectively.
- The interpretation of the site conditions is based on the available information (from literature and experience in the region). Professional judgement (analysis of available data) is considered to provide sufficient confidence to meet the objectives of this specialist desktop geotechnical study.
- Earth materials are, by nature, variable. Therefore, reasonable variance between the conditions and properties described and actual site conditions are expected. Recommendations provided are suitable for the purposes of this investigation, but are provisional in nature and will need to be confirmed by intrusive on-site investigations prior to construction.
- Third-party information (e.g., literature) has been utilised in good faith.
- Cumulative impacts are assessed by adding effects expected from this proposed development to existing and proposed developments with similar impacts in a 30 km radius. The current and proposed developments that were considered for cumulative impacts are discussed and displayed in Section 17.6.4.
- The cumulative impacts of the construction period are expected to be staggered, i.e., as one development's construction period is complete, the next commences, prolonging the cumulative impacts of the construction period. A similar approach has been adopted for the operation and decommissioning phases.
- It must be noted that there are no areas on site that should be avoided from a geotechnical sensitivity perspective. However, areas of moderate to steep topography would likely render development financially unfeasible (Map 17-5). Further, the Digital Elevation Model (DEM) used to generate the slope map (Map 17-5) indicated anomalous elevation values that run along the length of the overhead transmission lines. Based on the available evidence, these anomalous elevation values are considered erroneous.
- No responsibility will be accepted for consequences arising out of the fact that actual conditions vary from those presented/inferred. Engineering recommendations provided in this report are preliminary and must be confirmed through further intrusive investigations. The information must be verified by the undertaking of a detailed geotechnical site investigation. Such investigations would not be required to fulfil the requirements of the EIA process. However, it would be necessary prior to construction.
- There is no specific Assessment Protocol devised for Geotechnical Assessments, and the Screening Tool does not include any layers or themes for geotechnical conditions (as at May 2023). Therefore, the report needs to comply with Appendix 6 of the 2014 National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations (as amended). Appendix E of this chapter contains a table complying with Appendix 6 of the 2014 NEMA EIA Regulations (as amended).

17.2.3 Consultation Processes Undertaken

During the undertaking of the geohydrological[1] and geotechnical site verification process, all landowners were contacted to ensure that GEOSS was able to locate their boreholes and inspect the landforms across their properties. This was mainly to ensure consent was granted; this was achieved telephonically by Christel Van Staeden of GEOSS South Africa.

17.3 Description of Project Aspects relevant to this Geotechnical Specialist Assessment

The project applicant intends to construct several solar panel arrays across the proposed development area of Kudu Solar Facility. To do so, construction will be required, which typically entails the following:

1. Stripping and clearing of vegetation, where necessary, within the approved development footprint to facilitate the construction and/or establishment of infrastructure. Note that vegetation is planned to be trimmed within the PV array area (and not removed completely);
2. Levelling and grading of the site.
3. Excavation of foundation trenches and/or installation [method dependent on conditions] of pile foundation systems for the solar panel arrays and related infrastructure.

The above activities generally affect the surrounding environment as follows:

- Displacement of geological materials.
- Contamination of geological materials.
- Generation of construction and demolition waste.

To date, apart from the construction of farmhouses and the erection of boundary and subcamp fences for farming purposes; little disturbance of the subsoils and rocks in the area proposed for development has taken place.

17.4 Baseline Environmental Description

17.4.1 Study Area Definition

The study area for the proposed Kudu Solar Facilities 1 to 12 is the full extent of the eight affected farm properties on which the proposed PV Facilities will be constructed. The full extent of these properties has been assessed in this study in order to identify environmental sensitivities and no-go areas. The total **study area** for Kudu Solar Facilities 1 to 12 is approximately 8 150 hectares (ha).

At the commencement of this Scoping and EIA Process, the **Original Scoping Buildable Areas** which fall within the study area were identified by the Project Developer following the completion of high-level environmental screening based on the Screening Tool.

[1] Note that a separate Geohydrology Assessment is included in Chapter 16 of this EIA Report

Following the identification of sensitivities during the Scoping Phase, the Project Developer considered such sensitivities and formulated the **Revised Scoping Buildable Areas**. The **Revised Scoping Buildable Areas** were used to inform the design of the layout, and further assessed during this EIA Phase of the project in order to identify the preferred development footprint of the proposed project on the approved site as contemplated in the accepted Scoping Report. The development footprint is where the actual development will be located, i.e. the footprint containing the PV solar arrays and associated infrastructure.

For simplicity, the maps contained within this report include all boundaries of the study area. However, each report is focused on a single component of the investigation, e.g., Kudu Solar Facility 4.

17.4.2 General Description

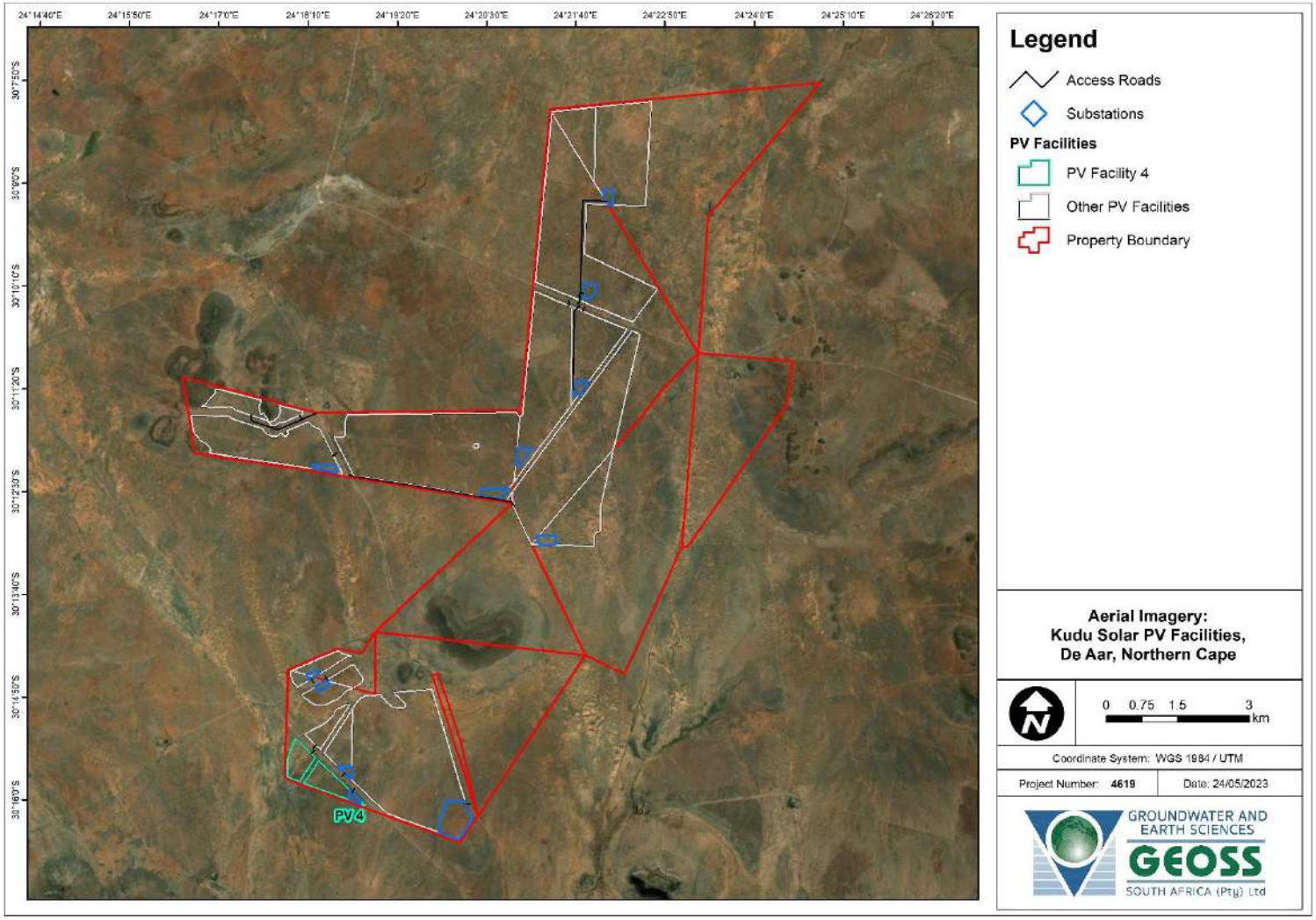
The nearest town to the proposed project is De Aar, approximately 60 km to the southwest. The landscape in the surrounding area is arid, with transported sands occurring widely along plains with dolerite sills (generally northwest of the study area) and mudstone, shale and sandstones (generally southeast of the study area) outcropping in areas of higher elevation. It is understood that the farms in the area are mainly used for livestock farming purposes.

Receptors that could be impacted by changes in the geotechnical conditions of the study area include (but are not limited to):

- Destruction/alteration of endemic fauna and flora environment due to displacement of geologic materials, e.g., removal of soils and/or rocks on site.
- Reduced food for livestock and inhabitants of the farms, decreased crop yields (although uncommon in this region) due to erosion and contamination, and consequential soil loss.

Acceptable levels of change in terms of geotechnical conditions would generally be characterised by safe tolerable levels. For the EIA process this would include identification of fatal flaws and levels of change via desktop study. This information can be later refined after EA with data based on observations made during the structural design phase which includes intrusive investigations, detailed designs, design verifications and calculations. This would also include applicable norms and standards deemed relevant by the geotechnical professional.

Map 17-2 presents relevant boundaries of the study area with solar facility boundaries superimposed on the aerial imagery, and Map 17-3 presents the solar facility and land portion boundaries overlain on the geological map.



Map 17-2: Aerial view delineating the study area of the 12 Kudu Solar Facilities (Google, 2022). Note that this report is focused on Kudu Solar Facility 4.

17.4.3 Project Specific Description

17.4.3.1 Climate

The study area experiences a semi-arid climate, with most of the rainfall occurring during February to March. Figure 17-1 shows the monthly average minimum and maximum air temperature distribution and Figure 17-2 shows the monthly average rainfall and evaporation distribution for the study area (Schulze, 2009). The long-term (1950 – 2000) average annual precipitation for the study area is 281 mm/a. The rainfall does not exceed evaporation during the course of the year.

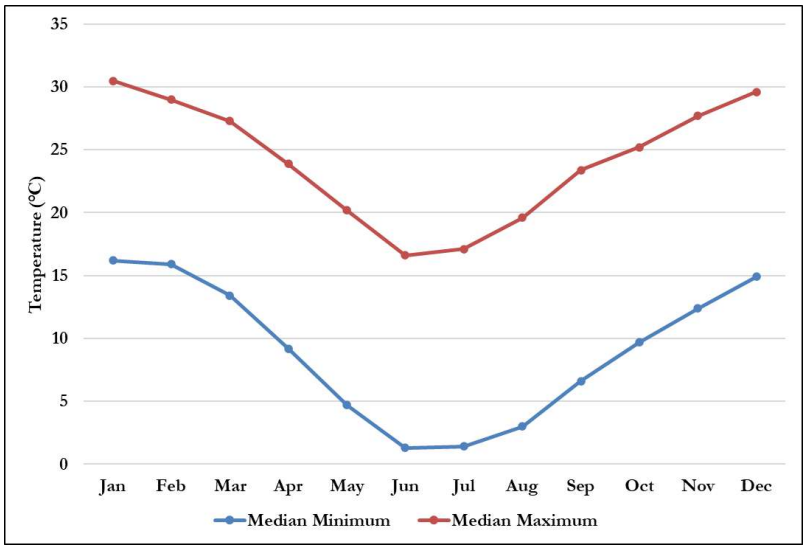


Figure 17-1: Monthly average air temperature distribution for the Kudu Solar Facility study area (Schulze, 2009)

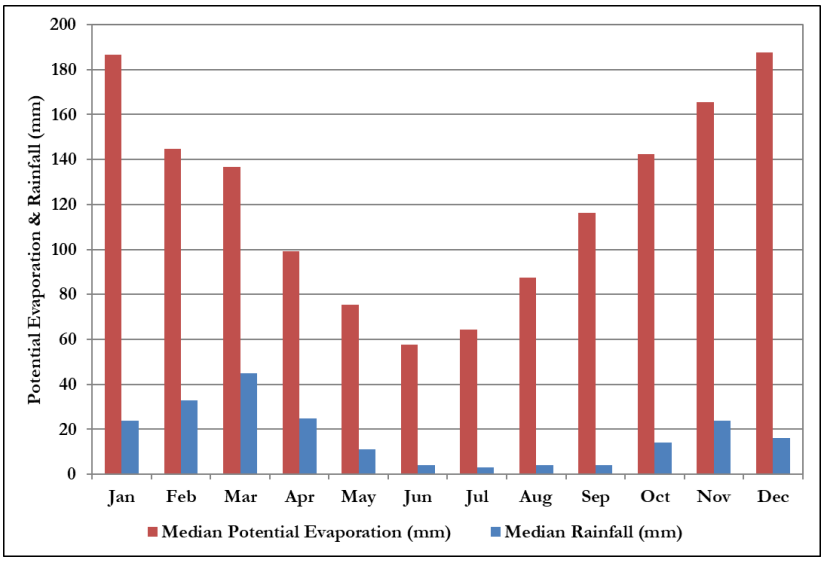


Figure 17-2: Monthly average rainfall and potential evaporation distribution for the Kudu Solar Facility study area (Schulze, 2009).

17.4.3.2 Weinert 'N' Value

The present and past climate is a useful indicator of the typical soil conditions that may be encountered on a particular site (Weinert, 1975). Weinert (1975) developed a general model to categorise the climate of southern Africa based on what he termed the 'N'-value (Figure 17-3). The Weinert 'N'-value for the project area is greater than 5 (Brink, 1983). For areas where Weinert 'N'-values exceed five (5), transported soils vary in thickness, and residual soils are anticipated to be shallow, and where pedocretes are developed they are expected to be calcrete and less commonly silcrete.

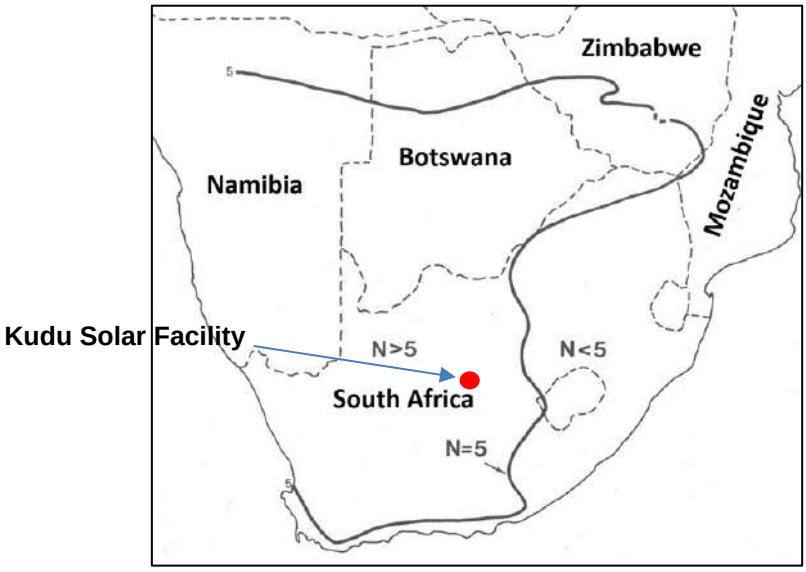


Figure 17-3: Climatic 'N' value = 5 plotted for southern Africa (after Weinert, 1967).

17.4.3.3 Regional Geology

The Geological Survey of South Africa (now the Council for Geoscience) has mapped the area at 1:250 000 scale (3024, Colesberg). The geological setting is shown in Map 17-3. The main geology of the area is listed in Table 17-2.

Table 17-2: Geological formation within the study area.

Symbol	Formation	Group	Lithology
~	Quaternary Deposit		Alluvium / Terrace Gravel
Qc			Calcrete
Jd	Jurassic Intrusion		Dolerite
Pa	Adelaide Subgroup	Beaufort Group	Blue-grey silty mudstone, subordinate brownish-red mudstone; sandstone
Pt	Tierberg Formation	Ecca Group	Blue-grey to black shale with carbonate-rich concretions; subordinate siltstone and sandstone in upper part

The Kudu Solar Facility 4 is mainly underlain by well-developed calcretes, with a small portion to the west underlain by Quaternary alluvium deposits. These quaternary deposits, in turn, overly either dolerite sills and dykes, (Jd) or undifferentiated sediments of the Adelaide Subgroup (Pa) and/or Tierberg Formation (Pt). The Adelaide Subgroup (Pa) comprises interbedded mudstones, siltstones and sandstone, whilst the Tierberg Formation (Pt) consists primarily of shale and sandstone. Both of these units were deposited within a braided river to deltaic setting within the Karoo basin during the Permian Period some 268 to 247 Million years ago (Johnson et al., 2006). These sediments were subsequently intruded during the Jurassic Period by dolerite sills and dykes of the Karoo Dolerite Suite. There are no known large structural geological features in the surrounding area of the proposed project; however, the dolerite sills in the area commonly show extensive jointing as a result of cooling and exhumation (Senger et al., 2015).

The site has been broadly classified into three zones of similar anticipated geological and geotechnical characteristics (Zones A, B and C). The zones are presented in Map 17-4, and are expanded upon in subsequent sections. Supporting information and literature on the anticipated engineering characteristics for materials anticipated for soils and rocks in geotechnical zones are presented in **Appendix G of this chapter**.

17.4.3.4 Geotechnical Properties and Engineering Geology

Sandstones and mudstones (Zone A)

Problems with slope stability may be experienced where sandstones and shales/mud rocks of the Karoo Supergroup are closely intercalated, as weathering of the fine-grained rocks may result in undercutting (Brink, 1983). Porewater pressure may develop at the interface between sand- and mud-/siltstones (Brink, 1983). Where sandstones are thickly bedded and highly jointed, joint-controlled block and wedge failures can potentially occur (Brink, 1983).

Dolerite (Zone B)

The end of the Karoo age was terminated by the intrusion of dolerite dykes and sills into the Karoo sedimentary rocks. The intrusive dolerites only had a limited thermal metamorphism effect on the surrounding Karoo sediments, as a rule of thumb, causing changes to the host lithology of equivalent thickness to the dyke itself (Brink, 1983).

During the late 1960s and early 1970s, several tests were undertaken to determine the strength properties of dolerite rock. The general description of dolerite was as follows, bluish-grey, very hard to extremely hard rock, variably fine- and medium-grained, variably jointed and fractured, with calcite, chlorite and zeolite minerals present on the joint and fracture surfaces in varying amounts (Brink, 1983). Of relevance to this assessment, dolerite rocks are considered erosion resistant.

Quaternary sediments (Zone C)

Quaternary sediments in the region include alluvium and terrace gravels (CGS, 1991). The geotechnical characteristics of such materials are variable in nature. Typical construction constraints with such materials include a potentially collapsible grain structure associated with sandy sediments, and challenging excavation conditions associated with terrace gravels, particularly where boulders are encountered. Often, transported soils of mixed origin may be potentially collapsible (Brink, 1983). Moreover, alluvium, depending on several factors, can be potentially expansive. The potential geotechnical problems would have to be investigated during the field investigations. Calcrete has been

mapped in the area. Calcrete could be investigated as a construction material for incorporation in the construction of the proposed development. The reserves of calcrete would have to be proven on-site.

Expected soil profile

In the region between Orange River and Beaufort West, the sandstones and mudrocks of the Karoo supergroup often dip gently. The topography is generally undulating, and areas of strong relief are usually present where intrusive dolerite sills create a capping characterised by a landscape of mesas and buttes. According to Brink (1983), the hillslopes of such topography, here and in most arid areas of the world, usually display up to four soil profiles (Figure 17-4).

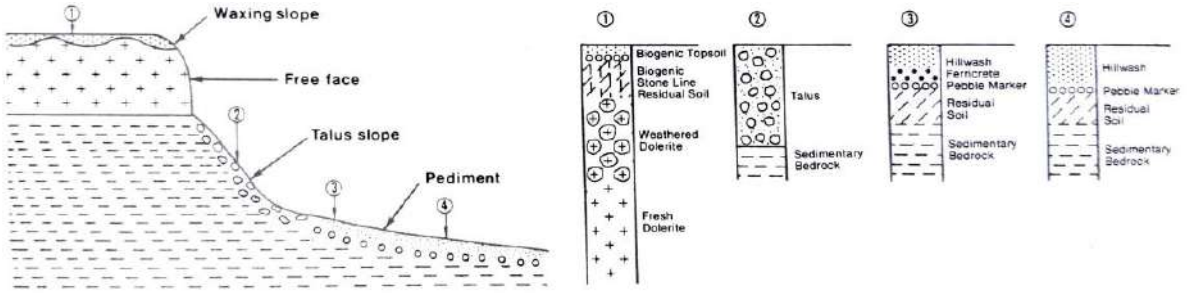


Figure 17-4: Elements of typical Karoo hillslopes and anticipated soil profiles (Brink, 1982)

Slope Classification

The topography is the region that has been classified in terms of development based on classes suggested by Stiff et al. (1996), see Map 17-5. A digital elevation model (DEM, 2018) has been used to determine slope gradients, which have been classified in terms of development potential in the region where development is to take place. The majority of the region is classified as “most favourable” and “intermediate” due to the generally flat nature of the site. A northeast trending linear feature of “least favourable” development potential (red) has been determined to be an overhead transmission line, i.e., a powerline (Map 17-5).

Seismicity

It is common practice to design structures for seismic loads when the nominal peak acceleration exceeds a 0.1 g once every 475 years (Retief and Dunaiski, 2009). Retief and Dunaisk (2009) delineated such regions in southern Africa, the approximate position of the proposed Kudu Solar Facility is shown in red on Figure 17-5 relative to these regions. The region surrounding Kudu Solar Facility, although generally low, is shown to have a nominal peak ground of more than 0.1 g; therefore, seismic loads should be considered when designing structures in this area.

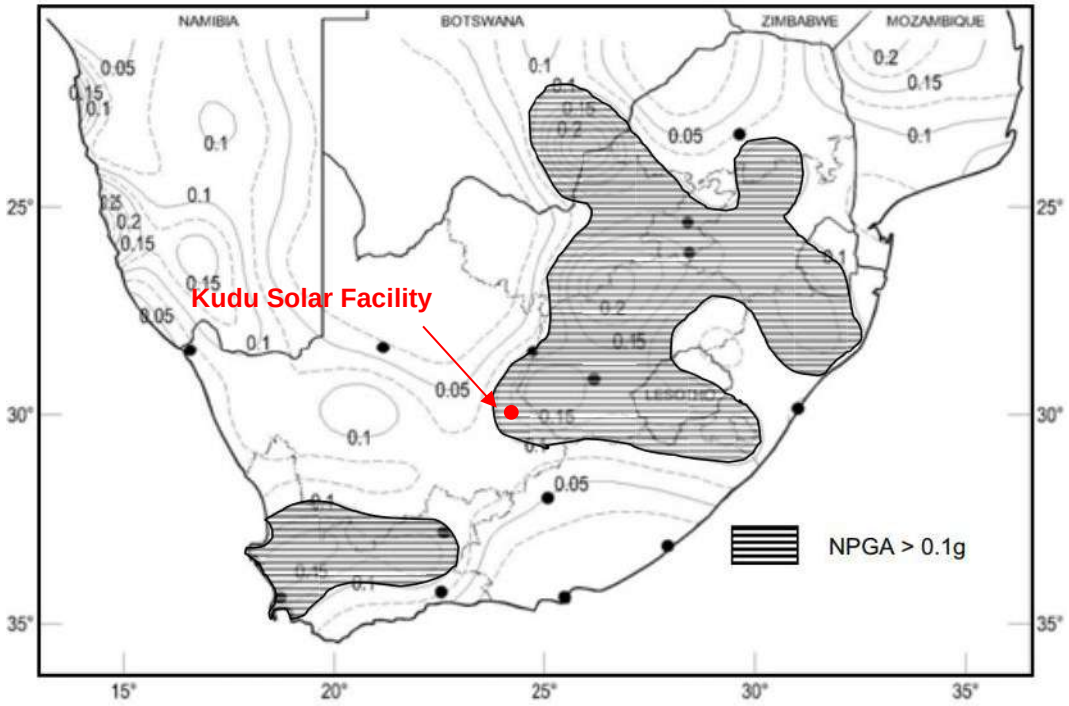
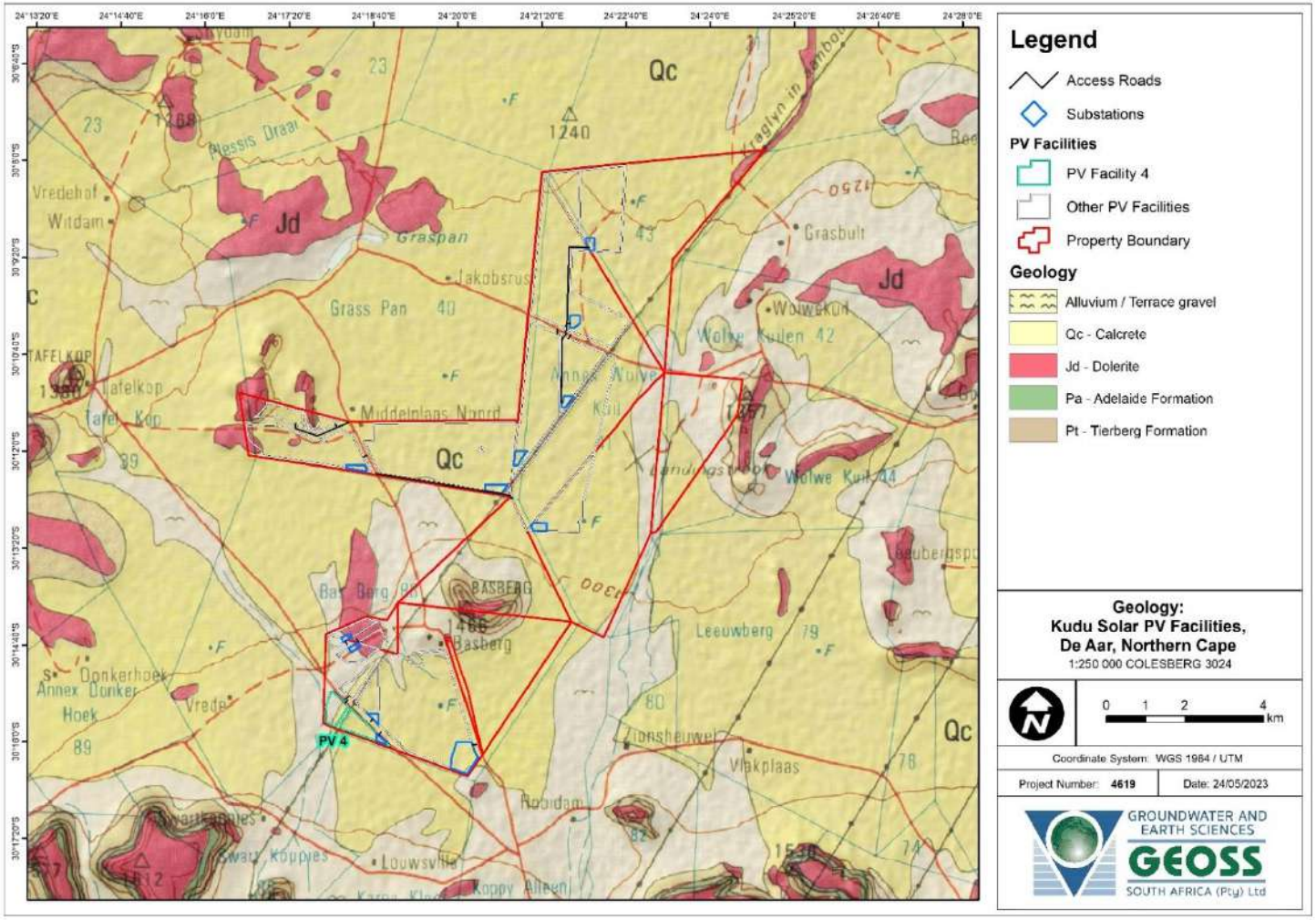


Figure 17-5: Zones in South Africa with nominal peak ground acceleration (NPGA) of more than 0.1 g for 10% in 50 years probability showing approximate position of the Kudu Solar Facility (after Retief and Dunaiski, 2009).

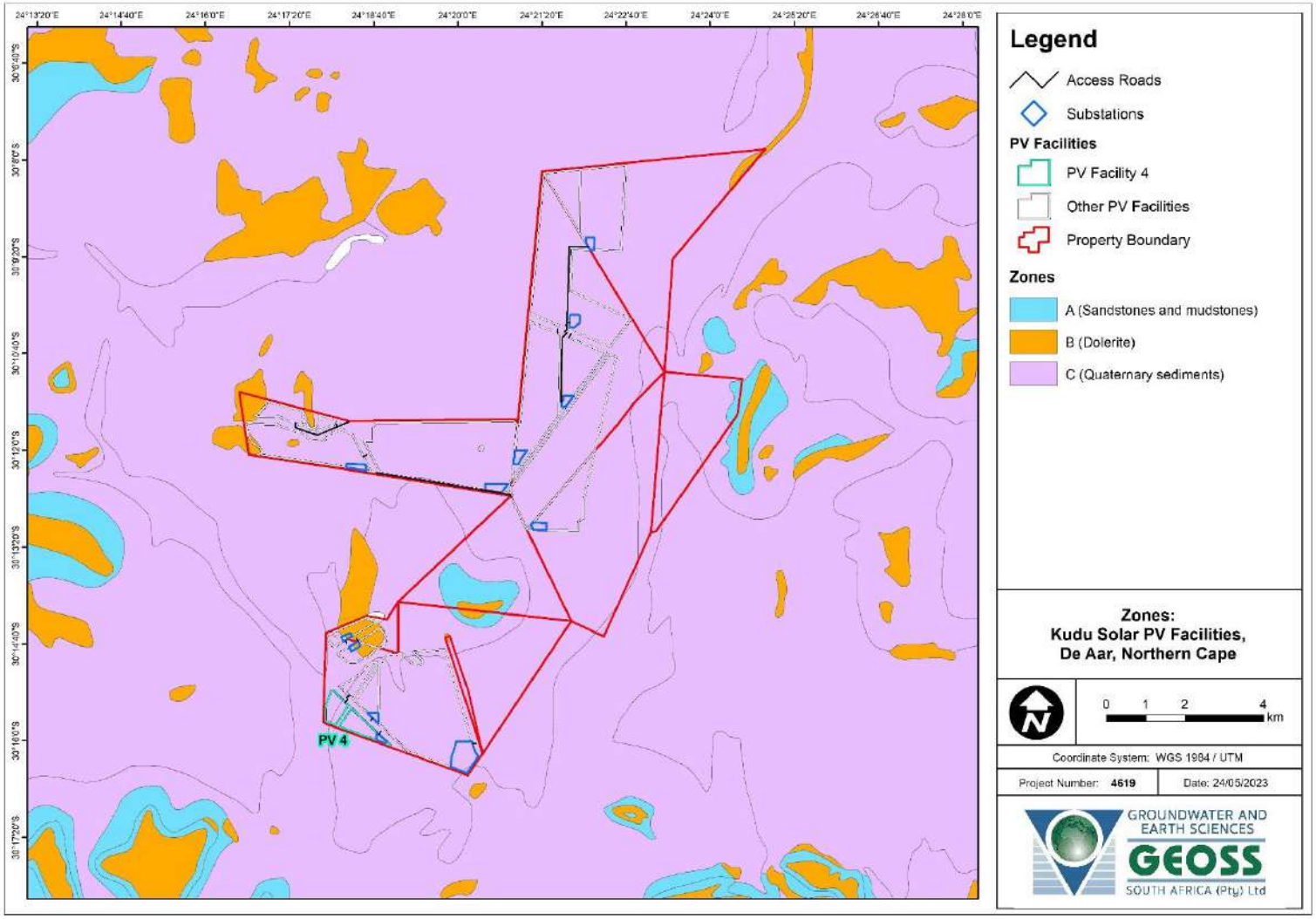
Regional Hydrogeology

The regional aquifer directly underlying the proposed project is classified by the Department of Water Affairs and Forestry (DWAF) (DWAF, 2005) as a fractured aquifer with an average yield potential of 0.5 – 2.0 L/s. However, based on the geological map and the site-specific information, it is known that the Quaternary Deposits of alluvium and calcrete form an intergranular aquifer on top of the fractured bedrock. There is no known published information about this aquifer.

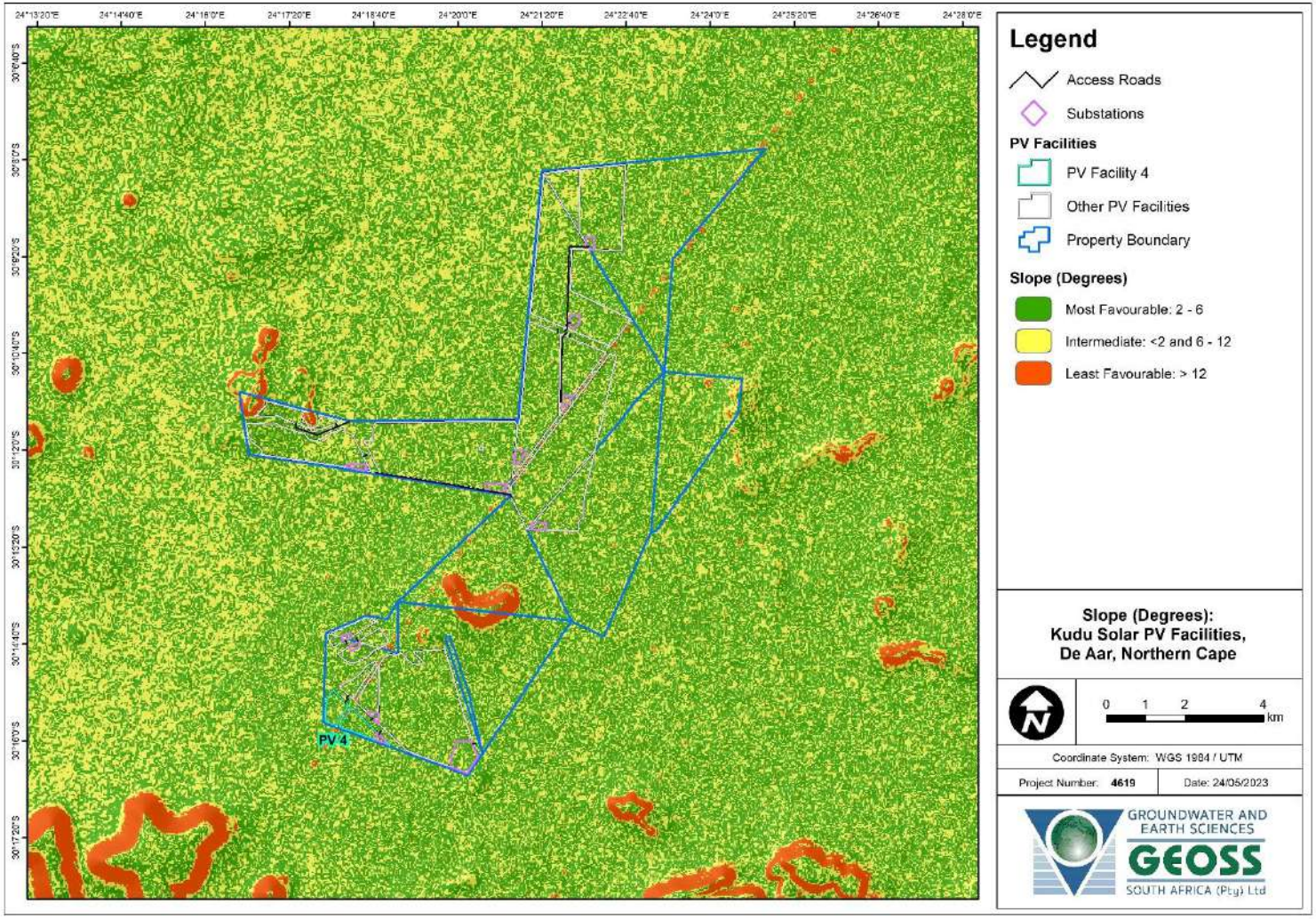
Based on the DWAF (2005) mapping of the regional groundwater quality, as indicated by electrical conductivity (EC), the groundwater underlying the Kudu Solar Facility and the surrounding area is in the range of 70 – 300 mS/m. This is considered to be “good to marginal” quality for water with respect to drinking water standards. Both these classifications are based on regional datasets and therefore only indicate conditions to be expected.



Map 17-3: Geological setting of the study area for the 12 Kudu Solar Facilities. Note that this report is focused on Kudu Solar Facility 4.



Map 17-4: Broad geotechnical zones across the study area. Note that this report is focused on Kudu Solar Facility 4.



Map 17-5: Regional slope classification based on Stiff et al. (1996). Note that this report is focused on Kudu Solar Facility 4.

17.4.4 Identification of Environmental Sensitivities

17.4.4.1 Sensitivities identified by the National Web-Based Environmental Screening Tool

Part of the terms of reference for the Kudu Solar Facility was to identify sensitivities by the National Web-Based Environmental Screening Tool. However, it is important to note that there are no dedicated Geotechnical themes on the National Web-based Environmental Screening Tool (Screening Tool) (as of May 2023); therefore, the environmental sensitivity of the proposed project area as identified by the Screening Tool is not applicable. For this reason, no site sensitivity verification report is required, and no map can be made available. Furthermore, no dedicated assessment protocol is prescribed for conducting a Desktop Geotechnical Assessment. Therefore, this specialist assessment has been undertaken in compliance with Appendix 6 of the NEMA EIA Regulations of 2014.

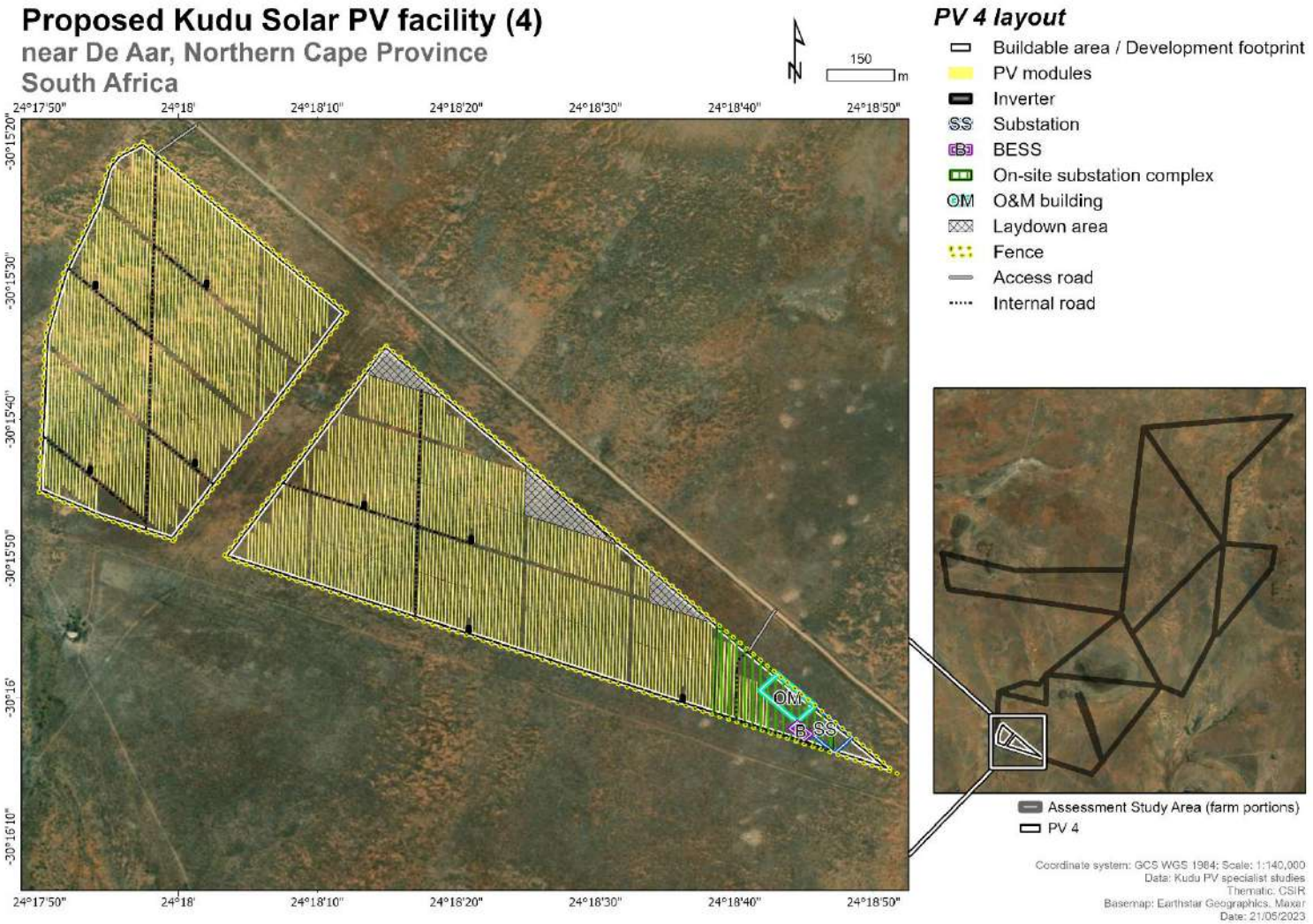
17.4.4.2 Specialist Sensitivity Analysis and Verification

The construction of infrastructure for the proposed solar facility will require several activities, e.g., stripping of vegetation (where required), excavation of foundation trenches etc., to take place (as described in Section 17.1.4 and Section 17.3) which will disturb the soils and rocks underlying the site. In areas of the study area where steeper topography is present, deeper excavations or more extensive site levelling may be required for construction to take place. The boundary of Kudu Solar Facility has been superimposed on the slope classifications and is indicated on (Map 17-5). In areas classed as “least favourable”, steep slopes are expected; these will likely need to be dealt with by excavation where necessary. Here relevant mitigation measures will need to be adopted; these are expanded on in the section “Impact Assessment”.

17.4.4.3 Sensitivity Analysis Summary Statement

No site sensitivity information is available for the study area and there are no areas on site that should be avoided from a geotechnical sensitivity perspective. However, areas of moderate to steep topography would likely render development financially unfeasible. GEOSS had previously undertaken a site sensitivity verification during the groundwater specialist assessment, the details of which are indicated in **Appendix C of this chapter (Site Sensitivity Verification)**. The information collected during the groundwater specialist assessment generally confirms the geotechnical information available for the lithologies in the area.

As indicated above, following the identification of sensitivities during the Scoping Phase, the Project Developer considered such sensitivities and formulated the Revised Scoping Buildable Areas. The Revised Scoping Buildable Areas led to the identification of the development footprints and detailed layouts in the EIA Phase. The development footprint and detailed layout are considered suitable from a geotechnical perspective. The development footprint and detailed layout are shown in Map 17-6. Changes to the detailed layouts are deemed acceptable if the changes remain within the approved buildable areas / development footprints and area assessed during the Scoping and EIA Process with no-go sensitive areas avoided.



Map 17-6: Detailed layout of Kudu Solar Facility 4.

17.5 Issues, Risks and Impacts

17.5.1 Identification of Potential Impacts/Risks

Potential impacts during construction, operational, and decommissioning phases are listed in this section.

Potential impacts on the geotechnical conditions as a consequence of the proposed development are as follows for the construction phase:

- Impact 1: Displacement of geologic materials.
- Impact 2: Contamination of subsoils and loss of topsoil.

Potential impacts on the geotechnical conditions as a consequence of the proposed development are as follows for the operational phase:

- Impact 1: Increased unnatural hard surfaces yielding increased runoff, potentially increasing erosion.
- Impact 2: Contamination of subsoils and loss of topsoil.

Potential impacts on the geotechnical conditions as a consequence of the proposed development are as follows for the decommissioning phase:

- Impact 1: Increased unnatural hard surfaces yielding increased runoff, potentially increasing erosion.
- Impact 2: Contamination of subsoils and loss of topsoil.

It is important to mention that the phases, construction, operation and decommissioning include all infrastructure-related components of the proposed development. The components of the proposed development are elaborated on in the Section 17.1.4 and Section 17.3.

Cumulative Impacts

- Impact 1 - Displacement of geologic materials.
- Impact 2 – Contamination of geologic materials.
- Impact 3 – Increased unnatural hard surfaces yielding increased runoff, potentially increasing erosion.

A possible positive indirect impact could be the accumulation of topsoil in low-lying areas surrounding the site.

17.5.2 Summary of Issues identified during the Public Consultation Phase

No issues were raised during the Scoping Phase regarding geotechnical impacts.

17.6 Impact Assessment

The impact of the proposed project on the geological and/or geotechnical environment will predominantly relate to the impact/effect that the development will have on the soils / rock units beneath the site through topsoil stripping, excavations for foundations (where required), trenching, the construction of access tracks and associated light infrastructure. Bulk earthworks, where required, particularly in areas of steeper topography, for the construction of platforms and access tracks, and may generate a significant impact on the soils and rocks where such construction activities take place. For example, in such areas, removal of large quantities of rock may be required.

A primary concern in terms of potential environmental impacts associated with geotechnical works is displacement of geologic materials, e.g., increased soil erosion on site due to stripping of vegetation during the construction phase of the project. Removal of vegetation reduces infiltration, thereby increasing runoff yielding increased erosion. Further, compaction during earthworks reduces rainwater infiltration and increase surface runoff and increase erosion. The construction of paved and/or hard-surfaced areas increases runoff and often localises discharge of stormwater, which may lead to increased erosion and consequently loss of topsoil. Disturbance of the soil may extend beyond the footprint of the structures should such conditions persist for long periods of time, e.g., more than ten years.

Coupled with the potential for the displacement of geologic materials is the risk of soil contamination from on-site activities. Conventional construction and earthworks make use of construction equipment, which with poor maintenance, cause leakages and result in refuelling spillages during construction and/or decommissioning.

Potential risks associated with the operational phase mainly include erosion and contamination of geologic materials. This could be mitigated and managed by adopting appropriate drainage designs.

The above is discussed in subsequent sections with particular reference to possible activities and phases of development.

17.6.1 Potential Impacts during the Construction Phase

The impact table for the Construction Phase is presented in Table 17-3.

17.6.1.1 Impact 1: Displacement of Geologic Material: Removal of rocks and other geologic materials for site levelling and grading, resulting in loss of geologic materials, e.g., topsoil removal/loss, and potentially the destruction of habitats of endemic species.

Stripping of topsoil, general site levelling, and the removal of rocks is common during the initial stages of the construction phase. The loss of geologic material, the disturbance of naturally intact soil, and the removal of vegetation might all result in soil erosion. The status of this impact is rated as negative with a local spatial extent and a short-term duration (i.e., for the construction phase). The consequence and probability of the impact are respectively rated as moderate and very likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as low. With effective implementation of mitigation actions, the impact is predicted to be of very low significance. The mitigation measures are listed in the table below.

17.6.1.2 Impact 2: Contamination of geologic materials as a consequence of the construction activities by earthworks machinery and other apparatus.

Construction involves heavy machinery and apparatus especially during earth work activities. This might include graders, bulldozers, rollers, excavators, water trucks and, concrete mixers. This type of equipment requires regular greasing and operates with hydraulic fluid and diesel which might potentially cause contamination of geological materials. The status of this impact is rated as negative with a local spatial extent and a short-term duration (i.e. for the construction phase). The consequence and probability of the impact are respectively rated as moderate and very likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as low. With effective implementation of mitigation actions, the impact is predicted to be of very low significance. The mitigation measures are listed in the table below.

17.6.1.3 Impact Summary Tables: Construction Phase

Table 17-3: Impact Summary Tables: Construction Phase

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Impact 1 *Displacement of geologic materials*	*Status* *Spatial Extent* *Duration* *Consequence* *Probability* *Reversibility* *Irreplaceability*	*Negative* *Local* *Short term* *Moderate* *Very likely* *Moderate* *Moderate*	*Low*	▪ *Favour dolerite as an aggregate (as opposed to Karoo sandstones and mudstones). Subject to investigation.* ▪ *Any road cuttings should be designed by an appropriately qualified professional.* ▪ *Drainage in the region should be designed and managed appropriately.* ▪ *Investigate and confirm the geotechnical suitability of each structure (or other appropriate level of investigation) prior to construction (i.e., determine that soil with an adequate bearing capacity is obtained beneath each footing). Such investigations would not be required to fulfil the requirements of this Environmental Impact Assessment (EIA) process. However, it would be necessary prior to construction.* ▪ *Only strip vegetation necessary for the next phase of construction.* ▪ *Install temporary drainage to divert stormwater away from active construction activities, where required.* ▪ *Stormwater Management Plan must be developed in the preconstruction phase. It should detail the stormwater structures and management interventions that must be installed to manage the increase of surface water flow directly into any natural systems (in consultation with suitably qualified professionals). Effective stormwater management must include effective*	*Very Low*	*Medium*

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
				stabilisation (e.g., gabions and Reno mattresses) of exposed soil. ▪ *Suitable stormwater management systems must be installed along roads and other areas and be monitored during the first few months of use. Any erosion/sedimentation must be resolved through any additional interventions that may be necessary (e.g., extension, energy dissipaters, spreaders, etc.).* ▪ *Where impacted through construction-related activities, all sloped areas must be stabilised to ensure proper rehabilitation is affected and erosion is controlled.* ▪ *Sloped areas stabilised using designed structures or vegetation as specified in the design to prevent erosion of embankments. The contract design specifications must be adhered to and implemented strictly.* ▪ *Any rehabilitation should be scheduled to ensure rehabilitation can take place at the optimal time for vegetation establishment.* ▪ *Where earthwork is being undertaken near any watercourses, slopes must be stabilised using suitable materials, e.g., sandbags or geotextile fabric, to prevent sand and rock from entering the channel.* ▪ *Appropriate rehabilitation and re-vegetation measures for any disturbed watercourse banks must be implemented timeously. In this regard, the banks should be appropriately and incrementally stabilised as soon as development allows.*		

Table 17-3: Impact Summary Tables: Construction Phase (cont.)

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Impact 2 *Contamination of geologic materials*	*Status*	*Negative*	*Low*	▪ *During the execution of the works, appropriate measures to prevent pollution and contamination of the riparian environment must be implemented, e.g. including ensuring that construction equipment is well maintained.* ▪ *Provision must be made for refuelling at the storage area by protecting the soil with an impermeable groundcover. Where dispensing equipment is used, a drip tray must be used to ensure small spills are contained.* ▪ *Where refuelling away from the dedicated refuelling station is required, a mobile refuelling unit must be used. Appropriate ground protection such as drip trays must be used.* ▪ *If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilt material, as reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.*	*Very Low*	*Medium*
	Spatial Extent	*Local*				
	Duration	*Short term*				
	Consequence	*Moderate*				
	Probability	*Very likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Moderate*				

17.6.2 Potential Impacts during the Operational Phase

The impact table for the Operational Phase is presented in Table 17-4.

17.6.2.1 Impact 1: Increased unnatural hard surfaces yielding increased runoff, potentially increasing erosion.

The operational phase will partially consist of access point/s and internal roads. This involves newly constructed road layers effectively creating unnatural hard surfaces. This might also include earth/concrete drains to divert water away from access points/roads. In return this might yield increased runoff effectively increasing erosion. The status of this impact is rated as negative with a local spatial extent and a long-term duration. The consequence and probability of the impact are respectively rated as moderate and likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as low. With effective implementation of mitigation actions, the impact is predicted to be of very low significance. The mitigation measures are listed in the table below.

17.6.2.2 Impact 2: Contamination of geologic materials as a consequence of typical maintenance activities, as example, washing of solar panels, or spillages associated with battery energy storage facilities.

During the operational phase, geologic material might potentially be contaminated as a consequence of maintenance activities and/or spillages. For optimal functionality of the solar facility, solar panels must be free from dust deposits and any obstruction from the solar panel face. Washing and maintaining of solar panels might result in chemical contamination of geologic materials. Further chemical contamination may transpire from spillages by the BESS as these facilities potentially contain either flow based batteries or solid state batteries. The status of this impact is rated as negative with a local spatial extent and a short-term duration. The consequence and probability of the impact are respectively rated as moderate and very likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as low. With effective implementation of mitigation actions, the impact is predicted to be of very low significance. The mitigation measures are listed in the table below.

17.6.2.3 Impact Summary Tables: Operational Phase

Table 17-4: Impact Summary Tables: Operational Phase

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
OPERATIONAL PHASE						
Impact 1 *Increased unnatural hard surfaces*	*Status*	*Negative*	*Low*	▪ *Install drainage to divert stormwater away from activities, roads/tracks, structures, where required.* ▪ *Generic management for typical infrastructure of the proposed development, including:* 1. *Stormwater Management Plan must be developed in the preconstruction phase and should detail the stormwater structures and management interventions that must be installed to manage the increase of surface water flows directly into any natural systems, where possible and lawful. Effective stormwater management must include effective stabilisation (e.g., gabions and Reno mattresses) of exposed soil etc.* 2. *Suitable stormwater management systems must be installed along roads and other areas and monitored during the first few months of use. Any erosion / sedimentation must be resolved through any additional interventions that may be necessary (e.g., extension, energy dissipaters, spreaders, etc.).* 3. *Sloped areas stabilised using design structures or vegetation as specified in the design to prevent erosion of embankments.* 4. *No regular maintenance activities to take place outside of the authorised footprint and all vehicles to remain on authorised roads and tracks.*	*Very Low*	*Medium*
	Spatial Extent	*Local*				
	Duration	*Long term*				
	Consequence	*Moderate*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Moderate*				

Table 17-4: Impact Summary Tables: Operational Phase (cont.)

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
OPERATIONAL PHASE						
Impact 2 *Contamination of geologic materials*	*Status*	*Negative*	*Low*	▪ *During the execution of the operations, appropriate measures to prevent pollution and contamination of the riparian environment must be implemented e.g. including ensuring that construction equipment is well maintained;* ▪ *Provision must be made for refuelling at the storage area by protecting the soil with an impermeable groundcover/bunding. Where dispensing equipment is used, a drip tray must be used to ensure small spills are contained.* ▪ *Where refuelling away from the dedicated refuelling station is required, a mobile refuelling unit must be used. Appropriate ground protection such as drip trays must be used.* ▪ *Electrolyte spillage to be mitigated through leak detection, double containment and suitably designed bunding for the structure, approved by a qualified professional.* ▪ *If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, as reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.*	*Very Low*	*Medium*
	Spatial Extent	*Local*				
	Duration	*Short term*				
	Consequence	*Moderate*				
	Probability	*Very likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Moderate*				

17.6.3 Potential Impacts during the Decommissioning Phase

The impact table for the Decommissioning Phase is presented in Table 17-5.

17.6.3.1 Impact 1: Increased unnatural hard surfaces yielding increased runoff, potentially increasing erosion.

Access points, internal road and sufficient drainage will continue to form part of the decommissioning phase. Unnatural hard surfaces will potentially be present continuously yielding runoff causing erosion. The status of this impact is rated as negative with a local spatial extent and a short-term duration. The consequence and probability of the impact are respectively rated as slight and likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as very low. With effective implementation of mitigation actions, the impact is predicted to be of very low significance. The mitigation measures are listed in the table below.

17.6.3.2 Impact 2: Contamination and disturbance of geologic materials as a consequence of typical decommissioning activities.

Similar to the construction phase, dismantling of the facility will potentially involve the use of heavy machinery. On going maintenance of equipment and refuelling activities increase the risk of spillages which might potentially cause contamination of geological material. The status of this impact is rated as negative with a local spatial extent and a short-term duration. The consequence and probability of the impact are respectively rated as slight and likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as very low. With effective implementation of mitigation actions, the impact is predicted to be of very low significance. The mitigation measures are listed in the table below.

17.6.3.3 Impact Summary Tables: Decommissioning Phase

Table 17-5: Impact Summary Tables: Decommissioning Phase

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
DECOMMISSIONING PHASE						
Impact 1 *Increased unnatural hard surfaces*	*Status*	*Negative*	*Very low*	▪ *Only drive and park vehicles where necessary.* ▪ *Land rehabilitation to near natural state, i.e., removal of foundations and backfilling of any resultant voids within the soil, as well as removal of hard surfaced areas. Replacement soil should be sourced locally to ensure homogeneity.* ▪ *Reinstate natural topography where cut-to-fill embankments have been constructed.* ▪ *Implement generic environmental management procedures for infrastructure.*	*Very Low*	*Medium*
	Spatial Extent	*Local*				
	Duration	*Short term*				
	Consequence	*Slight*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Moderate*				
Impact 2 *Contamination of geologic materials*	*Status*	*Negative*	*Very low*	▪ *During the execution of the decommissioning, appropriate measures to prevent pollution and contamination of the riparian environment must be implemented e.g., including ensuring that equipment is well maintained;* ▪ *Provision must be made for refuelling at the storage area by protecting the soil with an impermeable groundcover. Where dispensing equipment is used, a drip tray must be used to ensure small spills are contained.* ▪ *Where refuelling away from the dedicated refuelling station is required, a mobile refuelling unit must be used. Appropriate ground protection such as drip trays must be used.* ▪ *If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, as reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.*	*Very Low*	*Medium*
	Spatial Extent	*Local*				
	Duration	*Short term*				
	Consequence	*Slight*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Moderate*				

17.6.4 Cumulative Impacts

The cumulative impacts of the proposed Kudu Solar Facility and other approved and in process renewable energy facilities and electricity grid infrastructure (EGI) within a 30 km radius from the study area are presented in this section. The cumulative impacts identified include the impacts related to the construction, operational and decommissioning phases across the proposed Kudu Solar Facility. In general, the impacts during the different phases of the project are quite similar therefore, their intensities increase as the project progresses resulting in a higher probability for the impact to occur.

According to information collected by the CSIR from the Renewable Energy EIA Database and the South African Heritage Resources Information System (SAHRIS) (~February 2023), 12 other renewable energy facility clusters and EGI have been approved, or in the process of approval in terms of the NEMA EIA Regulations, that are located within a 30 km radius from the Kudu Solar Facilities Map 17-7. Three of these renewable energy facilities are already existing and operational. In addition, approximately 10 existing Eskom power lines fall within the 30 km radius of the proposed project, with three Eskom planned power line projects, as shown in Map 17-7. Failing to implement effective mitigation measures throughout the lifespan of projects might cause the intensity of different identified impacts to increase. **Appendix F** of this chapter contains APPENDIX F - APPROVED RENEWABLE ENERGY PROJECTS

Table covering the details of approved, existing and in process projects within a 30 km radius of the proposed Kudu Solar Facility as provided by the CSIR.

The types of impacts of these developments are nearly identical to each other, with the main cumulative effect being an increase in impact severity for construction, operational, and decommissioning phase. This increase in cumulative severity will be especially exacerbated for the construction phase, in the case that construction of all the proposed developments within a 30km radius occurs simultaneously. The cumulative impact of all these developments during the operational phase should be quite low as long as the proposed mitigation measures and appropriate erosion monitoring is implemented.

Livestock farming is the main activity in the developable area of the proposed project. It is therefore crucial that the footprint of the proposed Kudu Solar Facility does not exceed its borders and negatively impact neighbouring agricultural activities. However, note that an Agricultural Compliance Statement has been undertaken as part of this EIA Process, which adequately addresses agricultural impact. Refer to Chapter 6 of the EIA Report for the Agricultural Compliance Statement. The intensity of the identified cumulative impacts should be suppressed by implementing effective mitigation measures to minimise (1) the contamination of geological materials and (2) the displacement of geological materials.

The cumulative impacts and mitigation measures for the Construction, Operational and Decommissioning Phases are contained in Table 17-6**,** Table 17-7, and Table 17-8, respectively.

Overall, the risk that impacts associated with removal, displacement, and contamination of geological material beyond this project site is very low as long as the appropriate mitigation measures are

implemented. Furthermore, the risk of this project receiving cumulative impacts from the surrounding developments is also quite low, providing appropriate mitigation measures are followed.

17.6.5 Potential Cumulative Impacts during the Construction Phase

17.6.5.1 Impact 1: Displacement of Geologic Material: Removal of rocks and other geologic materials for site levelling and grading, resulting in loss of geologic materials, e.g., topsoil removal/loss, and potentially the destruction of habitats of endemic species.

Refer to the description of the impact above for the construction phase. The status of this impact is rated as negative with a regional spatial extent and a medium-term duration. The consequence and probability of the impact are respectively rated as substantial and very likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as moderate. With effective implementation of mitigation actions, the impact is predicted to be of low significance. The mitigation measures are listed in the table below.

17.6.5.2 Impact 2: Contamination of geologic materials as a consequence of the construction activities by earthworks machinery and other apparatus.

Refer to the description of the impact above for the construction phase. The status of this impact is rated as negative with a regional spatial extent and a medium-term duration. The consequence and probability of the impact are respectively rated as substantial and very likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as moderate. With effective implementation of mitigation actions, the impact is predicted to be of low significance. The mitigation measures are listed in the table below.

17.6.6 Potential Impacts during the Operational Phase

17.6.6.1 Impact 1: Increased unnatural hard surfaces yielding increased runoff, potentially increasing erosion.

Refer to the description of the impact above for the operational phase. The status of this impact is rated as negative with a regional spatial extent and a long-term duration. The consequence and probability of the impact are respectively rated as substantial and very likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as moderate. With effective implementation of mitigation actions, the impact is predicted to be of low significance. The mitigation measures are listed in the table below.

17.6.6.2 Impact 2: Contamination of geologic materials as a consequence of typical maintenance activities, as example, washing of solar panels, or spillages associated with battery energy storage facilities.

Refer to the description of the impact above for the operational phase. The status of this impact is rated as negative with a regional spatial extent and a medium-term duration. The consequence and probability of the impact are respectively rated as substantial and very likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the

implementation of mitigation measures is rated as moderate. With effective implementation of mitigation actions, the impact is predicted to be of low significance. The mitigation measures are listed in the table below.

17.6.7 Potential Impacts during the Decommissioning Phase

17.6.7.1 Impact 1: Increased unnatural hard surfaces yielding increased runoff, potentially increasing erosion.

Refer to the description of the impact above for the decommissioning phase. The status of this impact is rated as negative with a local spatial extent and a short-term duration. The consequence and probability of the impact are respectively rated as substantial and likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as moderate. With effective implementation of mitigation actions, the impact is predicted to be of low significance. The mitigation measures are listed in the table below.

17.6.7.2 Impact 2: Contamination and disturbance of geologic materials as a consequence of typical decommissioning activities.

Refer to the description of the impact above for the decommissioning phase. The status of this impact is rated as negative with a local spatial extent and a short-term duration. The consequence and probability of the impact are respectively rated as substantial and likely. The reversibility and irreplaceability of the impact are rated as moderate. The significance of the impact without the implementation of mitigation measures is rated as moderate. With effective implementation of mitigation actions, the impact is predicted to be of low significance. The mitigation measures are listed in the table below.

17.6.7.3 Impact Summary Tables: Cumulative Impacts

Table 17-6: Cumulative Impact Summary Tables: Construction Phase

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Impact 1 *Displacement of geologic materials*	*Status*	*Negative*	*Moderate*	▪ *Only strip vegetation necessary for the next phase of construction.* ▪ *Install temporary drainage to divert stormwater away from active construction activities, where required.* ▪ *Stormwater Management Plan must be developed in the preconstruction phase. It should detail the stormwater structures and management interventions that must be installed to manage the increase of surface water flows directly into any natural systems (in consultation with suitably qualified professionals). Effective stormwater management must include effective stabilisation (e.g., gabions and Reno mattresses) of exposed soil.* ▪ *Suitable stormwater management systems must be installed along roads and other areas and be monitored during the first few months of use. Any erosion/sedimentation must be resolved through any additional interventions that may be necessary (e.g., extension, energy dissipaters, spreaders, etc).* ▪ *Where impacted through construction-related activities, all sloped areas must be stabilised to ensure proper rehabilitation is affected and erosion is controlled.* ▪ *Sloped areas stabilised using designed structures or vegetation as specified in the*	*Low*	*Medium*
	Spatial Extent	*Regional*				
	Duration	*Medium-term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Moderate*				

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
				design to prevent erosion of embankments. The contract design specifications must be adhered to and implemented strictly. ▪ *Any rehabilitation should be scheduled to ensure rehabilitation can take place at the optimal time for vegetation establishment.* ▪ *Where earthwork is being undertaken in near any watercourses, slopes must be stabilised using suitable materials, e.g. sandbags or geotextile fabric, to prevent sand and rock from entering the channel.* ▪ *Appropriate rehabilitation and re-vegetation measures for any disturbed watercourse banks must be implemented timeously. In this regard, the banks should be appropriately and incrementally stabilised as soon as development allows.*		

Table 17-6: Cumulative Impact Summary Tables: Construction Phase (cont.)

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Impact 2 *Contamination of geologic materials*	*Status*	*Negative*	*Moderate*	▪ *During the execution of the works, appropriate measures to prevent pollution and contamination of the riparian environment must be implemented, e.g., including ensuring that construction equipment is well maintained.* ▪ *Provision must be made for refuelling at the storage area by protecting the soil with an impermeable groundcover. Where dispensing equipment is used, a drip tray must be used to ensure small spills are contained.* ▪ *Where refuelling away from the dedicated refuelling station is required, a mobile refuelling unit must be used. Appropriate ground protection such as drip trays must be used.* ▪ *If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, as reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.*	*Low*	*Medium*
	Spatial Extent	*Regional*				
	Duration	*Medium-term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Moderate*				

Table 17-7: Cumulative Impact Summary Tables: Operational Phase

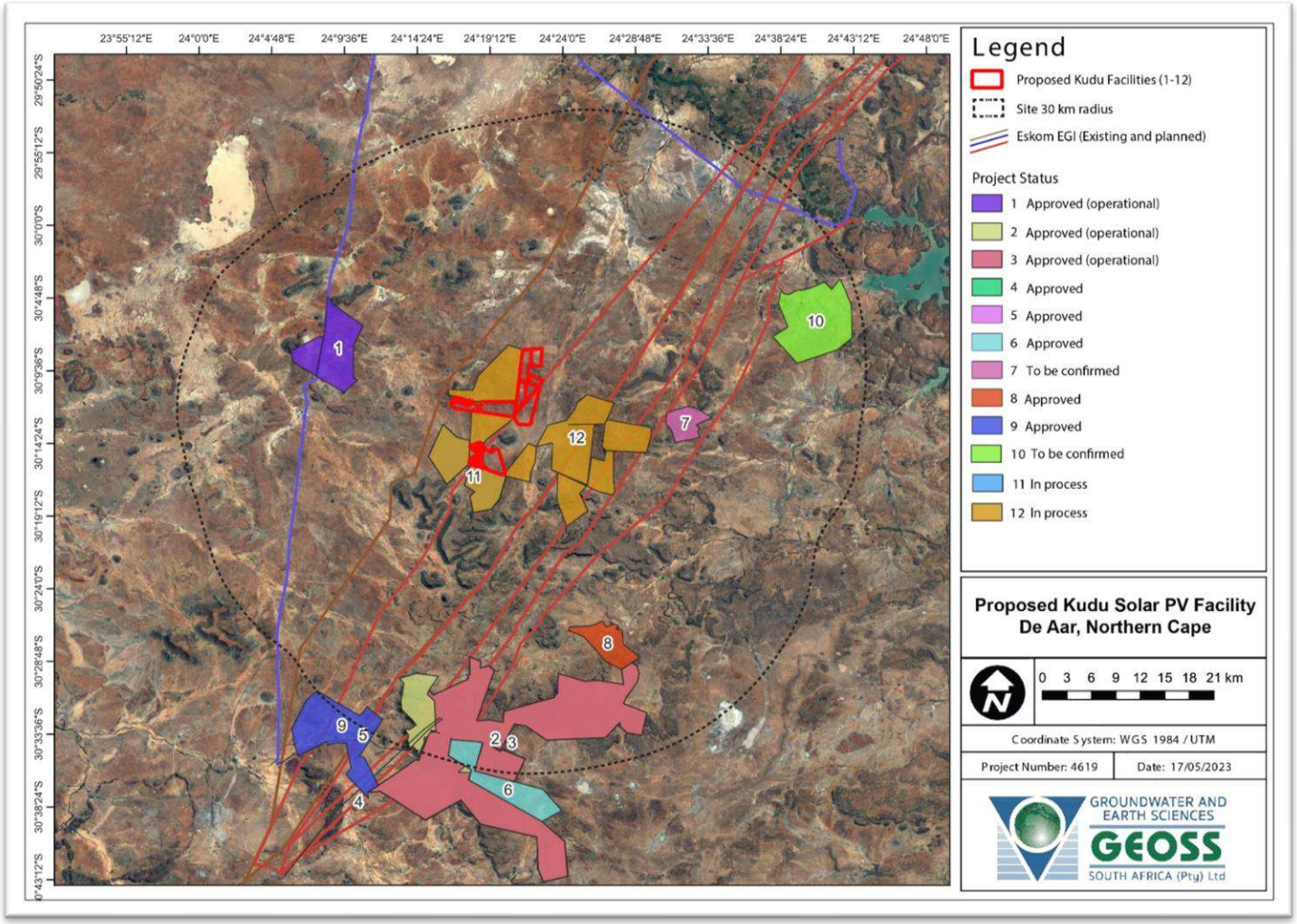
Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
OPERATIONAL PHASE						
Impact 1 *Increased unnatural hard surfaces*	*Status*	*Negative*	*Moderate*	▪ *Install drainage to divert stormwater away from activities, roads/tracks, structures, where required.* ▪ *Generic management for typical infrastructure of the proposed development, including:* *1. Stormwater Management Plan must be developed in the preconstruction phase and should detail the stormwater structures and management interventions that must be installed to manage the increase of surface water flows directly into any natural systems, where possible and lawful. Effective stormwater management must include effective stabilisation (gabions and Reno mattresses) of exposed soil etc.* *2. Suitable stormwater management systems must be installed along roads and other areas and monitored during the first few months of use. Any erosion / sedimentation must be resolved through any additional interventions that may be necessary (e.g., extension, energy dissipaters, spreaders, etc.).* *3. Sloped areas stabilised using design structures or vegetation as specified in the design to prevent erosion of embankments.* *4. No regular maintenance activities to take place outside of the authorised footprint and all vehicles to remain on authorised roads and tracks.*	*Low*	*Medium*
	Spatial Extent	*Regional*				
	Duration	*Long-term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Moderate*				

Table 17-7: Cumulative Impact Summary Tables: Operational Phase (cont.)

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
OPERATIONAL PHASE						
Impact 2 *Contamination of geologic materials*	*Status*	*Negative*	*Moderate*	▪ *During the execution of the operations, appropriate measures to prevent pollution and contamination of the riparian environment must be implemented e.g., including ensuring that construction equipment is well maintained.* ▪ *Provision must be made for refuelling at the storage area by protecting the soil with an impermeable groundcover/bunding. Where dispensing equipment is used, a drip tray must be used to ensure small spills are contained.* ▪ *Where refuelling away from the dedicated refuelling station is required, a mobile refuelling unit must be used. Appropriate ground protection such as drip trays must be used.* ▪ *Electrolyte spillage to be mitigated through double containment and suitably designed bunding for the structure, approved by a qualified professional.* ▪ *If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, as reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.*	*Low*	*Medium*
	Spatial Extent	*Regional*				
	Duration	*Medium-term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Moderate*				

Table 17-8: Cumulative Impact Summary Tables: Decommissioning Phase

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
DECOMMISSIONING PHASE						
Impact 1 *Increase of unnatural hard surfaces*	*Status* *Spatial Extent* *Duration* *Consequence* *Probability* *Reversibility* *Irreplaceability*	*Negative* *Local* *Short term* *Substantial* *Likely* *Moderate* *Moderate*	*Moderate*	▪ *Only drive and park vehicles where necessary.* ▪ *Land rehabilitation to near natural state, i.e., removal of foundations and backfilling of any resultant voids within the soil, as well as removal of hard surfaced areas. Replacement soil should be sourced locally to ensure homogeneity.* ▪ *Reinstate natural topography where cut-to-fill embankments have been constructed.* ▪ *Implement generic environmental management procedures for infrastructure.*	*Low*	*Medium*
Impact 2 *Contamination of geologic materials*	*Status* *Spatial Extent* *Duration* *Consequence* *Probability* *Reversibility* *Irreplaceability*	*Negative* *Local* *Short term* *Substantial* *Likely* *Moderate* *Moderate*	*Moderate*	▪ *During the execution of the decommissioning, appropriate measures to prevent pollution and contamination of the riparian environment must be implemented e.g., including ensuring that equipment is well maintained;* ▪ *Provision must be made for refuelling at the storage area by protecting the soil with an impermeable ground cover. Where dispensing equipment is used, a drip tray must be used to ensure small spills are contained.* ▪ *Where refuelling away from the dedicated refuelling station is required, a mobile refuelling unit must be used. Appropriate ground protection such as drip trays must be used.* ▪ *If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, as reported. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.*	*Low*	*Medium*



Map 17-7: Approved renewable energy projects within a 30 km radius from the proposed Kudu Solar Facility.

17.6.8 No-go Alternatives

In terms of the no-go alternative, if the proposed development does not go ahead, there will be no need for displacement and/or loss of topsoil in the area. However, to date, apart from the construction of farmhouses and the erection of boundary and subcamp fences for farming purposes; little disturbance of the subsoils and rocks in the area proposed for development has taken place. For this reason, the no-go alternative is considered of low significance. However, as noted above, the potential impacts of the proposed project from a geotechnical perspective are not considered to be very significant, especially if the recommended mitigation measures are adopted.

17.6.9 Battery Energy Storage System

Lithium-Ion BESS and Redox Flow BESS were both considered for the proposed project. For Redox Flow BESS, various chemical compositions are likely, such as Vanadium. Refer to Chapter 15 of this EIA Report for a High-Level Safety, Health and Environment Risk Assessment, which provides high level information on the safety, health and environmental risks of the BESS technologies.

Both Lithium Ion and Redox Flow BESS technologies have been assessed. It is important to note that the choice of technology will not be influenced by geotechnical factors, thus both options are considered suitable from a geotechnical standpoint.

17.7 Impact Assessment Summary

The overall impact significance findings, following the implementation of the proposed mitigation measures are shown in the Table 17-9.

Table 17-9: Overall Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	Very Low
Operational	Very Low
Decommissioning	Very Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Low
Cumulative - Operational	Low
Cumulative - Decommissioning	Low

The overall impact significance for all three phases of the Kudu Solar PV 4 Facility is considered very low, with the cumulative impacts for all of the Kudu Facilities and other relevant projects within a 30 km radius rated considered as Low, provided that responsible construction practises are adopted, and the proposed mitigation measures are utilized; for example, correct culvert design.

17.8 Legislative and Permit Requirements

This section has been divided as follows, based on the impacts that may transpire during the construction, operation and decommissioning phases of the proposed development:

- Loss of geological materials.
- Removal of geologic materials.
- Contamination of geologic materials as a consequence of typical maintenance activities.

From a permitting perspective, mining and quarrying on the proposed site is likely seen as a listed activity in terms of the NEMA, as amended. However, existing and permitted borrow pits will be used for the proposed projects, where necessary. Furthermore, where there may be existing services on the proposed development site and an excavation/wayleave permit may be required.

The norms and references given below are not exhaustive.

17.8.1 Loss of geologic materials (soil erosion)

Relevant legislation and guidelines pertaining to soil conservation, particularly soil erosion includes:

- Conservation of Agricultural Resources Act, 1983 (Act No 43 of 1983).
- Environmental Conservation Act, 1998 (Act No 73 of 1989).
- National Forestry Act, 1998 (Act No 84 of 1998, as amended).
- National Environmental Management Act, 1998 (Act No 107 of 1998), as amended.
- The Department of Water Affairs and Forestry, February 2005. Environmental Best Practice Specifications: Construction Integrated Environmental Management Sub-Series No. IEMS 1.6. Third Edition. Pretoria.

17.8.2 Contamination of geologic materials

Relevant literature pertaining to contamination of soil, includes:

- National Environmental Management: Waste Act, 2008 (Act No 59 of 2008).
- National Water Act, 1998 Act No 36 of 1998) Section 19.

17.9 Environmental Management Programme Inputs

From a Geotechnical point of view there are three main impacts caused by the different stages of the proposed development:

1. Displacement of geologic materials
2. The creation of unnatural hard surfaces
3. Contamination of geologic materials

From the impact assessment it can be anticipated that by displacing geological materials the existing soil conditions are disturbed and natural vegetation removed potentially causing soil erosion. Another impact that might further escalate erosion is the creation of unnatural hard surfaces i.e., road surfaces and stormwater drainage. Finally, potential contamination of geological material might be caused by spillages/leakages and maintenance procedures. Mitigating and monitoring of these impacts during the different phases of the project forms a vital part in the success of the development. Failing to implement mitigation and monitoring measures, the intensity of the different impacts may rise. All mitigation measures recommended in this assessment are included in the project EMPr. Listed below are the main EMPr inputs and management actions.

Construction Phase

The development of a stormwater management plan prior to the construction phase by a qualified professional is recommended. Suitable systems must preferably be installed along roads and other areas in order to divert water away from zones where the solar infrastructure is to be constructed. These systems should be monitored throughout the first few months of the construction phase during which any erosion/sedimentation should be resolved. It is recommended that rehabilitation commence soon after construction at the optimal time for vegetation establishment.

Provision should be made during refuelling operations to protect soil by means of impermeable ground cover. If spillages occur, they should be contained and removed as rapidly as possible with the correct disposal procedures. Ideally proof of disposal should be obtained and retained on file for auditing purposes.

Operational Phase

Similarly, to the construction phase it is recommended that a stormwater management plan to be implemented. It should preferably be designed by a qualified professional. This phase will potentially contain unnatural hard surfaces in the form of access roads, road layers, earth/concrete drains and, foundations. Similar to the construction phase, water should preferably be diverted away from road layers and erected structures.

It is recommended that similar mitigations and provisions with regards to spillages/leakages from the construction phase to be implemented during the operational phase. Additionally, proper designed bunding structures and double containment to be implemented at BESS to mitigate potential electrolyte spillage. It is recommended that the design should be approved by a qualified professional. Furthermore, maintenance of solar panels to be closely monitored and the use of hazardous chemical products to be avoided when solar panels are cleaned.

Decommissioning Phase

The main impacts are increased unnatural hard surfaces and the contamination of geological material. It is recommended that the natural topography to be reinstated and that rehabilitation of the land should take place to near natural state which might include but is not limited to the removal of foundations and hard surfaced areas followed by the backfilling of resultant voids. To ensure homogeneity, material utilised for backfilling and reinstating should be locally sourced. Implementation of generic environmental management procedures for infrastructure is highly recommended.

Appropriate measures should be in place to prevent pollution and contamination of the riparian zone e.g., well maintained equipment. Provision should be made during refuelling operations to protect soil by means of impermeable ground cover. If spillages occur, they should be contained and removed as rapidly as possible with the correct disposal procedures. Ideally proof of disposal should be obtained and retained on file for auditing purposes.

17.10 Final Specialist Statement and Authorisation Recommendation

17.10.1 Statement and Reasoned Opinion

Soil and rock conditions vary across the proposed Kudu Solar Facility study area resulting in the likely variation of geotechnical properties that might be encountered. These variations might influence foundation conditions, foundation designs, drainage properties, excavatability of soil and rock mass, and the occurrence of problem soils. It is, therefore, vital that an intrusive geotechnical study be undertaken prior to the development of Kudu Solar Facility to confirm the anticipated geotechnical conditions identified in this report.

The proposed Kudu Solar Facility may impact the environment by means of increased soil erosion and the contamination of geological material. It is understood that the main land use of the proposed development is livestock farming and it is therefore crucial that the potential impacts do not exceed the proposed footprints/buildable areas of Kudu Solar Facility. Although the impacts from neighbouring renewable facilities are notably similar to those of Kudu Solar Facility, cumulatively the intensity of these impacts can potentially increase if proper mitigation measures are not implemented. Proper designed mitigation measures should be implemented at all the Kudu Solar facilities to successfully suppress the intensities of impacts in order to achieve a low post mitigation significance.

Based on the geotechnical analysis conducted, it is recommended that the proposed Kudu Solar Facility be authorized, as no fatal flaws were found during this desktop assessment. However, it is crucial to implement appropriate mitigation measures at every phase of the project to minimize the intensity of the identified impacts.

The following conclusions are made:

1. Based on the findings of this geotechnical desktop study, development should proceed provided the mitigation measures are implemented.
2. Increased soil erosion and contamination may transpire as an impact of the proposed development, and this may persist for the life of the project. However, the impact of this is expected to be very low to low significance.
3. Published data for the area, e.g., geological map, is generally confirmed by fieldwork undertaken by GEOSS in the area. However, variable soil and rock conditions will exist across the site, broadly these have been divided as follows:
   Zone A – Karoo Sandstones and mudstones
   Zone B – Karoo dolerite
   Zone C – Areas of thicker soil cover (generally within drainage channels)
4. It is anticipated that conventional foundations can be employed for all structures. Karoo mudrock and sandstone should be avoided when selecting aggregates for concrete mixes.
5. The footprint of each proposed structure would have to be investigated prior to compilation of final design.
6. Owing to the variable geologic and soil conditions across the proposed development area, the subgrade conditions will vary across the site. Dolerite has been proven to perform well as an aggregate for wearing courses in other areas of the Karoo. Dolerite has also been incorporated as an aggregate in concrete mixes.
7. The excavatability of the stratum on site are anticipated to variable, based on material composition and texture, the degree of weathering, and the nature of discontinuities within the rock and/or soil mass.
8. The seismicity in the region should be considered during design.
9. Road cuttings and drainage systems should be designed by an appropriately qualified professional.
10. Detailed geotechnical investigations will need to be undertaken prior to construction. Such investigations would not be required to fulfil the requirements of the EIA process. However, it would be necessary prior to construction.
11. GEOSS has endeavored to highlight and characterise all potential geotechnical risks that are presented by the site that has been proposed for development. However, due to the anisotropic (variable) nature of earth materials, each point on the site will present results that differ. For this reason, it is considered of the utmost importance that the foundation excavations be inspected prior to casting to ensure that soil with an adequate bearing capacity is obtained beneath each footing, and/or piling conditions be assessed. These works should be carried out by an appropriately qualified individual, during construction of the facility.

17.10.2 EA Condition Recommendations

From the impact assessment it is evident that the development will have a very low to low impact significance on the local soil conditions and geology. As such, the project is authorised to continue from a geotechnical impact perspective with the following recommendations:

- The removal of vegetation should be kept to a minimum and only removed where necessary.
- A stormwater management plan should be developed prior to the construction phase by an accredited professional.
- The management plan should be managed throughout the duration of the project to successfully mitigate potential soil erosion.
- Rehabilitation of soil and geological material to commence during the construction phase, if possible, alternatively following the construction phase to allow successful re-vegetation.
- Authorised vehicles to only use proposed access points and roads and keep within the footprint of the facility.
- The land should be reinstated to natural or near natural conditions following decommissioning.
- Machinery and equipment to be maintained throughout the project.
- Ground protection measures to be implemented during maintenance and refuelling operations.
- Suitably designed bunding structures, double containment and leak detection to be implemented at BESS facilities.
- Spillages to be removed and contained as rapidly as possible.

17.11 References

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APPENDICES

APPENDIX A - SPECIALIST EXPERTISE

CURRICULUM VITAE – HARDY LUTTIG

GENERAL

Nationality:	South African
Profession:	Geotechnical / Engineering Geologist
Specialization:	Soil classification for engineering purposes. Groundwater exploration and sampling.
Date commenced	*09 January 2023*
Year of birth & ID #:	1993 – 930725 514 60 86
Language skills:	Afrikaans (mother tongue, good - speaking, reading and writing), English (good - speaking, reading and writing)

KEY SKILLS

- Geotechnical site investigation and site assessment.
- Field mapping
- Rock & soil profiling
- Material classification and material use determination.
- Hydrocensus studies
- Borehole drilling supervision and analysis
- Groundwater monitoring - development and analysis of groundwater level and quality data.
- ArcGIS, QGIS

EDUCATIONAL AND PROFESSIONAL STATUS

Qualifications

2018	MEng (Geotechnical Engineering)	University of Stellenbosch, South Africa
2015	PDIP (Geotechnical Engineering)	University of Stellenbosch, South Africa
2014	B.Sc Earth Science	University of Stellenbosch, South Africa

EMPLOYMENT RECORD

January 2023 to present	GEOSS South Africa (PTY) Ltd
January 2019 to December 2022	Martin & East (PTY) Ltd
January 2018 to October 2018	Ndodana Consulting Engineers (PTY) Ltd

CURRICULUM VITAE – SHANE TEEK

GENERAL

Nationality:	South African
Profession:	Geotechnical Specialist & Hydrogeologist
Specialization:	Soil classification for engineering purposes. Groundwater exploration and sampling.
Position in firm:	Geotechnical Geologist & Hydrogeologist at GEOSS – South Africa (Pty) Ltd.
Date commenced:	17 July 2021
Year of birth & ID #:	1994 – 9404135162084
Language skills:	English (good – speaking, reading, and writing) Afrikaans (good - speaking, reading, and writing).

KEY SKILLS

- Geotechnical investigations
- Compilation of factual reports.
- Field mapping.
- Soil and rock profiling.
- Material classification and material use determination.
- Supervision of geotechnical contractors.
- Groundwater geophysics and conducting hydrocensus studies.
- Groundwater development - borehole drilling and test pumping supervision and analysis.
- Groundwater monitoring - development and analysis of groundwater level and quality data.
- Groundwater management - sustainable aquifer development and management.
- Groundwater contamination assessments.
- ArcGIS, QGIS, Python, FLAC/SLOPE, Midas GTS NX.

EDUCATIONAL AND PROFESSIONAL STATUS

Qualifications

2021	M.Eng. (Civil Engineering – Cum Laude)	University of the Stellenbosch, South Africa
2016	B.Sc. Hons. (Earth Science)	University of the Stellenbosch, South Africa
2015	B.Sc. (Geology: Earth Science)	University of the Stellenbosch, South Africa

Memberships

- Geological Society of South Africa – Member No. 970413
- South African Council for National Scientific Professions (SACNASP) Mem. No. 126397/20
- Founding member of the UNESCO Groundwater Youth Network (GWYN)

EMPLOYMENT RECORD

July 2021 to present	GEOSS South Africa (Pty) Ltd, South Africa
Jan 2020 to June 2021	Geotechnics Africa Western Cape, South Africa
Feb 2019 to July 2019	Polytechnique Montréal, Canada
Jan 2017 to Dec 2017	Remote Exploration Services, South Africa.

CURRICULUM VITAE – DALE BARROW

GENERAL

Nationality:	South African
Profession:	Hydrogeologist
Firm:	GEOSS South Africa (Pty) Ltd
Position:	Director and Hydrogeologist
Specialization:	Groundwater exploration, development, management and monitoring including numerical modeling. Hydrogeological impact studies and assessment of groundwater – surface water interaction.
Date commenced:	February 2008
Year of birth & ID #:	1985 – 851205 5227 082
Language skills:	English (mother tongue), Afrikaans (average)

KEY SKILLS

- Project Management
- Hydrogeological technical input on projects
- Groundwater surface water interaction assessment
- Groundwater exploration - (aerial photo interpretation, resistivity, magnetic and EM34 geophysical surveys for borehole siting purposes, geological conceptualization)
- Groundwater development - borehole drilling and test pumping supervision and analysis.
- Groundwater monitoring –development and analysis of groundwater level and quality data.
- Groundwater management – sustainable aquifer development and management.
- Numerical modelling of groundwater flow and mass transport.
- Groundwater component of Catchment Management Strategies and other Groundwater Resource Directed Measures.
- Groundwater contamination assessments.
- GIS / WISH and GW Vistas and typical software skills.

EDUCATIONAL AND PROFESSIONAL STATUS

Qualifications

2017	MBA (Cum Laude)	University of Stellenbosch, South Africa
2010	M.Sc. (Geohydrology)	University of the Free State, South Africa
2007	B.Sc (Hons) Structural Geology	University of Stellenbosch, South Africa
2006	B.Sc Geology – Applied Earth Science	University of Stellenbosch, South Africa

Courses

2019 Water Governance in South Africa: IWRM, the NWA, and water use authorizations, focusing on WULAs and IWWMPs. WISA accredited. Carin Bosman (CBSS)
2016 SPRING Software Modelling Course
2015 European Management Residency in Economics and Business (Maastricht University School of Business and Economics)
2013 Aquifer Firm Yield; Wellfield Design; Wellfield costing
2010 Introduction to QGIS (GISSA)
2010 Presentation Skills (Elsabé Daneel productions cc)
2009 Introduction to Isotope Hydrology in Southern Africa (GSSA)
2009 Aquifer Mechanics (IGS-UOFS)
2009 Groundwater Chemistry (IGS-UOFS)

2009 Groundwater Geophysics (IGS-UOFS)
2009 Groundwater Modelling (IGS-UOFS)
2009 Groundwater Management (IGS-UOFS)

Memberships

- Groundwater Division of the Geological Society of South Africa
- South African Council for National Scientific Professions (SACNASP) Mem. No. 400289/13

EMPLOYMENT RECORD

1 February 2008 to present:	GEOSS – Geohydrological and Spatial Solutions International (Pty) Ltd, Stellenbosch
23 July 2018 - November 2019	Design and part time lecturing of the Hydrogeology course for 3rd year students at Stellenbosch University

APPENDIX B - SPECIALIST STATEMENT OF INDEPENDENCE

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 - 12), near De Aar, Northern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

Details of Specialist, Declaration and Undertaking Under Oath

Page 1 of 3

1. SPECIALIST INFORMATION

Specialist Company Name:	GEOSS South Africa (Pty) Ltd.			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	3	Percentage Procurement recognition	110%
Specialist name:	**Hardy Luttig**			
Specialist Qualifications:	B.Sc. Earth Sciences; MEng Civil (Geotechnical Engineering)			
Professional affiliation/registration:	SACNASP (Pending)			
Physical address:	Unit 12, Techno Stell Bldg, 09 Quantum Street, Techno Park, Stellenbosch			
Postal address:	PO Box 12412, Die Boord, Stellenbosch			
Postal code:	7613	Cell:	082 397 7182	
Telephone:	021 880 1079	Fax:	n/a	
E-mail:	hluttig@geoss.co.za			

2. DECLARATION BY THE SPECIALIST

I, **Hardy Luttig**, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

GEOSS SOUTH AFRICA (PTY) LTD

Name of Company:

07 July 2023

Details of Specialist, Declaration and Undertaking Under Oath

Date

3. **UNDERTAKING UNDER OATH/ AFFIRMATION**

I, **Hardy Luttig**, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

GEOSS SOUTH AFRICA (PTY) LTD

Name of Company

07 July 2023

Date

Signature of the Commissioner of Oaths

07 July 2023

Date

7/7/23

Ex officio COMMISSIONER OF OATHS (RSA)
Samantha Schoeman ACMA – 1-7FUWGN
The Boulevard Office Park, Block B
Ground Floor, Searle Street, Woodstock, 7925

Details of Specialist, Declaration and Undertaking Under Oath

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environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

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Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	GEOSS SOUTH AFRICA (PTY) LTD			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	3	Percentage Procurement recognition	110%
Specialist name:	SHANE TEEK			
Specialist Qualifications:	MEng – Civil Engineering			
Professional affiliation/registration:	SACNASP: 126397			
Physical address:	Unit 12, Techno Stell Bldg, 09 Quantum Street, Techno Park, Stellenbosch			
Postal address:	PO Bo12412, Die Boord, Stellenbosch			
Postal code:	7613	Cell:	079 183 7782	
Telephone:	021 880 1079	Fax:	n/a	
E-mail:				

2. DECLARATION BY THE SPECIALIST

I, SHANE TEEK, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

GEOSS SOUTH AFRICA (PTY) LTD

Name of Company:

28 November 2022

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, SHANE TEEK, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

GEOSS SOUTH AFRICA (PTY) LTD

Name of Company

28 November 222

Date

Samantha Schoeman
ACMA 1-7 FUWGN
17 Schoongezicht Ste, Heldervue, 7130

Signature of the Commissioner of Oaths

29/11/2022

Date

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment Processes for the Proposed Development of 12 Solar Photovoltaic (PV) Facilities and associated infrastructure (i.e. Kudu Solar Facility 1 - 12), near De Aar, Northern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
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Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	**GEOSS SOUTH AFRICA (PTY) LTD**			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	**3**	Percentage Procurement recognition	**110%**
Specialist name:	**DALE BARROW**			
Specialist Qualifications:	MSc in Hydrogeology			
Professional affiliation/registration:	SACNASP: 400289/13			
Physical address:	Unit 12, Techno Stell Bldg, 09 Quantum Street, Techno Park, Stellenbosch			
Postal address:	PO Box 12412, Die Boord, Stellenbosch			
Postal code:	7613	Cell:	074 172 2862	
Telephone:	021 880 1079	Fax:	n/a	
E-mail:	dbarrow@geoss.co.za			

2. DECLARATION BY THE SPECIALIST

I, **Dale Barrow,** declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

GEOSS SOUTH AFRICA (PTY) LTD

Name of Company:

07 July 2023

Date

Details of Specialist, Declaration and Undertaking Under Oath

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Dale Barrow, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

GEOSS SOUTH AFRICA (PTY) LTD

Name of Company

07 July 2023

Date

Signature of the Commissioner of Oaths

07 July 2023

Date

Ex officio COMMISSIONER OF OATHS (RSA)
Samantha Schoaman ACMA - 1-7FUWGN
The Boulevard Office Park, Block B
Ground Floor, Searle Street, Woodstock, 7925

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

APPENDIX C - SITE SENSITIVITY VERIFICATION

Geotechnical themes do not exist on the National Web-based Environmental Screening Tool (Screening Tool) (as of May 2023); therefore, the environmental sensitivity of the proposed project area as identified by the Screening Tool is not applicable. For this reason, no site sensitivity verification report is required. Furthermore, there is no dedicated assessment protocol prescribed for conducting a Desktop Geotechnical Assessment. Therefore, this specialist assessment has been undertaken in compliance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014. However, GEOSS had previously undertaken a site visit during the undertaking of the separate groundwater specialist assessment (Chapter 16 of this EIA Report), the details of which are indicated below:

Date of Site Visit	23-24 March 2022
Specialist Name	Christel van Staden and Dale Barrow
Professional Registration Number	Cand.Sci.Nat: 122591 and Pr.Sci.Nat: 400289/13
Specialist Affiliation / Company	GEOSS

The relevant data collected during the hydrogeological site visit have been considered in this report. For example, no additional/unmapped rock types or sedimentary deposits were identified. Therefore, the desktop analysis of the geotechnical conditions is considered to be appropriate for the scope of the present investigation.

All relevant desktop information, consultation with landowners, and previous assessments undertaken by the author in the study area have been taken into consideration during the undertaking of this specialist desktop geotechnical assessment.

The hydrogeological site visit was undertaken using the following means:

(a) desk top analysis, using satellite imagery; geological maps and hydrogeological and geotechnical reports and databases where possible and applicable.
(b) preliminary on-site inspection; and drive over.
(c) collected water samples, field chemistry and water levels where possible and relevant; assessed site conditions to determine whether literature information is generally confirmed.

APPENDIX D - IMPACT ASSESSMENT METHODOLOGY

The impact assessment includes:

- *the nature, status, significance and consequences of the impact and risk;*
- *the extent and duration of the impact and risk;*
- *the probability of the impact and risk occurring;*
- *the degree to which impacts and risks can be mitigated;*
- *the degree to which the impacts and risks can be reversed; and*
- *the degree to which the impacts and risks can cause loss of irreplaceable resources.*

Terminology used in impact assessment can overlap. To avoid ambiguity, please note the following clarifications (that are based on NEMA and the EIA Regulations):

- *The term environment is understood to have a broad interpretation that includes both the natural (biophysical) environment and the socio-economic environment. The term socio-ecological system is also used to describe the natural and socio-economic environment and the interactions amongst these components.*
- *Significance = Consequence x Probability, which means that significance is equivalent to risk.*
- *The impact can have a positive or negative status. The significance of a negative impact may be called a risk, and the significance of a positive impact may be called an opportunity.*

The following principles are to underpin the application of this methodology:

- *Transparent and repeatable process - specialists are to describe the thresholds and limits they apply in their assessment, wherever possible.*
- *Adapt parameters to context (where justified) – the methodology proposes some thresholds (e.g. for spatial extent, in Step 3 below), however, if the nature of the impact requires a different definition of the categories of spatial extent, then this can be provided and described.*
- *Combination of a quantitative and qualitative assessment – where possible, specialists are to provide quantitative assessments (e.g. areas of habitat affected, decibels of noise, number of jobs), however, it is recognised that not all impacts can be quantified, and then qualitative assessments are to be provided.*

As per the DFFE Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect and cumulative:

- *Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.*
- *Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.*
- *Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective*

impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

The impact assessment methodology includes the aspects described below.

- ***Step 1**: **Nature** of impact/risk - The type of effect that a proposed activity will have on the environment.*

- ***Step 2**: **Status** - Whether the impact/risk on the overall environment will be:*
  - *Positive - environment overall will benefit from the impact/risk;*
  - *Negative - environment overall will be adversely affected by the impact/risk; or*
  - *Neutral - environment overall not be affected.*

- ***Step 3**: **Qualitatively** determine the **consequence** of the impact/risk by identifying the **a) SPATIAL EXTENT; b) DURATION; c) REVERSIBILITY; AND d) IRREPLACEABILITY**.*

  - ***A) Spatial extent** – The size of the area that will be affected by the impact/risk:*
    - *Site specific;*
    - *Local (<10 km from site);*
    - *Regional (<100 km of site);*
    - *National; or*
    - *International (e.g., Greenhouse Gas emissions or migrant birds).*

  - ***B) Duration** – The timeframe during which the impact/risk will be experienced:*
    - *Very short term (instantaneous);*
    - *Short term (less than 1 year);*
    - *Medium term (1 to 10 years);*
    - *Long term (the impact will cease after the operational life of the activity (i.e., the impact or risk will occur for the project duration)); or*
    - *Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e., the impact will occur beyond the project decommissioning)).*

  - ***C) Reversibility** of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):*
    - *High reversibility of impacts (impact is highly reversible at end of project life i.e., this is the most favourable assessment for the environment);*
    - *Moderate reversibility of impacts;*
    - *Low reversibility of impacts; or*
    - *Impacts are non-reversible (impact is permanent, i.e., this is the least favourable assessment for the environment).*

  - ***D) Irreplaceability** of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):*

- *High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e., this is the least favourable assessment for the environment);*
- *Moderate irreplaceability of resources;*
- *Low irreplaceability of resources; or*
- *Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e., this is the most favourable assessment for the environment).*

Some of the criteria are quantitative (e.g., spatial extent and duration) and some may be described in a quantitative or qualitative manner (e.g., reversibility and irreplaceability). The specialist then combines these criteria in a qualitative manner to determine the ***consequence****.*

The consequence terms ranging from slight to extreme must be calibrated per Specialist Study so that there is transparency and consistency in the way a risk/impact is measured. For example, from a biodiversity and ecology perspective, the consequence ratings could be defined according to a reduction in population or occupied area in relation to Species of Conservation Concern (SCC) status, ranging from slight consequence for defined areas of Least Concern, to extreme consequence for defined areas that are Critically Endangered. For example, from a social perspective, a slight consequence could refer to small and manageable impacts, or impacts on small sections of the community; a moderate consequence could refer to impacts which affect the bulk of the local population negatively or may produce a net negative impact on the community; and an extreme consequence could refer to impacts which could result in social or political violence or institutional collapse.

- ***Consequence*** *– The anticipated consequence of the risk/impact is generally defined as follows:*
  - *Extreme (extreme alteration of natural or socio-economic systems, patterns or processes, i.e., where environmental or socio-economic functions and processes are altered such that they permanently cease*);
  - *Severe (severe alteration of natural or socio-economic systems, patterns or processes, i.e., where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease);*
  - *Substantial (substantial alteration of natural or socio-economic systems, patterns or processes, i.e., where environmental or socio-economic functions and processes are altered such that they temporarily or permanently cease;*
  - *Moderate (notable alteration of natural or socio-economic systems, patterns or processes, i.e., where the natural or socio-economic environment continues to function but in a modified manner; or*
  - *Slight (negligible and transient alteration of natural or socio-economic systems, patterns or processes, i.e., where natural systems/environmental or socio-economic functions, patterns, or processes are not affected in a measurable manner, or if affected, that effect is transient and the system recovers).*

- ***Step 4****: Rate the* ***probability*** *of the impact/risk using the criteria below:*

  - ***Probability*** *– The probability of the impact/risk occurring:*
    - *Extremely unlikely (little to no chance of occurring);*
    - *Very unlikely (<30% chance of occurring);*

- *Unlikely (30-50% chance of occurring)*
- *Likely (51 – 90% chance of occurring); or*
- *Very Likely (>90% chance of occurring regardless of prevention measures).*

- ***Step 5**: Use both the **consequence** and **probability** to determine the **significance** of the identified impact/risk (qualitatively as shown in* Figure 17-6*). Significance definitions and rankings are provided below:*

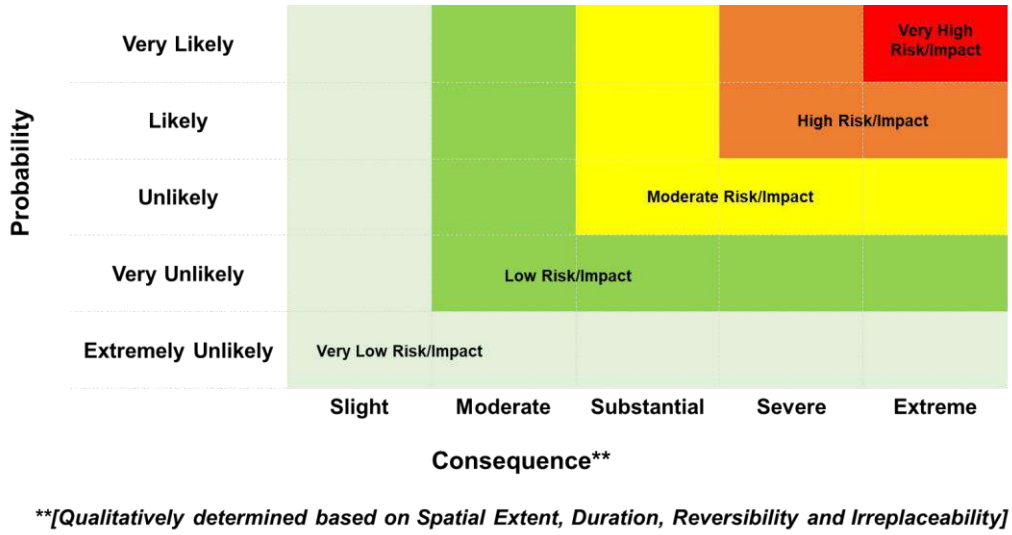


Figure 17-6: Guide to assessing risk/impact significance as a result of consequence and probability.

- ***Significance** – Will the impact cause a notable alteration of the environment?*
  - *Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
  - *Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
  - *Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);*
  - *High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and*
  - *Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e., the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).*

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- *Very low = 5;*
- *Low = 4;*
- *Moderate = 3;*
- *High = 2; and*
- *Very high = 1.*

The specialists must provide a written supporting motivation of the assessment ratings provided.

- ***Step 6**: Determine the **Confidence Level** – The degree of confidence in predictions based on available information and specialist knowledge:*
    - *Low;*
    - *Medium; or*
    - *High.*

APPENDIX E - COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

Requirements of Appendix 6 (Specialist Reports) of Government Notice R326 (Environmental Impact Assessment (EIA) Regulations of 2014, as amended)	***Section where this has been addressed in the Specialist Report***
1. (1) A specialist report prepared in terms of these Regulations must contain - *a) details of -* *i. the specialist who prepared the report; and* *ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;*	*Section 17.1.2* *Appendix A*
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	*Appendix B*
c) an indication of the scope of, and the purpose for which, the report was prepared;	*Section 17.1.1 and Section 17.1.3*
(car) an indication of the quality and age of base data used for the specialist report;	*Section 17.2.1*
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	*Section 17.4, Section 17.6*
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	*Section 17.1, Section 17.2 and Appendix C*
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	*Section 17.2*
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	*Sections 17.2, Section 17.4 and 17.6*
g) an identification of any areas to be avoided, including buffers;	*Sections 17.4 & 17.6*
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	*Section 17.4 and Section 17.6*
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	*Section 17.2*
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	*Section 17.6*
k) any mitigation measures for inclusion in the EMPr;	*Section 17.6 and Section 17.9*
l) any conditions for inclusion in the environmental authorisation;	*Sections 17.6 and 17.10*
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	*Sections 17.6, Section 17.9 and 17.10*
n) a reasoned opinion- *i. whether the proposed activity, activities or portions thereof should be authorised;* *(iA) regarding the acceptability of the proposed activity or activities; and* *ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;*	*Section 17.10*
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	*Section 17.2*
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	*Section 17.2 and Section 17.5*
q) any other information requested by the competent authority.	*n/a*
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	*There is no specific Assessment Protocol devised for Geotechnical Assessments. Therefore, Part*

Requirements of Appendix 6 (Specialist Reports) of Government Notice R326 (Environmental Impact Assessment (EIA) Regulations of 2014, as amended)	***Section where this has been addressed in the Specialist Report***
	A of the March 2020 Assessment Protocol (GN 320) applies, which refers to Appendix 6 of the 2014 NEMA EIA Regulations (as amended).

APPENDIX F - APPROVED RENEWABLE ENERGY PROJECTS

Table 17-10: Approved renewable energy projects, located within 30 km of the proposed Kudu Solar Facility.

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/ KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
1	12/12/20/2258 12/12/20/2258/1	Solar PV	75	Approved and Preferred Bidder (Operational)	The Proposed Establishment of Photovoltaic (Solar Power) Farms in the Northern Cape Province - Kalkbult	2010	Scoping and EIA	Scatec Solar SA Pty Ltd	Sustainable Development Projects cc
2	12/12/20/2463/1 12/12/20/2463/1/2 12/12/20/2463/1/A2 12/12/20/2463/1/AM3 12/12/20/2463/1/AM4 12/12/20/2463/1/AM5	Onshore Wind	140	Approved and Preferred Bidder (Operational)	Longyuan Mulilo De Aar 2 North Wind Energy Facility Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility The Wind Energy Facility (North and South) situated on the Plateau Near De Aar, Northern Cape Province	2010 and 2014	Scoping and EIA and Amendment	Longyuan Mulilo De Aar 2 South (Pty)	Aurecon South Africa (Pty) Ltd and Holland and Associates Environmental Consultants
3	12/12/20/2463/2 12/12/20/2463/2/AM2	Onshore Wind	100	Approved and Preferred Bidder (Operational)	Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility The Wind Energy Facility (North and South) Situated On The Plateau Near De Aar, Northern Cape Province	2010 and 2014	Scoping and EIA and Amendment	Mulilo Renewable Energy (Pty) Ltd	Aurecon South Africa (Pty) Ltd
4	14/12/16/3/3/1/1166 14/12/16/3/3/1/1166/AM3 14/12/16/3/3/1/1166/AM4	Transmission line	132	Approved	Basic Assessment for the proposed construction of a 132 kV transmission line corridor adjacent to the existing Eskom transmission line from	2010 and 2014	Basic Assessment	Longyuan Mulilo De Aar 2 North (Pty) Ltd	Aurecon South Africa (Pty) Ltd

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/ KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
					Longyuan Mulilo De Aar 2 North Wind Energy Facility (WEF) to the Hydra Substation in De Aar, Northern Cape				
5	14/12/16/3/3/1/785	Transmission line	132	Approved	Proposed construction of two 132kV transmission lines from the South & North Wind Energy Facilities on the Eastern Plateau (De Aar 2) near De Aar, Northern Cape.	2010	Basic Assessment	Mulilo Renewable Energy (Pty) Ltd	Aurecon South Africa (Pty) Ltd
6	14/12/16/3/3/2/278 14/12/16/3/3/2/278/1 14/12/16/3/3/2/278/2	Onshore Wind	118	Approved	Proposed Castle Wind Energy Facility Project, located near De Aar, Northern Cape	2010 and 2014	Scoping and EIA	Castle Wind Farm (Pty) Ltd	Aurecon South Africa (Pty) Ltd; and Savannah Environmental Consultants (Pty) Ltd
7	14/12/16/3/3/2/564 14/12/16/3/3/2/564/AM1 14/12/16/3/3/2/564/AM2	Solar PV	75	To be confirmed	Proposed Swartwater 75MW solar PV power facility in Petrusville within Renosterburg Local Municipality, Northern Cape	2010 and 2014	Scoping and EIA and Amendment	AE-AMD Renewable Energy (Pty) Ltd	USK Environmental and Waste Engineering (Pty) Ltd
8	14/12/16/3/3/2/740	Solar PV	300	Approved	Proposed 300MW Solar Power Plant in Phillipstown area in Renosterberg Local Municipality	2010	Scoping and EIA	To be confirmed	Tshikovha Environmental and Communication Consultants
9	14/12/16/3/3/2/744	Solar PV	0	Approved	Proposed PV facility on farm Jakhalsfontein near De Aar	2010	Scoping and EIA	Solar Capital (Pty) Ltd	Eco Compliance (Pty) Ltd
10	14/12/16/3/3/2/739	Solar PV	70 - 100	To be confirmed	Proposed 70 - 100 MW Solar Power Plant in Petrusville	2010	Scoping and EIA	To be confirmed	Tshikovha Environmental and Communication Consultants

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/ KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
11	Not issued yet (it is understood that the project is still within the pre-application stage)	Solar PV	800 (Maximum)	Pre-Application	The Proposed Keren Energy Odyssey Solar PV Facilities (Odyssey Solar 1, Odyssey Solar 2, Odyssey Solar 3, Odyssey Solar 4, Odyssey Solar 5, Odyssey Solar 6, Odyssey Solar 7 And Odyssey Solar 8)	2014	Scoping and EIA	Keren Energy Group Holdings	EnviroAfrica cc
12	To be confirmed	Solar PV	3050	Scoping	The Proposed Development of the Crossroads (formally referred to as the Hydra B) Green Energy Cluster of Renewable Energy Facilities and Grid Connection Infrastructure, Pixley Ka Seme District Municipality, Northern Cape Province. The Cluster entails the development of up to 21 solar energy facilities, with the Scoping and EIA Processes consisting of three phases. Phases 1, 2 and 3 consist of 9, 6 and 6 solar facilities, respectively. The Phase 1 Scoping and EIA Processes were launched in January 2023.	2014	Scoping and EIA	Akuo Energy Afrique	Savannah Environmental Consultants (Pty) Ltd
Study area shown on map	14/12/16/3/3/2/2244 14/12/16/3/3/2/2245 14/12/16/3/3/2/2246 14/12/16/3/3/2/2247 14/12/16/3/3/2/2248 14/12/16/3/3/2/2249	Solar PV	2180	Scoping and EIA Process underway	Proposed Development of 12 Solar Photovoltaic (PV) Facilities (Kudu Solar Facility 1 to 12) and associated infrastructure, near De Aar, Northern Cape Province	2014	Scoping and EIA	Kudu Solar Facility 1 (Pty) Ltd to Kudu Solar Facility 12 (Pty) Ltd	CSIR

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/ KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
	14/12/16/3/3/2/2250 14/12/16/3/3/2/2251 14/12/16/3/3/2/2252 14/12/16/3/3/2/2253 14/12/16/3/3/2/2254 14/12/16/3/3/2/2255								
Shown on map as Existing HV Lines	N/A	Transmission Line	220	Existing Power Line	HYDRA ROODEKUIL 2	-	-	-	-
Shown on map as Existing HV Lines	N/A	Transmission Line	132	Existing Power Line	HYDRA ROODEKUIL 1	-	-	-	-
Shown on map as Existing HV Lines	N/A	Transmission Line	765	Existing Power Line	BETA HYDRA 2	-	-	-	-
Shown on map as Existing HV Lines	N/A	Transmission Line	400	Existing Power Line	HYDRA PERSEUS 3	-	-	-	-
Shown on map as Existing HV Lines	N/A	Transmission Line	220	Existing Power Line	VAN DER KLOOF ROODEKUIL 2	-	-	-	-
Shown on map as Existing HV Lines	N/A	Transmission Line	220	Existing Power Line	VAN DER KLOOF ROODEKUIL 1	-	-	-	-
Shown on map as	N/A	Transmission Line	400	Existing Power Line	BETA HYDRA 1	-	-	-	-

CSIR NUMBER	DFFE REFERENCE	TECHNOLOGY	MW/ KV	STATUS	PROJECT TITLE	EIA REGULATIONS	ASSESSMENT PROCESS	APPLICANT	EAP
Existing HV Lines									
Shown on map as Existing HV Lines	N/A	Transmission Line	400	Existing Power Line	HYDRA PERSEUS 2	-	-	-	-
Shown on map as Existing HV Lines	N/A	Transmission Line	132	Existing Power Line	KALKBULT/KAREEBOSCHPAN 1	-	-	-	-
Shown on map as Existing HV Lines	N/A	Transmission Line	132	Existing Power Line	ROODEKUIL/ORANIA 1	-	-	-	-
Shown on map as Planned HV Lines	N/A	Transmission Line	765	Planned Power Line	Perseus to Gamma 2nd 765 kV line Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line	-	-	-	-
Shown on map as Planned HV Lines	N/A	Transmission Line	765	Planned Power Line	Relocate Beta-Hydra 765kV line to form Perseus-Hydra 1st 765kV line Cape Corridor Phase 2: Zeus - Hydra 765kV Integration	-	-	-	-
Shown on map as Planned HV Lines	N/A	Transmission Line	765	Planned Power Line	Perseus to Gamma 2nd 765 kV line Cape Corridor Phase 4: 2nd Zeus-Per-Gam-Ome 765kV Line	-	-	-	-

APPENDIX G - RELEVANT GEOTECHNICAL LITERATURE & INFORMATION

G.1 Sandstones and mudstones (Zone A)

Karoo sandstone is often not desirable in construction, e.g. as an aggregate, as it may cause concrete to deteriorate over time (Brink, 1977). In this regard, the following has been observed when making use of Karoo sandstones in construction (after Brink, 1983):

1. Deflection and shrinkage of reinforced members.
2. Corrosion of reinforcing steel.
3. Coincident cracking of concrete and reinforcement.
4. Surface crazing or pattern cracking.
5. Premature distress of roads constructed using aggregates derived from Karoo sandstones.

Control of material properties is required when making use of Karoo sandstones in construction.

Table 17-11: Strength and deformation characteristics of some Karoo Sandstones (Brink, 1983).

		Vryheid Formation*			Estcourt Formation			
		UCS (MPa)	E_t (GPa)	Bulk density (kg/m³)	UCS (MPa)	$E_{t(50)}$ (GPa)	Poisson's ratio ν	Bulk density (kg/m³)
Maximum	x_m	44,7	11,364	2 493	271	13,4	0,28	2 660
Minimum	x_m	8,6	0,621	2 356	57	5,9	0,06	2 350
Mean	$\bar{x}$	27,0	2,426	2 421	116	9,9	0,14	2 473
Number of tests	n	17	17	17	20	9	9	3
Standard deviation	S	12,3	2,9	43,6	56,5	2,43	0,08	164
Coefficient of variation	S/$\bar{x}$	0,45	1,18	0,02	0,49	0,25	0,57	0,07

UCS = Unconfined compressive strength
E_t = Tangent modulus
$E_{t(50)}$ = Tangent modulus at 50 per cent ultimate strength
*Data provided by W. J. Neely.

Table 17-12: Geotechnical properties of Ecca Group sandstone at Matimba Power Station (Brink, 1983).

		Density (kg/m³)	UCS (MPa)	Secant modulus (GPa)	Poisson's ratio ν	Point load index (MPa)
Maximum	x_M	2 452,0	83,2	49,7	0,21	7,2
Minimum	x_m	2 332,8	46,6	19,6	0,11	0,1
Mean	$\bar{x}$	2 394,6	69,1	36,1	0,16	2,9
Number of tests	n	19	19	19	19	20
Standard deviation	S	31,7	8,9	10	0,04	1,9
Coefficient of variation	$S/\bar{x}$	0,01	0,13	0,28	0,25	0,66

Table 17-13: Drying and shrinkage determinations on some sandstones of the Beaufort Group (Brink, 1983).

Subgroup	Locality	Reference	Depths below surface	Linear shrinkage per cent	
				Specimen cut parallel to bedding	Specimen cut 90° to bedding
Adelaide	Graaff-Reinet municipal quarry	Stutterheim (1954)	Quarry face near surface	0,038	0,058
Adelaide	Adendorp quarry (near Graaff-Reinet)	Stutterheim (1954)	Quarry face near surface	0,23	0,84
Tarkastad	Cores from borehole situated at: x = 324,300 y = 1 235,350 approx. lat. 31° 15′ S approx. long. 25° 30′ E (cores supplied by Orange–Fish Tunnel Consultants; tests by NBRI–CSIR	Pienaar (1966)	7 m 48 m 116 m 156 m 222 m 311 m		0,12 0,12 0,07 0,16 0,095 0,11
Adelaide	Aberdeen	Roper (1959)	Near surface	0,024	
Tarkastad	Queenstown	Roper (1959)	Near surface	0,12	
Adelaide	Beaufort West	Roper (1959)	Near surface	0,04*	

* Quartzitic sandstone.

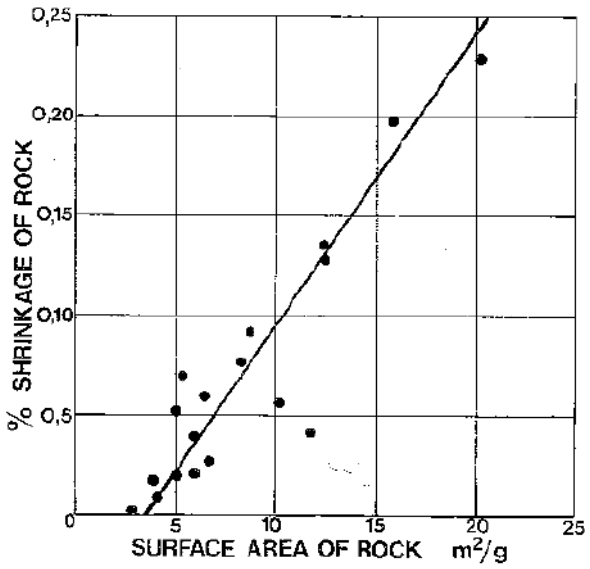


Figure 17-7: Relation between shrinkage and surface area for a variety of rocks including Karoo sandstone (Brink, 1983).

Table 17-14: Road construction characteristics of some Karoo sandstones (Brink, 1983).

		Molteno, Elliot and Clarens Formations*			Laingsburg Formation**		
		CBR (%)	CBR +3% cement (%)	10% FACT (kN)	ACV (%)	10% FACT (kN)	Treton (%)
Maximum	x_M	125	417	136	46	410	72,9
Minimum	x_m	24	157	7	9,7	160	16,4
Mean	$\bar{x}$	68	234	46	17,3	282	31,4
No. of tests	n	10	7	10	21	10	21
Standard deviation	S	38	86	35,4	7,7	84,4	13,7
Coefficient of variation	$S/\bar{x}$	0,56	0,37	0,77	0,45	0,23	0,44

* Partly after Holleman (1975)
**Data provided by Ninham Shand inc

Table 17-15: Changes in engineering properties of Adelaide Subgroup sandstone aggregates under traffic (Brink, 1983).

		PI		Percentage coarse sand (cs) 0,425mm <cs<2mm		Percentage smaller than 75μm		10% FACT wet/dry ratio
		(a)*	(b)†	(a)	(b)	(a)	(b)	(b)
1. Road in vicinity of East London								
Maximum	x_M	6	8	50	39	12	13	
Minimum	x_m	2	4	24	26	2	7	
Mean	$\bar{x}$	4,3	6,0	33,2	31,0	7,9	9,3	
Number of tests	n	156	32	158	32	158	32	
Standard deviation	S	0,94	1,20	4,14	3,0	1,30	2,53	
Coefficient of variation	S/$\bar{x}$	0,22	0,20	0,12	0,10	0,16	0,27	
2. Road in vicinity of Richmond								(115/215) (53%)
Maximum	x_M	6	9	42	35	11	13	
Minimum	x_m	3	7	26	25	6	7	
Mean	$\bar{x}$	5,2	7,6	31,9	30,6	8,3	9,2	
Number of tests	n	10	5	10	5	10	5	
Standard deviation	S	1,0	1,3	4,4	4,5	1,5	2,4	
Coefficient of variation	S/$\bar{x}$	0,19	0,17	0,14	0,15	0,18	0,26	
3. Road in vicinity of Colesberg								(75/185) (40%)
Maximum	x_M	7	10	47	39	14	19	
Minimum	x_m	5	7	24	18	5	9	
Mean	$\bar{x}$	6,0	9,0	35,5	29,9	8,6	14,0	
Number of tests	n	28	7	28	14	28	7	
Standard deviation	S	0,79	1,15	5,98	5,07	1,93	3,65	
Coefficient of variation	S/$\bar{x}$	0,13	0,13	0,17	0,17	0,22	0,26	
4. Road in vicinity of Noupoort								
Maximum	x_M	6	13	48	56	9	13	
Minimum	x_m	3	6	33	30	5	6	
Mean	$\bar{x}$	4,2	9,8	40,5	38,6	6,6	10,2	
Number of tests	n	13	12	13	12	13	12	
Standard deviation	S	1,07	1,76	3,86	7,3	1,12	2,25	
Coefficient of variation	S/$\bar{x}$	0,25	0,18	0,10	0,19	0,17	0,22	

* (a) Construction control data
† (b) Data obtained during later investigations after distress occurred

G.2 Dolerite (Zone B)

Dolerite has been used extensively in road construction; however, material from chill zones (surrounding metamorphosed rocks) are usually undesirable due to low adhesion properties (Brink, 1983). Dolerite has also been used successfully as a concrete aggregate (Brink, 1983).

Table 17-16: Engineering properties of very hard rock dolerite from various locations (Brink, 1983).

Locality	Percussion drill-bit penetration rate (minutes/ 200 mm)	Loss of drill-bit length (mm/10 minutes)	Loss of drill-bit gauge (mm/10 minutes)	Abrasive-ness (mass loss) (g)	Energy consumed during rod milling (kWh/kg)	Proto-dyakonov strength (MPa)
1. Hilton, Pietermaritzburg	—	—	—	53,47	$4,87 \times 10^{-3}$	—
2. Mountain Rise, Pietermaritzburg	—	—	—	67,59	$3,33 \times 10^{-3}$	31,66
3. Kinross	—	—	—	74,71	$2,45 \times 10^{-3}$	34,53
4. Standerton	15,4	0,15	0,22	69,32	$4,87 \times 10^{-3}$	30,95
5. Cradock	—	—	—	64,87	$2,20 \times 10^{-3}$	23,39
6. Beaufort West	12,2	0,26	0,15	61,25	$3,40 \times 10^{-3}$	35,88
7. Bloemfontein	16,2	0,22	0,17	71,20	$3,28 \times 10^{-3}$	32,92
8. Hendrik Ver-woerd dam site	13,7	0,19	0,20	61,26	$3,75 \times 10^{-3}$	33,51
9. P.K. le Roux dam site	12,1	0,10	0,13	65,94	$3,10 \times 10^{-3}$	29,92

Table 17-17: Strength properties of fresh dolerite from various locations (Brink, 1983).

			Site 1 Hilton quarry, Pietermaritz-burg	Site 2 Mountain Rise quarry, Pietermaritz-burg	Site 3 Kinross road cutting	Site 4 Borchards Crushers quarry, Standerton	Site 5 South African Railways quarry, Cradock	Site 6 South African Railways National Roads quarry, Beaufort West
Unconfined Compressive Strength (MPa)	Maximum	x_M	540	368	285	489	363	497
	Minimum	x_m	426	269	233	222	173	298
	Mean	$\bar{x}$	472	336	267	370	293	406
	Number of tests	n	6	9	6	6	15	27
	Standard deviation	S	42,32	33,77	21,34	119,04	53,51	57,66
	Coefficient of variation	S/$\bar{x}$	0,090	0,100	0,080	0,322	0,183	0,142
Tensile Strength (MPa)	Maximum	x_M	38,9	29,8	25,9	35,2	30,6	42,5
	Minimum	x_m	34,9	16,3	22,7	28,2	15,3	22,5
	Mean	$\bar{x}$	37,6	26,3	23,8	30,4	24,4	31,4
	Number of tests	n	6	9	6	6	15	34
	Standard deviation	S	1,47	4,36	1,40	4,12	4,12	4,20
	Coefficient of variation	S/$\bar{x}$	0,039	0,166	0,059	0,136	0,169	0,134
Shear box Strength (MPa)	Maximum	x_M	34,2	33,1	32,2	37,9	36,0	47,2
	Minimum	x_m	14,5	25,6	14,2	25,2	19,2	18,6
	Mean	$\bar{x}$	28,1	29,8	25,0	32,4	26,6	30,3
	Number of tests	n	7	9	6	6	15	27
	Standard deviation	S	8,02	2,59	6,24	4,80	4,50	7,13
	Coefficient of variation	S/$\bar{x}$	0,285	0,087	0,250	0,148	0,157	0,235

			Site 7 Olive Hill quarry, Bloemfontein	Site 8 Hendrik Verwoerd dam			Site 9 P.K. le Roux dam	
				A Excavations for wall and abutments	B Quarry A	C Quarry B	A Lower quarry	B Left flank
Unconfined Compressive Strength (MPa)	Maximum	x_M	386	551	527	465	360	479
	Minimum	x_m	254	133	164	285	238	326
	Mean	$\bar{x}$	303	388	382	391	321	392
	Number of tests	n	15	82	49	28	15	18
	Standard deviation	S	42,50	66,56	67,68	45,28	29,10	56,80
	Coefficient of variation	S/$\bar{x}$	0,140	0,172	0,177	0,116	0,091	0,145
Tensile Strength (MPa)	Maximum	x_M	31,6	46,3	43,5	39,1	31,9	32,7
	Minimum	x_m	23,1	9,5	19,5	26,9	11,9	26,3
	Mean	$\bar{x}$	27,0	30,5	31,7	31,9	25,9	29,9
	Number of tests	n	15	81	50	28	15	18
	Standard deviation	S	2,24	5,67	4,29	2,60	5,12	1,83
	Coefficient of variation	S/$\bar{x}$	0,083	0,186	0,135	0,081	0,198	0,061
Shear box Strength (MPa)	Maximum	x_M	30,5	66,3	49,7	59,2	34,8	24,3
	Minimum	x_m	18,0	15,5	14,3	16,6	16,8	18,8
	Mean	$\bar{x}$	22,7	32,1	32,1	35,9	24,2	21,4
	Number of tests	n	15	81	49	28	15	18
	Standard deviation	S	3,26	9,39	7,95	9,71	4,60	1,76
	Coefficient of variation	S/$\bar{x}$	0,144	0,292	0,248	0,270	0,190	0,082

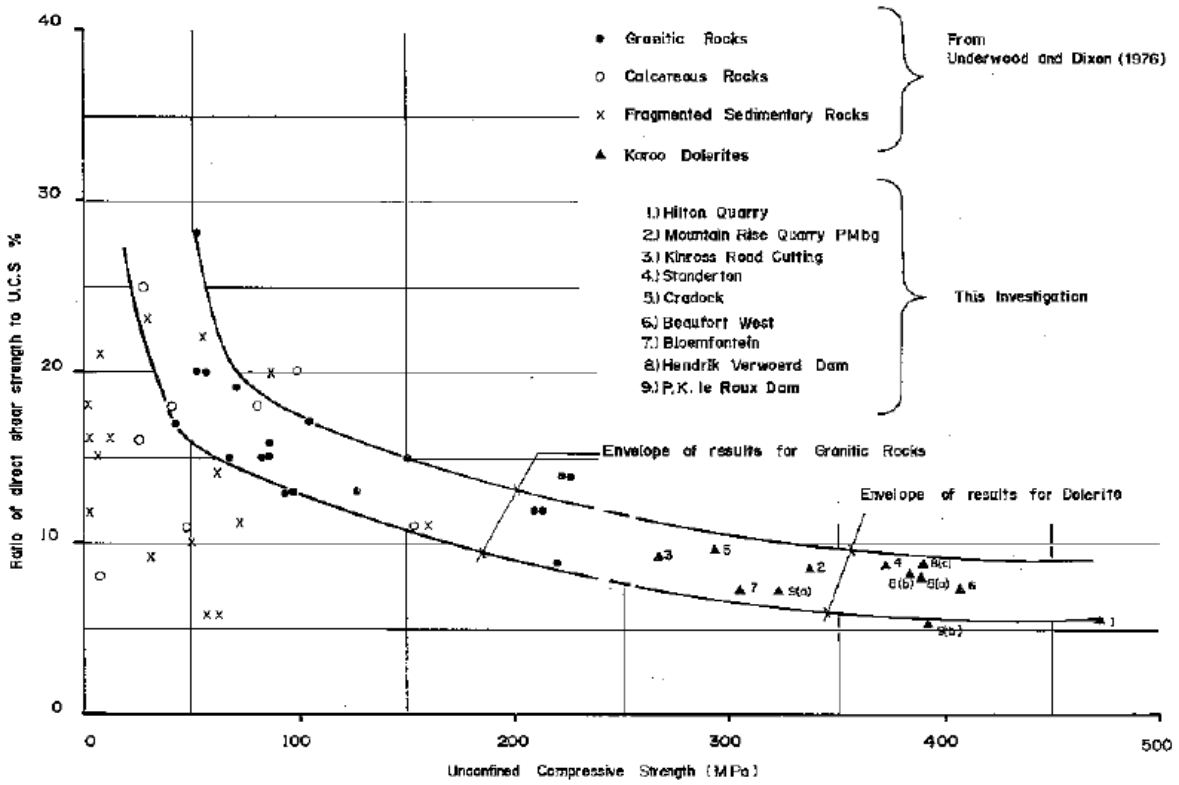


Figure 17-8: Variations of the shear strength to unconfined compressive strength ratio with the Unconfined Compressive Strength (UCS) for dolerite compared with other rock types (Brink, 1983).

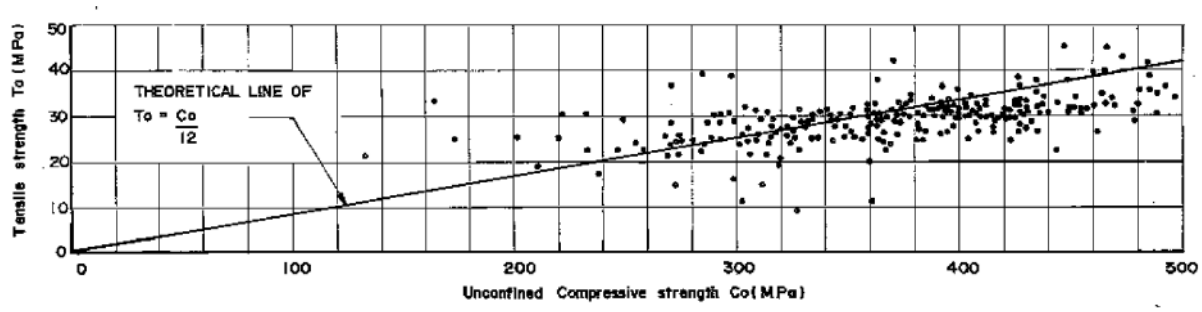


Figure 17-9: Relation between tensile strength and Unconfined Compressive Strength (UCS) of fresh dolerite specimen from South Africa (Brink, 1983).

Table 17-18: Weathering classes and characteristics of dolerite in South Africa (Brink, 1983).

Proposed class	Characteristics	Excavation	Grade of weathering according to AEG (1978)	Grade of weathering according to Weinert (1964, 1980)
Solid dolerite	Fresh rock: hard to extremely hard, variably jointed; <15% weathered material in whole rock mass	Blasting	W1 or W2	Fresh
Fractured dolerite	Fresh angular boulders of <0,5 m diameter, moderately thick zones of weathered material in joint spaces	Blasting or very heavy ripping depending on mass and type of joint fillings	W1 or W2 for boulders, otherwise W3 or W4	Boulders fresh, joint fillings weathered or highly weathered
Boulder dolerite	Boulders with rounded edges and corners and >0,5 m diameter are fresh and strong; up to 1 m thick zones of intensely weathered material between boulders. 'Stacks' of loose boulders to be included in this class	Blasting for boulders, otherwise rippable; bulldozing for 'stacks' of loose boulders	Boulders W1, otherwise W4 or W5	Boulders fresh, otherwise highly weathered (mostly highly decomposed)
Gravel dolerite	Gravelly with solid particles <75 mm diameter. Particles vary from fresh to very weathered material	Can usually be ripped or even picked; blasting rarely required	W4	Highly weathered (mostly highly disintegrated)
Granular (sugar) dolerite	Fine gravelly to occasionally clayey; remnants of boulders with weathered 'onion' shells. May include calcrete where N>5 and ferricrete where N<5	Normally picking, bulldozing or shovelling, occasionally ripping	W4 or W5	Highly weathered (highly disintegrated where N>5, highly decomposed where N<5)
Residual dolerite soil	Soft, homogeneous sandy to clayey soil	Shovelling, bulldozing or picking	W5	Residual soil (sand where N>5, clay where N<5), occasionally highly weathered

Table 17-19: Influence of climate on selected physical properties of weathering classes of dolerites (Brink, 1983).

Climatic N-value			N = <2			N = 2–5			N = ~5		
			%<0,075 mm	PI	Mod AASHO Max. dens. (kg/m³)	%<0,075 mm	PI	Mod AASHO Max. dens. (kg/m³)	%<0,075 mm	PI	Mod AASHO Max. dens. (kg/m³)
Gravel dolerite	Maximum	x_M	32	28	—	15	19	—	23	17	2220
	Minimum	x_m	6	8	—	5	1	—	9	6	1719
	Mean	$\bar{x}$	25	15	—	9	13	—	16	12	2098
	Number of tests	n	6	6	—	3	12	—	15	15	7
	Standard deviation	s	13,4	6,3	—	4,3	8,3	—	3,6	1,8	176
	Coefficient of variation	s/$\bar{x}$	0,53	0,42	—	0,48	0,64	—	0,23	0,15	0,08
Granular dolerite	Maximum	x_M	85	42	2 008	60	21	2098	49	22	2254
	Minimum	x_m	10	8	1 573	10	3	1970	14	3	1767
	Mean	$\bar{x}$	37	18	1 790	27	13	1986	31	9	2026
	Number of tests	n	23	21	6	15	21	5	54	53	22
	Standard deviation	s	16,9	8,2	159	10,9	4,5	140	11,4	4,2	131
	Coefficient of variation	s/$\bar{x}$	0,46	0,45	0,09	0,40	0,34	0,07	0,37	0,47	0,06
Residual dolerite soil	Maximum	x_M	95	50	—	94	33	1914	74	33	1978
	Minimum	x_m	50	11	—	48	3	1514	44	8	1621
	Mean	$\bar{x}$	64	23	1 620	71	18	1673	59	18	1831
	Number of tests	n	59	23	1	33	33	7	37	37	11
	Standard deviation	s	12,1	10,36	—	17,5	4,4	136	7,7	7,2	105
	Coefficient of variation	s/$\bar{x}$	0,19	0,46	—	0,25	0,25	0,08	0,13	0,40	0,06

Climatic N-value			N = 5–10			N = ~10			N = >10		
			%<0,075 mm	PI	Mod AASHO Max. dens. (kg/m³)	%<0,075 mm	PI	Mod AASHO Max. dens. (kg/m³)	%<0,075 mm	PI	Mod AASHO Max. dens. (kg/m³)
Gravel dolerite	Maximum	x_M	16	32	2 275	21	18	2 323			
	Minimum	x_m	1	2	2 034	3	0	2 066			
	Mean	$\bar{x}$	7	12	2 146	6	8	2 211		No Results	
	Number of tests	n	35	35	5	33	33	12			
	Standard deviation	s	3,1	6,2	88	3,51	4,21	91			
	Coefficient of variation	s/$\bar{x}$	0,44	0,52	0,04	0,55	0,51	0,04			
Granular dolerite	Maximum	x_M	51	29	2 227	24	10	2 195	15	14	2370
	Minimum	x_m	2	1	1 810	2	0	1 970	1	1	1842
	Mean	$\bar{x}$	13	9	2 082	9	4	2 082	4	4	2163
	Number of tests	n	80	80	13	61	61	16	218	216	80
	Standard deviation	s	12,8	6,7	142	5,48	2,82	57	1,59	3,06	114
	Coefficient of variation	s/$\bar{x}$	0,98	0,74	0,07	0,06	0,07	0,03	0,40	0,77	0,05
Residual dolerite soil	Maximum	x_M	56	29	2 291	39	26	2 370	35	18	2355
	Minimum	x_m	5	1	1 826	4	1	1 810	2	1	1954
	Mean	$\bar{x}$	25	12	2 066	18	11	2 082	15	6	2243
	Number of tests	n	103	103	11	52	51	13	261	261	89
	Standard deviation	s	10,2	6,2	121	8,90	5,60	140	5,81	2,91	87
	Coefficient of variation	s/$\bar{x}$	0,41	0,52	0,06	0,11	0,30	0,07	0,39	0,49	0,04

Table 17-20: Concrete making properties of dolerite (Brink, 1983).

		Specific gravity (or relative density)	Loose bulk density (coarse) (kg/m³)	Loose bulk density (fine) (kg/m³)	Mortar shrinkage (%)	10% FACT (kN)
Maximum	x_M	3,05	1 500	1 700	0,070	340
Minimum	x_m	2,85	1 350	1 350	0,037	180
Mean	$\bar{x}$	2,94	1 420	1 520	0,053	300
Number of tests	n	210	120	46	31	37
Standard deviation	S	0,037	29,24	79,19	0,008	37,65
Coefficient of variation	S/$\bar{x}$	0,013	0,021	0,052	0,152	0,125

Table 17-21: Deformation characteristics (expressed in MPa) for different weathering classes of dolerite from South Africa as determined by a GB Menard pressure meter and jacking tests (Brink, 1983).

		Residual dolerite soil	Granular dolerite	Gravel dolerite	Boulder dolerite	Fractured dolerite	Fresh dolerite	
							From H.F. Verwoerd dam	From P.K. le Roux dam
Degree of weathering		W5	W4/W5	W4	W3	W2	W1	W1
Maximum	x_M	11,7	200,7	923,3	1 302,0	3 215,5	9 076	19 760
Minimum	x_m	7,3	89,4	404,7	1 071,6	2 034,9	5 615	9 062
Mean	$\bar{x}$	9,2	158,3	593,2	1 156,5	2 625,2	7 692	12 587
Number of tests	n	3	4	3	3	2	18	15

G.3 Quaternary Sediments (Zone C)

Quaternary sediments overlying the Karoo Supergroup are variable in nature based on various case studies presented by Brink (1985). Potential geotechnical problems arising from such sediments include expansive and collapsible soils. Based on investigations previously undertaken in the region, some 30 km south of the site, such soils may be encountered. Transported materials are often thin to non-existent, and where present in natural drainage depressions often become more clayey and often exhibit desiccation cracks (Van Rooyen, 2012). Laboratory test results revealed that transported sediments (sheetwash and alluvium/gulleywash in this case) in the region have been described as “worse than G10” and the materials have ‘low’ to ‘high’ potential.



CHAPTER 18:

Civil Aviation Site Sensitivity Verification

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18. CIVIL AVIATION SITE SENSITIVITY VERIFICATION 18-4

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Abbreviations	
ATNS	Air Traffic and Navigation Services SOC Limited
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DSR	Draft Scoping Report
ICAO	International Civil Aviation Organisation Code
NEMA	National Environmental Management Act
PV	Photovoltaic
REDZ	Renewable Energy Development Zones
SACAA	South African Civil Aviation Authority
SEA	Strategic Environmental Assessment

18. CIVIL AVIATION SITE SENSITIVITY VERIFICATION

18.1 Introduction

This report serves as the Site Sensitivity Verification for Civil Aviation for the Scoping and Environmental Impact Assessment (EIA) Process for the proposed development of the Kudu Solar Facility 4 and associated infrastructure near De Aar in the Northern Cape. The proposed project forms part of a cluster of 12 Solar Photovoltaic (PV) facilities and associated infrastructure. This report deals with Kudu Solar Facility 4 (hereafter referred to as the "Kudu Solar Facility" or "proposed project").

18.2 Need for the Site Sensitivity Verification

On 20 March 2020, in Government Gazette 43110, Government Notice (GN) R320, the Department of Environment, Forestry and Fisheries (DEFF) [now operating as the Department of Forestry, Fisheries and the Environment (DFFE)] published procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) when applying for an Environmental Authorisation (EA). GN R320 prescribes general requirements for undertaking Site Sensitivity Verification, as well as protocols for assessment and minimum report content requirements of environmental impacts associated with specified environmental themes for relevant activities requiring EA. GN R320 was enforced within 50 days of publication of the notice i.e. on 9 May 2020.

GN R320 specifically includes a protocol that provides the criteria for the specialist assessment and minimum report content requirements for impacts on civil aviation installations for relevant activities requiring EA. This protocol replaces the requirements of Appendix 6 of the 2014 NEMA EIA Regulations (as amended).

This specific protocol states that proposed developments (where relevant) that occur on sites identified as Very High, High or Medium sensitivity, as depicted on the National Web-Based Environmental Screening Tool (Screening Tool), must include a Civil Aviation Compliance Statement. It further states that there are no requirements if the proposed developments occur on sites identified as Low sensitivity on the Screening Tool. However, a Site Sensitivity Verification is required for the Civil Aviation Protocol for all sensitivity levels.

Therefore, since the proposed projects require an EA in terms of the 2014 NEMA EIA Regulations (as amended), and Civil Aviation was identified as a relevant theme in the Screening Tool Report, GN R320 must be complied with.

18.3 Methodology

The Site Sensitivity Verification Process and Report has been compiled based on the following methodology:

- Existing spatial databases were used to determine the location of civil aviation installations in relation to the proposed project study area, and to identify preliminary areas of concern in terms of impacts to civil aviation installations;
- The proposed project study area was plotted on the Screening Tool to identify the sensitivity allocated;
- A site visit was undertaken to confirm the current land use and the environmental sensitivity as it relates to Civil Aviation;
- Additional research was undertaken to substantiate the Site Sensitivity Verification process; and
- A Site Sensitivity Verification Report was compiled (i.e. this report).

The information sources listed in Table 18-1 were used in the Site Sensitivity Verification process.

Table 18-1: Information Sources used for the Site Sensitivity Verification process

Data / Information	Source	Date	Type	Description
National Web-Based Environmental Screening Tool (Screening Tool)	Department of Forestry, Fisheries, and the Environment (DFFE)	2022-2023	Spatial / Online Assessment	The Screening Tool is a geographically based web-enabled application which allows a proponent intending to submit an Application for EA in terms of the 2014 NEMA EIA Regulations (as amended) to screen the proposed site for any environmental sensitivity[1].
RSA Airspaces in 3D	Air Traffic and Navigation Services SOC Limited (ATNS)	2022	Google Earth KMZ File	The RSA Airspaces in 3D data KMZ file is an initiative undertaken by the ATNS to illustrate the definitions and complexities of airspace, routes, aerodromes and navigational facilities within South Africa to the public in the interest of safety[2].
Wind and Solar PV Phase 1 Strategic Environmental Assessment (SEA)	Department of Environmental Affairs (DEA) [now operating as the DFFE]	2015	Report	SEA commissioned by the DEA (now operating as the DFFE) in 2013 for an assessment of wind and solar PV energy in South Africa, with an aim of identifying eight Renewable Energy Development Zones (REDZs) to focus and incentivize such development (i.e. Phase 1 REDZs SEA: CSIR Report Number: CSIR/CAS/EMS/ER/2015/0001/B).
Wind and Solar PV Phase 2 SEA	Department of Environment, Forestry, and Fisheries (DEFF) [now operating as the DFFE]	2019	Report	SEA commissioned by the DEFF (now operating as the DFFE) in 2016 for an assessment of wind and solar PV energy in South Africa, with an aim of identifying three additional REDZs to focus and incentivize such development (i.e. Phase 2 REDZ SEA. CSIR Report Number: CSIR/SPLA/SECO/ER/2019/0085).
Scoping Level and EIA Phase Visual Impact Assessments for the proposed project	Quinton Lawson and Bernard Oberholzer, QARC and BOLA	2022, 2023	Report	This Visual Impact Assessment was commissioned for the proposed project.

Therefore, the Site Sensitivity Verification was undertaken using desktop analysis, satellite imagery, on-site inspection, and other available and relevant information.

[1] https://screening.environment.gov.za/screeningtool/index.html#/pages/welcome
[2] https://www.atns.co.za/rsakmz.php

18.4 Proposed Project Location

The proposed Kudu Solar Facility is located within the Renosterberg Local Municipality, which falls within the Pixley Ka Seme District Municipality. The proposed project is not located within any of the gazetted Renewable Energy Development Zones (REDZs); however is located within the Central Strategic Transmission Corridor that was gazetted in GN 113 on 16 February 2018. The proposed solar facility and its associated infrastructure will be constructed on a selection of the farm portions indicated in the table below, which also served as the study area for this EIA.

Table 18-2: Farm portions associated with the Kudu Solar Facilities

Farm Portion	SG code
Remaining Extent of the Farm Bas Berg No. 88	C05700000000008800000
Remaining Extent of Portion 3 of the Farm Bas Berg No. 88	C05700000000008800003
Portion 4 (Portion of Portion 3) of the Farm Bas Berg No. 88	C05700000000008800004
Remaining Extent of Portion 2 (Middel Plaats) (a Portion of Portion 1) of the Farm Grasspan No. 40	C05700000000004000002
Remaining Extent of the Farm Annex Wolve Kuil No. 41	C05700000000004100000
Portion 1 (Wolve Kuil West) of the Farm Annex Wolve Kuil No. 41	C05700000000004100001
Portion 2 of the Farm Wolve Kuil No. 43	C05700000000004300002
Remaining Extent of the Farm Wolve Kuilen No. 42	C05700000000004200000

Refer to Chapter 2 of the EIA Report for a list of affected farm properties for each proposed solar facility.

18.5 Details of the EIA Team

GN R320 states that prior to commencing with a specialist assessment, the current use of the land and the potential environmental sensitivity of the site under consideration as identified by the Screening Tool must be confirmed by undertaking a Site Sensitivity Verification.

This Site Sensitivity Verification was undertaken by Lizande Kellerman and Helen Antonopoulos. Lizande Kellerman is registered with the South African Council for Natural and Scientific Professions (SACNASP), with Registration Number 400076/10 in the field of Botanical Sciences. Helen Antonopoulos is an intern Environmental Scientist in the Environmental Management Services (EMS) group of the CSIR and holds BSc, BSc Honours, and MSc degrees in Environmental and Geographical Science from the University of Cape Town.

Inputs to the Site Sensitivity Verification Report were provided by Lizande Kellerman, Helen Antonopoulos, Rohaida Abed and Luanita Snyman-Van der Walt of the CSIR. Refer to Appendix A of the EIA Report for Curriculum Vitae of the project team.

18.6 Findings of the Screening Tool

Screening Tool Reports and/or maps were generated for the proposed projects using the following classifications:

- **Solar PV:** Utilities Infrastructure → Electricity → Generation → Renewable → Solar → PV → Solar PV; and
- **Substations:** Utilities Infrastructure → Electricity → Distribution and Transmission → Substation.

The Solar PV classification results in the use of the Solar PV methodology, whilst the substations classification results in the use of the general methodology on the Screening Tool.

The civil aviation theme (for Solar PV developments) on the Screening Tool depicted that the entire study area is located in a low sensitivity area from a civil aviation perspective i.e. there are no major or other types of civil aviation aerodromes or buffers that intersect with the study area or the Original and Revised Scoping Buildable Areas. Figure 18-1 illustrates the civil aviation sensitivity in relation to the entire study area and the development footprints. The development footprints were identified following the analysis of the Original and Revised Scoping Buildable Areas in the Scoping Phase.

In line with the above, the civil aviation theme (for substation developments) on the Screening Tool depicted that the entire study area is located in a low sensitivity area from a civil aviation perspective (Figure 18-2). However, the civil aviation theme for substation developments also depicted the following features, which are outside of the study area, and a significant distance away:

- De Aar Aerodrome (classified as “Other Civil Aviation Aerodrome”) located approximately 54 km south-west of the study area. High and medium sensitivity are respectively allocated to the area that extends 8 km from the De Aar Aerodrome; and between 8 and 15 km of the aerodrome;
- Petrusville Aerodrome (classified as “Other Civil Aviation Aerodrome”) located approximately 25 km north-east of the study area. High and medium sensitivity are respectively allocated to the area that extends 8 km from the Petrusville Aerodrome; and between 8 and 15 km of the aerodrome;
- Dangerous and restricted airspace demarcated as high sensitivity, which is located more than 50 km to the south-west of the study area;
- Civil Aviation Radar, which is located at point 30° 27' 51.4" S and 23° 59' 19.1" E; approximately 37 km south-west of the study area. The area within 15 km of the civil aviation radar is demarcated with a high sensitivity; and the area between 15 and 35 km of the civil aviation radar is rated with a medium sensitivity. This same facility is highlighted under the RFI theme as a Sentech High Power Terrestrial Broadcasting Facility and a Telecommunication Facility; and
- The same area above overlaps with a medium sensitivity area allocated to 5 km from an air traffic control or navigation site.

In terms of GN R320, this means that no further requirements are applicable i.e. a Compliance Statement is not required, if the site is indeed found to be of low sensitivity during the site visit.

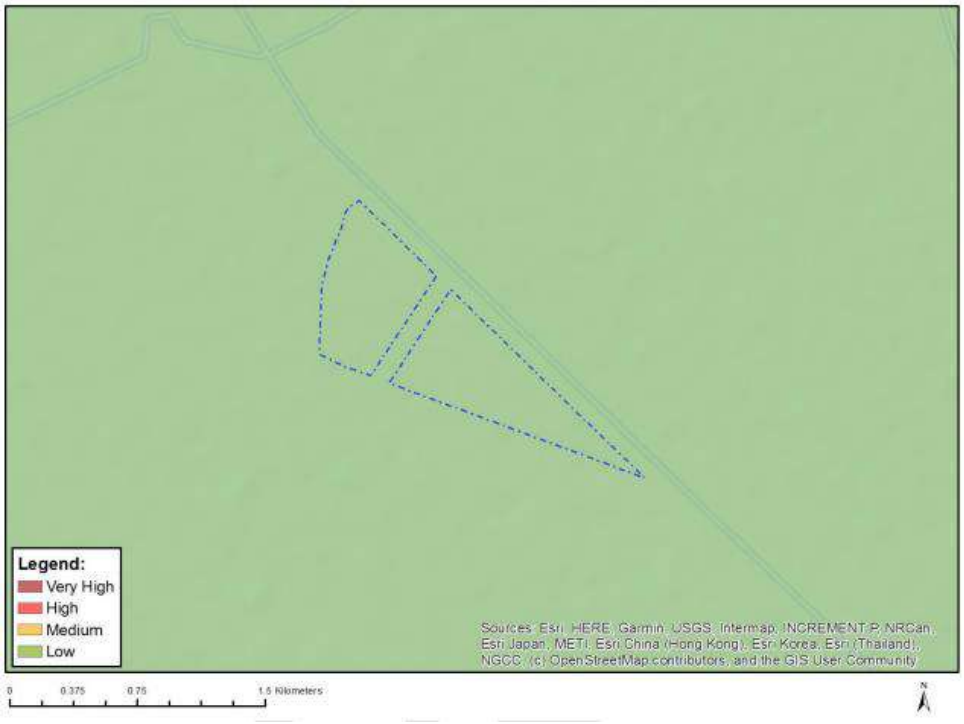


Figure 18-1: Screening Tool Map showing the buildable area for the proposed Kudu Solar Facility in terms of Civil Aviation Sensitivity (Source: DFFE Screening Tool, 2023).



Figure 18-2: Screening Tool Map showing the buildable area for the proposed Solar Facility, as well as the on-site substation complex, in terms of Civil Aviation Sensitivity (Source: DFFE Screening Tool, 2023).

18.7 Details of the Site Visit

The details of the site visit are noted below:

Date of Site Visit	29 – 31 August 2022
Specialist Name	Lizande Kellerman
Professional Registration Number	SACNASP Registration Number 400076/10
Specialist Affiliation / Company	CSIR

18.8 Findings

The site visit confirmed that the land within the study area is used for livestock grazing, and that there are structures such as farm steads, livestock pens, waterpoints, farm roads and fences, and existing high voltage power lines within the area. This is corroborated by the Agricultural Compliance Statement (Chapter 6 of the EIA Report) which states that moisture availability is insufficient for crop production without irrigation and the potential agricultural land use of the study area is therefore limited to grazing. As noted in the Terrestrial Biodiversity and Species Assessment (Chapter 7 of the EIA Report), the study area is located in the Northern Upper Karoo (NKu3), Eastern Upper Karoo (NKu4) and the Besemkaree Koppies Shrubland vegetation types. The habitat is homogenous and consists of extensive plains with low shrubs and grasses. **No civil aviation installations were found within the proposed project study area.** Refer to Figure 18-3 and Figure 18-4 for views of the farm portion on which the proposed project will take place.



Figure 18-3: Panoramic (180°) view from a main gravel road towards Remaining Extent of Portion 3 of the Farm Bas Berg No. 88 (NW to SE direction). This photo pertains to PV4 (Photo: L. Kellerman)



Figure 18-4: View from a main gravel road towards Remaining Extent of Portion 3 of the Farm Bas Berg No. 88 (SW direction). This photo pertains to PV4 (Photo: L. Kellerman)

The Air Traffic and Navigation Services SOC Limited (ATNS) data has confirmed that there is an unlicensed aerodrome outside of the 30 km radius of the proposed project site. The Petrusville Airfield (International Civil Aviation Organisation Code (ICAO): FAPV) (30° 5' 0.69" S; 24° 40' 48.16" E) is located approximately 26 km north-east of the entire study area. During the site visit it was concluded that the airfield is out of use, as indicated by the dilapidated condition of the runway and lack of civil aviation infrastructure, such as windsocks. Figure 18-5 and Figure 18-6 show the airfield and its lack of maintenance. The location of the Petrusville Airfield, which is approximately 1.4 km long and is oriented SE to NW, is indicated on the Screening Tool as medium sensitivity for solar PV developments; and high sensitivity within 8 km of the aerodrome for substation developments (based on the general methodology); however, the actual aerodrome will not be impacted on by the proposed solar facility and associated infrastructure due to its distance from the study area.



Figure 18-5: Petrusville Airfield (FAPV) (view in NW direction) (*Photo*: L. Kellerman)



Figure 18-6: Petrusville Airfield (FAPV) (view in SE direction). Note the lack of aviation infrastructure, such as a windsock (*Photo*: L. Kellerman)

Research indicates that the Department of Defence Ammunition Depot and School of Ammunition is located approximately 5 km north-west of De Aar (ArchaeoMaps Archaeological Consultancy, 2009)[3]. The ATNS data classifies this facility as restricted airspace, which is located more than 50 km to the south-west of the study area. The Screening Tool shows this area as dangerous and restricted airspace (high sensitivity) based on the general methodology for substations; however, it is not identified for the Solar PV methodology. The De Aar Airport (International Civil Aviation Organisation Code: FADA) (30°41'29.51"S; and 24°1'27.13" E) lies roughly 4 km east of the Department of Defence Ammunition Depot and School of Ammunition; and approximately 55 km south-west of the study area (at its closest point), thus falling outside of the 30 km radius around the study area. Based on their locations, neither the restricted airspace nor the De Aar Airport will be impacted on by the proposed project.

The ATNS data also notes that both Conventional (Upper and Lower ATS) and Area Navigation Routes associated with the Johannesburg Area Central Airspace fall within the 30 km radius of the study area. However, the proposed solar panels will range to a maximum height of 3.5 m, and the substation complex is estimated to extend up to 10 m from ground level and are thus not likely to impact negatively on civil aviation installations or air traffic associated with the Johannesburg Area Central Airspace. Most of the features noted above are in line with the findings of the Phase 1 and Phase 2 Wind and Solar SEA Reports.

Figure 18-7 indicates the location of the civil aviation features noted above, which informed this Site Sensitivity Verification.

[3] ArchaeoMaps Archaeological Consultancy (2009). Archaeological Impact Assessment: Establishment of an Ammunition Disposal Plant, Sinclair's Dam 133, De Aar, Northern Cape, South Africa. Date: 2009-03-23. Available online: https://sahris.sahra.org.za/sites/default/files/heritagereports/AIA%20-%20ADP,%20Sinclairs%20Dam,%20De%20Aar,%20NC.pdf, Accessed October 2022.

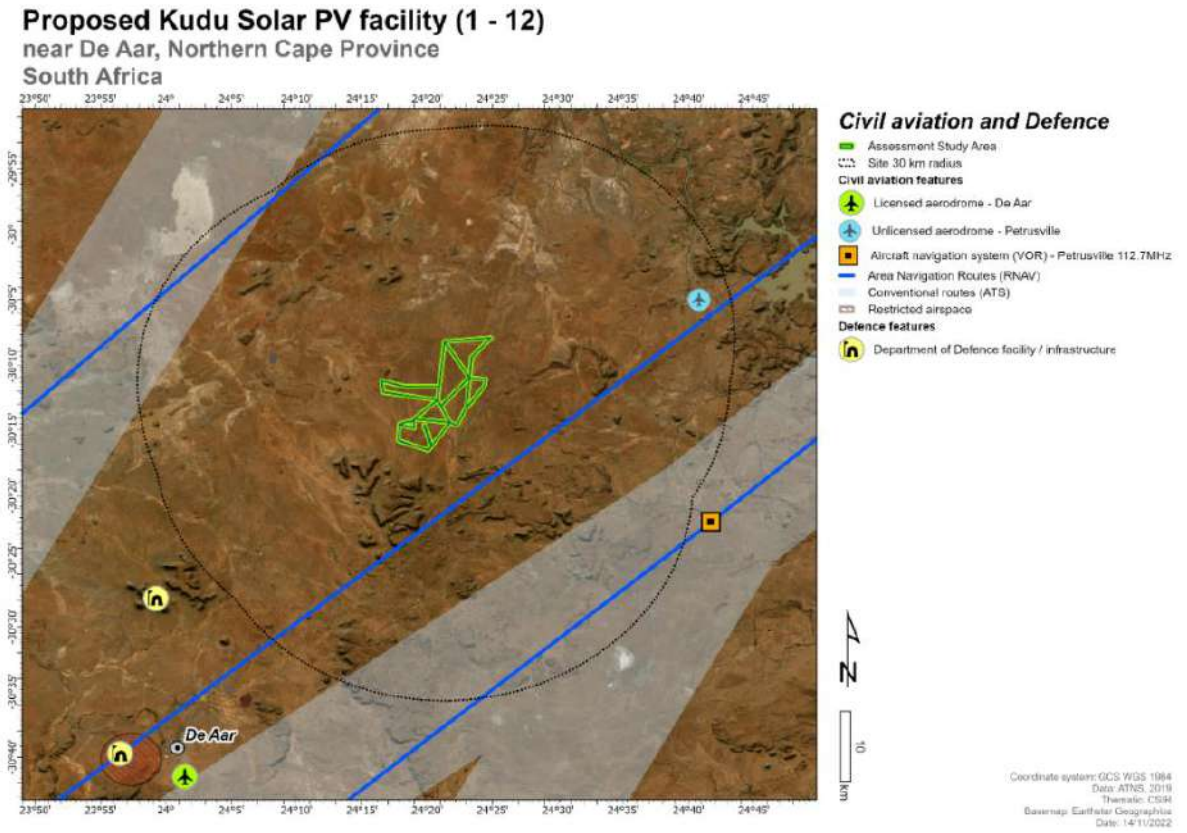


Figure 18-7: Civil Aviation features relative to the proposed project study area based on the site visit and existing databases.

18.9 Review of the Scoping and EIA Reports

The Draft EIA Reports were made available to all registered Interested and/or Affected Parties (I&APs), Organs of State and other relevant key stakeholders for a 30-day comment period which extended from 2 June to 3 July 2023, excluding public holidays, whereas the Draft Scoping Reports (DSRs) were made available to all registered I&APs Organs of State and other relevant key stakeholders for a 30-day comment period which extended from 09 December 2022 to 30 January 2023, excluding public holidays and the regulated shutdown period.

The South African Civil Aviation Authority (SACAA) and the ATNS are included as key stakeholders on the project stakeholder database and were afforded the opportunity to comment on the DSRs and Draft EIA Reports, including this Site Sensitivity Verification Report for the Civil Aviation (Solar) Theme applicable to the proposed project.

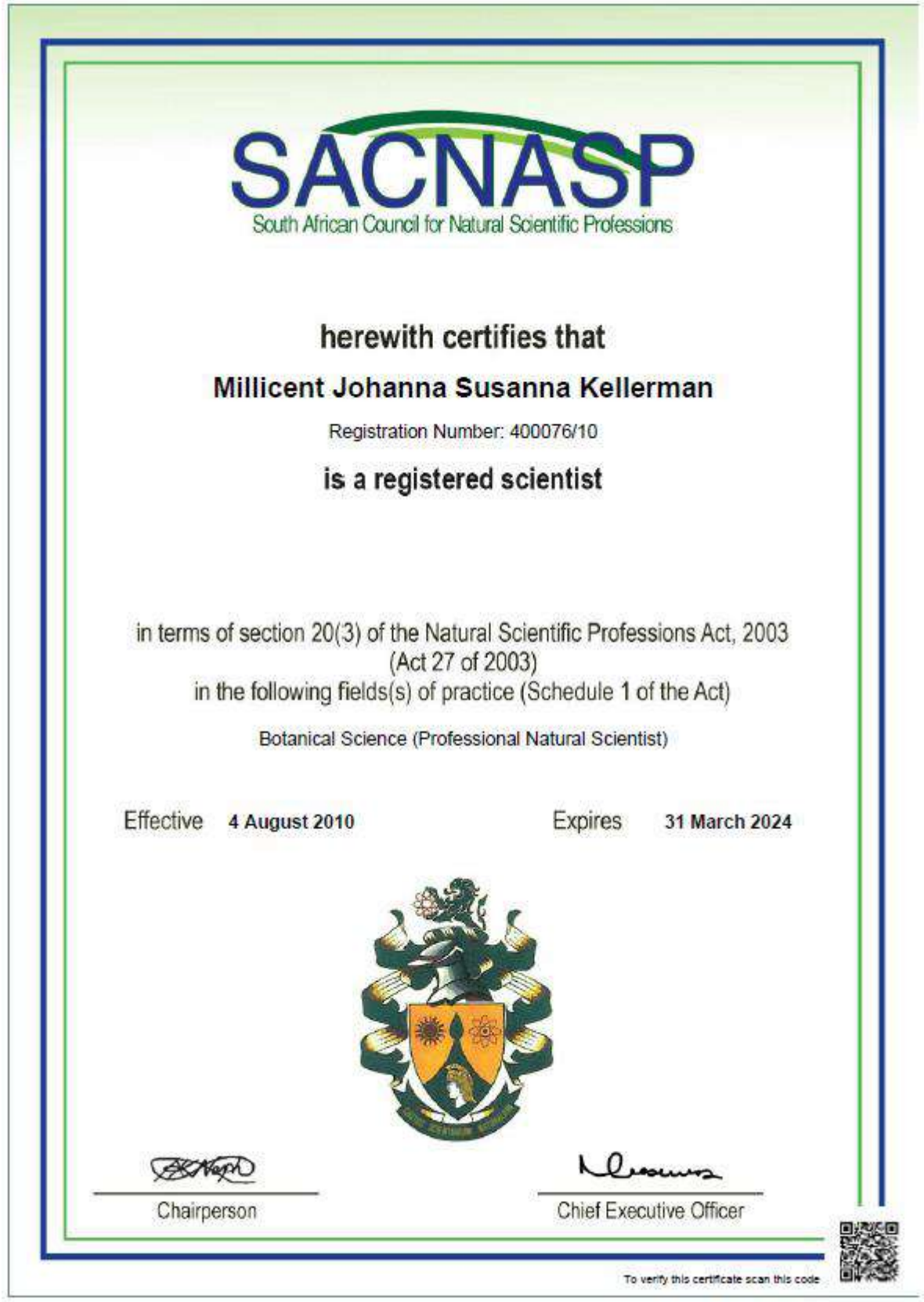
The SACAA provided written comment during the Background Information Document phase, acknowledging the acceptance of the Final Scoping Report, and EIA Phase, in which it was noted that ATNS is responsible for Solar Obstacle Applications, as published on the SACAA website[4]. The Project Applicant has lodged the necessary documents for the Obstacle Application and approval in

[4] https://www.caa.co.za/

May 2023 (outside of the NEMA process). Moreover, during the EIA Phase, the SACAA confirmed that they have no objection against the proposed development. Refer to Appendix H.6 of this EIA Report for a copy of this correspondence.

18.10 Concluding Statement

The proposed project study area was determined and verified to be of low sensitivity (as it relates to civil aviation). This was determined through a site visit and based on existing databases, and confirms the sensitivity allocated on the Screening Tool. Based on the above, in terms of GN R320, no further requirements are applicable i.e. a Compliance Statement is not required.



SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Millicent Johanna Susanna Kellerman

Registration Number: 400076/10

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Botanical Science (Professional Natural Scientist)

Effective **4 August 2010** Expires **31 March 2024**

Chairperson

Chief Executive Officer

To verify this certificate scan this code



CHAPTER 19:
Defence Site Sensitivity Verification



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19. DEFENCE SITE SENSITIVITY VERIFICATION 19-4

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Figure 19-5: Defence features relative to the proposed project study area based on the site visit and existing databases. _____19-10



Abbreviations	
ATNS	Air Traffic and Navigation Services SOC Limited
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DoD	Department of Defence
DSR	Draft Scoping Report
NEMA	National Environmental Management Act
PV	Photovoltaic
REDZ	Renewable Energy Development Zone
SANDF	South African National Defence Force
SEA	Strategic Environmental Assessment

19. DEFENCE SITE SENSITIVITY VERIFICATION

19.1 Introduction

This report serves as the Site Sensitivity Verification for Defence for the Scoping and Environmental Impact Assessment (EIA) Process for the proposed development of the Kudu Solar Facility 4 and associated infrastructure near De Aar in the Northern Cape. The proposed project forms part of a cluster of 12 Solar Photovoltaic (PV) facilities and associated infrastructure. This report deals with Kudu Solar Facility 4 (hereafter referred to as the "Kudu Solar Facility" or "proposed project").

19.2 Need for the Site Sensitivity Verification

On 20 March 2020, in Government Gazette 43110, Government Notice (GN) R320, the Department of Environment, Forestry and Fisheries (DEFF) [now operating as the Department of Forestry, Fisheries and the Environment (DFFE)] published procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) when applying for an Environmental Authorisation (EA). GN R320 prescribes general requirements for undertaking Site Sensitivity Verification, as well as protocols for assessment and minimum report content requirements of environmental impacts associated with specified environmental themes for relevant activities requiring EA. GN R320 was enforced within 50 days of publication of the notice i.e. on 9 May 2020.

GN R320 specifically includes a protocol that provides the criteria for the specialist assessment and minimum report content requirements for impacts on defence installations for relevant activities requiring EA. This protocol replaces the requirements of Appendix 6 of the 2014 NEMA EIA Regulations (as amended).

This specific protocol states that proposed developments (where relevant) that occur on sites identified as Very High, High or Medium sensitivity, as depicted on the National Web-Based Environmental Screening Tool (Screening Tool), must include a Defence Compliance Statement. It further states that there are no requirements if the proposed developments occur on sites identified as Low sensitivity on the Screening Tool. However, a Site Sensitivity Verification is required for the Defence Protocol for all sensitivity levels.

Therefore, since the proposed projects require an EA in terms of the 2014 NEMA EIA Regulations (as amended), and Defence was identified as a relevant theme in the Screening Tool Report, GN R320 must be complied with.

19.3 Methodology

The Site Sensitivity Verification Process and Report has been compiled based on the following methodology:

- Existing spatial databases were used to determine the location of defence installations in relation to the proposed project study area, and to identify preliminary areas of concern in terms of potential impacts to defence installations;
- The proposed project study area was plotted on the Screening Tool to identify the sensitivity allocated;
- A site visit was undertaken to confirm the current land use and the environmental sensitivity as it relates to Defence;
- Additional research was undertaken to substantiate the Site Sensitivity Verification process; and
- A Site Sensitivity Verification Report was compiled (i.e. this report).

The information sources listed in Table 19-1 were used in the Site Sensitivity Verification process.

Table 19-1: Information Sources used for the Site Sensitivity Verification process

Data / Information	Source	Date	Type	Description
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The proposed Kudu Solar Facility is located within the Renosterberg Local Municipality, which falls within the Pixley Ka Seme District Municipality. The proposed project is not located within any of the gazetted Renewable Energy Development Zones (REDZs); however is located within the Central Strategic Transmission Corridor that was gazetted in GN 113 on 16 February 2018. The proposed solar facility and its associated infrastructure will be constructed on a selection of the farm portions indicated in the table below, which also served as the study area for this EIA:

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Remaining Extent of the Farm Annex Wolve Kuil No. 41	C05700000000004100000
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Portion 2 of the Farm Wolve Kuil No. 43	C05700000000004300002
Remaining Extent of the Farm Wolve Kuilen No. 42	C05700000000004200000

Refer to Chapter 2 of the EIA Report for a list of affected farm properties for each proposed solar facility.

19.5 Details of the EIA Team

GN R320 states that prior to commencing with a specialist assessment, the current use of the land and the potential environmental sensitivity of the site under consideration as identified by the Screening Tool must be confirmed by undertaking a Site Sensitivity Verification.

This Site Sensitivity Verification was undertaken by Lizande Kellerman and Helen Antonopoulos. Lizande Kellerman is registered with the South African Council for Natural and Scientific Professions (SACNASP), with Registration Number 400076/10 in the field of Botanical Sciences. Helen Antonopoulos is an intern Environmental Scientist in the Environmental Management Services (EMS) group of the CSIR and holds BSc, BSc Honours, and MSc degrees in Environmental and Geographical Science from the University of Cape Town.

Inputs to the Site Sensitivity Verification Report were provided by Lizande Kellerman, Helen Antonopoulos, Rohaida Abed and Luanita Snyman-Van der Walt of the CSIR. Refer to Appendix A of the EIA Report for Curriculum Vitae of the project team.

19.6 Findings of the Screening Tool

Screening Tool Reports and/or maps were generated for the proposed projects using the following classifications:

- **Solar PV:** Utilities Infrastructure → Electricity → Generation → Renewable → Solar → PV; and
- **Substations:** Utilities Infrastructure → Electricity → Distribution and Transmission → Substation.

The Solar PV classification results in the use of the Solar PV methodology, whilst the substations classification results in the use of the general methodology on the Screening Tool.

The defence theme (for Solar PV developments) on the Screening Tool depicted that the entire study area is located in a low sensitivity area from a defence perspective i.e. there are no major or other types of defence installations or buffers that intersect with the study area or the Original and Revised Scoping Buildable Areas. Figure 19-1 illustrates the defence sensitivity in relation to the entire study area and the development footprints. The development footprints were identified following the analysis of the Original and Revised Scoping Buildable Areas in the Scoping Phase.

In line with the above, the defence theme (for substation developments) on the Screening Tool depicted that the entire study area is located in a low sensitivity area from a defence perspective (Figure 19-2).

In terms of GN R320, this means that no further requirements are applicable i.e. a Compliance Statement is not required, if the site is indeed found to be of low sensitivity during the site visit.



Figure 19-1: Screening Tool Map showing the buildable area for the proposed Kudu Solar Facility in terms of Defence Sensitivity (Source: DFFE Screening Tool, 2023).

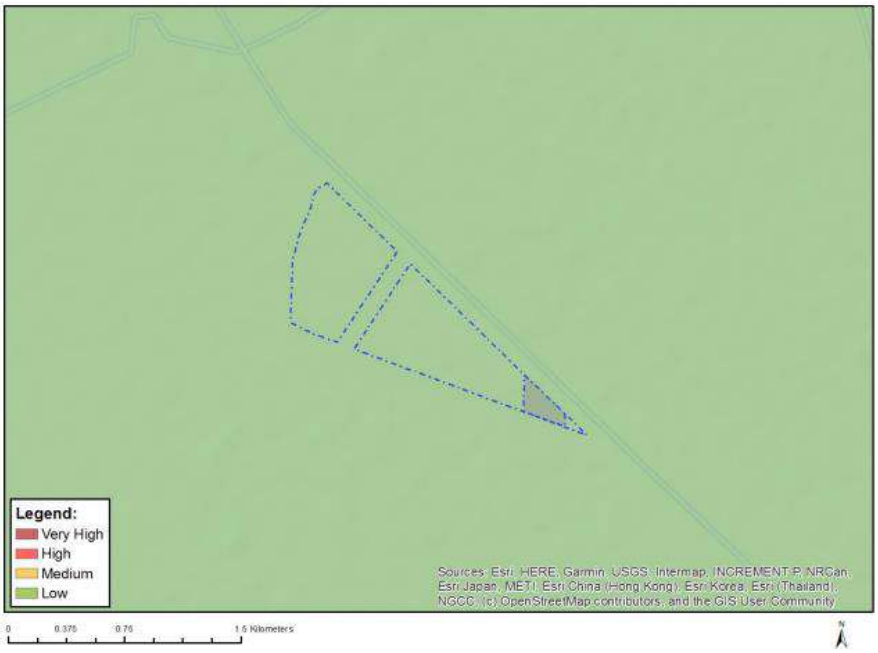


Figure 19-2: Screening Tool Map showing the buildable area for the proposed Solar Facility, as well as the on-site substation complex, in terms of Defence Sensitivity (Source: DFFE Screening Tool, 2023).

19.7 Details of the Site Visit

The details of the site visit are noted below:

Date of Site Visit	29 – 31 August 2022
Specialist Name	Lizande Kellerman
Professional Registration Number	SACNASP Registration Number 400076/10
Specialist Affiliation / Company	CSIR

19.8 Findings

The site visit confirmed that the land within the study area is used for livestock grazing, and that there are structures such as farm steads, livestock pens, waterpoints, farm roads and fences, and existing high voltage power lines within the area. This is corroborated by the Agricultural Compliance Statement (Chapter 6 of the EIA Report) which states that moisture availability is insufficient for crop production without irrigation and the potential agricultural land use of the study area is therefore limited to grazing. As noted in the Terrestrial Biodiversity and Species Assessment (Chapter 7 of the EIA Report), the study area is located in the Northern Upper Karoo (NKu3), Eastern Upper Karoo (NKu4) and the Besemkaree Koppies Shrubland vegetation types. The habitat is homogenous and consists of extensive plains with low shrubs and grasses. **No defence installations were found within the study area.** Refer to Figure 19-3 and Figure 19-4 for views of the farm portion on which the proposed project will take place.



Figure 19-3: Panoramic (180°) view from a main gravel road towards Remaining Extent of Portion 3 of the Farm Bas Berg No. 88 (NW to SE direction). This photo pertains to PV4 (Photo: L. Kellerman)



Figure 19-4: View from a main gravel road towards Remaining Extent of Portion 3 of the Farm Bas Berg No. 88 (SW direction). This photo pertains to PV4 (Photo: L. Kellerman)

Research indicates that the Department of Defence Ammunition Depot and School of Ammunition is located approximately 5 km north-west of De Aar (ArchaeoMaps Archaeological Consultancy, 2009)[3]. The Air Traffic and Navigation Services SOC Limited (ATNS) data classifies this facility as restricted airspace, which is located more than 50 km to the south-west of the study area. The Screening Tool shows this area as low sensitivity in relation to the solar methodology; however based on the general methodology for substations, this area is indicated as medium and very high sensitivity (for a military and defence site). The Screening Tool also shows another military and defence site as very high sensitivity located approximately 25 km north-west of De Aar and 37 km south-west of the study area. This same facility is highlighted under the RFI theme as a Sentech High Power Terrestrial Broadcasting Facility and a Telecommunication Facility. However, based on its location and vast distance from the study area, it will not be impacted on by the proposed project.

The features noted above are in line with the findings of the Phase 1 and Phase 2 Wind and Solar Strategic Environmental Assessment (SEA) Reports.

Figure 19-5 indicates the location of the defence features noted above, which informed this Site Sensitivity Verification.

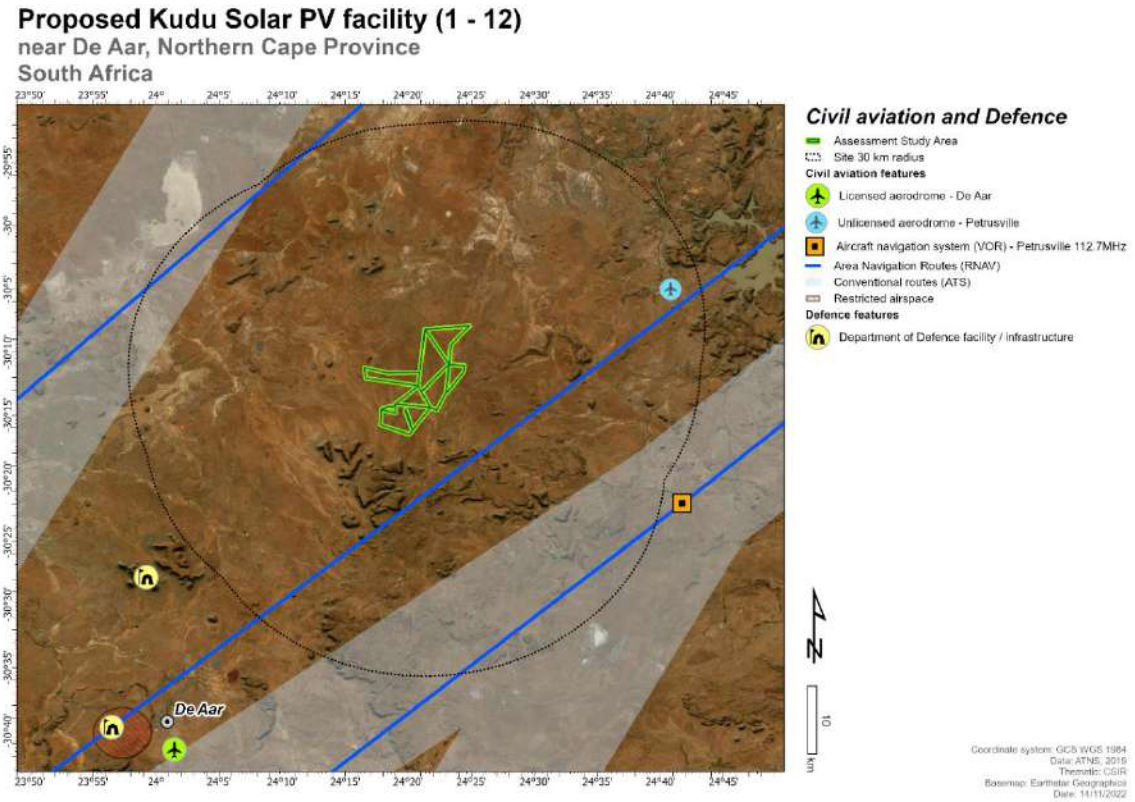


Figure 19-5: Defence features relative to the proposed project study area based on the site visit and existing databases.

[3] ArchaeoMaps Archaeological Consultancy (2009). Archaeological Impact Assessment: Establishment of an Ammunition Disposal Plant, Sinclair's Dam 133, De Aar, Northern Cape, South Africa. Date: 2009-03-23. Available online: https://sahris.sahra.org.za/sites/default/files/heritagereports/AIA%20-%20ADP,%20Sinclairs%20Dam,%20De%20Aar,%20NC.pdf, Accessed October 2022.

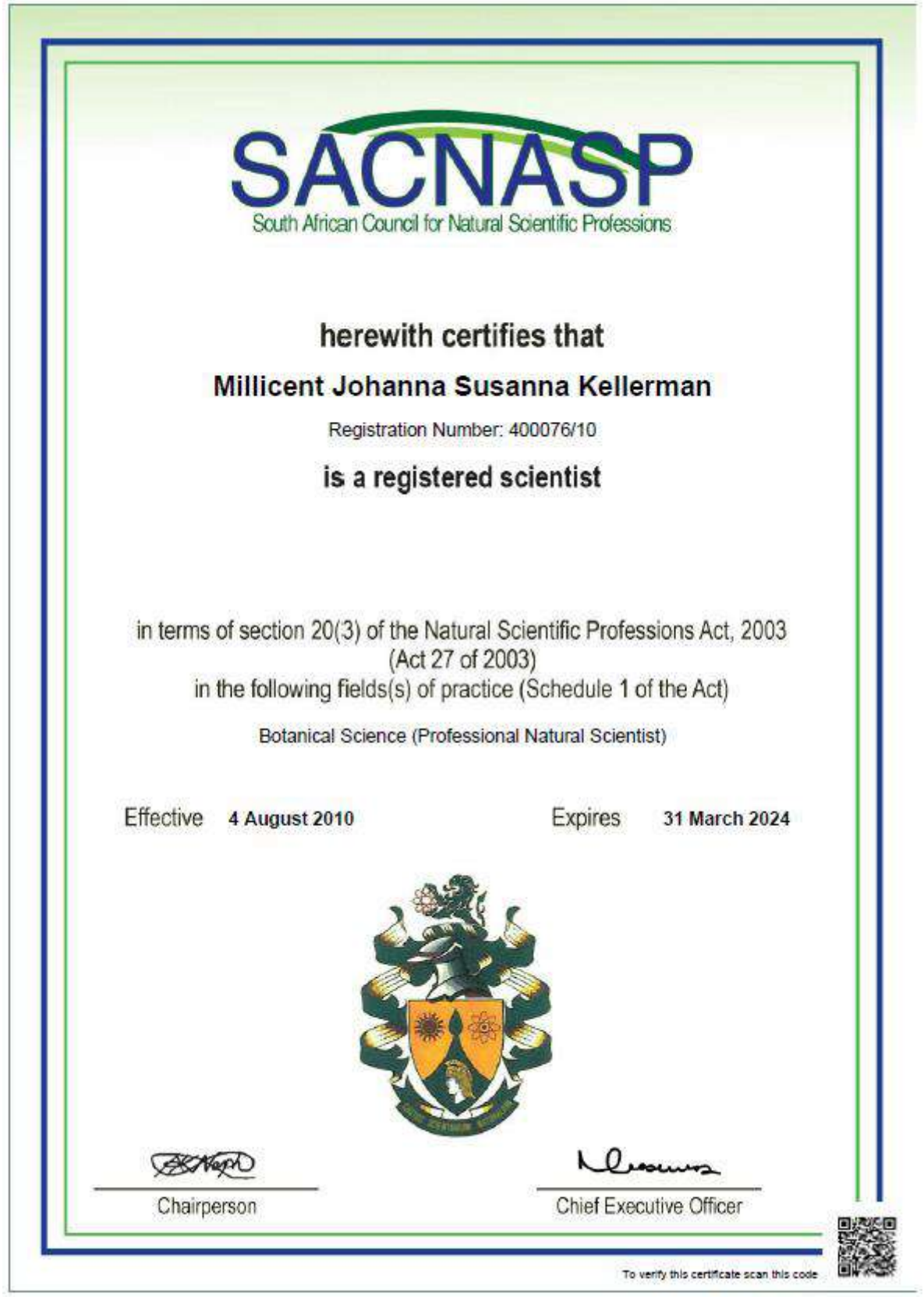
19.9 Review of the Scoping and EIA Reports

The Draft EIA Reports were made available to all registered Interested and/or Affected Parties (I&APs), Organs of State and other relevant key stakeholders for a 30-day comment period which extended from 2 June to 3 July 2023, excluding public holidays, whereas the DSRs were made available to all registered I&APs Organs of State and other relevant key stakeholders for a 30-day comment period which extended from 09 December 2022 to 30 January 2023, excluding public holidays and the regulated shutdown period.

The Department of Defence (DoD) is included as a key stakeholder on the project stakeholder database and was afforded the opportunity to comment on the DSRs and Draft EIA Reports, including this Site Sensitivity Verification Report for the Defence (Solar) Theme applicable to the proposed project. Note that no comments were received from the SANDF or the DoD on the DSRs or Draft EIA Reports, apart from a request for a KMZ file of the proposed project. Refer to Appendix H.6 of this EIA Report for a copy of this email request.

19.10 Concluding Statement

The proposed project study area was determined and verified to be of low sensitivity (as it relates to defence installations). This was determined through a site visit and based on existing databases, and confirms the sensitivity allocated on the Screening Tool. Based on the above, in terms of GN R320, no further requirements are applicable i.e. a Compliance Statement is not required.



SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Millicent Johanna Susanna Kellerman

Registration Number: 400076/10

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Botanical Science (Professional Natural Scientist)

Effective **4 August 2010** Expires **31 March 2024**

Chairperson

Chief Executive Officer

To verify this certificate scan this code



CHAPTER 20:
Conclusions and Recommendations



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20. CONCLUSIONS AND RECOMMENDATIONS

This chapter contains the main conclusions and recommendations from the Environmental Impact Assessment (EIA) Process, provides the key findings of the specialist assessments (i.e., outlines the most significant impacts identified, together with the key mitigation and management actions required to avoid or mitigate the negative impacts or enhance positive benefits), and an integrated summary of factors that will inform decision-making by the Competent Authority (i.e., the Department of Forestry, Fisheries and the Environment (DFFE)). In addition, the chapter also includes the recommendation of the Environmental Assessment Practitioner (EAP) on the environmental suitability of the project and whether the project should receive Environmental Authorisation (EA).

This EIA Report has investigated and assessed the significance of potential positive and negative direct, indirect and cumulative impacts associated with the proposed Kudu Solar Facility 4 project (hereafter referred to as the "proposed project" or "Kudu Solar Facility"). Detailed assessments of the potential impacts identified and assessed by the specialists during the EIA Phase are included in Chapter 6 to 17 of this EIA Report. **Following the exclusion of all "no-go" areas as shown in Figure 20.2, no negative residual impacts have been identified within this EIA that, in the opinion of the EAP who has conducted this Scoping and EIA Process, should be considered "fatal flaws" from an environmental perspective, and thereby necessitate substantial re-design or termination of the project.**

This chapter constitutes an **Environmental Impact Statement**, as required in terms of Appendix 3 of the 2014 NEMA EIA Regulations (as amended), which includes the following:

- a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred development footprint on the approved site as contemplated in the accepted Scoping Report indicating any areas that should be avoided, including buffers (Section 20.1);
- a summary of the identified project alternatives (Sections 20.2);
- a summary of the key findings of the environmental impact assessment (Section 20.4 and Section 20.5); and
- a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives (Section 20.4 and Section 20.5).

20.1 Environmental Sensitivity Mapping and Development Footprint for Approval

During the Scoping Phase, detailed specialist assessments were conducted for the 8150 ha study area, including further desktop analysis and field surveys, where relevant. The farm portions forming part of the study area are listed in the previous chapters of this EIA Report. The assessment of the study area led to the identification of environmental features, which were assigned relevant sensitivities by the specialists, as described in Table 20.1 below. The sensitivities identified were taken into consideration and the Revised Scoping Buildable Areas were formulated, which avoid all no-go areas. During the EIA Phase, the development footprint and layout plan were developed based on the acceptable buildable areas.

Table 20-1: Key Environmental Features and Sensitivities identified by the Specialists

Specialist Assessment / Technical Study	Environmental Features and Sensitivities Identified
Chapter 6: Agriculture Compliance Statement	▪ The Site Sensitivity Verification (SSV) verified that the entire study area is of less than high agricultural sensitivity with a land capability value of 5 to 6. There are no areas that need to be avoided from an agricultural perspective. The layout has no relevance to agricultural impact in this case. ▪ **Project specific description**: The development footprint for the PV Facility is mainly medium sensitivity, with some low sensitivity areas.
Chapter 7: Terrestrial Biodiversity, Terrestrial Plant Species, and Terrestrial Animal Species Assessment	**High Sensitivity:** ▪ The Koppies habitat is considered highly sensitive which must be avoided. No buffers are allocated. Note that this is applicable to Kudu Solar Facility 6, but it is important to mention from a contextual perspective for the study area. ▪ Linear infrastructure such as roads and overhead powerlines should not cross the Koppies, and pylons should not be constructed in this habitat. ▪ Linear infrastructure such as roads and overhead powerlines can cross the Watercourse, but it is advised to construct pylons outside the buffer areas. **Medium Sensitivity:** ▪ The White and Shrubby Grasslands are considered of medium sensitivity owing to its pristine nature with limited major impacts. ▪ The Watercourse sensitivity is medium as per the findings of the Aquatic Specialist. Refer to the feedback below. **Very Low Sensitivity:** ▪ Existing transformed areas. ▪ **Project specific description**: The development footprint for the PV Facility is entirely medium sensitivity due to White Grassland. The medium and low sensitivity watercourse features are avoided and do not intersect with the layout for the development footprint of the PV Facility.
Chapter 8: Aquatic Biodiversity	▪ The recommended buffer area between the aquatic features and the project components to ensure these aquatic ecosystems are not impacted by the proposed activities is as follows: o The larger tributary: The delineated edge of the surrounding floodplain wetland features (medium sensitivity). No buffer area is deemed to be required. o Smaller streams and drainage features that are indicated to be of medium sensitivity: At least 35 m for the watercourse or the delineated edge of wetland features.

Specialist Assessment / Technical Study	Environmental Features and Sensitivities Identified
	▪ The Battery Energy Storage System (BESS) should be preferably not be placed within 100 m of major rivers, watercourses and wetlands. ▪ Pans: One pan was found within the study area on Remaining Extent of the farm Wolve Kuilen No. 42. A 50 m buffer around this pan has been recommended. It does not intersect with the development footprint. ▪ Features that have been allocated a low sensitivity (smaller feeder streams, dams and minor drainage features) do not need to be avoided by the proposed development. ▪ Some access roads do cross water courses, which would be acceptable provided the recommended mitigation is implemented. For road crossings, the sensitivities are not regarded as no-go. ▪ **Project specific description**: The development footprint for the PV Facility is entirely low sensitivity. The nearby medium sensitivity watercourse features are avoided and do not intersect with the layout for the development footprint of the PV Facility.
Chapter 9: Avifauna Assessment	▪ **All infrastructure exclusion zones**: Verreaux's Eagle nest: A 1 km all infrastructure exclusion zone is recommended to prevent the displacement of the breeding pair during the construction phase due to disturbance. ▪ **Solar panel exclusion zones (other infrastructure allowed)**: **Water points (e.g. water troughs, dams, boreholes)**: Surface water in this semi-arid habitat is important for priority avifauna and many non-priority species. The surrounding area contains several boreholes which are sources of surface water. It is preferable to leave some open space where possible with no solar panels, for birds to access and leave the surface water area unhindered. Some water points have been buffered by a minimum of 50 m, and some may be removed. ▪ **High sensitivity areas**: The entire Study Area is a high sensitivity zone due to the potential presence of several SCC including Ludwig's Bustard, Secretarybird, Martial Eagle, Cape Vulture and White-backed Vulture which could utilise the whole Study Area for foraging. However, these species do not require specific avoidance because there is still adequate habitat available outside the Study Area. Therefore, the high sensitivity is not a no-go and does not need to be avoided. ▪ **Project specific description**: The entire development footprint is High Sensitivity (not a no-go and does not need to be avoided, as described above). The development footprint does not overlap with any waterpoint solar panel exclusion zones, it overlaps with a waterpoint which will be removed, as discussed above, and this does not present a significant risk to avifauna. Verreaux's Eagle nest is more than 2 km away from the development footprint.

Specialist Assessment / Technical Study	Environmental Features and Sensitivities Identified
Chapter 10: Visual Impact Assessment	The following features are assigned Very High sensitivity (i.e. no-go) and need to be avoided for the proposed solar PV Facility itself (i.e. not for associated infrastructure such as substations, BESS, internal power lines and access roads; which would have minor buffers): ▪ Scenic Resources: o Topographic features: Feature. o Steep slopes: Slopes > 1:4. o Drainage courses: Feature. o Cultural landscapes within 250 m. ▪ Protected Landscapes / Sensitive Receptors: o Nature reserves / game farms within 500 m. o Farmsteads outside study area within 500 m. o Farmsteads inside study area within 250 m. o Arterial routes within 250 m (not applicable). ▪ District roads within 50 m. Note that the area of high sensitivity to the western end of the development footprint / buildable area is due to a 50 m buffer from a drainage course as per the Visual Impact Assessment, however this is not a no-go area, as confirmed by the specialist and explained in the study, and the layout as currently proposed succeeds in avoiding visually sensitive areas. Note that all aquatic no-go areas have also been considered in the layout planning (discussed above). ▪ **Project specific description**: The proposed solar PV borders on a drainage feature and local road but outside the no-go buffer areas. The nearest surrounding farmstead, Vrede, is 2.59 km away, and well outside the buffer area. The development footprint is low sensitivity from a visual perspective.
Chapter 11: Heritage Impact Assessment (Archaeology and Cultural Landscape)	▪ Most resources located within the study area are cultural landscape components and are of low cultural significance and hence sensitivity. The site visit confirmed that the study area is of low sensitivity but with several pockets of higher sensitivity being present in the surrounding landscape (where archaeological and other heritage resources were found). Some of these areas outside of the project development footprint are considered to be archaeologically sensitive (i.e. of high sensitivity), but those sites marked as low cultural significance can be seen as medium sensitivity. The remaining land in between is of low sensitivity. A minimum 50 m buffer has been placed around relevant features. ▪ There are no significant concerns for the proposed project. The facility layout has been designed to avoid all known culturally significant heritage resources with the exception of the cultural landscape which will not be significantly impacted. There are no areas requiring avoidance and no further protective buffers are needed.

Specialist Assessment / Technical Study	Environmental Features and Sensitivities Identified
	▪ **Project specific description**: The development footprint is low sensitivity from a heritage perspective.
Chapter 12: Palaeontology Site Sensitivity Verification Report	▪ There are no areas that need to be avoided from a palaeontology perspective. The site visit undertaken by the specialist found very low bedrock exposure and concluded that the site is of low to very low palaeo-sensitivity. ▪ **Project specific description**: The development footprint has a low desktop and field-based palaeo-sensitivity. No fossils were recorded within the footprint.
Chapter 13: Socio-Economic Assessment	▪ Not applicable. There are no sensitivities of this nature that can be mapped and that would influence the layout of the proposed project. ▪ **Project specific description**: Not applicable.
Chapter 14: Traffic Impact Assessment	▪ Not applicable. There are no sensitivities of this nature that can be mapped and that would influence the layout of the proposed project. ▪ **Project specific description**: Not applicable.
Chapter 15: Battery Energy Storage System High Level Safety, Health and Environment Risk Assessment	▪ The BESS should be placed at least 50 m away from known boreholes and water points, and 100 m away from major surface water features, such as major rivers and wetlands. ▪ Due to the possibility of noxious smoke from potential fires, any lithium-ion BESS should be located over 500 m from residential areas, in this case isolated farm houses that are occupied. If this is not possible, it is noted that the risks are low and advice of mitigative measures should be provided to the farm occupants, e.g. shelter in place indoors. ▪ **Project specific description:** The BESS is located 50 m away from known water points and boreholes; 100 m away from major surface water features identified by the Aquatic Biodiversity Specialist; and more than 500 m away from the nearest farmstead.
Chapter 16: Geohydrology Assessment	▪ It is recommended that all BESS are placed a minimum of 50 m from any borehole. ▪ **Project specific description:** The BESS is located 50 m away from known boreholes.
Chapter 17: Geotechnical Assessment	▪ There are no areas within the study area that should be avoided from a geotechnical sensitivity perspective. However, areas of moderate to steep topography would likely render development financially unfeasible. ▪ **Project specific description**: No areas identified for avoidance in the development footprint.

Specialist Assessment / Technical Study	Environmental Features and Sensitivities Identified
Chapter 18: Civil Aviation	▪ No sensitive civil aviation features have been identified within the study area. ▪ **Project specific description**: The development footprint is low sensitivity from a civil aviation perspective.
Chapter 19: Defence	▪ No sensitive defence features have been identified within the study area. ▪ **Project specific description**: The development footprint is low sensitivity from a defence perspective.

Based on the environmental sensitivities identified and verified by the specialists on site, an overall combined environmental feature map and environmental sensitivity map have been compiled for the study area. The comments received from the DFFE on the requirements for the sensitivity maps have been considered and incorporated as best as possible.

Figure 20.1 shows the identified and assessed environmental features present within the study area and allocated buffers; whereas Figure 20.2 shows the environmental sensitivity that has been allocated to these features. These maps indicate that the inherent environmental sensitivity of the proposed project study area is generally medium to low, with some very high and high sensitivity areas. The study area is suited for the development of the proposed project based on the understanding that measures have been taken to firstly avoid the sensitive features as best as possible, and all aspects to manage or mitigate potential impacts have been taken into consideration and detailed during the EIA Phase.

The buildable areas and development footprints are overlain onto these maps to show how they relate to the environmental features and sensitivities, and how the no-go areas have been avoided. Figure 20.3 shows a detailed layout map indicating the development footprint and buildable area; and Figure 20.4 indicates a combined layout and sensitivity map. Figure 20.5 is a combined cumulative impacts and environmental sensitivity map (based on the sensitivities identified by the specialists). Key maps are also included in Appendix C of this EIA Report.

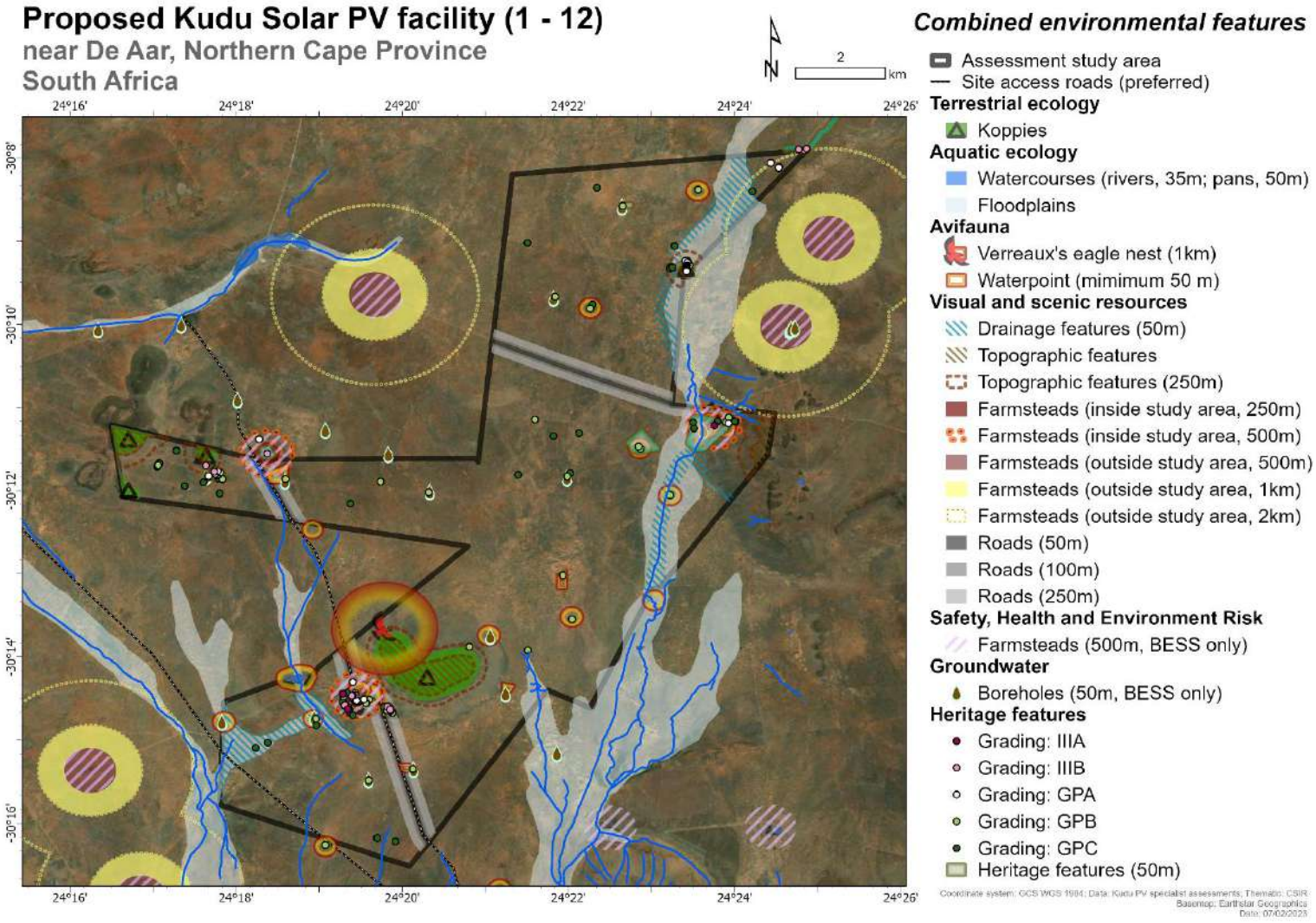


Figure 20-1: Combined environmental feature map for the proposed project study area based on specialist inputs.

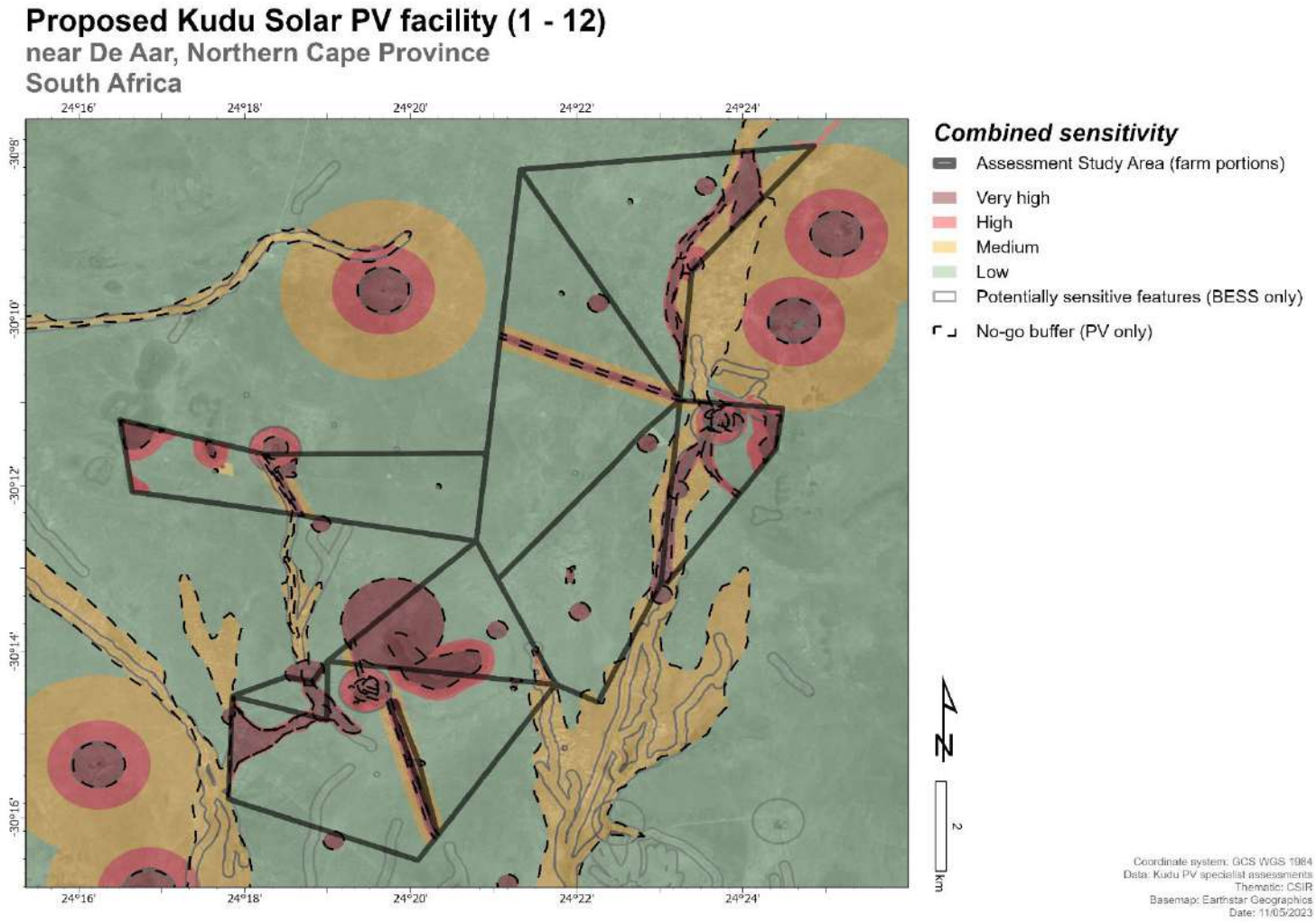


Figure 20-2: Combined environmental sensitivity map for the proposed project study area based on specialist inputs.

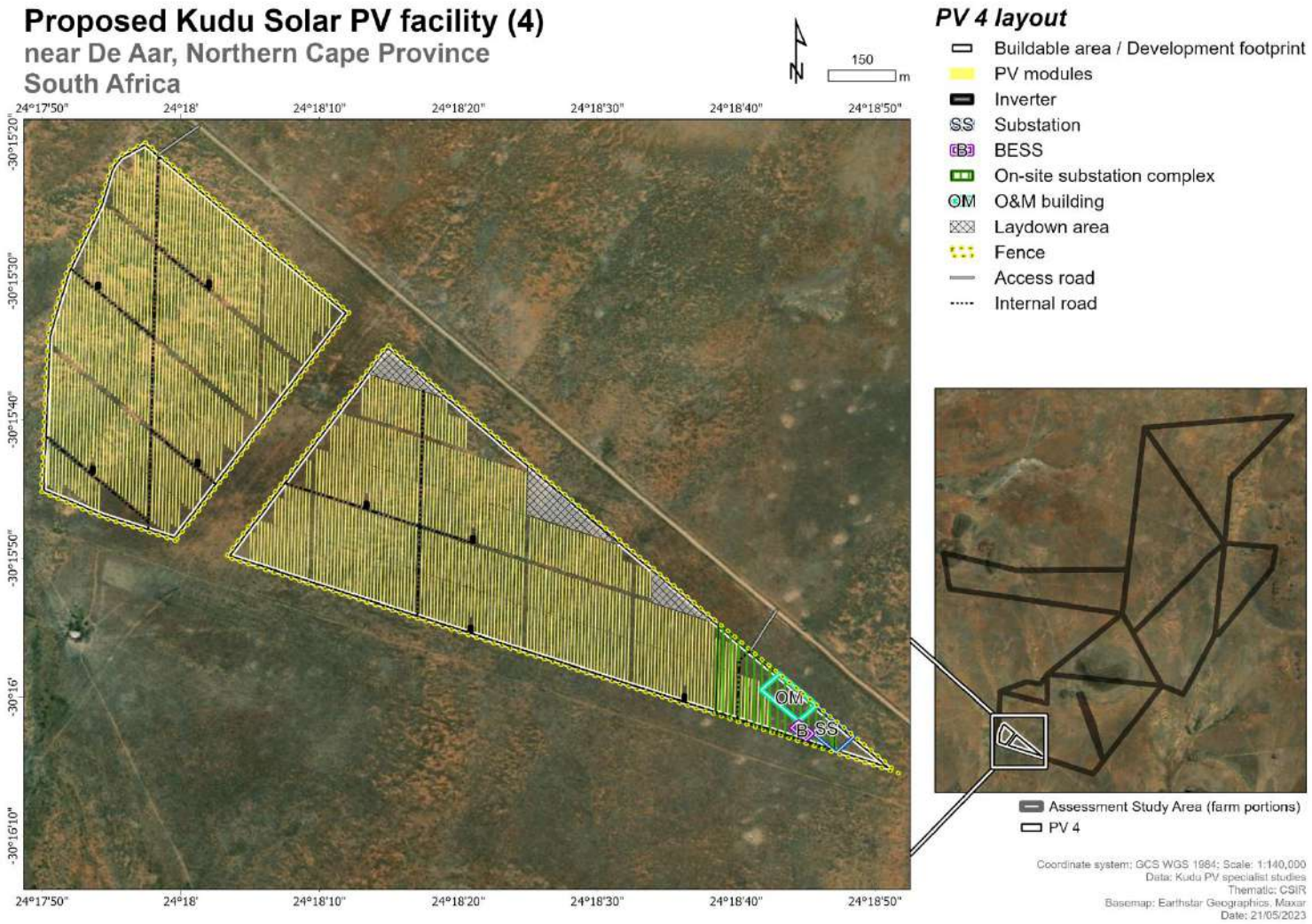


Figure 20-3: Project Layout Map showing the detailed infrastructure, buildable area and development footprints.

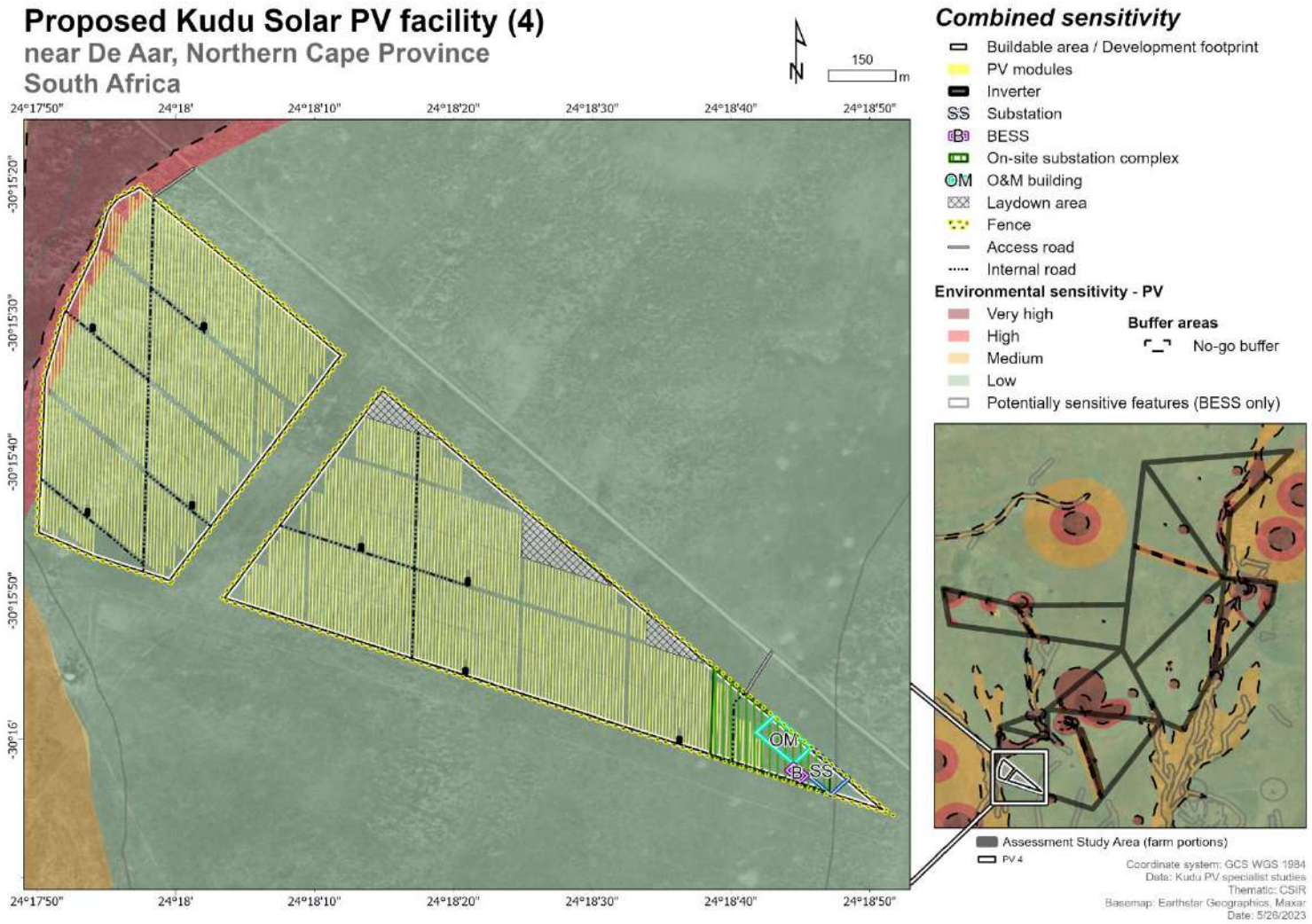


Figure 20-4: Combined Project Layout and Sensitivity Map.

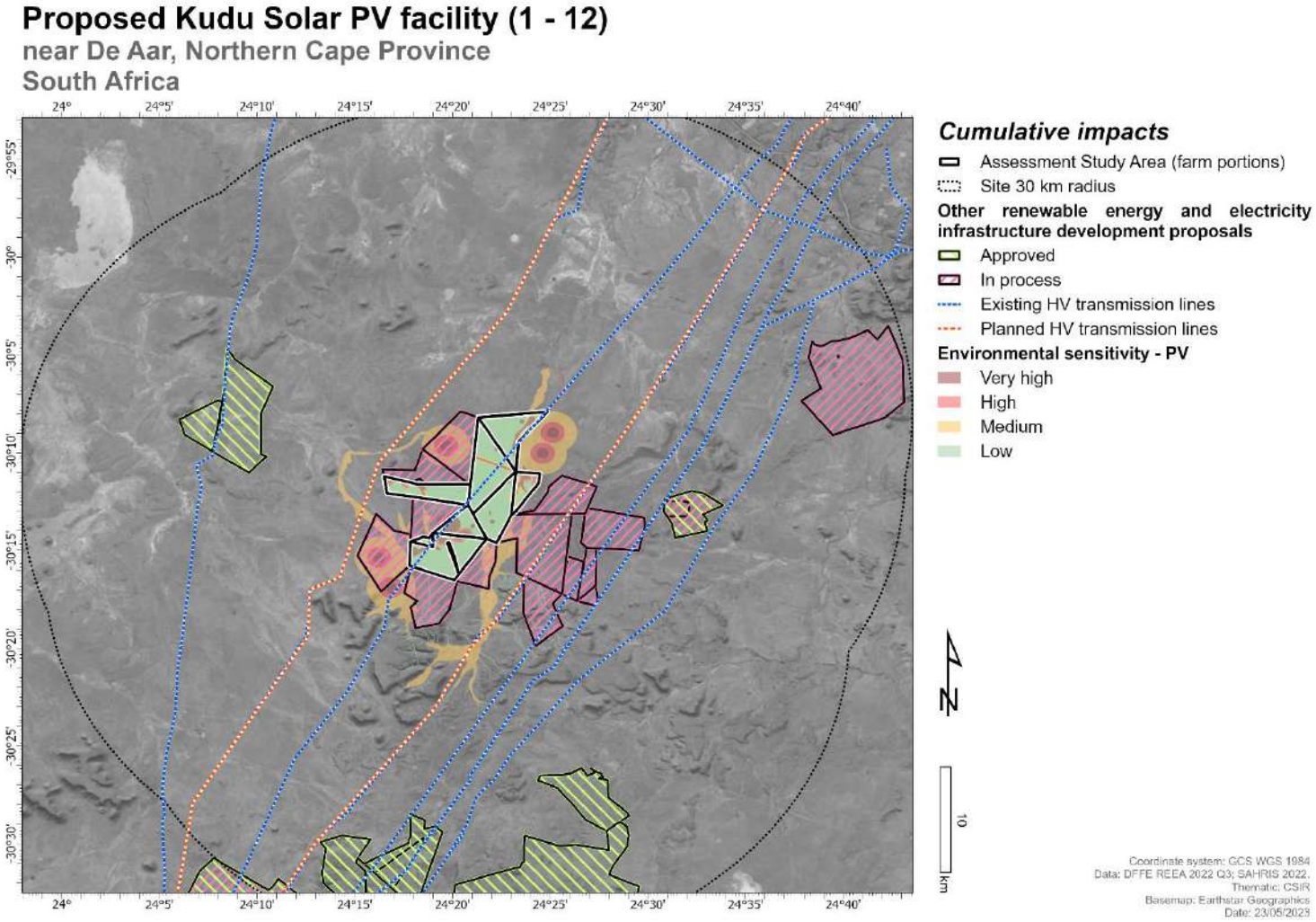


Figure 20-5: Combined Environmental Sensitivity and Cumulative Impact Map.

20.2 Summary of Project Alternatives

As discussed in Chapter 5 of this EIA Report, various alternatives have been considered and assessed as part of the EIA Phase.

- **Land-Use Alternative:**
  - The current land-use is agriculture, specifically low density small stock grazing. There is no cultivation in the area. The study area has low to medium agricultural sensitivity. The Solar PV facility is regarded as the preferred land-use.

- **Type of Activity Alternative:**
  - This relates to the generation of electricity from a renewable energy source, and in this particular case, from solar resources. The **generation of electricity from a renewable energy source was the only activity considered**, and thus considered in this Scoping and EIA Process. **No other activity types were considered or deemed appropriate** based on the expertise of the Project Developer.

- **Renewable Energy Alternatives:**
  - Given the above, the development of Solar PV is the preferred and only renewable energy technology to be developed on site because the site has a **very good solar resource availability** (i.e. GHI of 2 000 to 2 200 kWh/m^2 in terms of the long-term yearly total) and the **local conditions are favourable**.

- **Preferred Site and Development Footprint within the site:**
  - The preferred site for all the proposed Kudu Solar Facilities comprises eight farm portions which cover a combined footprint of 8 150 ha, which serves as the study area for this Scoping and EIA Process. This is the approved site as per the accepted Final Scoping Report.
  - This led to the identification of the buildable areas and development footprints within the preferred site that avoids no-go environmental sensitivities identified by the specialists. The combined layout and environmental sensitivity map is shown in Figure 20.4.
  - The approach followed was to use environmental and social constraints to avoid sensitive features, thus applying mitigation hierarchy thinking. This approach replaces the need to rank alternative sites and locations, as it leads to the selection of the least sensitive development footprint.

- **No-Go Alternative:**
  - The no-go alternative assumes that the proposed project will not go ahead i.e. it is the option of not constructing the proposed Kudu Solar Facility. This alternative would result in no environmental impacts (positive and negative) on the preferred site or surrounding local area, as a result of the proposed project. The no-go alternative has been assessed by all relevant specialists during the EIA Phase. Table 20.2 is a summary of the findings of the no-go alternative consideration.

Table 20-2: Summary of the No-Go Alternative based on Specialist Assessments

Specialist Assessment	No-Go Alternative
Chapter 6: Agriculture Compliance Statement	▪ The no-go alternative considers impacts that will occur to the agricultural environment in the absence of the proposed development. There are no agricultural impacts of the no-go alternative. ▪ The development offers an alternative income source to agriculture, but it excludes agriculture from a proportion of the land. Therefore, even though the excluded land has no crop production potential, the negative agricultural impact of the development is more significant than that of the no-go alternative, and so, purely from an agricultural impact perspective, the no-go alternative is the preferred alternative between the development and the no-go. However, the no-go option would prevent the proposed development from contributing to the environmental, social and economic benefits associated with the development of renewable energy in South Africa.
Chapter 7: Terrestrial Biodiversity, Terrestrial Plant Species, and Terrestrial Animal Species Assessment	▪ The no-go alternative means the project does not get developed and no transformation or disturbance of topsoil and vegetation takes place, and no removal of provincially protected species are required. The baseline conditions signify the two grasslands, the Northern Upper Karoo and the Eastern Upper Karoo, remain as is with all current impacts still present, including livestock pens, waterpoints, windpumps, alien invasive species, fences and existing overhead powerlines. Furthermore, impacts on ecosystem functions including biodiversity protection, water regulation, quantity and quality, protection of medicinal plants, and climate refugia habitats will not be impacted on, and will continue as normal. ▪ Should the development not proceed, the landowners will continue to utilise the grassland (baseline - dominant land use) for grazing purposes and creates an opportunity for the land to be used for other means, should the landowner, for example, wish to do other developments on site. Any development considered for this site, should result in a net benefit to society and should avoid undesirable negative impacts. ▪ It must be noted however, that not approving this project does not exclude other renewable energy projects from being developed in this area. ▪ Accordingly, since this area is not considered an exclusion zone for development, multiple applications for renewable energy has and is being submitted to the competent authority for approval. ▪ Therefore, the no-go alternative cannot be looked in isolation and must take into account the regional land use and other developments to determine the 'sense of place' and whether this development will significantly impact on the baseline conditions in a regional context.
Chapter 8: Aquatic Biodiversity	▪ The watercourses and associated wetlands and floodplains are in a largely natural to moderate condition due to the low level of impact in the area. ▪ The no-go option will thus result in no additional impacts on aquatic biodiversity and will result in the ecological status quo being maintained, which will be to the advantage of aquatic systems and biodiversity. ▪ However, with that being said, no fatal flaws were discovered in the course of the investigations for the proposed Kudu Solar Facility. The potential aquatic ecosystem impact significance for the proposed activities, with mitigation, is rated as very low.
Chapter 9: Avifauna Assessment	▪ The no-go option will result in no additional impacts on avifauna and will result in the ecological status quo being maintained, which will be to the advantage of the avifauna. However, with that being said, no fatal flaws were discovered in the course of the investigations for the proposed Kudu Solar Facilities, and with mitigation the potential impact significance is rated as mainly low.
Chapter 10: Visual Impact Assessment	▪ The 'no-go' alternative is the option of not constructing the project in which case the status quo of the current landscape character would prevail, the disadvantage being that no solar energy would be produced for export to the national grid. The potential visual impact would be neutral where the status quo is maintained, with neither impacts or benefits occurring.

Specialist Assessment	No-Go Alternative
Chapter 11: Heritage Impact Assessment (Archaeology and Cultural Landscape)	▪ If the project were not implemented, then the site would stay as it currently is (impact significance of negligible for archaeology and graves and very low negative for the landscape). ▪ Although the heritage impacts with implementation would be greater than the existing impacts, the loss of socio-economic benefits is more significant and suggests that the No-Go option is less desirable in heritage terms.
Chapter 12: Palaeontology Site Sensitivity Verification Report	▪ Not applicable as the study did not require an impact assessment due to the low to very low palaeo-sensitivity.
Chapter 13: Socio-Economic Assessment	▪ The no development option would represent a lost opportunity for South Africa to improve energy security and supplement its current energy needs with clean, renewable energy. Given South Africa's current energy security challenges and its position as one of the highest per capita producers of carbon emissions in the world, this would represent a significant negative social cost. The no development option is not supported by the findings of the Socio-Economic Assessment.
Chapter 14: Traffic Impact Assessment	▪ The no-go option will result in no additional impacts on traffic and will result in the road and traffic status quo being maintained. ▪ However, with that being said, no fatal flaws were discovered in the course of the investigations for the proposed project, and with mitigation the potential impact significance is rated as mainly low to very low.
Chapter 15: Battery Energy Storage System High Level Safety, Health and Environment Risk Assessment	▪ No-go alternative is not required to be assessed based on technical nature of the study.
Chapter 16: Geohydrology Assessment	▪ The farm portions where the project is proposed does not currently utilise significant volumes of groundwater and small-scale abstraction is predominantly for domestic purposes. As such the No-go alternative does not represent a risk to groundwater or aquifer depletion. However, there is a low water demand in the study area and a large spatial extent; and the impacts relating to the use of ground water are not considered to be very significant, especially if the proposed projects are planned and phased suitably.
Chapter 17: Geotechnical Assessment	▪ In terms of the no-go alternative, if the proposed development does not go ahead, there will be no need for displacement and/or loss of topsoil in the area. However, to date, apart from the construction of farmhouses and the erection of boundary and subcamp fences for farming purposes; little disturbance of the subsoils and rocks in the area proposed for development has taken place. For this reason, the no-go alternative is considered of low significance. ▪ However, the potential impacts of the proposed project from a geotechnical perspective are not considered to be very significant, especially if the recommended mitigation measures are adopted.

- As outlined in Section 20.4 and Section 20.5 of this chapter, the majority of the negative impacts identified as part of this assessment can be reduced to moderate or low significance with the implementation of mitigation measures. None of specialists found that the proposed projects should not go ahead i.e. no fatal flaws were identified. As noted above, the Socio-Economic Impact Assessment identified positive impacts from a social upliftment perspective. These include benefits to the local community via employment opportunities and the development of locally-owned industries to support construction related activities.
- Therefore, while the "no-go" alternative will not result in any negative environmental impacts as a result of the proposed project; it will also not result in any positive community development or socio-economic benefits. It will not assist government in addressing climate change commitments and reaching its set targets for reduced carbon emissions. Furthermore, it will not assist in generating the additional electricity

that is urgently required to address the shortage of generation capacity in the country and the need for new solar PV generation capacity that is specified in the energy planning for the country. **Hence the "no-go" alternative is not a preferred alternative, or a reasonable and feasible alternative considered in this Scoping and EIA Process**.

- **Technology Alternatives**
  - Solid State Lithium Ion Battery Energy Storage System (BESS) and Redox Flow BESS technology types have been assessed and were considered by the specialists as part of the proposed project components.
  - None of the specialists have identified any specific concerns relating to the BESS.
  - As noted previously, a High-Level High Level Safety, Health and Environment Risk Assessment (Chapter 15 of the EIA Report) was specifically commissioned for the BESS and it provides significant detail and information of the BESS technology alternatives.
  - Table 20.3 provides a summary of the specialist findings regarding the BESS technologies.

Table 20-3: Summary of the BESS Technology Alternatives based on Specialist Assessments

Specialist Assessment	Battery Energy Storage System (BESS) Technology Assessment
Chapter 6: Agriculture Compliance Statement	▪ Technology alternatives with respect to the BESS will make absolutely no material difference to the significance of the agricultural impacts. ▪ All BESS technology alternatives are acceptable.
Chapter 7: Terrestrial Biodiversity, Terrestrial Plant Species, and Terrestrial Animal Species Assessment	▪ No BESS is located in a sensitive area, but it is located within the grassland. ▪ For the Solid State Lithium Ion BESS, the necessary measures need to be put in place to limit potential fires, including considering a fire break (i.e. A natural or constructed barrier used to stop or check fires that may occur), if possible, around each Kudu PV facility (this is a worst-case scenario). ▪ However, as a containerised approach including the usual good practice of separation between containers which will be applied for this project, the impacts are likely restricted to events to one container at a time. ▪ For Redox Flow BESS, the most significant hazard is the possibility of spills of corrosive and environmentally toxic electrolyte. Several preventative and mitigative measures have been proposed in the EMPr and High-Level BESS Safety, Health and Environment Risk Assessment. ▪ The type of BESS technology will have no influence on terrestrial biodiversity; therefore, both are considered viable options. There are no fatal flaws associated with the proposed battery installation for either technology types.
Chapter 8: Aquatic Biodiversity	▪ Both BESS technologies have been considered. ▪ The proposed BESS within the site is not of aquatic ecosystem concern, given that the aquatic ecosystems have been avoided and adequately buffered. ▪ Either BESS technology would thus be suitable.
Chapter 9: Avifauna Assessment	▪ Both BESS technologies have been considered in this assessment. ▪ The type of technology will have no influence on avifauna; therefore, both are considered viable from an avifaunal perspective. ▪ The impacts of habitat transformation and disturbance associated with the BESS are covered in the assessment.
Chapter 10: Visual Impact Assessment	▪ The substation and BESS have been considered as an integral part of the solar facility and mitigations for these have been included in the Visual Impact Assessment. ▪ Both BESS technologies are considered viable from a visual perspective.
Chapter 11: Heritage Impact Assessment (Archaeology and Cultural Landscape)	▪ Two different battery technologies are being considered, but this makes no difference to the heritage assessment and, being equally acceptable, they were not assessed separately in the Heritage Impact Assessment report.

Specialist Assessment	Battery Energy Storage System (BESS) Technology Assessment
Chapter 12: Palaeontology Site Sensitivity Verification Report	▪ Not applicable as the study did not require an impact assessment due to the low to very low palaeo-sensitivity. However, no concerns were raised for all project components. The BESS was considered as part of the project components.
Chapter 13: Socio-Economic Assessment	▪ The proposed BESS site is not located within significant proximity to any social receptors. The study area is very sparsely populated. No inhabited dwellings are located within 2 km of the site. The proposed site is therefore suitable from a social impact assessment point of view. ▪ Both proposed technology options (Redox flow and Lithium ion) are acceptable from a Social Assessment perspective.
Chapter 14: Traffic Impact Assessment	▪ Both BESS technologies have been considered in the Traffic Impact Assessment. ▪ This type of technology will have no significant influence on traffic; therefore, both are considered viable from a traffic perspective. ▪ The traffic impacts discussed in the Traffic Impact Assessment are also associated with the BESS.
Chapter 15: Battery Energy Storage System High Level Safety, Health and Environment Risk Assessment	▪ A detailed BESS High-Level Safety, Health and Environment Risk Assessment was undertaken as part of the EIA Process. Note that this assessment is a technical study and does not need to comply with the requirements of the 2014 NEMA EIA Regulations (as amended). ▪ From a safety and health point of view, the Risk Assessment shows that risks posed by Vanadium Redox Flow BESS may be slightly lower than those of Solid State Lithium Ion BESS, particularly with respect to fire and explosion risks. ▪ From an environmental spill and pollution point of view the Vanadium Redox Flow BESS present higher short-term risks than the SSL systems. ▪ However, the above conclusions may be due to the fact that the Vanadium Redox Flow BESS technology is not as mature as Solid State Lithium technology and therefore there is not as much operating experience and accident information available for the Redox Flow BESS. ▪ Overall, from a Safety, Health and Environment Risk Assessment point of view, there is no specific preference for a type of technology. ▪ The assessment confirmed that there are no fatal flaws associated with the proposed battery installation for either technology type.
Chapter 16: Geohydrology Assessment	▪ Both BESS technologies have been considered in the assessment. T ▪ he risks associated with each individual technology is such that, with strict adherence to the appropriate mitigation measures, both technologies will have little risk to the local hydrogeological system. ▪ Furthermore, no fatal flaws of either technology with respect to the geohydrological system have been identified. ▪ Considering this, both Lithium Ion BESS and Redox Flow BESS are considered suitable, and no preference is given to either one.
Chapter 17: Geotechnical Assessment	▪ Both Lithium Ion and Redox Flow BESS technologies have been assessed. ▪ It is important to note that the choice of technology will not be influenced by geotechnical factors, thus both options are considered suitable from a geotechnical standpoint.

Based on the above, and the High-Level Safety, Health and Environment (SHE) Risk Assessment which has provided significantly detailed inputs, Solid State Lithium Ion BESS has been selected as the preferred BESS technology.

It must be re-iterated that both BESS technologies were assessed during the EIA Phase and found to be acceptable. However, Solid State Lithium Ion is the preferred and if this changes post EA (should such authorisation be granted), the Project Applicant will apply for a separate amendment process with the Competent Authority.

20.3 Need and Desirability

This EIA considered the nature, scale and location of the proposed development as well as the wise use of land (i.e., is this the right time and place for the development of this proposed project). The proposed project is linked to the national planning vision for large-scale wind and solar development in South Africa. The development of solar energy is important for South Africa to reduce its overall environmental footprint from power generation (including externality costs), and thereby to steer the country on a pathway towards sustainability.

The development of renewable energy is strongly supported at a national, provincial, and local level. The Northern Cape region is attractive for renewable energy projects due to the significant solar energy resources. Several renewable energy projects have been approved within a 30 km radius of the proposed project side, with a few facilities already developed and in operation.

The Final Integrated Development Plan (IDP) (2022 – 2027) for the Pixley Ka Seme District Municipality (PKSDM) identifies solar energy as a development opportunity in the RLM. The 2019-2020 IDP notes that the economy in the PKSDM is characterized by high levels of poverty, and low levels of development despite the strategic location in terms of the national transport corridors. The IDP recognises renewable energy projects as potential sustainable economic development opportunities. The development of the proposed project will therefore also be in line with the vision of the PKSDM to diversify the job market by creating and supporting sustainable economic growth and development opportunities.

20.4 Specialist Impact Assessment

Based on the detailed specialist assessments, various potential impacts have been identified. A summary of the main impacts identified is provided in Table 20.4. Note that several mitigation measures have also been provided by the specialists, however only selected key measures are noted in the table below. The specialist assessments included in Chapters 6 to 17 of this EIA Report contain all the detail. The recommended mitigation measures have been included in the Environmental Management Programme (EMPr) in Appendix I and Appendix J of this EIA Report.

Table 20-4: Summary of Key Impacts that were identified and assessed during the EIA Phase as part of the Specialist Assessments, including key recommended mitigation measures

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
Chapter 6 – Agriculture Compliance Statement	**Negative Direct Impacts:** **Construction Phase**: • Loss of agricultural potential by occupation of land. • Loss of agricultural potential by soil degradation. Soil can be degraded by impacts in three different ways: erosion; topsoil loss; and contamination. • Loss of agricultural potential by dust generation. **Decommissioning Phase**: • Loss of agricultural potential by soil degradation. Soil can be degraded by impacts in three different ways: erosion; topsoil loss; and contamination. • Loss of agricultural potential by dust generation. **Positive Indirect Impacts (mainly during operations):** • Increased financial security for farming operations. • Improved security against stock theft and other crime due to the presence of security infrastructure and security personnel at the energy facility.	**Design Phase:** ▪ Design an effective system of stormwater run-off control, where it is required - that is at any points where run-off water might accumulate. The system must effectively collect and safely disseminate any run-off water from all accumulation points and it must prevent any potential down slope erosion. This is included in the stormwater management plan. **Construction and Decommissioning Phases:** ▪ Implement an effective system of stormwater run-off control, where it is required (as specified above). ▪ Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize disturbed soil against erosion. ▪ If an activity will mechanically disturb the soil below surface in any way, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. **Operational Phase:** ▪ Maintain the stormwater run-off control system. Monitor erosion and remedy the stormwater control system in the event of any erosion occurring. ▪ Facilitate re-vegetation of denuded areas throughout the site.
Chapter 7: Terrestrial Biodiversity, Terrestrial Plant Species, and Terrestrial Animal Species Assessment	**Negative Direct Impacts:** **Construction Phase:** • Habitat loss and fragmentation • Loss of protected species • Increased alien invasive species • Increased erosion and soil compaction • Littering and general pollution **Operational Phase:** • Loss of species composition and diversity • Increased alien invasive species • Littering and general pollution	**Construction Phase:** ▪ No development should take place within High sensitivity areas or buffer zones. Accordingly, the Koppies habitat (where relevant) should be avoided. The Watercourse habitats of medium sensitivity should be avoided, as recommended by the Aquatic specialist. ▪ No construction related activities, such as the site camp, storage of materials, temporary roads or ablution facilities may be located in the high sensitivity areas. ▪ Where the approved layout designs impact on individuals, permit applications are required for either the relocation or destruction of provincially protected species (Northern Cape Nature Conservation Act No.9 of 2009) and for protected trees in terms of the National Forests Act No. 84 of 1998. ▪ Alien invasive species establishment and spreading should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with such plants. ▪ Utilise existing access routes as far as possible. Confine the movement of vehicles to the access routes to and from the site and to the construction areas.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
	Decommissioning Phase: • Loss of habitat • Increased alien invasive species **Cumulative Impacts – Construction Phase and Negative:** • Loss of habitat and vegetation	▪ Rehabilitate new vehicle tracks and areas where the soil has been compacted as soon as possible. ▪ Monitor the entire site for signs of erosion. ▪ General good housekeeping in terms of spills, refuelling and waste management. These have been included in the Environmental Management Programme. **Operational Phase:** ▪ The loss of species composition and diversity cannot be mitigated due to a permanent structure which will change microclimatic conditions for the life of the facility operation. ▪ Implement appropriate rehabilitation measures to restore each habitat to a natural state that is representative of the respective vegetation type after construction. ▪ Follow an alien and invasive species control and monitoring plan. ▪ General good housekeeping in terms of spills, refuelling and waste management. These have been included in the Environmental Management Programme. **Decommissioning Phase:** ▪ The loss of vegetation is unavoidable within the approved layout development footprint, but sensitive areas must be avoided. ▪ Rehabilitation and alien invasive management as per the construction and operational phase.
Chapter 8: Aquatic Biodiversity	**<u>Negative Direct Impacts:</u>** **Construction Phase:** ▪ Disturbance of aquatic habitat and impact on aquatic biota; ▪ Removal of indigenous aquatic vegetation and associated loss of aquatic ecological integrity and functionality; ▪ Water supply for construction and stress on available water resources; ▪ Road crossing structures may impede flow in the aquatic features; ▪ Alien vegetation infestation within the aquatic features due to disturbance; and ▪ Increased sedimentation and contamination of surface water runoff may result from construction activities. **Operational Phase:** ▪ Ongoing disturbance of aquatic features and associated vegetation along access roads or adjacent to the infrastructure that needs to be maintained; ▪ Modified runoff characteristics from hardened surfaces has the potential to result in erosion of adjacent watercourses; and	**Construction Phase:** ▪ Ensure the final layout of the PV facility and associated infrastructure avoids watercourses and recommended buffers as far as possible; utilisation should be made of existing disturbed areas where possible. The medium sensitivity aquatic habitats should be avoided in the layout design, with only low-sensitivity habitats being disturbed during construction. Note that this has been achieved in the EIA Phase, whereby the recommended development setbacks (i.e. recommended buffer of at least 35 m for the smaller drainage features; and setback from the wider floodplain adjacent to the larger rivers) have been adopted in the identification of the development footprints. The recommended avoidance areas have been avoided. ▪ Clearing of indigenous vegetation should not take place within the aquatic features and the recommended buffers. ▪ Rehabilitate disturbed aquatic habitats by revegetating them with suitable local indigenous vegetation. ▪ Water use for construction should be minimised as much as possible. The water should be obtained from an existing water allocation or other viable water sources for construction purposes.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
	▪ Water supply and water quality impacts (e.g. contamination from sewage) as a result of the operation of the proposed Solar Facility and associated infrastructure. **Decommissioning Phase:** ▪ Increased disturbance of aquatic habitat due to the increased activity; and ▪ Increased sedimentation and contamination of surface water runoff. **<u>Negative Cumulative Impacts:</u>** **Construction and Decommissioning Phases:** ▪ Increased disturbance of aquatic habitat due to the increased activity in the wider area. **Operational Phases:** ▪ Degradation of ecological condition of aquatic ecosystems	▪ The road crossing structures should be designed to not impede flow in watercourses - low water crossing is preferred. Use existing crossings, as best as possible and where allowable. ▪ The existing road infrastructure, particularly within the floodplain, should be utilised as far as possible to access new infrastructure to minimise the overall disturbance. It is recommended that any new linear type of infrastructure crossings over watercourses be placed where there are existing structures or road crossings within the watercourse corridors, where possible. ▪ Undertake monitoring for the growth of alien vegetation. **Operational Phase:** ▪ Implement avoidance setbacks as recommended above the for the construction phase. ▪ Develop a stormwater management plan for the proposed development that addresses the stormwater runoff from the developed areas. ▪ Stormwater run-off infrastructure must be designed to mitigate both the flow and water quality impacts of any stormwater leaving the developed areas. The runoff should rather be dissipated over a broad area covered by natural vegetation or managed using appropriate shaping of the road with berms or channels and swales adjacent to hardened surfaces where necessary. Should any erosion features develop, they should be stabilised immediately. ▪ Sewage generated within the site should be discharged to a conservancy tank that is properly serviced and regularly evacuated to nearby wastewater treatment works. **Decommissioning Phase:** ▪ Minimise works within aquatic ecosystems. If the project layout avoided these areas, the decommissioning works would also be able to avoid aquatic habitats as delineated. Note that all aquatic areas recommended for avoidance have been avoided in the EIA phase layout identification. ▪ Rehabilitate and revegetate disturbed areas, where required. ▪ Decommissioning activities within aquatic features should be undertaken in the dry season where possible.
Chapter 9: Avifauna Assessment	**<u>Negative Direct Impacts:</u>** **Construction Phase:** ▪ Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure. **Operational Phase:** ▪ Displacement due to habitat transformation associated with the presence of the solar PV plant and associated infrastructure.	**Construction Phase:** ▪ Activity should as far as possible be restricted to the footprint of the infrastructure. ▪ Measures to control noise and dust should be applied according to best practice in the industry at the time. ▪ Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical. ▪ Access to the rest of the property must be restricted. ▪ The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
	▪ Collisions with the solar panels. ▪ Entrapment in perimeter fences. ▪ Electrocutions in the onsite substation complex. ▪ Electrocution of priority species on the internal 33kV powerlines. **Decommissioning Phase:** ▪ Displacement due to disturbance associated with the decommissioning of the solar PV plant and associated infrastructure. **<u>Negative Cumulative Impacts:</u>** **Construction and Decommissioning Phases:** ▪ Displacement due to disturbance associated with the construction and decommissioning of the solar PV plants and associated infrastructure. **Operational Phase:** ▪ Displacement due to habitat transformation associated with the presence of the solar PV plants and associated infrastructure. ▪ Collisions with the solar panels. ▪ Entrapment in perimeter fences. ▪ Electrocutions in the onsite substation complexes. ▪ Electrocution of priority species on the internal 33kV powerlines.	▪ A 1km all infrastructure exclusion zone around the Verreaux's Eagle nest at -30.227660° 24.329773° must be implemented to provide unhindered access to the nest. The development footprint assessed in this report does not infringe on this buffer. **Operational Phase:** ▪ The recommendations of the botanical specialist must be strictly implemented, especially as far as limiting the vegetation clearance to what is absolutely necessary, and rehabilitation of transformed areas are concerned. ▪ Where possible, surface water (pans, dams and water troughs) must be buffered by a minimum of 50m to ensure unhindered access of priority species to the water. No PV panels should be constructed in this zone. Note that some of the waterpoints in the development footprint will be removed, however, since the minimum circular solar panel exclusion zone of 50m will be applied, the removal of some of the waterpoints will therefore not be a significant impact. ▪ A single perimeter fence should be used. ▪ The hardware within the proposed substation yard is too complex to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded once operational, site-specific mitigation (insulation) be applied reactively. This is an acceptable approach because Red List priority species are unlikely to frequent the substation and be electrocuted. ▪ Use underground cabling as far as possible. Where the use overhead lines are unavoidable due to technical constraints, a bird-friendly pole design must be used. The avifaunal specialist must sign off on the pole design. **Decommissioning Phase:** ▪ Activity should as far as possible be restricted to the footprint of the infrastructure. ▪ Measures to control noise and dust should be applied according to best practice in the industry at the time. ▪ Maximum use should be made of existing access roads during the decommissioning phase and the construction of new roads should be kept to a minimum as far as practical. ▪ The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned.
Chapter 10: Visual Impact Assessment	**<u>Negative Direct Impacts:</u>** **Construction Phase:** ▪ Potential effect of dust and noise from trucks and construction machinery during the construction period, and the effect of this on nearby farmsteads and visitors to the area. ▪ Potential visual effect of haul roads, access roads, stockpiles and construction camps in the visually exposed landscape.	**Construction Phase:** ▪ Locate construction camps, batching plants and stockpiles in visually unobtrusive areas, away from public roads. ▪ Implement EMPr with ECO during construction. **Operational Phase:** ▪ Substation and BESS to be located in an unobtrusive low-lying area, away from public roads.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
	Operational Phase: ▪ Potential visual intrusion of solar arrays and related infrastructure on receptors including glint and glare. ▪ Potential visual impact of an industrial type activity on the pastoral / rural character and sense of place of the area. **Decommissioning Phase:** ▪ Potential visual effect of any remaining structures, platforms and disused roads on the landscape. **Negative Cumulative Impacts:** **Construction, Operational and Decommissioning Phases:** ▪ Potential combined visual effect of the proposed 12 solar PV facilities in the study area, seen together with other existing and proposed renewable energy facilities in the area, and could potentially increase the overall cumulative visual impact.	▪ Muted natural colours and non-reflective finishes to be used for structures generally. ▪ Internal access roads to be as narrow as possible, and existing roads or tracks used as far as possible. ▪ Outdoor/ security lighting to be fitted with reflectors to obscure the light source, and to minimise light spillage. ▪ Internal powerlines (i.e. 22 kV or 33 kV) to be located underground where possible. (In some cases, such as stream crossings, internal powerlines may need to be above ground). ▪ Outdoor signage to be discrete and commercial / billboard signage avoided. **Decommissioning Phase:** ▪ Solar arrays and infra-structure to be removed and recycled. ▪ Access roads no longer required to be ripped and regraded. ▪ Exposed or disturbed areas to be revegetated to blend with the surroundings.
Chapter 11: Heritage Impact Assessment (Archaeology and Cultural Landscape)	**Negative Direct Impacts:** **Construction Phase:** ▪ Potential impacts to archaeology; ▪ Potential impacts to graves; and ▪ Potential impacts to the cultural landscape. **Operational Phase:** ▪ Potential impacts to the cultural landscape. **Decommissioning Phase:** ▪ Potential impacts to the cultural landscape. **Negative Cumulative Impacts:** **Construction, Operational and Decommissioning Phases:** ▪ Potential impacts to the cultural landscape. **Construction Phase:** ▪ Potential impacts to archaeology; and ▪ Potential impacts to graves.	**Construction Phase:** ▪ Report any chance finds of dense clusters of artefacts to SAHRA and/or an archaeologist. Protect in situ and appoint archaeologist to sample as needed. ▪ Report any chance finds of graves to SAHRA and/or an archaeologist. Protect in situ and appoint archaeologist to exhume. ▪ Minimise the duration of construction period. ▪ Ensure effective rehabilitation, at the end of the construction period, of areas not needed during operation. **Operational Phase:** ▪ Ensure that all maintenance vehicles and operational activities stay within designated areas. ▪ Paint buildings in earthy colours to reduce contrast. ▪ Make use of motion detectors and downlighting to reduce night-time light pollution. **Decommissioning Phase:** ▪ Minimise duration of decommissioning period ▪ Ensure effective rehabilitation of the entire site once the infrastructure has been removed.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
Chapter 12: Palaeontology Site Sensitivity Verification Report	▪ The study area has been confirmed as low to very low palaeo-sensitivity. Provided that the Chance Fossil Finds Protocol is incorporated into the EMPrs and fully implemented during the construction phase of the solar PV facility, there are no objections on palaeontological heritage grounds to authorisation of the proposed project. Pending the discovery of significant new fossil finds before or during construction, no further specialist palaeontological studies, reporting, monitoring or mitigation are recommended for the proposed project.	▪ The Chance Fossil Finds Protocol has been incorporated into the project EMPrs (Appendix I and Appendix J of this EIA Report).
Chapter 13: Socio-Economic Assessment	**Direct Negative Impacts** **Construction Phase:** ▪ Impacts associated with the presence of construction workers on local communities. ▪ Impacts related to the potential influx of job seekers. ▪ Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site. ▪ Increased risk of grass fires associated with construction related activities; ▪ Nuisance impacts, such as noise, dust, and safety, associated with construction related activities and vehicles. ▪ Impact on productive farmland. **Operational Phase:** ▪ Visual impacts and associated impacts on sense of place. ▪ Potential impact on property values. ▪ Potential impact on tourism. **Decommissioning Phase:** ▪ Social Impacts associated with retrenchment, including loss of jobs and source of income. **Direct Positive Impacts** **Construction Phase:** ▪ Creation of employment and business opportunities, and opportunity for skills development and on-site training. **Operational Phase:** ▪ Establishment of infrastructure to improve energy security and support renewable sector. ▪ Creation of employment opportunities. ▪ Benefits associated with socio-economic contributions to community development. ▪ Benefits for local landowners.	Note that several mitigation and enhancement measures have been identified in the assessment. The list below is only a summary of some of the recommendations. **Positive Impacts – Enhancement Measures:** **Construction Phase:** ▪ Where reasonable and practical, the proponent should appoint local contractors and implement a 'locals first' policy, especially for semi and low-skilled job categories. However, due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area. ▪ Where feasible, efforts should be made to employ local contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria. ▪ Before the construction phase commences the proponent should meet with representatives from the Renosterberg Local Municipality (RLM) and the Emthanjeni Local Municipality (ELM) to establish the existence of a skills database for the area. If such as database exists, it should be made available to the contractors appointed for the construction phase. ▪ The local authorities, community representatives, and organisations on the interested and affected party database should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that the proponent intends following for the construction phase of the project. ▪ Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase. ▪ The recruitment selection process should seek to promote gender equality and the employment of women wherever possible. ▪ The proponent and contractor should develop a Code of Conduct (CoC) for construction workers. The code should identify which types of behaviour and activities are not acceptable. Construction workers in breach of the code should be subject to appropriate disciplinary action and/or dismissed. All dismissals must comply with the South African labour legislation. The CoC should be signed by the proponent and the contractors before the contractors move onto site. The CoC should form part of the CHSSP.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
	Cumulative impacts: ▪ Negative: Cumulative impacts on sense of place ▪ Negative: Cumulative impact on local services and accommodation ▪ Positive: Cumulative impact on local economy.	**Operational Phase:** ▪ Maximise the number of employment opportunities for local community members. ▪ Implement training and skills development programs for members from the local community. ▪ Maximise opportunities for local content and procurement. ▪ Implement agreements with affected landowners on which the PV facility will be constructed. **Negative Impacts – Mitigation Measures:** **Construction Phase:** ▪ Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase. ▪ Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase. ▪ All farm gates must be closed after passing through. ▪ Contractors appointed by the proponent should provide daily transport for low and semi-skilled workers to and from the site. ▪ Timing of construction activities should be planned to avoid / minimise impact on key farming activities. ▪ All areas disturbed by construction related activities, such as access roads on the site, construction platforms, workshop area etc., should be rehabilitated at the end of the construction phase. **Operational Phase:** ▪ The recommendations of the Visual Impact Assessment should be implemented. **Decommissioning Phase:** ▪ The proponent should ensure that retrenchment packages are provided for all staff retrenched when the plant is decommissioned. ▪ All structures and infrastructure associated with the proposed facility should be dismantled and transported off-site on decommissioning.
Chapter 14: Traffic Impact Assessment	**Direct Negative Impacts** **Construction and Decommissioning Phases:** ▪ Potential congestion and delays on the surrounding road network. ▪ Potential impact on traffic safety and increase in accidents with other vehicles or animals. ▪ Potential change in the quality of the surface condition of the roads. ▪ Potential noise and dust pollution.	**Construction and Decommissioning Phases:** ▪ Stagger delivery trips and schedule trips, including staff trips outside of peak hours where possible. ▪ Implement speed control by means of a stop and go system and speed limit road signage within the construction and decommissioning site. ▪ Ensure all vehicles are roadworthy, visible, adequately marked, and operated by an appropriately licenced operator. ▪ Regular maintenance of internal farm access roads by the contractor.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
	Operational Phase: ▪ The traffic generated during the operational phase are mainly related to the staff that will be transported to and from the sites and are not anticipated to have a significant traffic impact on the surrounding road network. **<u>Cumulative Negative Impacts</u>** **Construction and Decommissioning Phases:** ▪ Potential congestion and delays on the surrounding road network. ▪ Potential impact on traffic safety and increase in accidents with other vehicles or animals. ▪ Potential change in the quality of the surface condition of the roads. ▪ Potential noise and dust pollution.	▪ Ensure private access roads that are impacted on by the proposed development are restored to original pre-construction road condition. ▪ Implement dust control on gravel roads within the construction and decommissioning site.
Chapter 15: Battery Energy Storage System High Level Safety, Health and Environment Risk Assessment	Various risks were identified in terms of safety, health and the environment due to the proposed BESS. The BESS High Level Safety, Health and Environment Risk Assessment identified risks, hazards, and consequences, such as, but not limited to: ▪ Human Health - chronic exposure to toxic chemical or biological agents. Causes - Construction materials such as cement, paints, solvents, welding fumes, truck fumes etc. Consequences - Employee / contractor illness. ▪ Human Health - exposure to noise. Causes - Drilling, piling, generators, air compressors. Consequences - Adverse impact on hearing of workers. Possible nuisance factor in near-by areas. ▪ Human and Equipment Safety - exposure to fire radiation Causes – ▪ Involvement in an external fire. Fire involving fuels used in construction vehicles or vehicles themselves (e.g., tyre fire). Fire due to uncontrolled welding or other hot-work. Consequences - Injuries due to radiation especially amongst first responders and bystanders. Fatalities unlikely from the heat radiation as not highly flammable nor massive fire. ▪ Human and Equipment Safety - exposure to explosion over pressures. Transformer shorting / overheating / explosion. Consequences - Potential fatalities, e.g., amongst first responders. Damage to nearby equipment.	▪ There are numerous different battery technologies but using one consistent battery technology system for the BESS installations associated with all the proposed Kudu Solar Facilities would allow for ease of training, maintenance, emergency response and could significantly reduce risks. ▪ Where reasonably practicable, state-of-the-art battery technology should be used with all the necessary protective features e.g., draining of cells during shutdown and standby-mode, full Battery Management System (BMS) with deviation monitoring and trips, leak detection systems. ▪ Ensure that the technical and system suggestions for reducing risks, as specified in the assessment, specifically in terms of preventative and mitigative measures are included in the design. ▪ The overall design should be subject to a full Hazard and Operability Study (HAZOP) prior to finalisation of the design. ▪ For Redox Flow systems, an end of life (and for possible periodic purging requirements) solution for the large quantities of hazardous electrolyte should be investigated, e.g., can it be returned to the supplier for re-conditioning. ▪ Prior to importing any solid-state battery containers into the country, the contractor should ensure that: o An Emergency Response Plan is in place that would be applicable for the full route from the ship to the site. This plan needs to include details of the most appropriate emergency response to fires both while the units are in transit and once they are installed and operating. o An End-of-Life Plan is in place for the handling, repurposing or disposal of dysfunctional, severely damaged batteries, modules and containers. ▪ The site layout and spacing between lithium solid-state containers should be such that it mitigates the risk of a fire or explosion event spreading from one container to another. ▪ In order to limit the possibility of domino failures the BESS should be separated from the substation by at least 20 m.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
		▪ Where there is a choice of alternative locations for the BESS, those that are further from water courses would be preferred. Redox Flow BESS hazards are mostly related to possible loss of containment of electrolyte and solid-state systems may experience fires that may result in loss of containment of liquids or the use of large amounts of fire water which could be contaminated. The run-off should not enter water courses directly. ▪ Finally, it is suggested once the BESS technology has been chosen and more details of the final design are available, the necessary updated Risk Assessments should be in place (prior to commencement, after EA and other necessary approvals are granted (should such be granted)).
Chapter 16: Geohydrology Assessment	**Direct Negative Impacts:** **Construction Phase:** ▪ Potential lowering of the groundwater level from construction requirements; ▪ Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages. **Operational Phase:** ▪ Potential lowering of the groundwater level from operational requirements. ▪ Potential impact of groundwater quality as a result of using cleaning agents for cleaning the solar panels. ▪ Groundwater quality deterioration as a result of electrolyte that will be used for the BESS. **Decommissioning Phase:** ▪ Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages. ▪ Potential lowering of the groundwater level from decommissioning requirements. **Cumulative Negative Impacts:** ▪ Potential lowering of groundwater level during the construction, operational and decommissioning phase for all 12 of the Kudu PV facilities. ▪ Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages from the construction and the decommissioning phase for all 12 Kudu facilities.	**Construction and Decommissioning Phases:** ▪ Adhere to the borehole's safe yield and to monitor water levels and flow. ▪ Boreholes must be correctly yield tested according to the National Standard (SANS 10299-4:2003, Part 4 – Test pumping of water boreholes). This includes a Step Test, Constant Discharge Test and recovery monitoring. ▪ Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. ▪ Diesel fuel storage tanks, if required, should be above ground on an impermeable surface in a bunded area. ▪ Vehicles and equipment should also be refuelled on an impermeable surface. A designated area should be established at the construction site camp for this purpose, if off-site refuelling is not possible. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material, and reported. **Operational Phase:** ▪ Borehole's safe yield, monitoring and yield testing as per the construction phase. ▪ Use environmentally safe cleaning agents that breakdown naturally and do not cause adverse effects. ▪ Ensure that all electrolyte or chemicals stored or used on site have secondary containment systems in place with reliable leak detection, annunciation in place. Ensure that all chemicals are handled on concrete bunded surfaces and not on bare soil. ▪ Wastewater produced by fire hydrants should not be allowed to runoff into the environment. ▪ It is recommended that all BESS's are placed a minimum of 50m from any borehole.

Specialist Assessment undertaken	Key Impacts Identified	Recommended Mitigation Measures
	▪ Potential of impact on groundwater quality as a result of using cleaning agents for cleaning the solar panels during the operational phase for all the 12 Kudu facilities. ▪ Potential impact on groundwater quality as a result of electrolyte that will be used for the BESS. ▪ Other wind and solar, and EGI projects within a 30 km radius.	
Chapter 17: Geotechnical Assessment	**<u>Direct and Cumulative Negative Impacts:</u>** **Construction Phase:** ▪ Displacement of geologic materials. ▪ Contamination of geologic materials as a consequence of the construction activities. **Operational and Decommissioning Phase:** ▪ Increased unnatural hard surfaces. ▪ Contamination of geologic materials as a consequence of typical maintenance and decommissioning activities.	**Construction Phase:** ▪ Favour dolerite as an aggregate (as opposed to Karoo sandstones and mudstones). Subject to investigation. ▪ Any road cuttings should be designed by an appropriately qualified professional. ▪ Drainage in the region should be designed and managed appropriately. ▪ Investigate and confirm the geotechnical suitability of each structure (or other appropriate level of investigation) prior to construction (i.e., determine that soil with an adequate bearing capacity is obtained beneath each footing). Such investigations would not be required to fulfil the requirements of this EIA process. However, it would be necessary prior to construction. ▪ Only strip vegetation necessary for the next phase of construction. ▪ Install temporary drainage to divert stormwater away from active construction activities, where required. ▪ Where impacted through construction-related activities, all sloped areas must be stabilised to ensure proper rehabilitation is affected and erosion is controlled. **Operational Phase:** ▪ Install drainage to divert stormwater away from activities, roads/tracks, structures, where required. ▪ During the execution of the operations, appropriate measures to prevent pollution and contamination of the riparian environment must be implemented e.g. including ensuring that construction equipment is well maintained; **Decommissioning Phase:** ▪ Land rehabilitation to near natural state, i.e., removal of foundations and backfilling of any resultant voids within the soil, as well as removal of hard surfaced areas. Replacement soil should be sourced locally to ensure homogeneity. ▪ Reinstate natural topography where cut-to-fill embankments have been constructed.

20.5 Summary of Key Impact Assessment Findings

Based on the findings of the detailed specialist impact assessments, which are included in Chapter 6 to 17 of this EIA Report, the proposed project is considered to have an **overall Moderate to Very Low negative environmental impact** and an **overall High to Moderate positive socio-economic impact** (with the implementation of respective mitigation and enhancement measures). Table 20.5 below provides a summary of the impact assessment for the proposed project post mitigation for direct impacts. Table 20.6 provides the same information for the cumulative impacts.

As indicated in Table 20.5, the direct negative impacts were rated with an overall **Low to Very Low** post-mitigation impact significance for the **construction phase**, with only Terrestrial Biodiversity impacts being rated as Moderate. In terms of the **operational and decommissioning phases**, the majority of the direct negative impacts were rated with a **Low to Very Low** post-mitigation impact significance. In terms of direct positive impacts, the Socio-Economic impacts are rated as having a **Moderate** impact significance post-mitigation for the construction phase; and **Moderate to High** impact significance post-mitigation for the operational phase.

Based on Table 20.6, the majority of the cumulative negative impacts were rated with a **Low** post-mitigation impact significance for the **construction phase**, with the exception of Terrestrial and Socio-Economic impacts, which were respectively rated with a Moderate and Moderate to Low post-mitigation impact significance. A similar trend is applicable to the **operational phase**, with Visual and Avifauna impacts being rated as **Moderate**; and Socio-Economic impacts being rated as **Moderate to Low**.

During the **decommissioning phase**, the majority of cumulative impacts were rated with a **Low to Very Low** post-mitigation impact significance, whereas some were not identified, or are considered insignificant, or could not be measured empirically at the time of assessment. In terms of cumulative positive impacts, the Socio-Economic impacts were rated with an overall **Moderate** post-mitigation impact significance.

Table 20-5: Overall Impact Significance with the Implementation of Mitigation Measures for Direct Negative and Positive Impacts

Specialist Assessment	Construction Phase	Operational Phase	Decommissioning Phase
DIRECT NEGATIVE IMPACTS			
Agriculture and Soils	Low	Low	Low
Terrestrial Biodiversity, Terrestrial Plant Species, and Terrestrial Animal Species	Moderate	Low	Low
Aquatic Biodiversity	Very Low	Very Low	Very Low
Avifauna	Low	Very Low / Low	Low
Visual	Low	Low	Very Low
Heritage (Archaeology and Cultural Landscape)	Low	Low	Low
Palaeontology	Insignificant and/or not identified and/or not applicable	Insignificant and/or not identified and/or not applicable	Insignificant and/or not identified and/or not applicable
Socio-Economic	Low	Low	Low
Traffic	Low / Very Low	Insignificant	Low / Very Low
Geohydrology	Low / Very Low	Low / Very Low	Very Low
Geotechnical	Very Low	Very Low	Very Low
DIRECT POSITIVE IMPACTS			
Socio-Economic	Moderate	Moderate / High	Insignificant and/or not identified and/or not applicable

Table 20-6: Overall Impact Significance with the Implementation of Mitigation Measures for Cumulative Negative and Positive Impacts

Specialist Assessment	Construction Phase	Operational Phase	Decommissioning Phase
CUMULATIVE NEGATIVE IMPACTS			
Agriculture and Soils	Low	Low	Low
Terrestrial Biodiversity, Terrestrial Plant Species, and Terrestrial Animal Species	Moderate	Low	Low
Aquatic Biodiversity	Very Low	Very Low	Very Low
Avifauna	Low	Moderate	Low
Visual	Low	Moderate	Very Low
Heritage (Archaeology and Cultural Landscape)	Low	Low	Low
Palaeontology	Insignificant and/or not identified and/or not applicable	Insignificant and/or not identified and/or not applicable	Insignificant and/or not identified and/or not applicable
Socio-Economic	Low / Moderate	Low / Moderate	Insignificant and/or not identified and/or not applicable
Traffic	Low	Insignificant	Low / Very Low
Geohydrology	Low / Very Low	Low / Very Low	Very Low
Geotechnical	Low	Low	Low
CUMULATIVE POSITIVE IMPACTS			
Socio-Economic	Moderate	Moderate	Moderate

20.6 Overall Environmental Impact Statement and Reasoned Opinion from the EAP

The information presented above, contributes to this overall environmental impact statement and reasoned opinion from the EAP as to whether the proposed project should or should not be authorised, including any conditions that should be made in respect of the authorisation (should it be granted).

Based on the findings of the detailed specialist assessments and technical studies, which all recommend that the proposed project can proceed and should be authorised by the DFFE, the proposed project is considered to have an **overall Moderate to Very Low negative environmental impact, and an overall Moderate to High positive socio-economic impact** (with the implementation of respective mitigation and enhancement measures).

The proposed project will take place within the development footprint on the preferred and approved project site, as contemplated in the accepted Final Scoping Report. The development footprint and buildable areas will avoid the "no-go" sensitive features identified and mapped by the respective specialists, where relevant and applicable, as discussed in Section 20.1 of this chapter.

This EIA has considered the nature, scale and location of the development as well as the wise use of land. When considering the timing of this project, the IRP 2019 proposes to secure 17 800 MW of renewable energy capacity by 2030. As discussed in the preceding chapters of this EIA Report, it is the Project Applicant's intention to bid this project in the future bidding rounds of the REIPPPP.

The proposed project will be in line with and will be supportive of the objective of the PKSDM IDP in terms of creating more job opportunities. The proposed Solar PV Facility will assist in local job creation during the construction and operational phases of the project (if approved by the DFFE). It should be noted that employment during the construction phase will be temporary and provided for a period of 12 to 18 months.

Section 24 of the Constitutional Act states that "*everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures, that prevents pollution and ecological degradation; promotes conservation; and secures ecologically sustainable development and use of natural resources while promoting justifiable economic and social development*". Based on this, this EIA was undertaken to ensure that these principles are met through the inclusion of appropriate management and mitigation measures, and monitoring requirements. These measures will be undertaken to promote conservation by avoiding the sensitive environmental features present on site and through appropriate monitoring and management plans (refer to the EMPr in Appendix I and Appendix J of this EIA Report).

The outcomes of this project therefore succeed in meeting the environmental management objectives of protecting the ecologically sensitive areas and supporting sustainable development and the use of natural resources, whilst promoting justifiable socio-economic development in the towns nearest to the project site. The findings of this EIA show that all natural resources will be used in a sustainable manner (i.e., this project is a renewable energy project, and the majority of the negative site specific and cumulative environmental impacts are considered to be of low significance with mitigation measures implemented), while the benefits from the project will promote justifiable economic and social development. Furthermore, additional specialist studies (not recommended by the Screening Tool) have been undertaken as part of the EIA Process to ensure that all potential environmental impacts are addressed and assessed. Refer to Table 20.7 for a summary of reasoned opinions from the specialists.

Table 20-7: Summary of the Reasoned Opinions from the Specialists

Specialist Assessment undertaken	Reasoned Opinion on whether the project should be authorised
Chapter 6: Agriculture Compliance Statement	▪ The conclusion of the assessment is that the proposed development offers a valuable opportunity for renewable energy development with very little loss of future agricultural production potential. ▪ Based on various factors, the impact of the proposed development on the agricultural production capability of the site is assessed as being acceptable. Therefore, from an agricultural impact point of view, it is recommended that the development be approved.
Chapter 7: Terrestrial Biodiversity, Terrestrial Plant Species, and Terrestrial Animal Species Assessment	▪ The proposed development is not located in a threatened vegetation type or ecosystem and is located in an ESA mainly due to presence of sensitive birds and watercourses. However, in the specialist's opinion, ESA cannot be regarded as Very High sensitivity as it is not irreplaceable areas, and depending on what ecological features it is based on, can be regarded as Medium or High sensitivity. ▪ There are no high sensitivity features on site, and no plant SCC were recorded. However, provincially protected species recorded will require permits for relocation from the provincial authority. ▪ The proposed project can proceed should all no-go sensitive areas be avoided (which has been achieved in the layout plan), and the recommended mitigation measures are implemented.
Chapter 8: Aquatic Biodiversity	▪ Based on the findings of the specialist assessment, there is no reason from a freshwater perspective, why the proposed activity (with the implementation of the recommended mentioned mitigation measures) should not be authorised. ▪ The proposed development footprint within the preferred development site (i.e. study area) has been amended through the EIA process to ensure that it will be within aquatic ecosystem areas of "low" sensitivity and are thus considered appropriate areas for development.
Chapter 9: Avifauna Assessment	▪ The proposed project will have a range of potential pre-mitigation impacts on priority avifauna ranging from low to high significance, which is expected to be reduced to medium and low significance with the appropriate mitigation. ▪ No fatal flaws were discovered during the investigations. The proposed project is supported, and it is therefore recommended that the activity is authorised, with the understanding that all mitigation measures recommended in this report will be strictly implemented.
Chapter 10: Visual Impact Assessment	▪ The layout of the proposed facility has been subject to revisions, based on the various specialist findings, including the mapping of scenic resources and sensitive receptors. The currently proposed layout succeeds in avoiding visually sensitive areas as indicated on the visual sensitivity map in the Visual Impact Assessment. ▪ It is the opinion of the Visual Specialists that provided the recommended mitigation measures and EMPr are implemented, the proposed project would not present a potential fatal flaw in visual terms and may be authorised.

Specialist Assessment undertaken	Reasoned Opinion on whether the project should be authorised
Chapter 11: Heritage Impact Assessment (Archaeology and Cultural Landscape)	▪ Given the lack of significant heritage resources in the proposed project footprint and generally limited impacts to the cultural landscape, it is the opinion of the heritage consultant that the project may be authorised in full using either battery technology.
Chapter 12: Palaeontology Site Sensitivity Verification Report	▪ Provided that the Chance Fossil Finds Protocol is incorporated into the EMPrs and fully implemented during the construction phase of the solar PV facility, there are no objections on palaeontological heritage grounds to authorisation of the proposed renewable energy developments.
Chapter 13: Socio-Economic Assessment	▪ The establishment of the proposed project and associated infrastructure is supported by the findings of the socio-economic assessment.
Chapter 14: Traffic Impact Assessment	▪ The proposed project will have a range of potential traffic related impacts ranging from very low to moderate significance before mitigation, which is expected to be reduced to very low to low significance with the appropriate mitigation. ▪ No fatal flaws were discovered during the investigations. The proposed project is supported, and it is therefore recommended that the activity is authorised, with the understanding that all mitigation measures recommended in this report will be strictly implemented.
Chapter 15: Battery Energy Storage System High Level Safety, Health and Environment Risk Assessment	▪ The Risk Assessment found that with suitable preventative and mitigative measures in place, none of the identified potential risks are excessively high, i.e., from a Safety, Health and Environment (SHE) perspective no fatal flaws were found with either type of technology for the proposed BESS installation.
Chapter 16: Geohydrology Assessment	▪ Based on various factors, such as the anticipated demands of the facility (individually) being less than the regional yield potential of the underlying aquifer, and the low to very low post-mitigation impact assessment, it is the opinion of the specialist that development of the proposed project may be authorised, provided that the mitigation measures are implemented during each phase of the project to suppress the intensity of identified impacts.
Chapter 17: Geotechnical Assessment	▪ Based on the geotechnical analysis conducted, it is recommended that the proposed project be authorised, as no fatal flaws were found during the desktop assessment. However, it is crucial to implement appropriate mitigation measures at every phase of the project to minimise the intensity of the identified impacts.

Taking into consideration the findings of the Scoping and EIA Process and given the national and provincial strategic requirements for infrastructure development, particularly from an electricity generation perspective, and based on the fact that the environmental sensitivity of the study area is largely medium to low, with a few isolated high and very high sensitivity areas, it is the opinion of the EAP, that the project benefits outweigh the costs and that the project will make a positive contribution to sustainable infrastructure development in the RLM, as well as the towns of Petrusville and Phillipstown.

Provided that the specified mitigation measures and management actions are applied effectively throughout, it is recommended that the proposed project receive EA in terms of the 2014 NEMA EIA Regulations (as amended), promulgated under the NEMA.

It is understood that the information contained in this EIA Report and appendices is sufficient to make a decision in respect of the activity applied for.

It is recommended that the EA (should it be granted) be **valid for a period of 10 years**.

In addition, it is recommended that the EMPr compiled as part of this EIA Process, included in Appendix I and Appendix J of this EIA Report be approved concurrently in the EA (should it be granted). A detailed layout of the PV Facility has been identified at the EIA Phase. However, as confirmed by the specialists, changes to the detailed layouts are deemed acceptable if the changes remain within the approved buildable areas / development footprints and area assessed during the Scoping and EIA Process with no-go sensitive areas avoided. Any changes can be subjected to an EA amendment process, where warranted.

20.7 Cumulative Environmental Impact Statement

The cumulative impacts have been assessed by all the relevant specialists. The cumulative assessment included other renewable energy and grid connection projects within a 30 km radius of the proposed project.

No cumulative impacts have been identified that were considered to be fatal flaws. The specialists recommended that the project receive EA in terms of the 2014 NEMA EIA Regulations (as amended), including consideration of cumulative impacts, provided the mitigation is applied.

20.8 Conditions to be included in the EA

In order to ensure the effective implementation of the mitigation measures and management actions, EMPrs have been compiled and are included in Appendix I and Appendix J of this EIA Report. Appendix I includes the EMPr for the proposed Solar PV facility and associated infrastructure, and Appendix J includes the EMPr for the proposed Independent Power Producer (IPP) substation. The EMPr for the proposed IPP substation is a Generic EMPr and it is required to comply with the Generic EMPr published for substation development (Government Gazette 42323, GN 435, dated 22 March 2019).

The mitigation measures necessary to ensure that the proposed projects are planned and carried out in an environmentally responsible manner are listed in the EMPr. The EMPr includes the mitigation measures noted in this EIA Report, inclusive of the specialist assessments and technical studies. The EMPr is a dynamic document that should be updated as required and provides clear and implementable measures for the proposed project.

Listed below are the main recommendations applicable to the proposed project that should be considered for inclusion in the EA (should such authorisation be granted by the DFFE). These main recommendations as well as additional recommendations are included in the EMPr and EIA Report.

- Mitigation measures detailed within the EIA Report, specialist assessments and technical studies are to be implemented, where relevant and applicable.
- No-go areas of very high sensitivity identified by the specialists, and mapped accordingly, should be avoided.
- Vegetation clearing must be limited to the development footprint, as much as possible.
- A walk through of the approved site prior to construction activities must be undertaken in the relevant season to record all provincially protected species that will be impacted on by the development.
- Ensure the necessary permit applications are submitted with the provincial authority prior to construction for the relocation of provincially protected species. Copies of the permits must be kept on site by the Environmental Control Officer (ECO).
- Implement appropriate rehabilitation measures to restore each habitat to a natural state that is representative of the respective vegetation type after construction (for temporary use facilities in natural areas) and decommissioning.
- No alien and invasive plant species may be used for rehabilitation purposes; only indigenous species of the area / vegetation type may be used.
- Invasive alien plant growth and signs of erosion should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with invasive alien plants.
- The recommended buffer area between the aquatic features and the project components should be implemented.
- Visually permeable fences, preferably in a dark colour, should be used.
- Buildings are to be painted in earthy colours to reduce contrast.
- Night-time light spillage should be minimised, possibly through the use of motion detectors so that the area can stay dark until light is needed.
- If any archaeological material or human burials are uncovered during the course of development, then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.
- Implement the Chance Fossil Finds Protocol during the construction phase of the solar PV facility.
- Undertake regular maintenance of the internal farm access roads by the contractor during the construction and decommissioning phases and by the operator during the operational phase.
- Ensure that the necessary permits or approvals from the relevant road authority are in place for the removal of the island at the TR38/01 and DR3093 intersection to accommodate the turning movements of the abnormal load vehicles.
- The route to the site should be further investigated to ensure that the abnormal loads are not obstructed at any point by geometric, height and width limitations along the route.

- If groundwater is sourced from existing boreholes, in the case that multiple Kudu Solar Facility projects are constructed simultaneously, adherence to recommended mitigation measures should be strictly followed to prevent over abstraction of groundwater.
- Phase two of the groundwater monitoring plan is to be discussed and evaluated in the event that groundwater is to be used in the project.
- Ensure that the BESS facilities are placed at least 50 m from any boreholes along with appropriate bunding and secondary containment.
- A stormwater management plan should be developed prior to the construction phase by an accredited professional.
- Rehabilitation of soil and geological material to commence during the construction phase, if possible, alternatively following the construction phase to allow successful re-vegetation.
- Authorised vehicles to only use proposed access points and roads and keep within the footprint of the facility.
- Ground protection measures to be implemented during maintenance and refuelling operations.

Paul Lochner

NAME OF EAP



7 July 2023

SIGNATURE OF EAP **DATE**