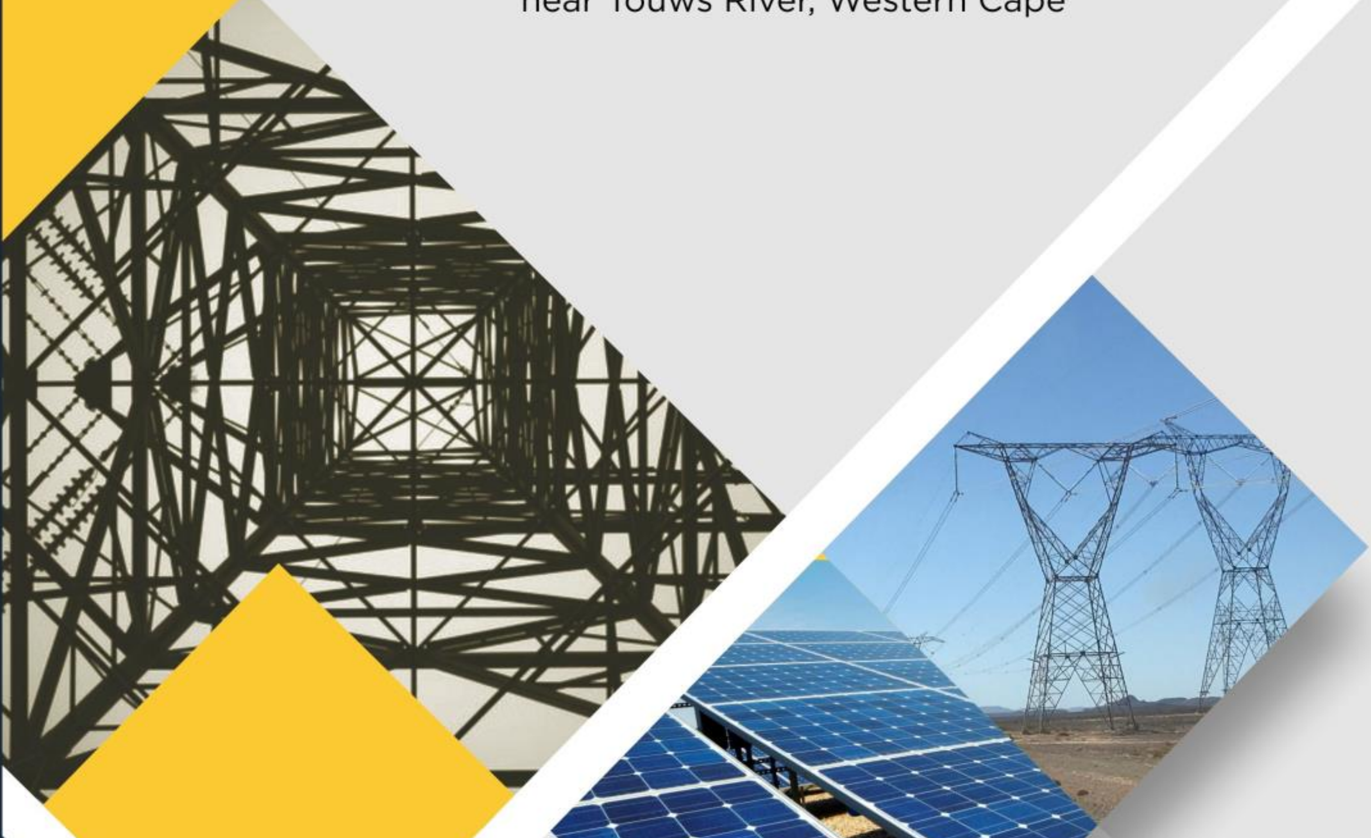
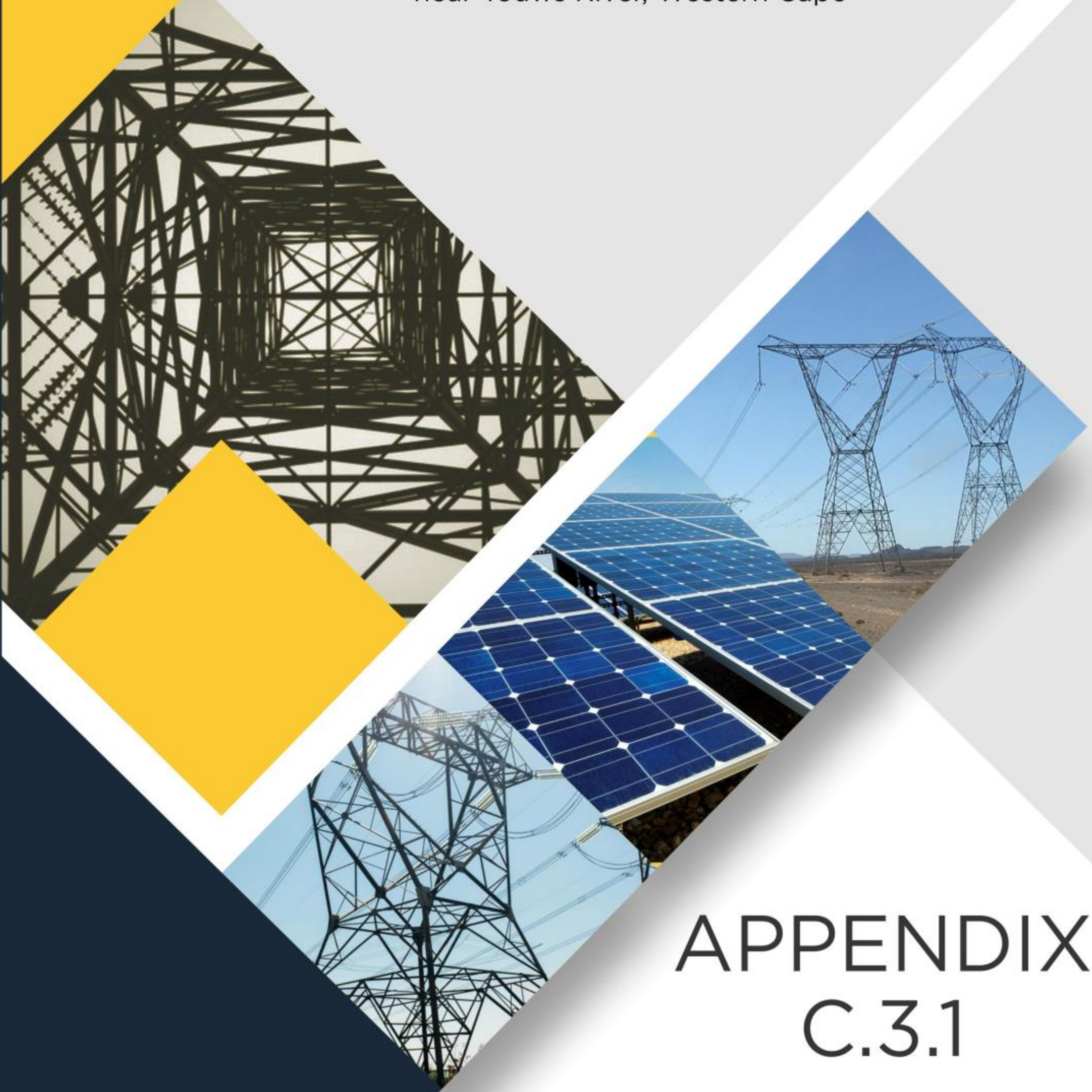
Basic Assessment for the Proposed Development of Electrical Grid Infrastructure to support the proposed nine 175 MW Solar Photovoltaic Facilities and associated Infrastructure (i.e. Witte Wall PV 1, Witte Wall PV 2, Grootfontein PV 1, Grootfontein PV 2, Grootfontein PV 3, Hoek Doornen PV 1, Hoek Doornen PV 2, Hoek Doornen PV 3, and Hoek Doornen PV 4), near Touws River, Western Cape



APPENDIX C.3

Heritage Impact Assessment (Archaeology, Cultural Landscape and Palaeontology)

Basic Assessment for the Proposed Development of Electrical Grid Infrastructure to support the proposed nine 175 MW Solar Photovoltaic Facilities and associated Infrastructure (i.e. Witte Wall PV 1, Witte Wall PV 2, Grootfontein PV 1, Grootfontein PV 2, Grootfontein PV 3, Hoek Doornen PV 1, Hoek Doornen PV 2, Hoek Doornen PV 3, and Hoek Doornen PV 4), near Touws River, Western Cape



APPENDIX C.3.1

Heritage Impact Assessment (Archaeology, Cultural Landscape and Palaeontology) for Witte Wall

HERITAGE IMPACT ASSESSMENT:

Basic Assessment for the Proposed Development of two 175 MW Solar Photovoltaic (PV) Facilities (Witte Wall PV 1 & PV 2) and associated Electrical Grid Infrastructure, near Touws River, Western Cape

HWC Case No.: 20081910SB0825E

Required under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999).

Report for:

CSIR – Environmental Management Services
P.O. Box 320, Stellenbosch, 7599
Tel: 031 242 2318
Email: RAbed@csir.co.za

On behalf of:

Veroniva (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: 9 October 2020
Draft for comment: 16 October 2020
Final report: 17 November 2020

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

Basic Assessments for the Proposed Development of two 175 MW Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure (i.e. Witte Wall 1 and Witte Wall 2), near Touws River, Western 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:	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:

11-10-2020

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

11-10-2020

Date

7234 7058
N BACA CST

Signature of the Commissioner of Oaths

2020-10-11

Date

SOUTH AFRICAN POLICE SERVICE
KIRSTENHOF SAPS
2020 -10- 11
CSC
SUID AFRIKAANSE POLISIEDIENS

Details of Specialist, Declaration and Undertaking Under Oath

EXECUTIVE SUMMARY

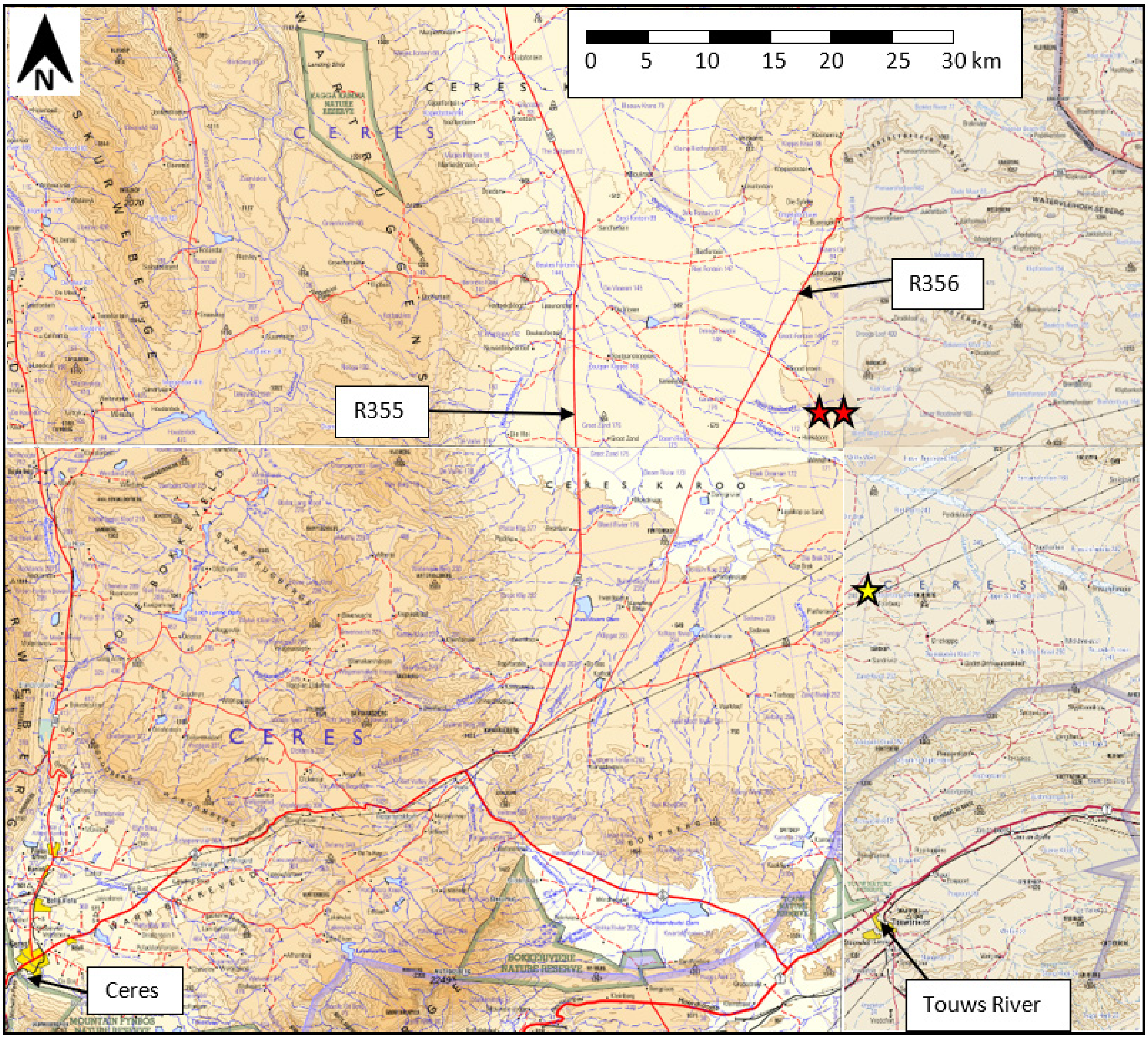
1. Site Name

Witte Wall

2. Location

Address: Off R356
Farms: Two photovoltaic (PV) facilities to be on Witte Wall 171 and two powerlines (within an assessed corridor) over farms Witte Wall 171, Die Brak 241 and Platfontein 240.
Centre of PV study area: S32° 59' 15" E19° 59' 20"
Southern end of powerline corridor: S33° 06' 36" E20° 00' 45"

3. Locality Plan



PV facilities at red stars, southern end of power line corridor at yellow star.

4. Description of Proposed Development

The proposed project includes two solar fields of 250 ha each and up to 10 m high, operation and maintenance buildings, two power lines and substations (i.e. electricity grid infrastructure (EGI)), access roads, battery energy storage facilities, fencing, and other associated and supporting infrastructure.

5. Heritage Resources Identified

Palaeontological resources were found to be very sparsely distributed across the landscape and the impacts to fossils are considered to be of generally low significance. Archaeological resources were widespread but very strongly dominated by background scatter. Dense areas of artefacts were rare and often associated with the river margins that are excluded from the development footprint area. One small pottery scatter was the most interesting find within the study area (located within the Witte Wall PV 2 footprint and still of low cultural significance). Elsewhere on the farm were some historical ruins (including *brakdaks*) and historical structures (including *brakdaks*). The cultural landscape (largely a natural landscape with aesthetic significance) was also identified as a heritage resource, but the location of the site within a Renewable Energy Development Zone (REDZ) was noted.

6. Anticipated Impacts on Heritage Resources

Fossils are sparse and difficult to locate. Impacts cannot be readily predicted but the chance of impacting significant fossils is low. The layout has been designed to avoid sensitive archaeological sites (although the pottery scatter in Witte Wall PV 2 could not be avoided). Nevertheless, large numbers of background scatter artefacts would likely be lost during development. The layout has avoided the steeper slopes on site which will reduce the visibility of the PV facilities. Given (1) the findings of the Visual Impact Assessment (VIA), (2) the design of the facilities, (3) their location within a REDZ and (4) the existence of a wind energy facility, large substation and power lines nearby, significant new impacts to the landscape are not expected.

7. Recommendations

Witte Wall PV 1

It is recommended that the proposed Witte Wall PV 1 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- The potential grave at waypoint 150 must be protected and avoided;
- A Chance Finds Procedure must be implemented for isolated fossil finds; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

Witte Wall PV 2

It is recommended that the proposed Witte Wall PV 2 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- The pottery scatter at waypoint 145 must be collected;
- The potential grave at waypoint 150 must be protected and avoided;
- A Chance Finds Procedure must be implemented for isolated fossil finds; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

EGI

It is recommended that the proposed EGI development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) whether any areas of background scatter artefacts should be sampled;
- A Chance Finds Procedure must be implemented for isolated fossil finds; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

8. Author/s and Date

Heritage Impact Assessment: Jayson Orton, ASHA Consulting (Pty) Ltd, 17 November 2020
Archaeological specialist study: Jayson Orton, ASHA Consulting (Pty) Ltd, 09 October 2020
Palaeontological specialist study: John Almond, Natura Viva cc, October 2020
Visual Impact Assessment: Quinton Lawson and Bernard Oberholzer, QARC and BOLA, 16 October 2020

Glossary

Background scatter: Artefacts whose spatial position is conditioned more by natural forces than by human agency

Brakdak: A roof building technique in which large beams are covered by smaller poles, bamboo or reeds and finally a layer of mud.

Early Stone Age: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.

Handaxe: A bifacially flaked, pointed stone tool type typical of the Early Stone Age.

Holocene: The geological period spanning the last approximately 10-12 000 years.

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.

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

DMR: Department of Mineral Resources

ECO: Environmental Control Officer

EGI: Electricity Grid Infrastructure

EIA: Environmental Impact Assessment

EMPR: Environmental Management Programme

ESA: Early Stone Age

GPS: Global Positioning System

GP: General Protection

HIA: Heritage Impact Assessment

HWC: Heritage Western Cape

LSA: Later Stone Age

MSA: Middle Stone Age

NCW: Not Conservation Worthy

NEMA: National Environmental Management Act (No. 107 of 1998)

NHRA: National Heritage Resources Act (No. 25) of 1999

NID: Notification of Intent to Develop

PHS: Provincial Heritage Site

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 3.1
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 7.4, 7.1.4, 7.5
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;	Section 1.1.3, Section 5, Appendix 3
g) an identification of any areas to be avoided, including buffers;	Section 13
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 13
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.5
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 10
l) any conditions for inclusion in the environmental authorisation;	Section 14
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;	Section 13.1
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 12
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 12
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.

Contents

1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by Veroniva (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed development of two 175 MW photovoltaic (PV) solar energy facilities on the farm Witte Wall 171 and two power lines (within an assessed corridor) stretching over farms Witte Wall 171, Die Brak 241 and Platfontein 240 to end at the existing Eskom Kappa Substation located on the latter farm. The centre of the PV study area is at S32° 59' 15" E19° 59' 20", while the Kappa Substation at the southern end of the powerline corridor is at S33° 06' 36" E20° 00' 45". The study area lies off the R356 in the Ceres Karoo with the proposed PV area being some 39 km north of Touws River and 35 km northeast of Karoo Poort (Figures 1 & 2).

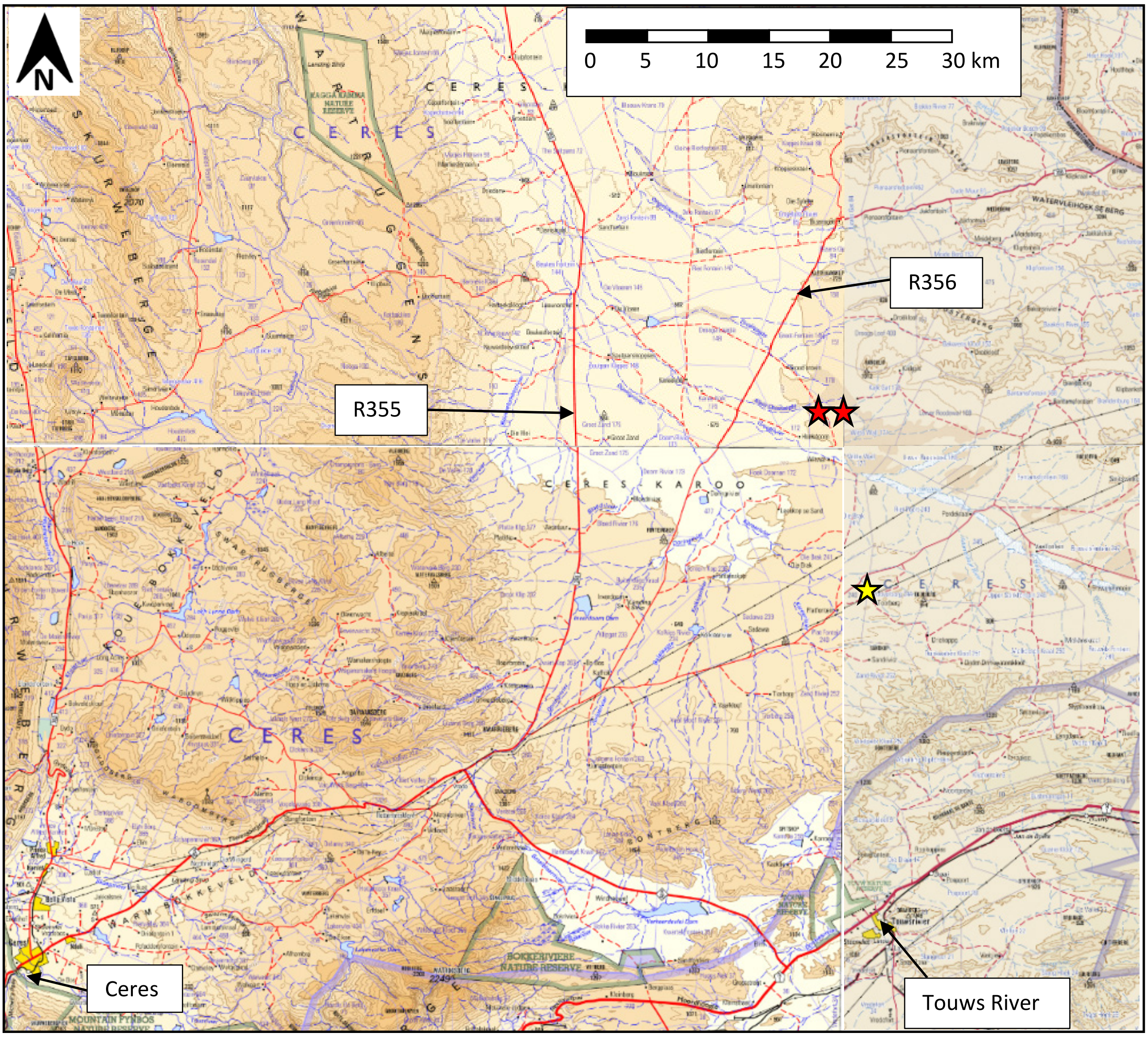


***Figure 1:** Composite of the 3218, 3220, 3319, and 3320 1:250 000 topographic maps showing the approximate location of the PV sites (red stars) and the existing Eskom Kappa Substation (yellow star). Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.*

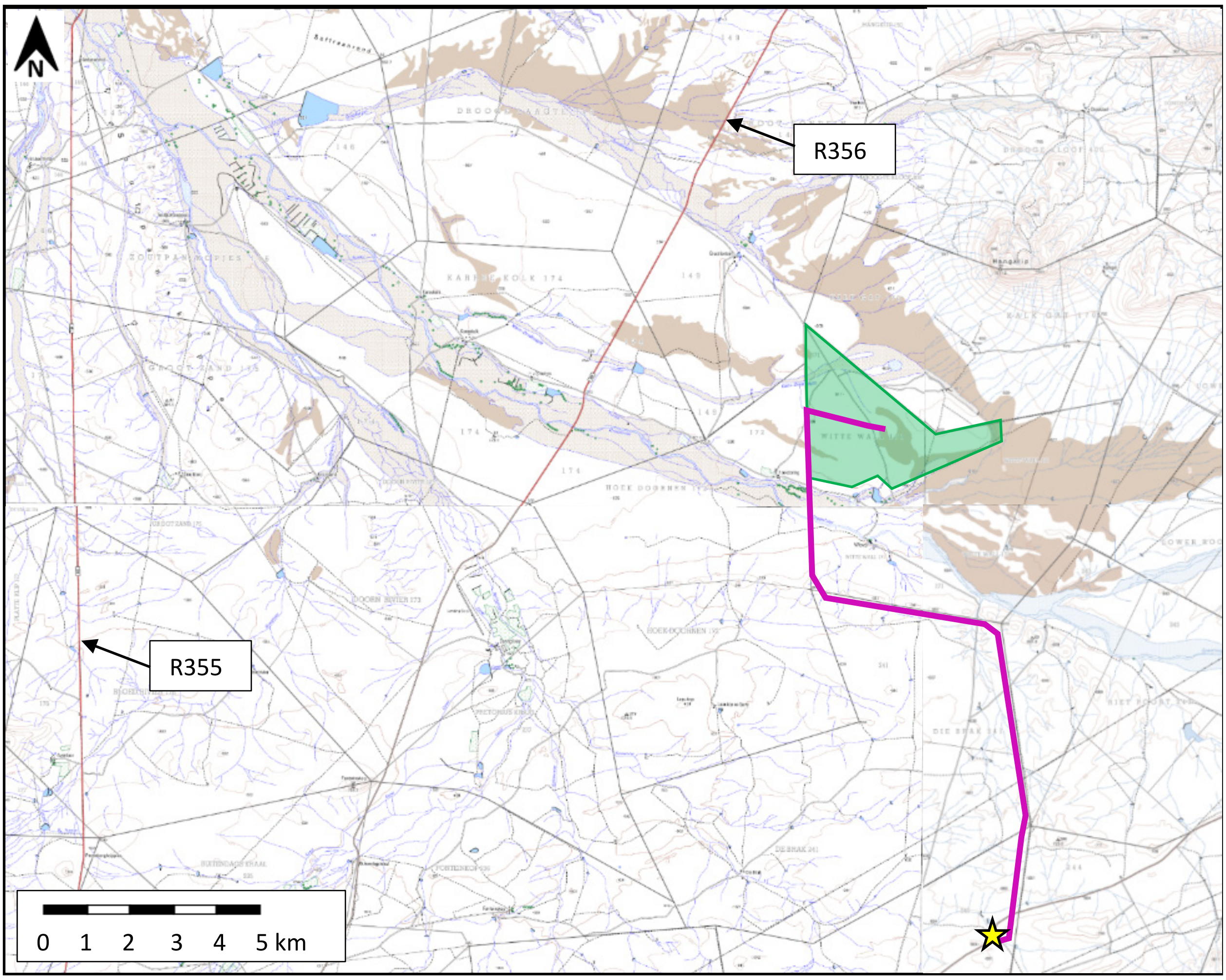


Figure 2: *Extract from 1:50 000 mapsheets 3219DD, 3319BB, 3220CC & 3220AA showing the approximate location of the PV study area (green shaded polygon), power line corridor (purple line) and Eskom Kappa Substation (yellow star).*

The Applicant is proposing to develop nine solar PV facilities and nine power lines and associated infrastructure to link the PV facilities to the Eskom Kappa Substation. Two PV facilities are being proposed on the farm Witte Wall 171; three PV Facilities are being proposed on the farm Grootfontein 149; and four PV Facilities will be constructed on the Farm Hoek Doornen 172. This Heritage Impact Assessment (HIA) deals with the Witte Wall projects to be known as Witte Wall PV 1 and Witte Wall PV 2.

1.1. The proposed project

1.1.1. Project description

Each PV project would comprise of the following components (Figure 3 shows the PV layout area and powerline corridor):

- Solar Field, comprising Solar Arrays with a maximum height of 10 m and maximum footprint of 250 hectares per project, including the following:
    - PV Modules;

- Single Axis Tracking structures (aligned north-south), Fixed Axis Tracking (aligned east-west), Dual Axis Tracking (aligned east-west and north-south), Fixed Tilt Mounting Structure or Bifacial Solar Modules;
  - Solar module mounting structures comprised of galvanised steel and aluminium; and
  - Foundations which will likely be drilled and concreted into the ground.
- Building Infrastructure
  - Offices (maximum height 7 m and footprint of 1000 m^2);
  - Operational and maintenance control centre (maximum height 7 m and footprint 500 m^2);
  - Warehouse/workshop (maximum height 7 m and footprint 500 m^2);
  - Ablution facilities (maximum height 7 m and footprint 50 m^2);
  - Converter/inverter stations (height from 2.5 m to 7 m (maximum) and footprint 2500 m^2);
  - On-site substation and/or a switching substation (footprint 20 000 m^2); and
  - Guard Houses (height 3 m, footprint 40 m^2).
- Associated Infrastructure
  - 132 kV overhead power line to connect to the existing Eskom Kappa Substation to be located within a corridor of approximately 300 m wide that has been assessed as part the Basic Assessment (BA) Process. The specific power line will have the following specifications:
    - Height = 22.5 m to 30 m.
    - The servitude for the 132 kV power line will be 33 m wide.
    - Length from the PV site to the Eskom Substation:
      - Witte Wall PV 1 Power Line: Approximately 19 km
      - Witte Wall PV 2 Power Line: Approximately 21 km
  - Associated electrical infrastructure at the Eskom Kappa Substation (including but not limited to feeders, Busbars, new transformer bay (up to 500 MVA) and extension to the platform at the Eskom Kappa Substation);
  - On-site substation and/or a switching substation;
  - Internal 33 kV power lines/underground cables (either underground to maximum depth of 1.6 m or above ground with height of 9 m);
  - A Lithium Ion battery storage facility for each Solar PV project, which may cover an area of up to 8 hectares and a height of up to 5 – 10 m (to be constructed within the proposed laydown area);
  - Underground low voltage cables or cable trays (underground to maximum depth of 1.4 m);
  - Access roads:
    - Width ranging between 4 - 8 m.
    - Total Length: Approximately 7 km for the Witte Wall Project.
    - Internal gravel roads and service road below the power line (width of 4 m);
  - Fencing (between 2 – 3 m high) around the PV Facilities - Access points will be managed and monitored by an appointed security service provider. The type of fencing will either

be of palisade, mesh type or a fully electrified option. Game fences will also be constructed around each PV facility;

- o Fencing for the power corridors: game fences will be constructed along the power line route to fence off the servitudes across the farms Witte Wall and Die Brak. No fencing will be constructed along the power line where it traverses the Platfontein Farm;
- o Panel maintenance and cleaning area;
- o Stormwater channels;
- o Construction work area (i.e. laydown area of maximum 13 ha);

It is proposed that panel cleaning will take place quarterly; however, this may be revised should the site conditions warrant more frequent cleaning. It is estimated that the panel washing process will require approximately 5 million to 8 million litres of water per year during operations; this is to be sourced from the Municipality. At this stage, no water is planned to be abstracted from or discharged to any surface water systems.

The construction phase for each proposed project is expected to extend 12 to 14 months.

The total maximum project footprint of each PV facility will be approximately 250 hectares including the PV facility and infrastructure such as internal roads for each PV facility. Some of the main access roads will fall outside of the 250 hectares. Therefore, overall the PV facility and associated infrastructure including access roads will cover an estimated area of 260 hectares.

1.1.2. Identification of alternatives

No site alternatives are being considered. However, the layout was designed after provision of sensitivity data by the specialists to ensure that it would have the least possible overall impact. One EGI corridor has been proposed but this is wide enough to allow some micrositing of the alignment to reduce impacts.

1.1.3. Aspects of the project 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.

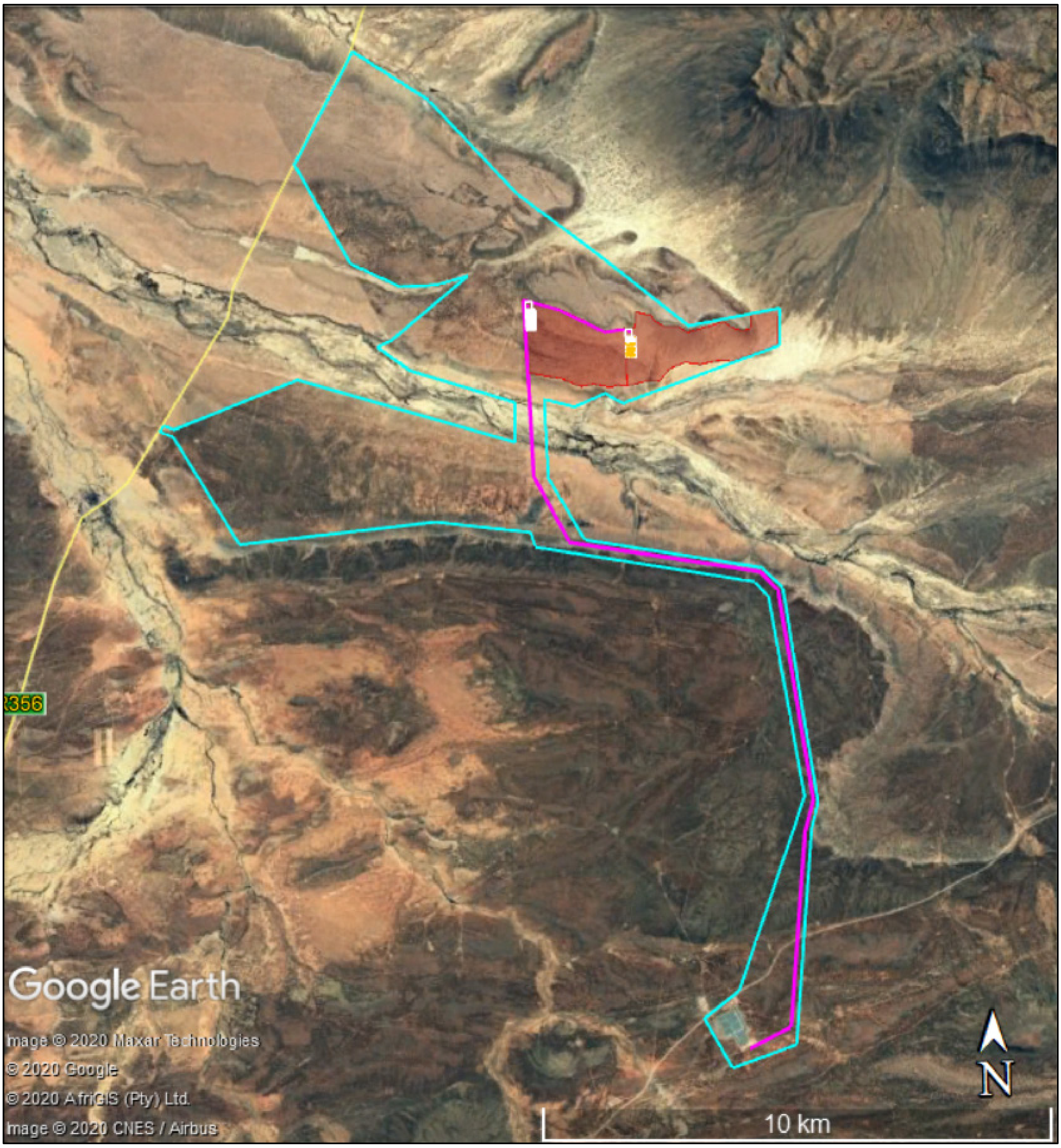


***Figure 3:** Aerial view of the greater project area for all nine PV facilities and the associated Electrical Grid Infrastructure (EGI) corridor (turquoise) showing the location of the proposed Witte Wall PV 1 & PV 2 facilities (red shading) and their associated powerlines (pink lines).*

1.2. Terms of reference

ASHA Consulting was asked to compile a Heritage Impact Assessment (HIA) that would meet the requirements of Heritage Western Cape (HWC) and that included assessments for each of the two proposed PV facilities, power lines and their associated infrastructure. The study also needed to include the following aspects:

- Comply with the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, Government Notice (GN) 320. This specifically includes Part A, which provides the Site Sensitivity Verification Requirements where a Specialist Assessment is required but no Specific Assessment Protocol has been prescribed.
- 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.
- Comply with Appendix 6 of the 2014 National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations (as amended), as well as any additional relevant legislation and guidelines that may be deemed necessary.
- The specialist must undertake a site visit in order to identify the level of sensitivity assigned to the project area on the National Web-Based Environmental Screening Tool (Screening Tool), and to verify and confirm this sensitivity and land-use.
- 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.
- Provide sensitivities in KMZ or similar GIS format.
- Provide review input on the preferred infrastructure layout following the sensitivity analysis and layout identification.
- Describe and map the heritage and features of the site and surrounding area based on desktop reviews, fieldwork, available databases, findings of the Renewable Energy Development Zones (REDZs) Phase 1 Strategic Environmental Assessment (SEA) (DEA 2015), and findings from other heritage studies in the area, where relevant. Include reference to the grade of heritage feature and any heritage status the feature may have been awarded. The assessment must also consider the maps generated by the Screening Tool.
- Map heritage sensitivity for the site. Clearly show any “no-go” areas in terms of heritage and provide recommended buffers or set-back distances. Indicate which very high sensitivity areas are regarded as complete no-go areas.
- Identify and assess the potential direct, indirect and cumulative impacts of the proposed development on the full scope of heritage features, including archaeology, palaeontology and the cultural-historical landscape, as required by heritage legislation. Impact significance must be rated both without and with mitigation, and must cover the construction, operational and decommissioning phases of the project.
- Liaise with the relevant authorities (i.e. HWC) in order to obtain a letter of approval, comments or a Permit in terms of National Heritage Resources Act, 1999 (Act No. 25 of 1999), including Regulations issued thereunder, as necessary. This also includes submitting a Notice of Intent to Develop to HWC and meeting the requirements of HWC.
- 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 Environmental Management Programme (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).
- Review the Generic EMPr for 1) Power Lines and 2) 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 are not included in the pre-approved generic EMPr (Part B – Section 1). If so, provide a list of these specific impact management outcomes and actions.

As part of the process a Notification of Intent to Develop (NID) form was submitted to HWC. Please note that at the time three PV facilities were proposed on Witte Wall but due to constraints on site only two are now proposed. HWC responded on 14th September 2020 with the following requirements for the HIA:

> Heritage Western Cape is in receipt of your application for the above matter received. This matter was discussed at the Heritage Officers meeting held on 7 September 2020.
>
> You are hereby notified that, since there is reason to believe that the proposed three 115 MW Solar Photovoltaic (PV) power generation facilities to be constructed on Witte Wall 171, farm Die Brak 241, farm Platfontein 240. Witzenbergwill impact on heritage resources, HWC requires that a Heritage Impact Assessment (HIA) that satisfies the provisions of section 38(3) of the NHRA be submitted. This HIA must have specific reference to the following:
>
> - A Visual Impact Assessment;
> - An Archaeological Impact Assessment; and
> - A Palaeontological Impact Assessment.
>
> The required HIA must have an integrated set of recommendations.
> Please note, should you require the HIA to be submitted as a Phased HIA, a written request must be submitted to HWC prior to submission. HWC reserves the right to determine whether a phased HIA is acceptable on a case by case Basis.
>
> The comments of relevant registered Conservation Bodies; all Interested and Affected parties; and the relevant Municipality must be requested and included in the HIA where provided. Proof of these requests must be supplied.

It should also be noted, however, that following S.38(3) of the National Heritage Resources Act (No. 25 of 1999), even though certain specialist studies may be specifically requested, all heritage resources should be identified and assessed.

1.3. Scope, purpose and objectives of the report

An HIA is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued by them for consideration by the Department of Environment, Forestry and Fisheries (DEFF) who will review the BA and grant or refuse authorisation. The HIA report outlines 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

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting HIAs and archaeological specialist studies in 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) Cultural Resources Management (CRM) section (Member #233) as follows:

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

2. HERITAGE LEGISLATION

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

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old 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.

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 NEMA (No. 107 of 1998), as amended, the project is subject to a BA. The present report provides the heritage component. HWC is required to provide comment on the proposed project in order to facilitate decision making by the DEFF.

3. APPROACH AND METHODOLOGY

3.1. Literature survey and information sources

Table 1 lists the sources of information used in this report.

Table 1: *Sources of information.*

Data / Information	Source	Date	Type	Description
1:50 000 map 3219DD	Chief Directorate: National Geo-Spatial Information	1960, 1987, 2003	Topographic maps	1:50 000 maps
1:50 000 map 3319BB	Chief Directorate: National Geo-Spatial Information	1969, 1987, 1997	Topographic maps	1:50 000 maps
3220CC	Chief Directorate: National Geo-Spatial Information	1968, 1986, 2005	Topographic maps	1:50 000 maps
3220AA	Chief Directorate: National Geo-Spatial Information	1967, 1986, 2005	Topographic maps	1:50 000 maps
1:250 000 map 3218	Chief Directorate: National Geo-Spatial Information	2003	Topographic map	1:250 000 maps
1:250 000 map 3220	Chief Directorate: National Geo-Spatial Information	2005	Topographic map	1:250 000 maps
1:250 000 map 3319	Chief Directorate: National Geo-Spatial Information	1997	Topographic map	1:250 000 maps
1:250 000 map 3320	Chief Directorate: National Geo-Spatial Information	2006	Topographic map	1:250 000 maps
Cadastral details	CapeFarmMapper	current	Cadastral map	Cadastral map
Descriptions of heritage resources	South African Heritage Resources Information System	Various	Unpublished reports	Commercial impact assessment reports listing heritage resources recorded during their compilation
Descriptions of heritage resources	Books	Various	Published books	Books on various aspects of local history

3.2. Field survey

The PV site was subjected to a foot survey on 8th and 9th September 2020. Sections of the EGI corridor in the north were also surveyed on those days, while other parts of the corridor to the south were also visited briefly on 28 January 2020 (Figure 4). These surveys were in spring and summer but, in this very dry area, the season makes no meaningful difference to vegetation covering and hence the ground visibility for the archaeological survey. Other heritage resources are not affected by seasonality. During the survey the positions of finds and survey tracks were recorded on a hand-held Global Positioning System (GPS) receiver set to the WGS84 datum. Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

It should be noted that amount of time between the dates of the field inspection and final report do not materially affect the outcome of the report.

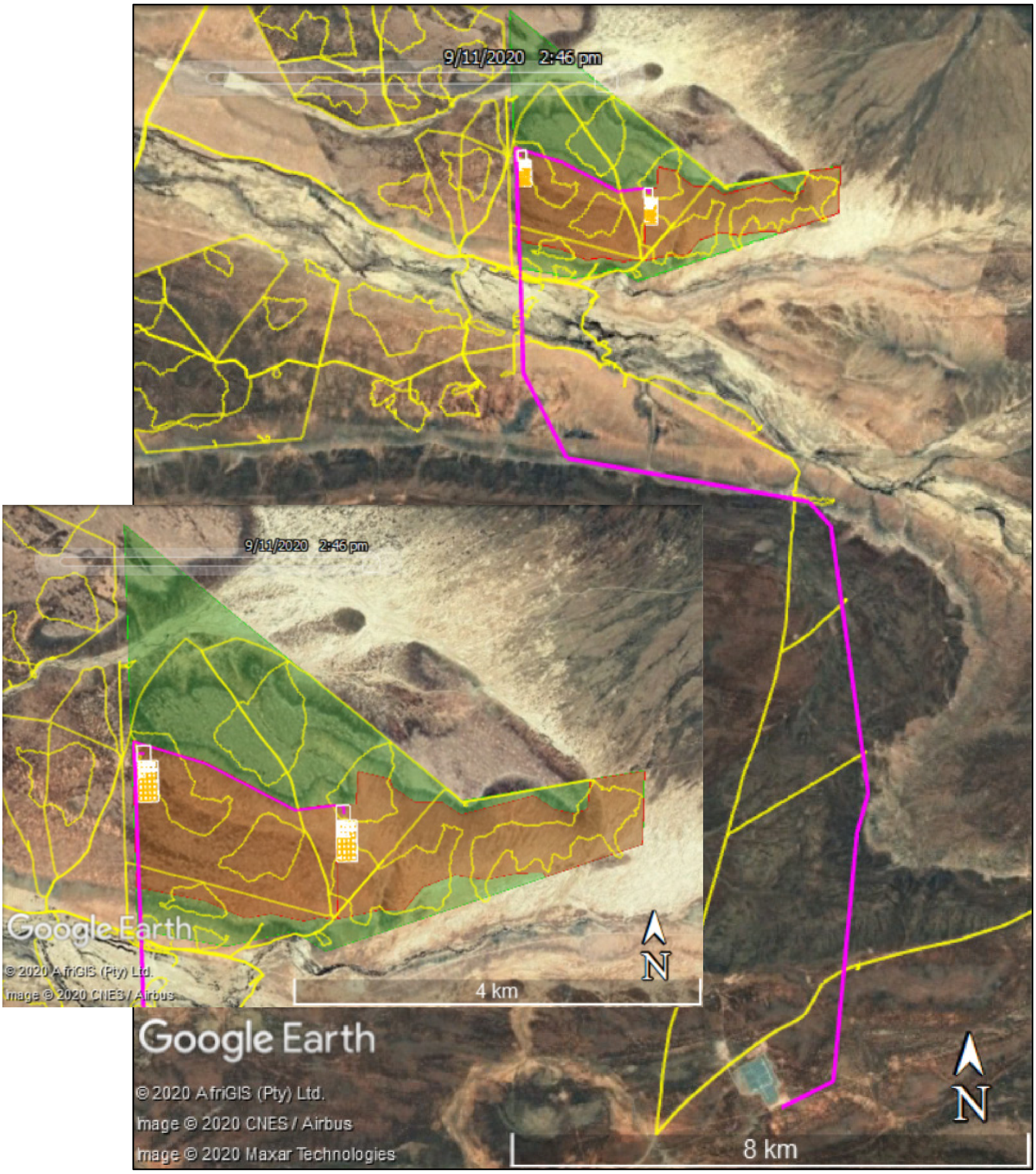


Figure 4: *Aerial view showing the survey tracks (yellow lines). The red shading shows the PV footprints and the green shading the broader study area considered for development. The approximate alignment of the power lines is shown in purple.*

3.3. Impact assessment

For consistency among specialist studies, the impact assessment was conducted through application of a scale supplied by the CSIR. The methodology is presented in full in the BA report.

3.4. Grading

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

It is intended that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. Heritage Western Cape (2016), however, uses a system in which resources of local significance are divided into Grade 3A, 3B and 3C. These approximately equate to high, medium and low local significance respectively, while sites of very low or no significance (and generally not requiring mitigation or other interventions) are referred to as Not Conservation Worthy (NCW).

3.5. 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. Due to the size of the site it was not possible to examine every part of it in detail. The focus was on understanding the distribution and types of heritage resources present and it was assumed that this distribution would be broadly true throughout the study area.

Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 30 km radius. The existing and proposed developments that were taken into consideration for cumulative impacts are shown in Figure 5[1]. Note that the cumulative impact assessment also takes into consideration the proposed Ceres PV development, i.e. nine solar PV and nine power lines.

[1] Please note that the map shows affected farms Witte Wall and Karrekolk, however it must be noted that there are no approved Renewable Energy projects on these farm portions. An updated map will be included in the BA Report.

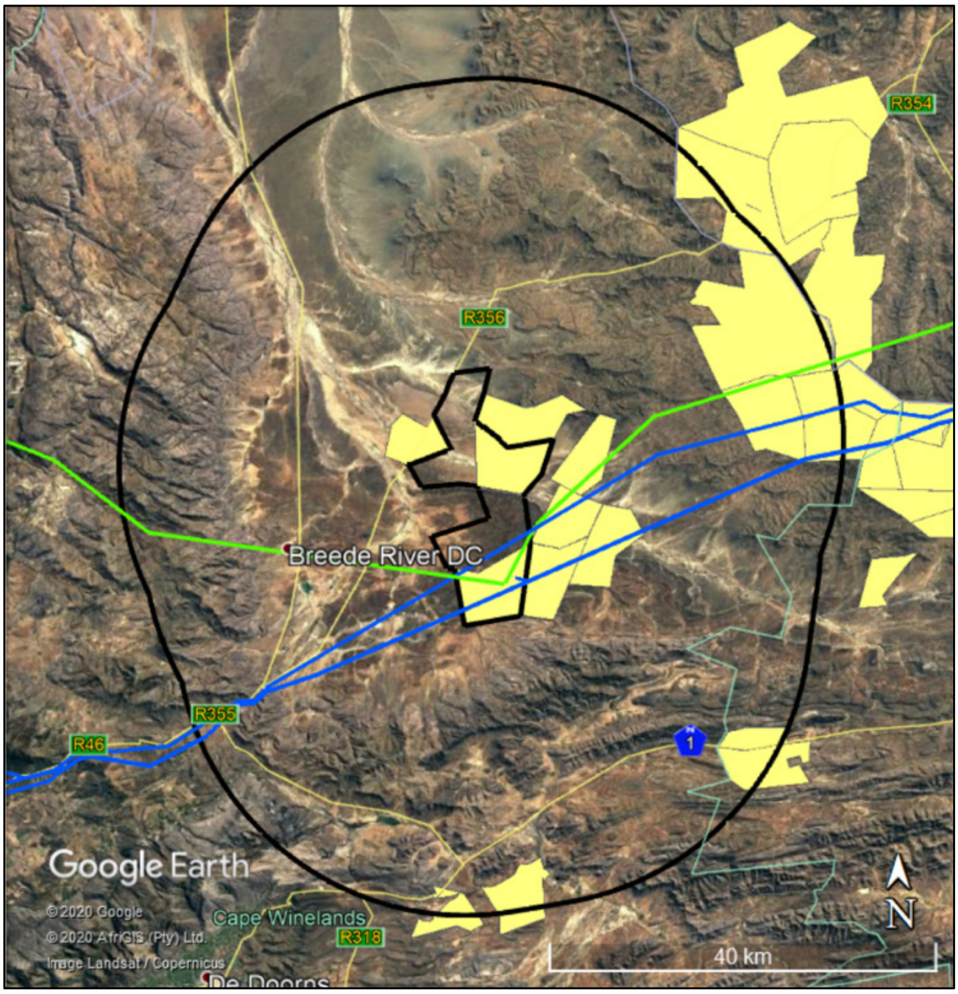


Figure 5: *Aerial view of the broader study area (black polygon) showing other existing and proposed renewable energy and electrical developments within a 30 km radius (black oval). Yellow shading denotes renewable energy facilities (but please see footnote 1), while the green and blue lines are large power lines (existing and proposed respectively).*

3.6. Consultation processes undertaken

The draft HIA was submitted to relevant interested and affected parties as required by HWC in their response to the NID application (Section 1.2). The report was also included in the main public participation process (PPP) required under NEMA as part of the EIA.

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The site is in a remote location in the Ceres Karoo. It lies off the R356 gravel road. Although the area is currently only used for the grazing of livestock and game, it does lie within the Komsberg REDZ and one wind energy facility (WEF) has already been developed between 9 km and 16 km to the southeast. The large Eskom Kappa Substation and several power lines occur in the south. Other infrastructure, aside from farm buildings and wind pumps, is largely absent from the local landscape.

4.2. Site description

The broader study area is a wide, flat plain bisected by the Groot River and its tributaries. The Witte Wall PV area is to the north of the Groot River on an older river terrace. A higher terrace to the north has been excluded from the development area (Figures 6 & 7). The ground is coated in sand and gravel with only very low vegetation. The exception is close to the rivers where trees occur. Many variable-sized expanses of naturally denuded ground afford excellent ground visibility. Some of these are ephemeral pans but others are only gravel patches (Figures 8-10).

Figure 6: *View towards the southeast across the Witte Wall PV 2 site from the high ground on its northern edge. The existing Perdekraal WEF is visible in the background. The study area lies on the flat ground between the viewer and the Groot River which is faintly visible (arrowed).*

Figure 7: *View towards the southwest from the high ground at the northern edge of the Witte Wall PV 2 site. The study area lies on the flat ground between the viewer and the Groot River which is*

faintly visible (arrowed). Witte Wall PV 1 would be located towards the right hand side in this view with Witte Wall PV 2 towards the left and in the centre.

***Figure 8:** View towards the southwest within the Witte Wall PV 2 site and showing a naturally denuded area.*

***Figure 9:** View towards the northeast across the northern part of the Witte Wall PV 1 site. The site ends at the slope break (arrowed).*

Figure 10: *View towards the southeast across the Witte Wall PV 1 site showing a naturally denuded area. The Perdekraal WEF is visible in the background.*

The powerline corridor was mostly visited in the north where it passed through the various PV study areas. However, during an earlier survey, parts of the corridor were visited and can be briefly described. Figure 11 shows a view towards the west along the west-east section of the power line corridor. It shows the ridge containing the Matjiesfontein Chert band. And the plains to its south. Figure 12 shows an example of one of the patches of fractured chert debris that occur along the ridge in places. The southernmost part of the corridor is very flat and ends at the large Eskom Kappa Substation (Figure 13).

Figure 11: *View towards the west from the eastern end of the west-east section of the power line corridor. The dashed line shows the approximate centre of the corridor until it passes over the ridge in the distance. The yellow arrow marks the location of Figure 12. Photographed 28 January 2020.*

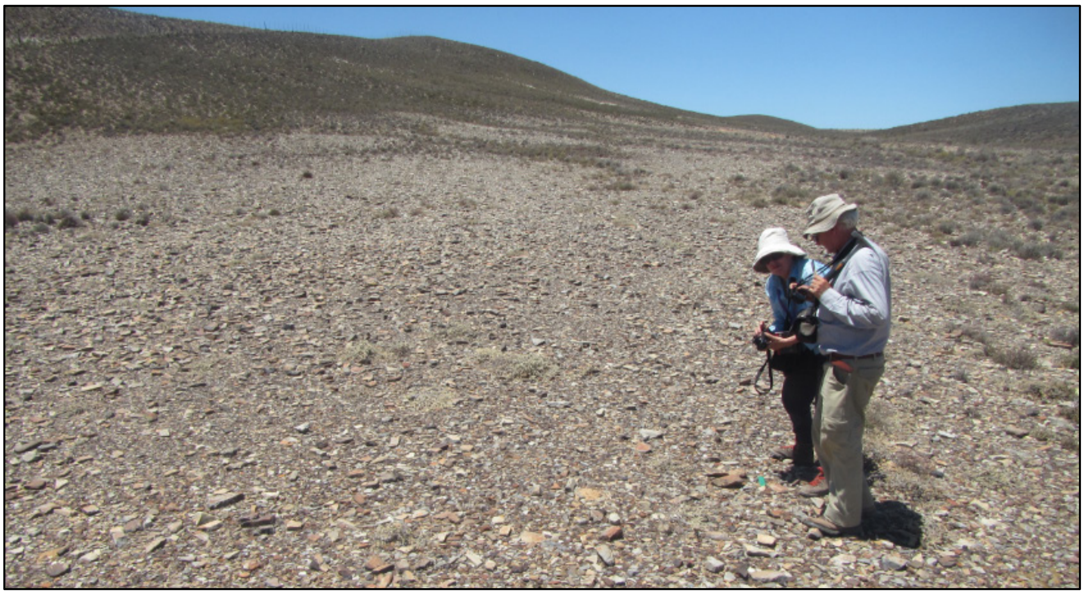


Figure 12: *View of the southern base of the Matjiesfontein Chert ridge showing the fractured debris that has accumulated from weathering of the ridge. Figure 11 was photographed from the skyline in mid-picture. Photographed 28 January 2020.*

Figure 13: *View towards the south of the Kappa Substation from within the southern end of the power line corridor. Photographed 28 January 2020.*

5. FINDINGS OF THE HERITAGE STUDY

This section describes the heritage resources recorded in the study area during the course of the project. Note that mapping has been included in Appendix 3.

5.1. Palaeontology

The South African Heritage Resources Information System (SAHRIS) Palaeosensitivity map shows the study area to be of medium to high sensitivity with a very narrow band of very high sensitivity along the west-east section of the power line corridor.

Almond (2020) notes that the project area is situated on a pediment surface of Neogene to Pleistocene age that has been planed off by river erosion. Beneath a thin capping of alluvial gravels, calcrete hardpans, sandy soils and downwasted surface gravels are Tierberg Formation (Ecca Group) sediments of Middle Permian age. They are weathered, folded and often tectonically-cleaved. Almond (2020:1) comments that "the only fossil remains recorded from such pediment settings in the Ceres Karoo comprise (1) sparse, generally small blocks of reworked silicified fossil wood within alluvial and surface gravels of uncertain provenance (probably Ecca Group) and (2) occasional calcretised fossil termite nests of probable Pleistocene age that are found embedded within calcretised superficial sediments as well as weathered, calcrete-veined bedrocks. … These fossils are of widespread occurrence within the Ceres Karoo region and are not of high scientific interest or conservation value." He notes that most fossil occurrences found in the field were outside of the PV footprint areas.

The power line corridor overlies rocks of the Permo-Carboniferous, glacial-related Dwyka Group and the lower Ecca Group (Prince Albert, Whitehill and Collingham Formations). The potentially-fossiliferous Prince Albert, Whitehill and Collingham Formations were found to be highly weathered and cleaved in the study area and no sensitive fossil sites have been found along the corridor (Almond 2020).

The full palaeontological specialist study is included in Appendix 4.

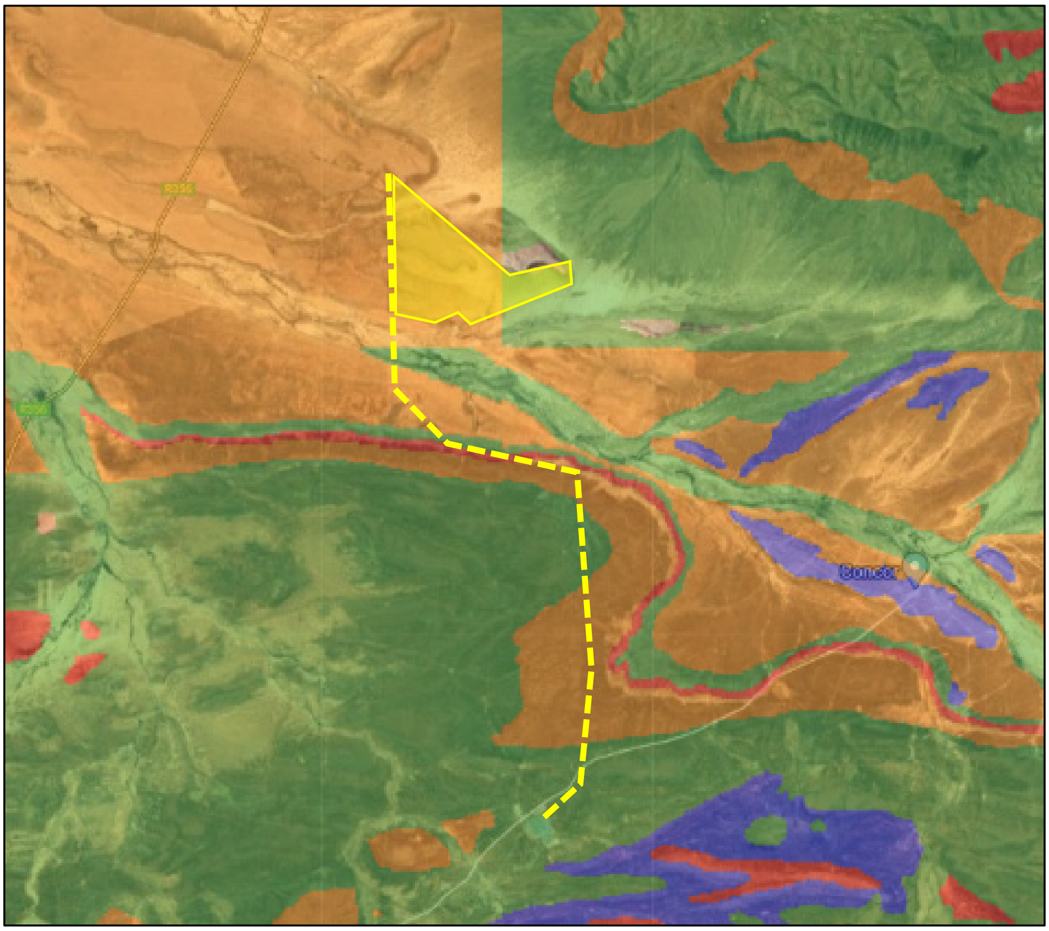


Figure 14: *Extract from the SAHRIS Palaeosensitivity map showing the study area to be of largely medium and high palaeontological sensitivity (green and orange shading respectively). A strip along the power line route is of very high sensitivity (red).*

5.2. Archaeology

5.2.1. Desktop study

Some other studies have been done in the area but few are available on SAHRIS. Halkett and Webley (2011) located many light scatters of artefacts in an area to the southeast of the present study area and focused along the margins of streams. The vast majority were considered to be Middle Stone Age (MSA) with far fewer relating to either the Early (ESA) or Late (LSA) Stone Ages. A few bifacial pieces seemed likely to be ESA handaxes though. Orton (2008) worked at the southern end of the present power line corridor and located a number of light scatters of artefacts. Most were MSA artefacts (e.g. Figure 15) but one small scatter was strongly dominated by LSA artefacts (Figure 16). A single willow pattern ceramic (plate) fragment was also found.

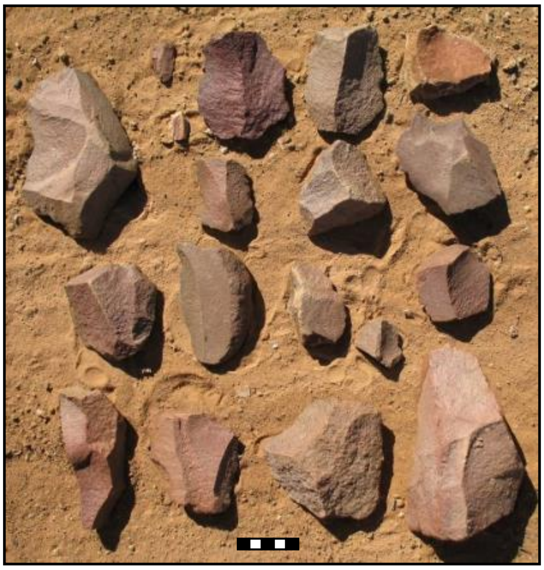


Figure 15: *Artefacts from PFN2008/007. Scale in cm. Source: Orton 2008: fig. 63.*

Figure 16: *A selection of artefacts from PFN2008/004. Note the inclusion of quartz and absence of quartzite. The dark rock is unweathered hornfels. Scale in cm. Source: Orton 2008: fig. 65.*

Towards the east and into the foothills of the escarpment, Smuts (2018) found stone artefacts to be far rarer than out on the plains but also noted that what was present was focused along rivers. Smuts (2018) also recorded a rock shelter with finger paintings and a single pot sherd. A subsequent visit to this site by the present author showed it to contain a good deposit with many stone artefacts, some grindstones, a grooved stone, many finger-painted images on the rear wall and a string of five *Nassarius kraussianus* shell beads. These are estuarine shells that had to have been brought to the site from the coast. Two other rock art sites – one a fine line painting and another a set of geometric paintings – have been seen by the present author some 16 km north of the PV study area.

5.2.2. Site visit

Table 1 provides a list and description of all heritage resources recorded during the ground survey. Not recorded are the very large number of isolated Stone Age artefacts seen throughout the study area (except for ESA bifaces and LSA lower grindstones which were recorded). These isolated artefacts are what are commonly referred to as background scatter, their distribution having been conditioned more by natural forces than anthropogenic ones (Orton 2016). They are dominated by MSA artefacts but ESA and LSA artefacts were also frequently seen. Figure 17 shows a selection of such isolated finds from the Witte Wall farm. Figures 18 to 20 show artefacts from two slightly denser areas of background scatter. Background scatter artefacts were seen in all of the few locations visited along the power line corridor, while some denser scatters of artefacts were recorded by Orton (2008) in the very southern end of the corridor alongside the Kappa Substation. The artefacts along the power line corridor seem to be largely MSA, as occurs elsewhere, but a number of ESA items have been seen by both the archaeologist and palaeontologist in close proximity to the Matjiesfontein Chert ridge.

Table 1: *List of heritage resources recorded during the survey.*

Waypoint	Location	Description	Significance	Grade
142	S32 59.945 E19 58.883	Farmhouse. It is a fairly small vernacular cottage, probably dating to the late 19th century. It was not examined in detail. There are large gum trees outside the cottage.	Medium	IIIB
143	S32 59.899 E19 58.952	Brakdak labourer's cottage, but now with a corrugated iron roof. It would be of higher significance if it was in better condition. It is located in the farm werf a short distance south of the waypoint 142 cottage.	Medium	IIIB
144	S32 58.924 E20 01.153	Patch of elevated density background scatter. Sandstone, CCS, Silcrete and hornfels all seen.	Very low	NCW
145	S32 59.033 E20 01.306	A scatter of potsherds that no doubt belong to one pot. There are no associated artefacts. The sherds include three plain rim sherds and part of a spout. The pottery is very thin-walled and has mineral temper.	Low **Collect sherds**	IIIC
146	S32 59.090 E19 59.617	Patch of elevated density background scatter. Lots of silcrete present. The artefacts are all MSA.	Very low	NCW
147	S32 59.086 E19 59.505	Patch of elevated density background scatter. CCS, silcrete and 'other' materials present.	Very low	NCW
148	S32 58.857 E19 58.944	Small stone feature (not a grave).	Very low	NCW
149	S32 58.873 E19 58.535	Patch of elevated density background scatter. Sandstone, CCS, Silcrete all seen. Potential sample location.	Very low	NCW
150	S32 59.675 E19 59.292	Stone-packed mound that might be a grave. It is directly across the road from waypoint 151 so the two may be associated. This might reduce the chances of this feature being a grave.	High **Avoid**	IIIA
151	S32 59.670 E19 59.292	Neatly packed stone circle of about 0.7 m diameter. Also a tin lid, some potjie fragments and two ceramics nearby. Age and function uncertain, but its preservation suggests it is not old. It is directly across the road from waypoint 150 so the two may be associated.	Very low	NCW
152	S32 59.744 E19 58.212	An ephemeral LSA artefact scatter on the river bank. Mostly hornfels but also some chert flakes nearby.	Very low	NCW
153	S32 59.732 E19 58.195	A stone feature with loosely clustered stones over an area of 1.0 by 2.5 m	Very low	NCW
154	S33 00.473 E19 59.136	A remnant of a stone and mud structure built with both cobbles and blocks.	Very low	NCW
155	S33 00.488 E19 59.122	A stone and sun-dried mudbrick ruin in two sections with the middle broken down/collapsed. There is lots of straw in the mudbricks. It had a brakdak which is still partially preserved over the eastern room. The beams are a mix of wooden poles and metal pipes indicating a relatively recent replacement or else that the structure is not that old. Above these are some flat planks and some half-round poles then thatching grass and mud. The eastern room is largely intact and has a wooden door frame (with no door) and wooden-framed muurkas which is visible from the outside due to erosion of the mudbricks. There is an ox wagon in poor condition and a new trailer with tires behind the ruin.	Low	IIIC
156	S33 00.465 E19 59.096	A brick house, not examined in detail as it was still occupied. It has had additions over time. Likely started as brakdak but now under corrugated iron. One section	Medium	IIIB

Waypoint	Location	Description	Significance	Grade
		is part stone with mudbrick above, while another is mudbrick on a stone plinth. An extremely large pepper tree stands outside the house to its north, betraying that this is likely the oldest house on the farm.		
157	S33 00.955 E20 00.490	A family graveyard containing four graves with a possible fifth one in the middle. The middle mound may be left over material from excavating the two northern graves which are cement covered and probably younger. The age of the graves is unknown.	High	IIIA
158	S33 01.004 E20 00.572	A house ruin of stone and mudbrick. The house was built in three phases starting with the kitchen on the northern end (Section A), then a two-roomed addition (Section B) and finally an extra room on the southern end (Section C). Section A: The kitchen has a large hearth along its western wall with the chimney built up higher than the roof. The door and hearth lintels look like logs from indigenous trees but more modern poles on the roof indicate a replacement of the roof. The east-facing door is wider than usual at 1.15 m. The room is about 3.0 m by 3.6 m measured outside. Section B: This section has newer wood than the oldest kitchen lintels throughout. A pole (possibly a gum poles) overlies the exterior door, while a plank overlies the internal linking door between the two rooms. The external door is 0.95 m wide. The southern of the two rooms is still under a brakdak, while the other half has collapsed. This section is 5.5 m long and 3.6 m wide. Sections A & B: The walls of both rooms are of rock throughout. Most are sub-rounded cobbles while others are blocks or slabs, with the latter mostly used above doors and windows, presumably to better spread their weight over the openings. The walls have mud mortar between the rocks and the outside was plastered with mud mortar and then white-washed. Section C: This newest addition was built with slabs and mud mortar but was plastered with grey cement both inside and outside. The outside was white-washed but not the inside. The lintel for the southern window is a tongue-in-groove plank. The external rood is 0.85 m wide. The western wall is not correctly aligned with the western wall of the rest of the structure with the result that the external dimension is about 0.15-0.20 m less.	High-Medium	IIIB
159	S33 00.985 E20 00.589	A single-roomed structure with three walls, that presumably functioned as a shed. The southern side is not walled and is presumed to have been a large entrance. The northern wall is not keyed into the eastern and western walls. The structure was built with sub-rounded cobbles, a few blocks, sun-dried mudbricks and mud mortar. The mudbricks have much fine gravel and straw in them. The outside was plastered with mud mortar. The western wall has a window larger than those of the house but with machined wood perhaps of similar age to Section B of the house. There is a small stone and mud mortar room to the west which is part of the northern wall. There are several car body parts including the bonnet with a Chevrolet decal, scattered	Low	IIIC

Waypoint	Location	Description	Significance	Grade
		about the vicinity of waypoints 158 and 159.		
160	S33 00.498 E19 58.987	A family graveyard (Smuts) with two graves dated 1978 and one dated 1986. Not heritage.	---	---
161	S33 00.116 E19 58.205	Waypoints 161-169 all represent one LSA site on a river floodplain. Two lower grindstones. One was face up while the other was ground on both sides but its lower surface was ochred.	Low	IIIC
162	S33 00.103 E19 58.205	One lower grindstone ground on both faces.		
163	S33 00.106 E19 58.200	One lower grindstone/anvil found face up.		
164	S33 00.110 E19 58.199	One lower grindstone ground on both sides but far more heavily so on the side facing down. Some fresh chert flakes and a core here and also a hammerstone/possible upper grindstone		
165	S33 00.112 E19 58.200	One lower grindstone found face down.		
166	S33 00.115 E19 58.193	One lower grindstone ground on both sides.		
167	S33 00.104 E19 58.191	One lower grindstone found face down.		
168	S33 00.099 E19 58.179	An upper grindstone.		
169	S33 00.047 E19 58.224	One lower grindstone found face down.		
170	S32 58.264 E19 58.105	A lower grindstone found face up with a few chert flakes nearby. The site is on the edge of a stream bed.	Very low	NCW
670	S33 05.494 E20 01.541	Low density background scatter on Dwyka Tillite gravel.	Very low	NCW
671	S33 02.423 E20 01.424	Low density background scatter on Dwyka Tillite gravel.	Very low	NCW
672	S33 01.542 E20 00.936	Background scatter along the edge of the Collingwood Formation which has several chert bands, including the well-known Matjiesfontein Chert. The scatter was low density but it was interesting to note the variety of items present. These includes material likely to be of all three Stone Ages. Notably, many artefacts were simply natural pieces of stone, often diamond-shaped in cross-section), that had been modified slightly for further use. This included many small slabs of rock with abundant edge-damage as well as well-weathered handaxes that were made with around 3 to 5 removals. Although outside the powerline route, it likely serves as a representative sample of what would be present in those places where the route crosses this geology elsewhere.	Low	IIIC
003	33° 06 41.9 S 20° 00 59.6 E	Deflated area with LSA and MSA artefacts on hornfels and quartzite. Recorded by Orton (2008).	Very low	NCW
004	33° 06 43.4 S 20° 00 50.7 E	Good scatter of LSA artefacts over an area about 5 m across, no evidence of organics, just two MSA. Recorded by Orton (2008).	Low **Sample**	IIIC
005	33° 06 37.4 S 20° 00 59.0 E	MSA background scatter artefacts in quartzite and hornfels. Recorded by Orton (2008).	Very low	NCW
006	33° 06 38.2 S 20° 01 03.1 E	MSA background scatter artefacts in quartzite and hornfels. Recorded by Orton (2008).	Very low	NCW
007	33° 06 35.6 S	Widespread MSA background scatter artefacts in	Very low	NCW

Waypoint	Location	Description	Significance	Grade
	20° 00 53.8 E	quartzite and hornfels. One LSA artefact. Recorded by Orton (2008).		
kraal 1	33° 06 51.5 S 20° 01 27.6 E	Historical stone-built kraal built on a north-facing hill slope. Also many LSA stone artefacts noted in the vicinity. Recorded by Orton (2008).	Medium	IIIB
kraal 2	33° 06 54.0 S 20° 01 31.0 E	Historical stone-built kraal built on a south-facing hill slope (same hill as kraal 1). Visible on aerial photography.	Medium	IIIB

Just one proper Stone Age archaeological site was found on Witte Wall. This was a strange occurrence within the Groot River floodplain and along the power line corridor. It was comprised of many lower grindstones with very few flaked stone artefacts spread over an area of about 30 m by 50 m. The substrate was hard silt, and it is highly unlikely that buried artefacts occur. Perhaps the most interesting occurrence was a scatter of LSA pottery found in the eastern part of the study area. It had no other finds associated with it and very likely represents a location where a passing person dropped a pot which broke (Figure 21). The scatter includes a spout and three rim sherds. All sherds are plain (i.e. undecorated).

Figure 17: *Selection of background scatter artefacts from the Witte Wall farm. They include mostly ESA and MSA artefacts with only rare LSA materials.*

Figure 18: *Background scatter artefacts from waypoint 144.*

Figure 19: *Background scatter artefacts from waypoint 144.*

Figure 20: *Background scatter artefacts from waypoint 147.*

Figure 21: *Pot sherds from waypoint 145. The large one in the centre of the upper row is a spout fragment, while three undecorated rims lie to its left.*

No historical materials were found in either the PV study area or the power line corridor, but some were noted elsewhere on Witte Wall, to the south of the river. They comprised of the ruins of some earlier houses and (probably) associated outbuildings. Outside one of them was an old wagon that is also considered a heritage resource. The finds are described in detail in Table 1 and, because they are well away from the study area, they are not discussed further here. Figures 22 to 32 illustrate the main finds (but note that many more photographs were taken for the record). Figures 33 and 34 show schematic plans of two ruins.

Figure 22: *Ruins at waypoint 154 and 155. A wagon lies behind the central structure.*

Figure 23: *Part of the ruin at waypoint 155.*

Figure 24: *Detail showing the use of metal in the roof structure.*

Figure 25: *View of the roof of the ruin at waypoint 155. It was a* brakdak*.*

Figure 26: *The old wagon standing behind he ruin at waypoint 155.*

Figure 27: *The front of the ruin at waypoint 158. The kitchen is at the near end.*

Figure 28: *The back of the ruin at waypoint 158. The back of the hearth is at the left.*

Figure 29: *Inside detail of the ruin at waypoint 158 showing stonework and plaster.*

Figure 30: *The hearth in the kitchen of the ruin at waypoint 158.*

Figure 31: *The join between the southern and central sections of the ruin at waypoint 158.*

Figure 32: *Roof detail of the ruin at waypoint 158 showing the* brakdak*.*

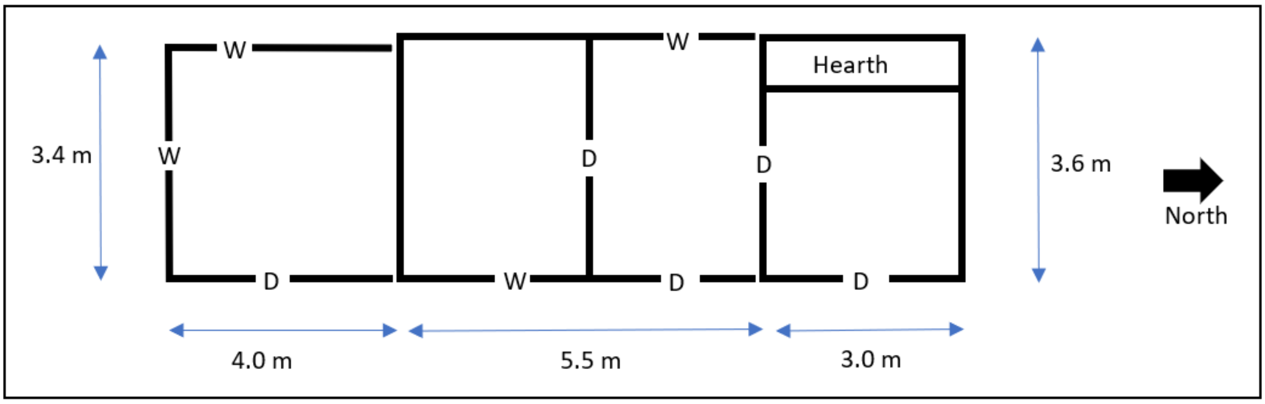


Figure 33: *Plan of the ruin at waypoint 158. D = door, W = window.*

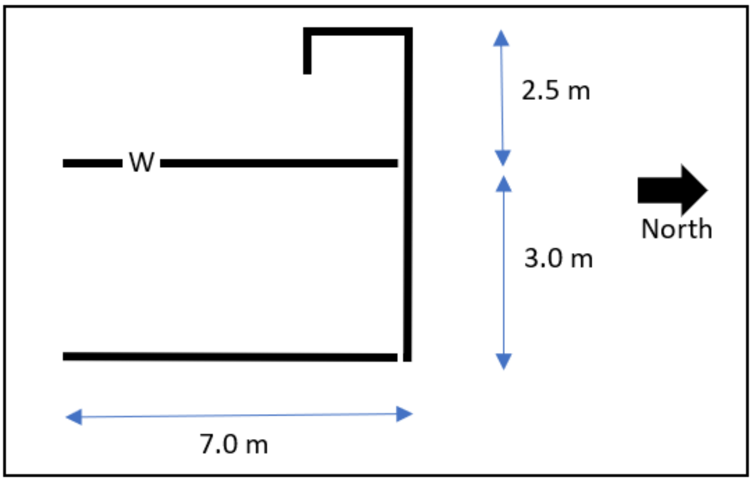


Figure 34: *Plan of the ruin at waypoint 158. D = door, W = window.*

5.3. Graves

Two small family graveyards were found on Witte Wall to the south of the river. One has undated cement-covered graves (Figure 35), while the other has three burials – a single grave dated 1986 and a double grave bearing the date 1978 (Figure 36). Although the first may be older than 60 years, the second is not and is thus not a heritage resource. Between the PV study area and the river two stone features were recorded. One was a mound of stones that was strongly suggestive of a grave (Figure 37), while the other, located immediately across the farm track, was a circular feature with a few metal and ceramic items alongside it (Figure 38). Because the latter is certainly not a grave, the former may also not be, but caution dictates that it should be treated as one until proven otherwise.

Figure 35: *Graves at waypoint 157. Two in the foreground and two in the background with a possible 5th in between.*

Figure 36: *Graves at waypoint 160. The double grave is of Nicolaas and Martha Smuts and has dates at death of 10-8-1978 and 29-10-1978.*

Figure 37: *Stone mound at waypoint 150 thought to be a grave. The waypoint 151 feature is arrowed.*

Figure 38: *Small stone feature at waypoint 151.*

5.4. Historical aspects and the Built environment

5.4.1. Desktop study

In addition to standing structures, Halkett and Webley (2011) found many small stone ruins. They were from a variety of features including houses, kraals, ovens, a possible threshing floor and a well. Smuts (2018) also noted many stone structures and ruins. To the south of the Kappa Substation and some 450 m outside the proposed power line corridor, a large stone-built kraal was recorded on a north-facing slope by Orton (2008; Figures 39 & 40). A second one lies over the hill about 100 m further to the southeast.

Figure 39: *View across the Platfontein site towards the kraal. The study area extends approximately as far as the power lines visible in the photograph and the kraal is some 350 m beyond its edge. Source: Orton (2008: fig. 66).*

Figure 40: *Close up view of the kraal looking southwards. Source: Orton (2008: fig. 67).*

Karoo Poort is an important historical passage that hosts a Provincial Heritage Site (PHS), the Karoopoort Outspan. The poort is located some 35 km southwest of the PV study area. The PHS buildings and grounds are sadly run down and the “mile-long row of ancient fig trees” mentioned by Mossop (1927:182) is now largely dead. The old road, or ‘Forgotten Highway’, to the diamond fields used to pass through Karoo Poort (also once known as Bokkeveld’s Poort) on its way to Sutherland. Figure 41 shows Mossop’s (1927: facing page 168) map of the area. The historical road approximately equates to the R356 of today with the latter simply being a straightened and modernised version. After passing the study area, the road makes its way below a prominent landmark hill known as Hanglip, for the slightly overhanging cliff visible in profile from the southwest and northeast. The original road lay closer to the foot of Hanglip (as shown by a photograph in Mossop (1927)). There was also an outspan at the foot of the hill.

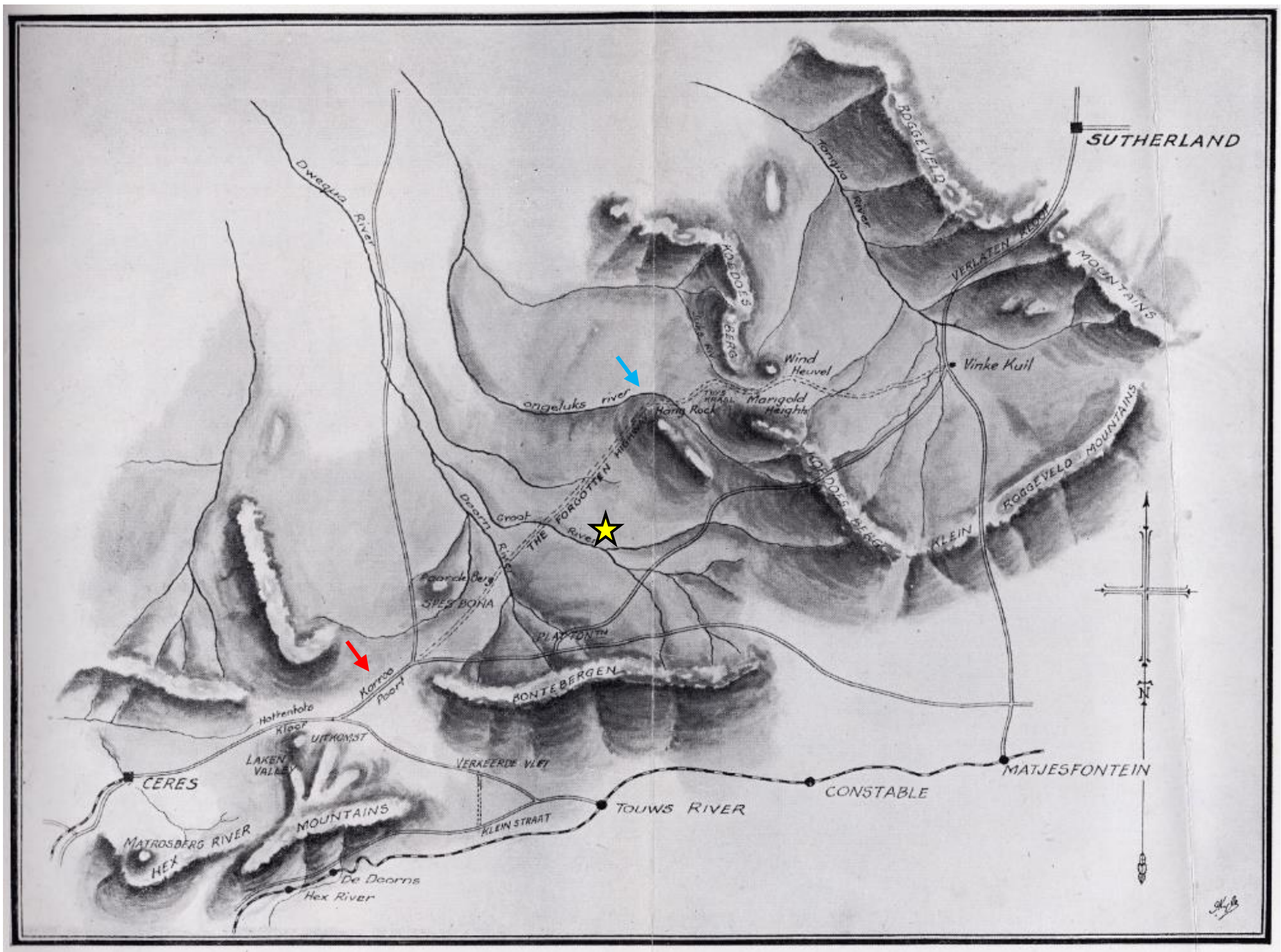


Figure 41: *Map of the Ceres Karoo showing the 'Forgotten Highway' leading past the study area (yellow star). The important landmarks of Karoo Poort (red arrow) and Hanglip (blue arrow) are indicated.*

5.4.2. Site visit

Three standing historical structures were located on Witte Wall. A labourer's cottage lies to the south of the Groot River, adjacent to the ruins at waypoints 154 and 155. The house is a flat-roofed house which very likely started as a brakdak. It has been added to and modified over the years in true vernacular fashion and, despite now having a corrugated iron roof, strongly retains its traditional character (Figure 42). The farm manager's house lies on the north side of the Groot River and appears to be a vernacular cottage with a pitched roof that may well date to the early decades of the 20th century (Figure 43). It has steel-framed windows but was not examined in detail due to being outside of the study area. Very nearby is a brakdak labourer's cottage that, despite maintenance work and the addition of a light-weight lean-to, strongly retains its original character (Figures 44 & 45).

Figure 42: *View of the cottage at waypoint 156.*

Figure 43: *View of the cottage at waypoint 142.*

Figure 44: *View of the south-eastern corner of the* brakdak *cottage at waypoint 143.*

Figure 45: *View of the north side of the* brakdak *cottage at waypoint 143.*

5.5. Cultural landscapes and scenic routes

The landscape is very strongly a natural one which has a distinctive aesthetic appeal to lovers of South Africa's dry landscapes. Figures 6 to 12 provide an impression of the landscape, showing its expansiveness and, within the Ceres Karoo basin, lack of steep topography. The triangular basin is ringed by mountains: the Swatruggens lie in the west, the Bontberg and other small unnamed mountains form the southern edge, and the Roggeveld Mountains lead up to the escarpment in the northeast. Although the area is very remote and has no paved roads, it has been included in the Komsberg REDZ which means that wind and solar farms can be expected to be developed in the area (Figure 46). The REDZ already hosts several wind farms, including one located to the southeast of the present study area. The Kappa Substation occurs at the southern end of the proposed power line corridor and several large power lines already traverse the Ceres Karoo going in and out of the substation (Figures 5 & 13).

Although Winter and Oberholzer (2013) list Karoo Poort as a Grade II scenic resource for its historical and architectural value and the uplands (Koedoesberge) to the north of the project area as a Grade III scenic resource rising from the flat plain, they ascribe no scenic value to the plain itself and the R356 that traverses it. The road is nevertheless considered by the present specialist to have at least some value as a local scenic route, especially given its historical role.

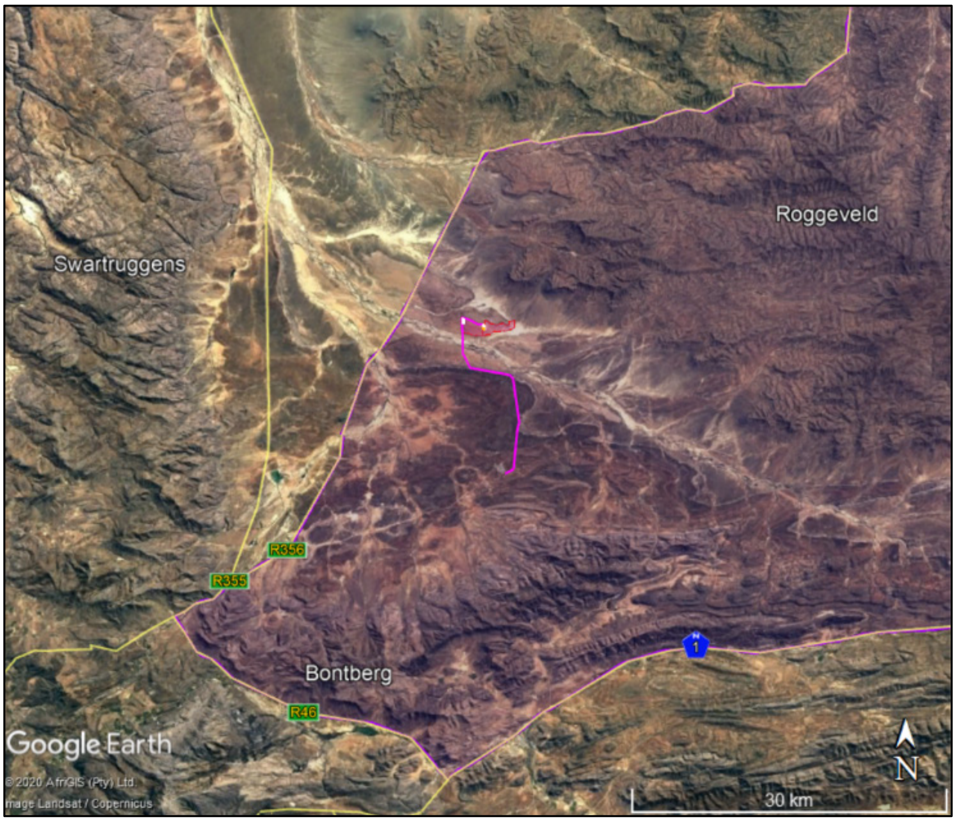


Figure 46: *Aerial view of the Ceres Karoo showing project site (PV Areas for Witte Wall PV 1 and PV 2 and power lines to the Eskom Kappa Substation) relative to the western part of the Komsberg REDZ (purple shading) and surrounding mountains (labelled).*

As already noted in Section 5.4.1, the Ceres Karoo hosted an important historical travel route. The small mountain known as Hanglip was a crucial landmark in the landscape as it signalled the end of the Ceres Karoo crossing and also arrival at an outspan. Hanglip is very prominent and forms a key component of the cultural landscape (Figure 47). For the rest, the natural landscape is marked only by rare houses, often accompanied by gum or other trees, farm fences and tracks and water infrastructure (earthen dams, round cement reservoirs and wind pumps). The anthropogenic imprint on the landscape is thus very light. Karoo Poort is also an important component of the wider cultural landscape but, owing to its distance from the project area, is not of concern here.

Figure 47: *View along the R356 northwards towards Hanglip, the small peak at the left end of the middle ground mountain.*

5.6. Visual impact assessment

A specialist visual assessment has been carried out by Oberholzer and Lawson (2020; see Appendix 5). They note that the viewshed extends up to 5 km but that the visual exposure is medium because some areas fall within a view shadow. They note that scenic resources are absent from the immediate area with only farmsteads serving as visual receptors. The landscape integrity is considered to be low with powerlines and the Perdekraal WEF having disturbed the landscape. Figures 48 and 49 show that the R356 will not be significantly visually affected by either the PV projects or the EGI. Figure 50 shows that the PV panels would be only very marginally visible from the R356. The power lines would be visible from the road passing the Kappa Substation but much other electrical infrastructure already occurs in that area.

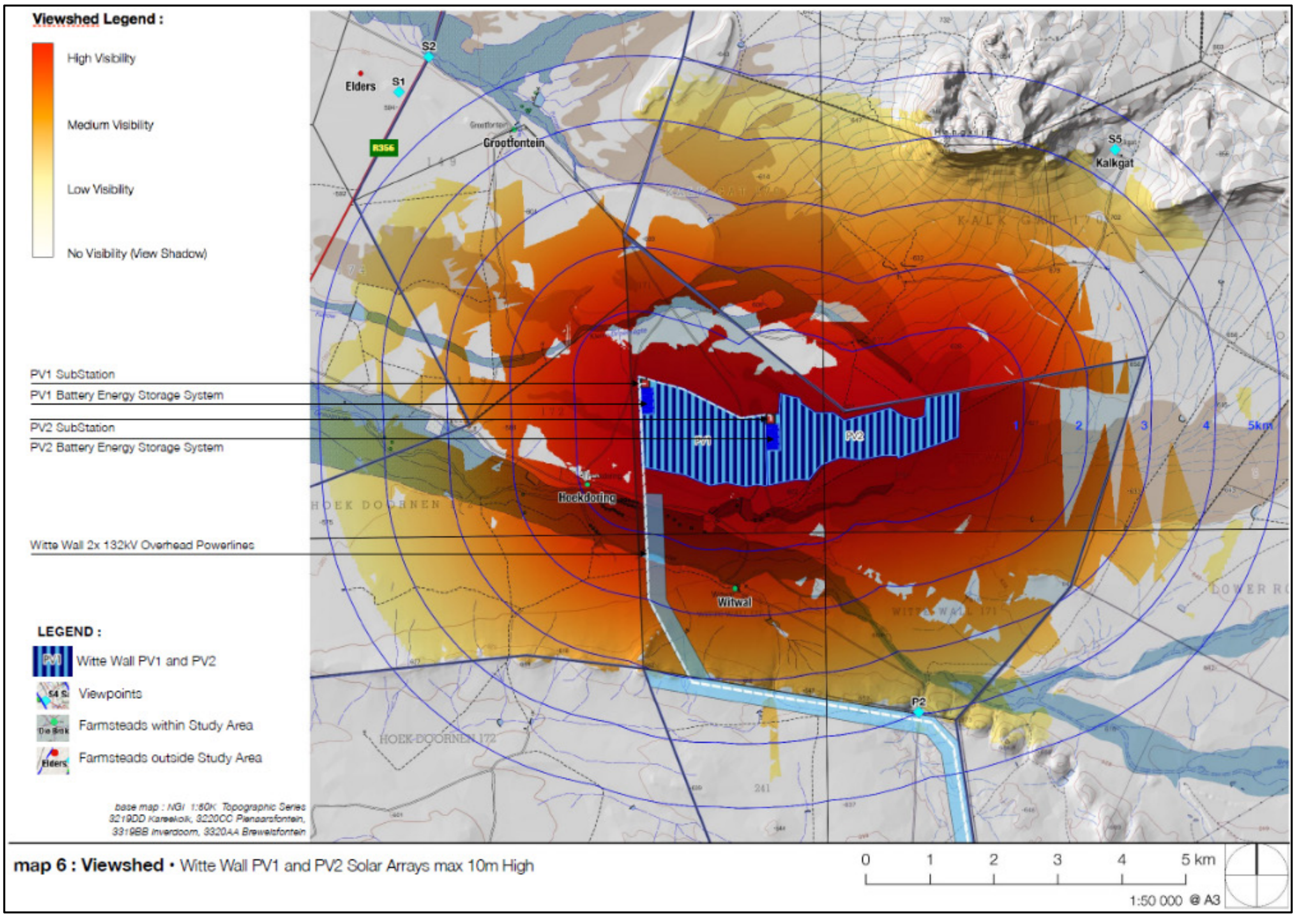


__Figure 48:__ Viewshed map for the two Witte Wall PV projects.

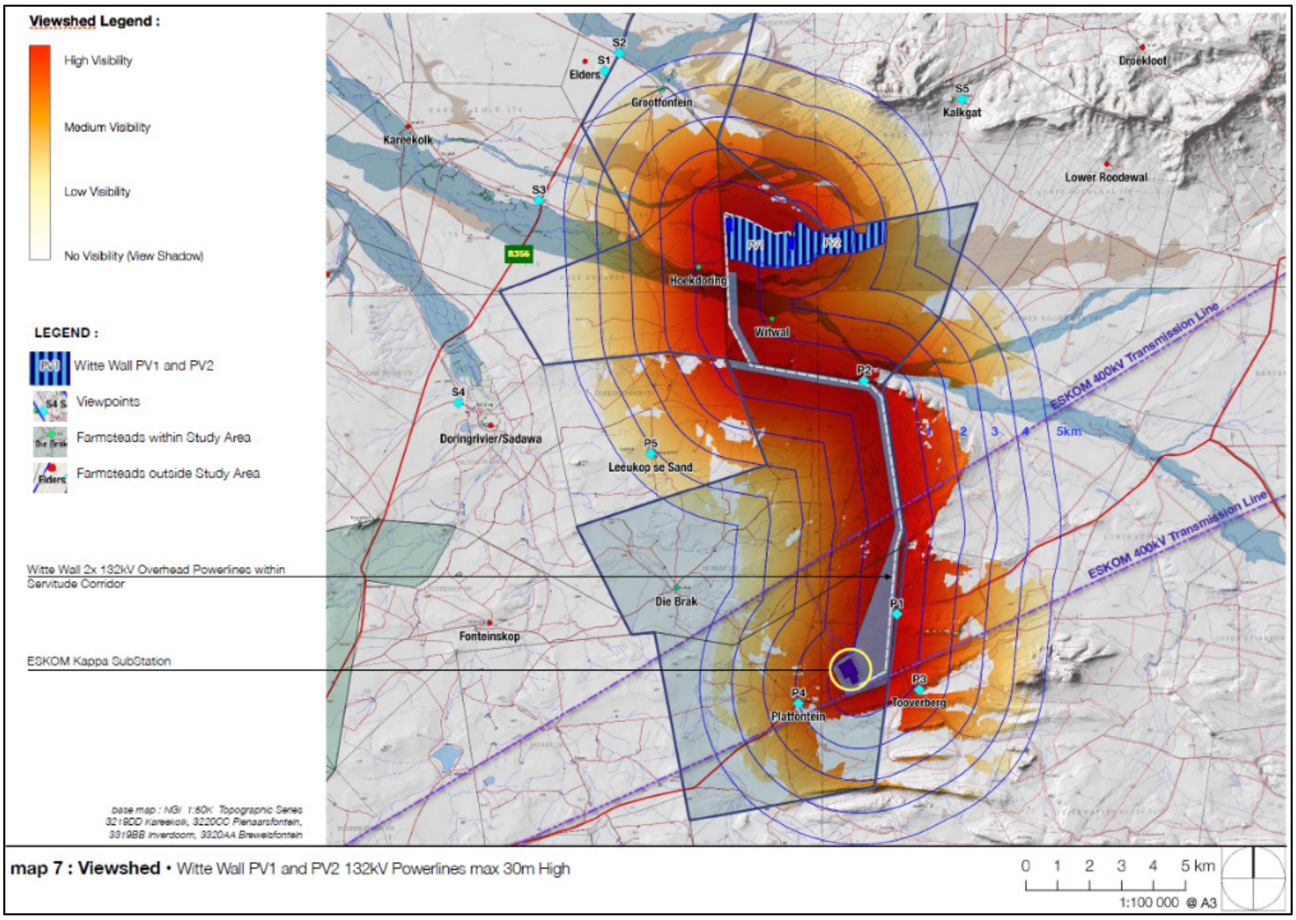


Figure 49: *Viewshed map for the Witte Wall EGI.*

Figure 50: *Photomontage looking eastwards from the R356. Source: Lawson & Oberholzer 2020: fig. P1).*

5.7. 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 palaeontological resources are deemed to have low cultural significance for their scientific value. Any fossils found are likely to be in the Grade IIIB to NCW range.

The archaeological resources within the Witte Wall PV 1 and PV 2 and power line study areas are deemed to have generally low cultural significance for their scientific value. The vast majority are rated as NCW but in a few instances grades of IIIC have been assigned. There are no historical archaeological resources within the study area but those to the south of the Groot River are considered to be of medium cultural significance and are allocated Grades of IIIB (Figure 51). The two stone kraals just outside the power line corridor are also given Grade IIIB.

Graves are deemed to have high cultural significance for their social value and are considered Grade IIIA resources. None are known within the development areas, but a likely grave does occur just to their south.

There are no buildings within the PV study areas but built heritage resources elsewhere on the farm are considered to be of medium cultural significance for their architectural and social values and are given a grade of IIIB.

The cultural landscape, despite already hosting significant electrical infrastructure, is considered to be of at least medium significance worthy of a IIIB grading. Certain iconic views, for example within Karoo Poort or of Hanglip can be considered as of high significance and worthy of grade IIIA.

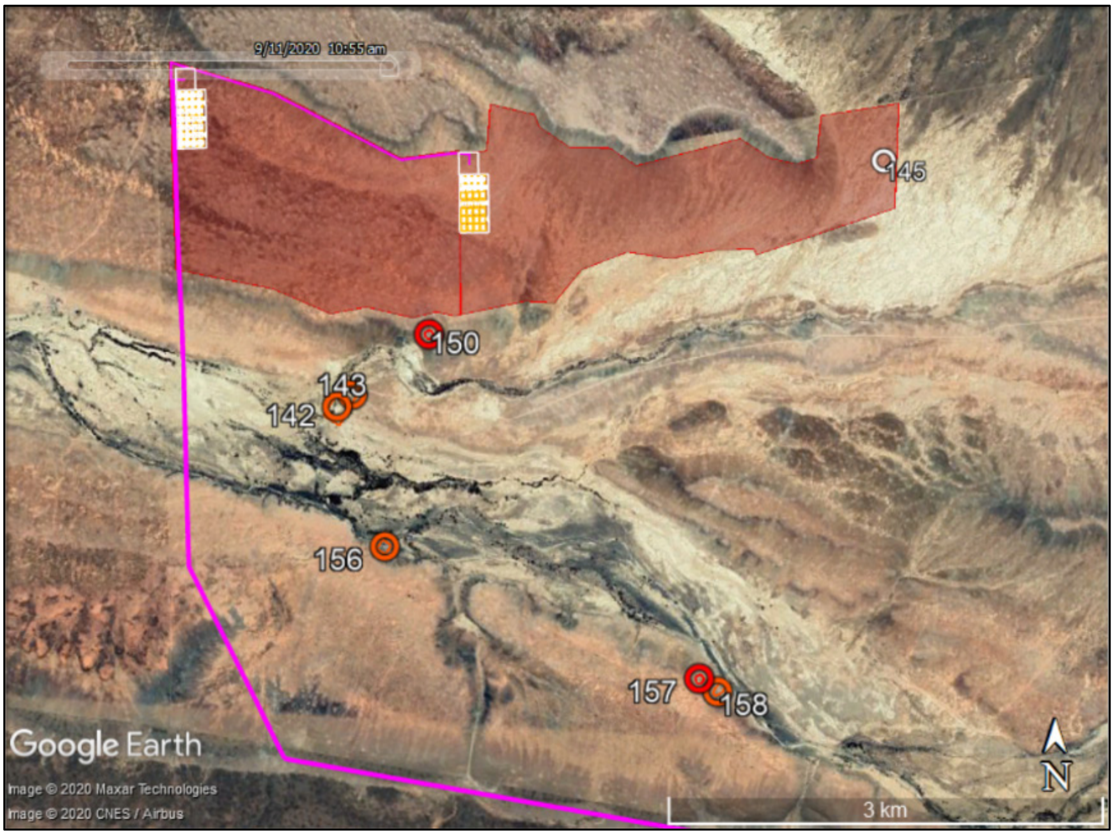


Figure 51: *Aerial view of the PV study area (red shading) and northern part of the power line corridor (pink lines) showing heritage resources of Grade IIIA (red circles) and IIIB (orange circles). One IIIC resource has been suggested for an artefact collection and is also indicated (white circle).*

5.8. Summary of heritage indicators

Fossils can be present in the landscape and are easily damaged or destroyed during development.

- Indicator: Significant fossils should not be damaged or destroyed.

Archaeological resources and graves are generally very fragile and vulnerable to damage or disturbance.

- Indicator: Significant archaeological resources and graves should not be damaged or destroyed.

The cultural landscape can be very easily spoiled by insensitive developments that dominate from many viewpoints.

- Indicator: The cultural landscape should not be visually dominated by the proposed development.
- Indicator: Steep slopes should be avoided for the PV layouts and BESS.

6. ISSUES, RISKS AND IMPACTS

6.1. Issues, risks and impacts

The potential impacts identified during the assessment are the **same** for **both the Witte Wall PV 1 and Witte Wall PV 2 projects (i.e. including the PV Facilities, Power Lines and Associated Infrastructure)**. They are:

Construction Phase

- Potential impacts to palaeontological resources
- Potential impacts to archaeological resources and graves
- Potential visual impacts to the cultural landscape

Operational Phase

- Potential visual impacts to the cultural landscape

Decommissioning Phase

- Potential visual impacts to the cultural landscape

Cumulative impacts

- Potential impacts to palaeontological resources
- Potential impacts to archaeological resources
- Potential impacts to the cultural landscape

7. IMPACT ASSESSMENT: WITTE WALL PV 1 & PV 2

The impact assessments for both projects are expected to be the same. Please note that the assessments for palaeontology have been provided in the attached palaeontological specialist study (Appendix 4) and are not repeated here, save to note that the impacts would occur during the construction phase and their significance would be **very low negative** both before and after mitigation.

The impacts below apply to the **PV Facilities, Power Lines and Associated Infrastructure**.

7.1. Direct Impacts

7.1.1. Construction Phase

Potential Impacts to archaeology and graves

Impacts to archaeology and graves would be direct impacts that might occur during construction when these resources are damaged or destroyed during excavation work. Although the impacts would be permanent and are very likely to happen, the moderate consequence means that significance before mitigation is **low negative** (Table 2). A detailed pre-construction survey of the final layouts (PVs and power lines) should be undertaken in order to determine appropriate sample areas from which to collect artefacts. There is a small possibility that more significant sites or even graves may be found. While background scatter artefacts occur widely and in variable densities across the landscape, it is suggested that one area per PV project footprint could be collected from in order to record some of the variability across the wider project area. Note that in the Witte Wall PV 2 area there is a small scatter of pottery that must also be collected during this exercise. Collection along the power line route can also be contemplated if necessary but, because of the limited footprint associated with the power lines, this is likely to not be needed, especially since micrositing of pylons and the service track should be fairly straightforward. The ECO should also ensure that all staff are alerted to the possibility of finding archaeological resources and instructed to report any unusual finds. With mitigation the impact significance is expected to be **very low negative**, although it is noted that new data from an otherwise poorly understood area could contribute some scientific benefit.

Table 2: *Impacts to archaeology & graves – construction phase.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Impacts to archaeology & graves	Status	*Negative*	*Low (4)*	*Pre-construction survey. Sample artefacts. Educate staff on possible finds.*	*Very low (5)*	*High*
	Spatial Extent	*Site specific*				
	Duration	*Permanent*				
	Consequence	*Moderate*				
	Probability	*Very likely*				
	Reversibility	*Non-reversible*				
	Irreplaceability	*High*				

Potential Impacts to the cultural landscape

Impacts to the cultural landscape would be direct impacts that might occur during construction when much machinery and equipment is on site and there is plenty of activity in what is an otherwise very quiet and tranquil landscape with minimal traffic. The impacts would be medium term (as long as construction takes) and are very likely to happen. The substantial consequence means that the significance before mitigation is **moderate negative** (Table 3). Mitigation would entail minimising the disturbance footprint, utilising dust suppression measures, ensuring effective rehabilitation of areas not needed during operation, locating the laydown area and batching plant (if needed) as far from public roads as possible and using natural colours and finishes on buildings. With mitigation the impact significance is expected to be **low negative**. It is noted that Lawson and Oberholzer (2020) have rated the significance of visual impacts as **low negative** both before and after mitigation.

Table 3: *Impacts to the cultural landscape – construction phase.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Impacts to cultural landscape	Status	*Negative*	*Moderate (3)*	*Minimise disturbance footprint.* *Employ dust suppression measures.* *Ensure effective rehabilitation.* *Locate laydown, batching plant and buildings far from public road.* *Natural colours and finishes on buildings.*	*Low (4)*	*High*
	Spatial Extent	*Local*				
	Duration	*Medium term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Non-reversible*				
	Irreplaceability	*High*				

7.1.2. Operation Phase

Potential Impacts to the cultural landscape

Impacts to the cultural landscape would be direct impacts that might occur during operation through the visual intrusion of an industrial-type facility on the otherwise rural cultural landscape. Because the facility layout has responded to the landscape character and will sit quite low in the landscape, the extent of impacts is expected to be local. The impacts would be long term and are very likely to happen. The moderate consequence means that significance before mitigation is **low negative** (Table 4). Once construction is over, there are only minor mitigation measures that can be applied. Security lighting should be directed to minimise light pollution and signage should be as small and unobtrusive as possible. These will not change the overall visual intrusion much and the post-mitigation significance thus remains **low negative**. It is noted that Lawson and Oberholzer (2020) have rated the significance of visual impacts as **low negative** both before and after mitigation.

Table 4: *Impacts to the cultural landscape – operation phase.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
OPERATION PHASE						
Impacts to cultural landscape	Status	*Negative*	*Low (4)*	*Minimise light pollution.* *Signage to be small and unobtrusive.*	*Low (4)*	*High*
	Spatial Extent	*Local*				
	Duration	*Long term*				
	Consequence	*Moderate*				
	Probability	*Very likely*				
	Reversibility	*Non-reversible*				
	Irreplaceability	*High*				

7.1.3. Decommissioning Phase

Potential Impacts to the cultural landscape

Impacts to the cultural landscape would be direct impacts that might occur during decommissioning when much machinery and equipment is on site and there is plenty of activity. The impacts would be long term because rehabilitation is likely to take decades to be completed. Impacts are very likely to happen. The substantial consequence means that significance before mitigation is **moderate** (Table 5). Mitigation would largely entail employing best practice i.e. minimising the disturbance footprint, utilising dust suppression measures, and ensuring effective rehabilitation of all areas. With mitigation the impact significance is expected to be **low**. It is noted that Lawson and Oberholzer (2020) have rated the significance of visual impacts before mitigation as **low negative** and after mitigation as **very low negative**.

Table 5: *Impacts to the cultural landscape – decommissioning phase.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
DECOMMISSIONING PHASE						
Impacts to archaeology & graves	Status	*Negative*	*Moderate (3)*	*Minimise disturbance footprint.* *Employ dust suppression measures.* *Ensure effective rehabilitation.*	*Low (4)*	*High*
	Spatial Extent	*Local*				
	Duration	*Long term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Non-reversible*				
	Irreplaceability	*High*				

7.1.4. Cumulative Impacts

Cumulative impacts relate to the loss of archaeological resources over wide areas and the presence of multiple electrical facilities in the landscape. Because significant archaeological sites are generally located and protected from development – and so few significant sites exist in developable areas – the cumulative impacts are driven mainly by the visual impacts to the cultural landscape. In this regard, wind turbines have the greatest impact, followed perhaps by power lines, although the latter reduce in visibility more quickly than turbines do. It is expected that the cumulative impacts to heritage will be **moderate negative**. Mitigation measures would be the same as proposed for the present projects but, because visual mitigation measures can never screen these large developments, the post-mitigation impacts are expected to remain **moderate negative**. Note that because the various facilities in the landscape will be built, operated and decommissioned at different times, there is no distinction made between the project phases for cumulative impacts.

Table 6: *Cumulative impacts to heritage resources.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
ALL PHASES						
Impacts to all heritage resources	Status	*Negative*	*Moderate (3)*	*Pre-construction archaeological surveys with sampling as needed.* *Minimise areas disturbed.* *Minimise light pollution and signage.* *Effective rehabilitation.*	*Moderate (3)*	*High*
	Spatial Extent	*Regional*				
	Duration	*Long term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Reversible*				
	Irreplaceability	*High*				

7.2. Indirect Impacts

No indirect impacts are anticipated.

7.3. The No-Go alternative

The No-Go alternative would entail not developing the projects and the landscape would remain in its present undeveloped state. Not developing the projects would not result in any new impacts to heritage resources. Existing natural erosion and weathering of artefacts, ruins and buildings would continue but at a very slow rate. Impact significance from the No-Go alternative is thus expected to be **very low negative** for all aspects of heritage.

7.4. 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 will affect archaeological materials, ruins and structures. Trampling from grazing animals and/or farm/other vehicles may also affect artefacts.

7.5. 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 vantage points is undesirable.

8. IMPACT ASSESSMENT SUMMARY

Table 7 provides a summary of the expected impacts after mitigation.

Table 7: *Overall Impact Significance (Post Mitigation)*

Phase	Overall Impact Significance
Construction	Low
Operational	Low
Decommissioning	Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Moderate
Cumulative - Operational	Moderate
Cumulative - Decommissioning	Moderate

9. LEGISLATIVE AND PERMIT REQUIREMENTS

This report and the proposed recommendations will need to be approved by HWC. There are no further legislative requirements for the approval process but if archaeological mitigation is needed then the appointed archaeologist will need to submit a Workplan to HWC to do the work. This must be carried out well in advance of construction to ensure that there is enough time for HWC to approve the mitigation work before construction commences.

10. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

EMPr inputs for palaeontology and visual concerns are provided in the separate palaeontological and visual specialist reports. This section deals only with archaeology as this was the specialist aspect conducted by the present author.

There are three main recommendations to be included in the EMPrs for all project components. The first is to commission a pre-construction survey of the approved PV layouts and power line routes. Further recommendations will stem from the results of that survey. The survey should be done well in advance of construction (preferably at least 6 months) in order to allow time for:

- The field survey;
- Reporting to HWC and application for Workplan approval;
- Conducting the mitigation fieldwork;
- Analysis and reporting; and
- Final approval by HWC

The project developer should ensure that this appointment is made or, if an Environmental Control Officer (ECO) is already appointed, they can see that the requirements are met.

The second measure is for the ECO to ensure that all project staff are aware of the possibility of finding buried heritage materials and that they know the procedure to protect and report such finds. Workers must keep a watch for such items during work.

The third is that the ECO must conduct formal monitoring site visits to (1) verify that all work is remaining within the authorised area and (2) check for any fossils or artefact concentrations that might be revealed.

One specific measure that is required is to ensure the protection of the possible grave at waypoint 150. The feature should be fenced and marked as a sensitive area.

The generic EMPrs for substations and power lines (GN 435) make provision for general monitoring by project staff and protection and reporting of any chance finds.

11. 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 projects will result in an improved electricity supply for South Africa which can have extensive benefits in terms of improving the economic outlook and investment potential in the country. At the local scale, it is likely that between about 90 and 150 skilled and between 400 and 460 unskilled employment opportunities will be created during the construction phase per project, while approximately 20 skilled and 40 unskilled employment opportunities would be created over the 20-year operational lifespan of the proposed facility. These unskilled jobs will be linked to services such as panel cleaning, maintenance and security. The heritage resources are not of such a significance that they outweigh the socio-economic benefits of the proposed developments.

12. CONSULTATION WITH HERITAGE CONSERVATION BODIES

This report[2] was submitted to the Witzenberg Municipality for comment as required by the HWC NID response. In addition, and because there are no conservation bodies registered in the area, the report was also sent to Hex Valley Tourism Association and the Touws River Heritage and Conservation Society as the next closest registered organisations. This was on 16 October 2020. By the time of finalising this report on 17 November 2020, only the Hex Valley Tourism Association had responded as shown below. They were in support of the project, the assessment and the recommendations of the HIA. The BA with all specialist studies is due to undergo full public participation shortly.

[2] Please note that since submission to the I&APs, the laydown areas for each project have been increased from 5 ha to 13 ha.

Re: Re[6]: Ceres Karoo heritage consultation

GA

From Graham Abrahams
to Jayson and copy to Hex Valley Tourism, christiaan@netandmail.com, david@witzenberg.gov.za, RAbed@csir.co.za

Mon 2020/11/16 12:20

⚠ Download pictures or always download pictures from this sender. To preserve privacy, external content was not downloaded.

Hi Jayson

I trust that you, your family and colleagues are all well?

Thank you for making the effort to connect with our society through your email, and for meeting with me. Thank you for sharing your work and findings and the supporting documents, in terms HWC Case No: 20081910SB0825E, in regard to the three heritage impact assessments for solar projects in the Tankwa Karoo region, that I received from you and which I have now read through.

I have definitely benefited (and am enlightened) from reading through your Impact Assessment papers. They certainly provided me with a fresh perspective on the content and quality of the detail that goes into a report such as this. Well done on providing such detailed and comprehensive content.
I respect your professional opinion in this regard in relation to all of the planned PV and associated EGI projects, and therefore support your findings and recommendations, since I am satisfied that they cover all of the issues that are contained in Appendix 6.

I have made copies of the general compliance requirements (Appendix 6) to distribute among my own committee members so that they too can have a better understanding of everything that is considered, such as the "Chance Find Procedure" you mention, and appropriate steps to take in terms of Impact Assessments from the Conservation standpoint.

Then, I have also spoken to my colleague, Melanie Esterhuyse (CEO of Hex River Valley Tourism), regarding your and my discussions on inviting you to address local Stakeholders and Media on Conservation issues in our valley. I think they will find this very interesting. Melanie suggested that one of the evenings of the Media Educational Tour, which at this stage is scheduled for the week 15th to 19th Feb 2021, would be most suitable. She is busy with logistics arrangements (due to limited accommodation in the valley) so I await to hear from her as to which date would be best, and I will let you know asap.

Once again thank you for making contact with us, and we look forward to seeing you next year!

Kind regards,

Graham
G.N.Abrahams: Chairman - Hex River Valley Heritage & Conservation Society
Cell: +27(0)61-583-4269

13. CONCLUSIONS

Table 8 lists the heritage indicators identified for these projects and shows the responses. Some are design responses but others will only be met later through the application of mitigation measures. There are no remaining concerns and it is considered that the proposed developments will not result in significant impacts to heritage resources. There are currently no areas within the PV layouts or power line corridors that require avoidance but there is a possible grave alongside an existing farm track to the south of the PV layouts that, for precautionary reasons, should be protected and avoided with a 30 m buffer. This site is illustrated in Figure 52.

Table 8: *Heritage indicators and design responses.*

Indicator	Project Response
Significant fossils should not be damaged or destroyed.	No design response possible but a Chance Finds Procedure will be implemented under the EMPr to ensure that any chance finds are recorded and/or collected as required.
Significant archaeological resources and graves should not be damaged or destroyed.	Known significant sites have been avoided by the PV layout and a pre-construction survey is recommended to (1) ascertain whether any further sites are present within the footprint and (2) choose the densest areas of background scatter for formal sampling.
The cultural landscape should not be visually dominated by the proposed development.	Because the PV developments are relatively low to the ground and the power lines lack significant mass, they should only be visible from relatively close to the sites. The development is far from local roads.
Steep slopes should be avoided for the PV layouts and BESS.	The PV project has avoided the highest and lowest terraces and is restricted to the flat area in between them.

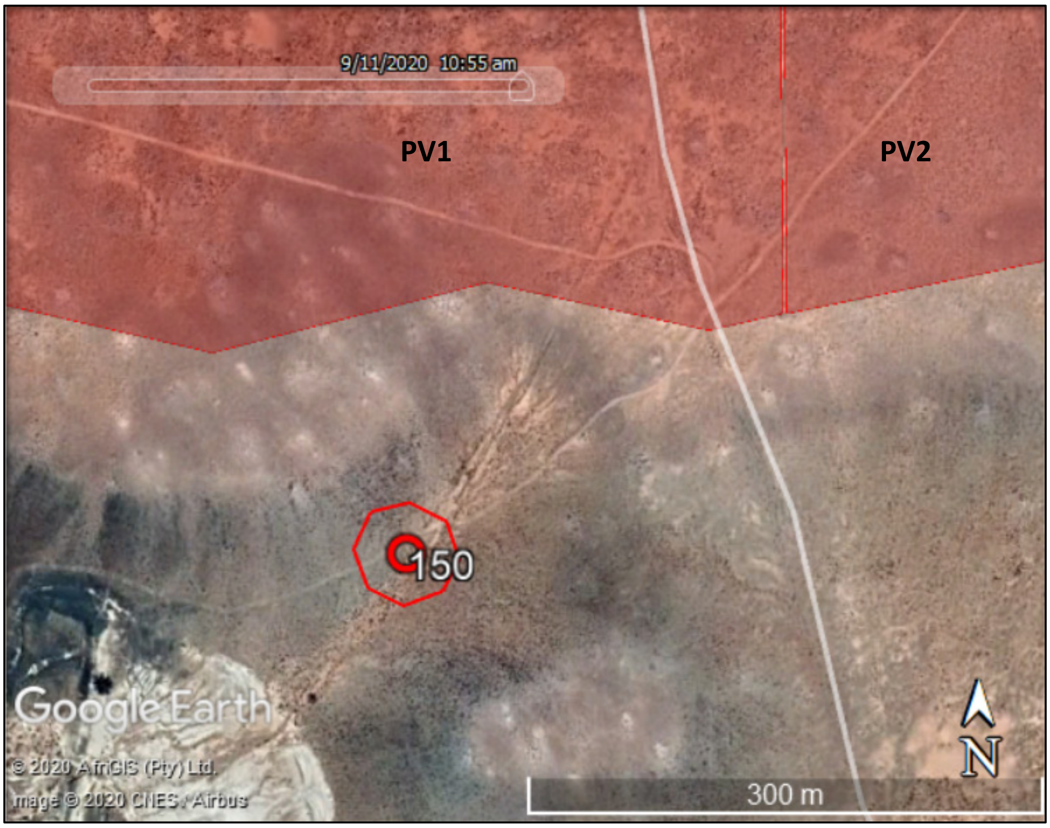


Figure 52: *Possible grave site (waypoint 150) with a 30 m buffer (red polygon) that should be avoided and protected during development.*

13.1. Statement and reasoned opinion of the specialist

Because no significant impacts to culturally significant heritage resources are anticipated and impacts of low significance can be easily managed or mitigated, both of the proposed Witte Wall PV developments and their associated EGI should be authorised in full.

14. RECOMMENDATIONS

14.1. Witte Wall PV 1

It is recommended that the proposed Witte Wall PV 1 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- The potential grave at waypoint 150 must be protected and avoided; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

14.2. Witte Wall PV 2

It is recommended that the proposed Witte Wall PV 2 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- The pottery scatter at waypoint 145 must be collected;
- The potential grave at waypoint 150 must be protected and avoided; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

14.3. EGI

It is recommended that the proposed EGI development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) whether any areas of background scatter artefacts should be sampled;
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

15. REFERENCES

Almond, J.E. 2020. Palaeontological input to Heritage Impact Assessment: proposed development of nine 175 Mw Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure near Touwsriver, Witzenberg Local Municipality, Western Cape. Unpublished report prepared for Veroniva (Pty) Ltd, Cape Town: Natura Viva.

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.

Halkett, D. & Webley, L. 2011. Heritage Impact Assessment: proposed Perdekraal Wind and Solar Energy Facility, Western Cape Province. Unpublished report prepared for ERM Southern Africa. St James: ACO Associates cc.

Heritage Western Cape. 2016. Grading: purpose and management implications. Document produced by Heritage Western Cape, 16 March 2016.

Mossop, E.E. 1927. *Old Cape Highways*. Cape Town: Maskew Miller Limited.

Orton, J. 2008. Heritage impact assessment of three sites for the proposed Kappa Substation, Ceres Magisterial District, Western Cape. Unpublished report prepared for Zitholele Consulting. Archaeology Contracts Office, University of Cape Town.

Orton, J. 2016. Prehistoric cultural landscapes in South Africa: a typology and discussion. *South African Archaeological Bulletin* 71: 119-129.

Smuts, K. 2018. Archaeological Impact Assessment Basic Assessment for the Proposed Development of the 325MW Kudusberg Wind Energy Facility and associated infrastructure, between Matjiesfontein and Sutherland in the Western and Northern Cape Provinces: BA report. Unpublished report prepared for CSIR – Environmental Management Services. Stanford: Katie Smuts.

Winter, S. & Oberholzer, B. 2013. Heritage and Scenic Resources: Inventory and Policy Framework for the Western Cape. Report prepared for the Provincial Government of the Western Cape Department of Environmental Affairs and Development Planning. Sarah Winter Heritage Planner, and Bernard Oberholzer Landscape Architect / Environmental Planner, in association with Setplan.

APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

Address:	40 Brassie Street, Lakeside, 7945
Telephone:	(021) 789 0327
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:

<u>Feasibility studies:</u>

- Heritage feasibility studies examining all aspects of heritage from the desktop

<u>Phase 1 surveys and impact assessments:</u>

- 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)

<u>Phase 2 mitigation and research excavations:</u>

- 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. The details of the site sensitivity verification are noted below:

Date of Site Visit	8 and 9 September 2020
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

<u>Method of the Site Sensitivity Verification</u>

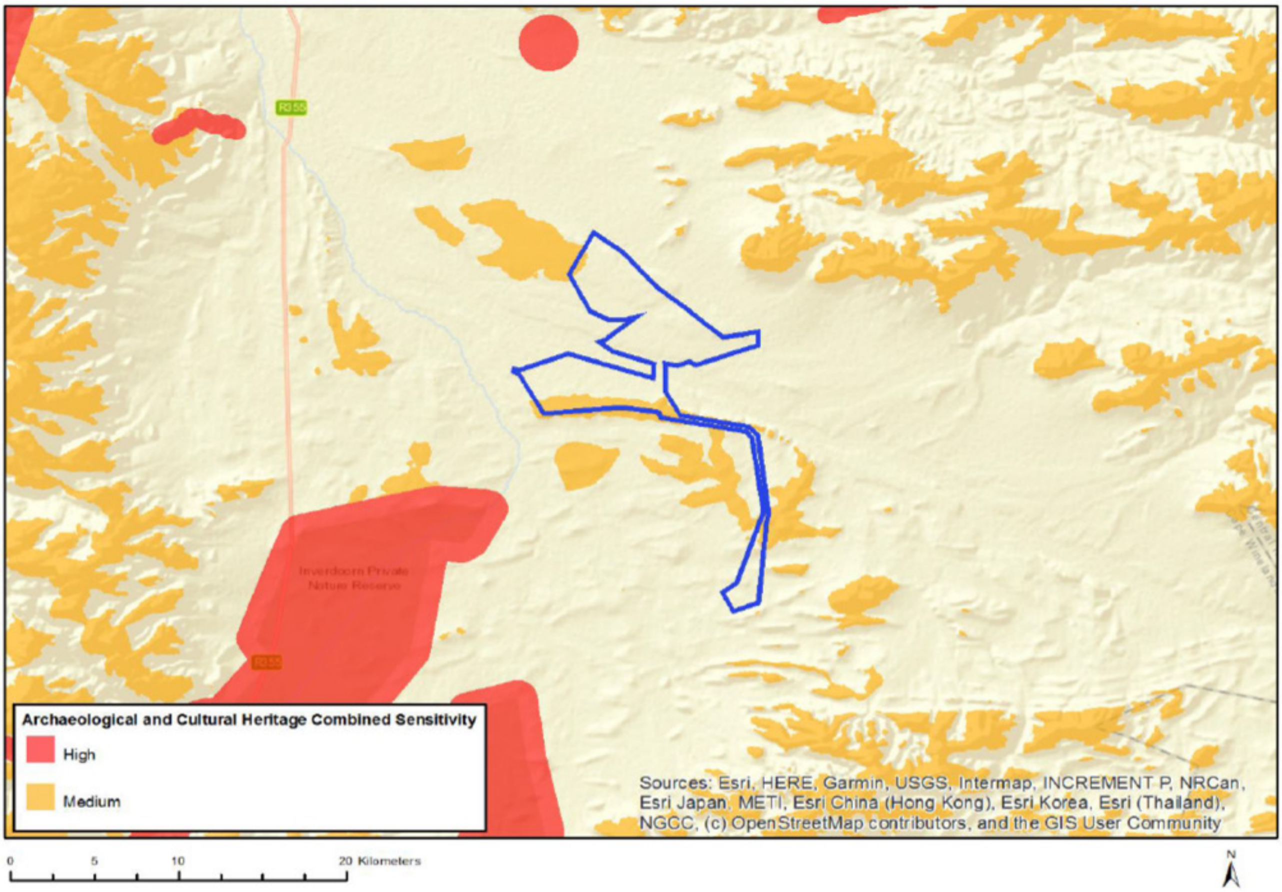
- Provide a description on how the site sensitivity verification was undertaken using the following means:
(a) desk top analysis, using satellite imagery;
(b) preliminary on -site inspection; and
(c) any other available and relevant information.

Initial work was carried out using satellite aerial photography in combination with the author's accumulated knowledge of the broader landscape. This was used to determine areas that should be targeted for fieldwork. Subsequent fieldwork then 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 all presented in the report (Section 5).

<u>Outcome</u>

- Provide a description of the outcome of the site sensitivity verification in order to:
(a) confirm or dispute 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.; and
(b) include a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity.

The map below is extracted from the screening tool report and shows the archaeological and heritage sensitivity to be low throughout the Witte Wall PV 1 and PV 2 study areas. The site visit confirms that the majority of the PV sites are of low sensitivity. Small pockets of higher sensitivity (where heritage resources occurred) were present elsewhere, but these were all closer to the Groot River and outside of the PV development areas. Figure 51 in the report shows the areas considered to be archaeologically sensitive. They have variably high and medium heritage significance. A photographic record and description of the relevant heritage resources is contained within the impact assessment report with further photographs on record with the specialist. The screening tool map shows parts of the power line corridor to be of medium sensitivity. This is disputed, however, since only sites of low cultural significance were found in the areas examined and there is little reason to believe that this would change with further survey. The nature of the archaeological resources along the area shown in the screening tool map as of medium sensitivity is such that it is an extensive resource with low cultural significance.



The screening tool map for palaeontology has been included and discussed in the palaeontological specialist report (Appendix 4 of the present HIA).

APPENDIX 3 – Mapping

Figure A3.1: *Aerial view of entire study area showing all heritage resources recorded.*

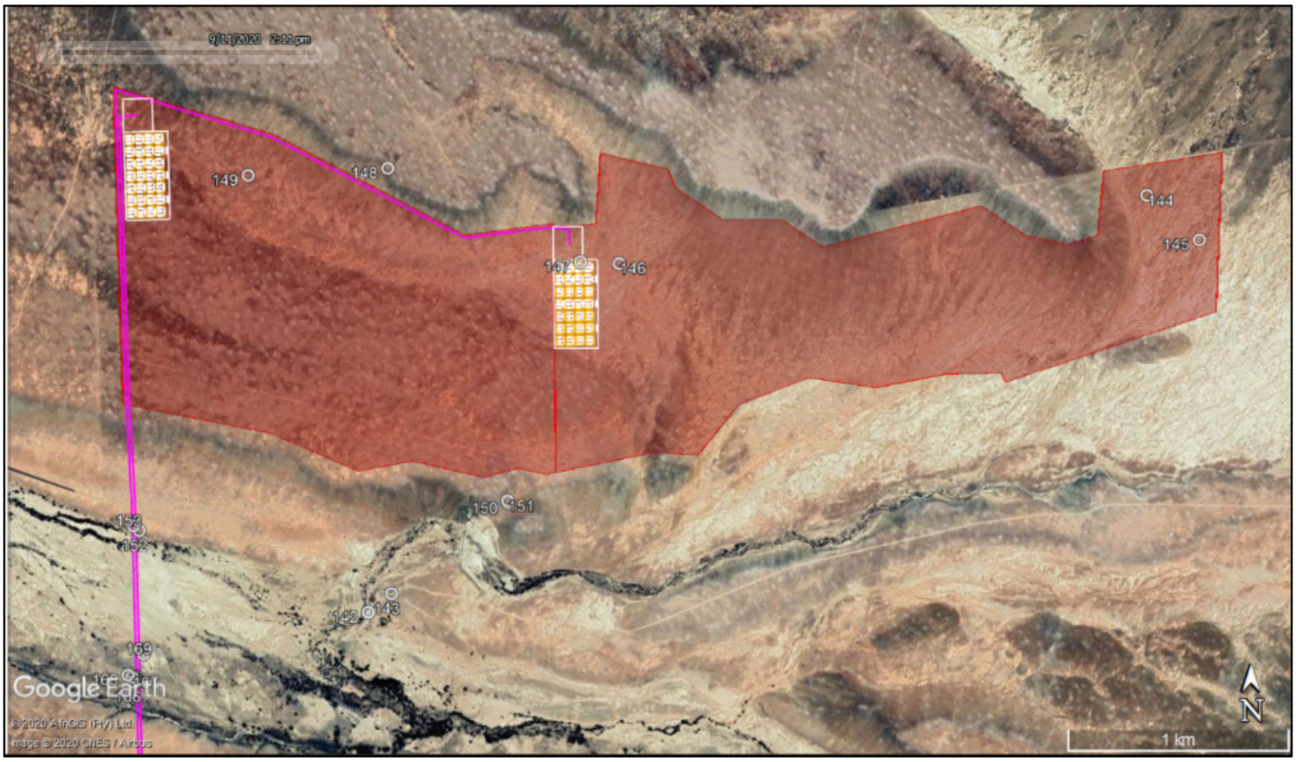


Figure A3.2: *Aerial view of the PV site (red shading) showing all heritage resources recorded.*

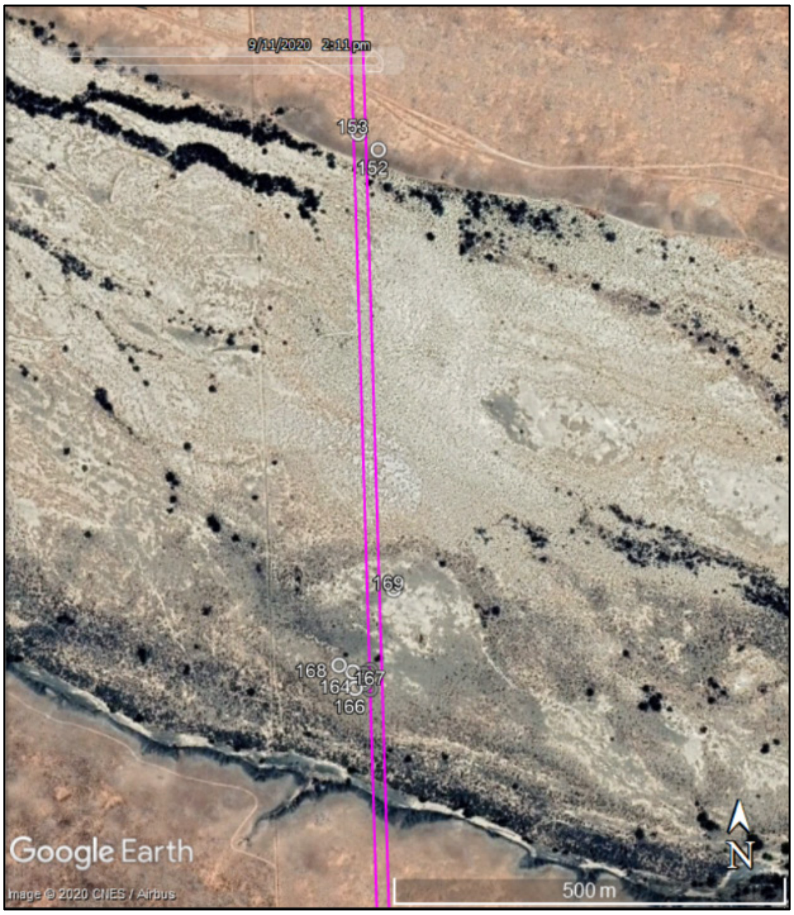


Figure A3.3: *Aerial view of the area where the power lines cross the river showing all heritage resources recorded.*

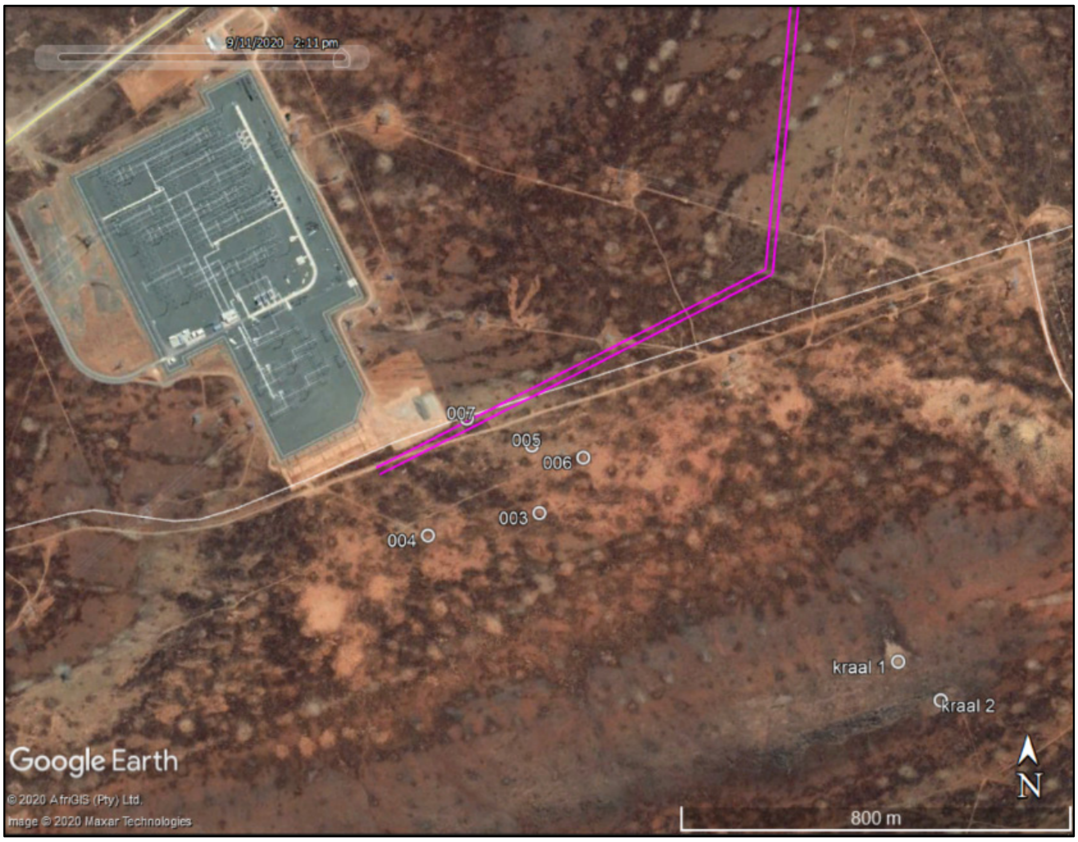


Figure A3.4: *Aerial view of the southern end of the power line corridor showing all heritage resources recorded.*

Figure A3.5: *Aerial view of the PV site and land to the south showing all Grade IIIA (red numbered symbols) and IIIB (orange) heritage resources. The white symbol is a Grade IIIC resource requiring mitigation.*

Figure A3.6: *Aerial view of the southern end of the power line corridor showing the Grade IIIC heritage resource requiring mitigation.*

APPENDIX 4 – Palaeontological study

Refer to separately attached document.

APPENDIX 4 OF THE HERITAGE IMPACT ASSESSMENT: PALAEONTOLOGICAL INPUT TO HERITAGE IMPACT ASSESSMENT

PROPOSED DEVELOPMENT OF NINE 175 MW SOLAR PHOTOVOLTAIC FACILITIES AND ASSOCIATED ELECTRICAL GRID INFRASTRUCTURE NEAR TOUWSRIVER, WITZENBERG LOCAL MUNICIPALITY, WESTERN CAPE

Dr John E. Almond
***Natura Viva* cc**
PO Box 12410 Mill Street
CAPE TOWN 8010, RSA

October 2020

EXECUTIVE SUMMARY

The Project Applicant is proposing to develop nine 175 MW Solar Photovoltaic (PV) power generation facilities in the Ceres Karoo region near Touwsrivier, situated in the Witzenberg Local Municipality of the Western Cape Province. Each solar PV facility will have a range of associated infrastructure, including an on-site substation with Battery Energy Storage System (BESS), and will connect to the existing Eskom Kappa Substation *via* a dedicated 132 kV power line. The proposed PV facilities will be constructed on the following farm portions: Remainder of Grootfontein Farm 149; Portion 5 of Grootfontein Farm 149; Remainder of Witte Wall Farm 171; and Portion 1 of Hoek Doornen Farm 172. The power lines will traverse these farm portions, as well as the farms Die Brak 241 and Platfontein 240. Given the very similar geological and palaeontological context and scale of each of the nine proposed solar PV facilities and its associated power lines, the impact assessments and mitigation recommendations for each project are identical and can be summarized as follows:

The solar PV facility project area is situated on a flat to gently-sloping pediment surface of Late Caenozoic (Neogene – Pleistocene) age on the flanks of the Grootrivier Valley which drains this sector of the Ceres Karoo. The pediment surface has been planed-off by river erosion into underlying fine-grained, non-marine, basinal to distal submarine fan sediments of the Tierberg Formation (Ecca Group) that are Middle Permian in age. Field surveys show that the Tierberg bedrocks beneath the thin (few dm to few meters maximum) capping of alluvial gravels, calcrete hardpans, sandy soils and downwasted surface gravels capping the pediment surface are weathered, folded and often tectonically-cleaved. The only fossil remains recorded from such pediment settings in the Ceres Karoo comprise (1) sparse, generally small blocks of reworked silicified fossil wood within alluvial and surface gravels of uncertain provenance (probably Ecca Group) and (2) occasional calcretised fossil termite nests of probable Pleistocene age that are found embedded within calcretised superficial sediments as well as weathered, calcrete-veined bedrocks. The majority of fossil sites recorded fall within designated No-Go areas lying *outside* the project footprint. These fossils are of widespread occurrence within the Ceres Karoo region and are not of high scientific interest or conservation value. No fossil sites of high sensitivity or No-Go areas were identified within the solar PV project areas during the palaeontological field survey and the palaeontological sensitivity of the project area is assessed as generally LOW.

The power line corridor between the solar PV sites and the existing Kappa Substation on Platfontein 240 traverses the outcrop areas of the Permo-Carboniferous, glacial-related Dwyka Group as well as the lower Ecca Group (Prince Albert, Whitehill and Collingham Formations). The potentially-fossiliferous Prince Albert, Whitehill and Collingham Formations are highly weathered and cleaved in this region. No sensitive fossil sites have been recorded within or close to the proposed corridor on Die Brak 241 and Platfontein 240 during the present field survey or several previous field studies in the vicinity by Almond (2010a-c, 2016a) and the palaeontological sensitivity of the corridor is assessed as LOW.

As a consequence of (1) the paucity of irreplaceable, unique or rare fossil remains within the development footprint, as well as (2) the extensive superficial sediment cover overlying most potentially-fossiliferous bedrocks within the solar PV facility and power line project area, the overall impact significance of the construction phase of the proposed solar PV facility regarding legally-protected palaeontological heritage resources is assessed as *VERY LOW* (*negative status*), with and without mitigation. This assessment applies to all the associated solar PV facility and power line infrastructure within the project area. No significant further impacts on fossil heritage are anticipated during the operational and decommissioning phases of the solar PV energy facility and associated infrastructure. The No-Go alternative (*i.e.* no solar PV facility and power line development) will probably have a neutral impact on palaeontological heritage. Confidence levels for this assessment are MEDIUM, given the generally low exposure levels of potentially-fossiliferous bedrocks.

Anticipated cumulative impacts in the context of other renewable energy projects in the Ceres Karoo region – *including* the nine solar PV facilities - are assessed as *LOW (negative)* without mitigation but *VERY LOW (negative)* with mitigation. It is concluded that as far as fossil heritage resources are concerned, the proposed solar facility and power line projects, whether considered individually or together, will *not* result in an unacceptable loss or unacceptable additional impacts, considering all the renewable energy projects proposed in the area. This analysis only applies *provided that* all the proposed monitoring and mitigation recommendations made for all these various projects are consistently and fully implemented.

No specialist palaeontological monitoring or mitigation is recommended for this development, pending the potential discovery of significant new fossil material here during the construction phase. The ECO should be made aware of the possibility of important fossil remains (bones, teeth, petrified wood, plant-rich horizons, fossil termitaria *etc.*) being found or unearthed during the construction phase of the development. Monitoring for fossil material of all major surface clearance and deeper (>1m) excavations by the Environmental Control Officer on an on-going basis during the construction phase is therefore recommended. Significant fossil finds should be safeguarded and reported at the earliest opportunity to Heritage Western Cape for recording and sampling by a professional palaeontologist. The palaeontologist concerned will need a Fossil Collection Permit from Heritage Western Cape and all fossil material collected must be properly curated in an approved repository (museum / university collection). These recommendations must be included within the Environmental Management Programme (EMPr) for the solar PV facility and power line developments. A protocol for Chance Fossil Finds is appended to this report (Appendix C).

There are no identified fatal flaws and no objections on palaeontological heritage grounds to authorisation of the proposed solar PV facilities with its associated power line connections to the Kappa Substation.

1. INTRODUCTION & BRIEF

1.1. Project outline

The Project Applicant is proposing to design, construct and operate nine 175 MW solar photovoltaic (PV) power generation facilities in the Ceres Karoo region near Touwsrivier, situated in the Witzenberg Local Municipality of the Western Cape Province. Each solar PV facility will have a range of associated infrastructure, including an on-site substation with a Battery Energy Storage System (BESS), and will connect to the Eskom Kappa Substation *via* a dedicated 132 kV power line. The proposed PV facilities will be constructed on the following farm portions (Fig. 1):

- Remainder of Grootfontein Farm 149;
- Portion 5 of Grootfontein Farm 149;
- Remainder of Witte Wall Farm 171; and
- Portion 1 of Hoek Doornen Farm 172.

The power lines will traverse these farm portions, as well as the farms Die Brak 241 and Platfontein 240 (Fig. 1).

A total of four separate Basic Assessment processes are being conducted for the following projects (Fig. 1):

- Witte Wall Farm 171: 2 PV Facilities (*i.e.* **Witte Wall PV 1 and PV 2**) and Associated Infrastructure;

- Grootfontein Farm 149: 3 PV Facilities (*i.e.* **Grootfontein PV 1, PV 2 and PV 3**) and Associated Infrastructure;

- Hoek Doornen Farm 172: 4 PV Facilities (*i.e.* **Hoek Doornen PV 1, PV 2, PV 3 and PV 4**) and Associated Infrastructure; and

- Electrical Grid Infrastructure for each PV Plant (*i.e.* 9 Power Lines and 9 onsite substations) and Associated Infrastructure.

A detailed description of each PV project is supplied in the Heritage Impact Assessment reports.

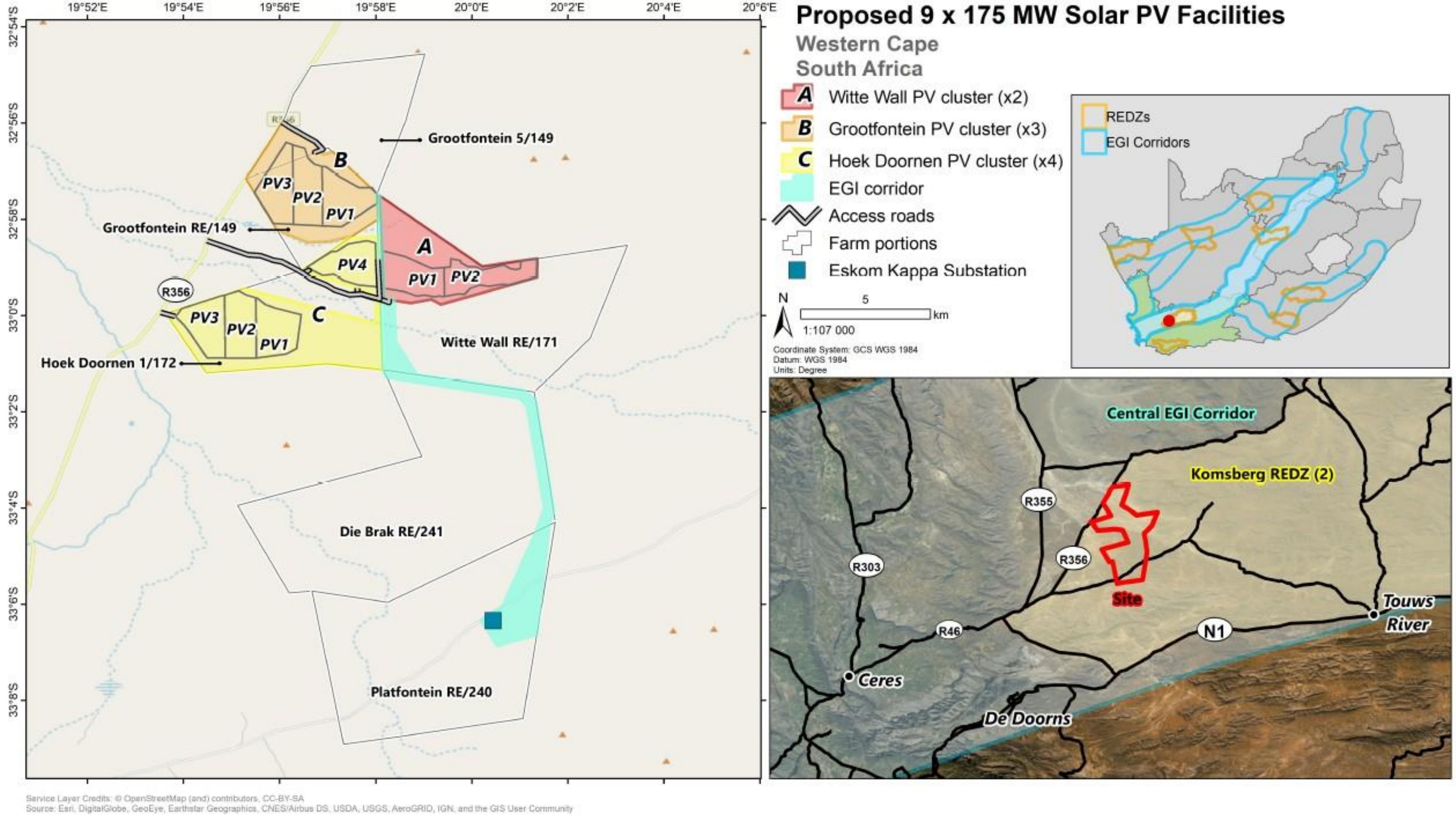


Figure 1: Maps showing the location of the solar PV facility project area in the Ceres Karoo region, *c*. 40 km north of Touwsrivier, Witzenberg Local Municipality, Western Cape Province (Image supplied by CSIR - Environmental Management Services). The project area lies within the Komsberg Renewable Energy Development Zone 2 (REDZ 2).

1.2. Purpose of report

The project area for the proposed solar PV facilities and associated power lines is underlain by potentially-fossiliferous sedimentary bedrocks of the Karoo Supergroup (Dwyka and Ecca Groups) as well as Late Caenozoic superficial deposits (Sections 4 & 5). The construction phase of the developments may entail the disturbance, damage, destruction or sealing-in of scientifically valuable and legally protected palaeontological heritage resources preserved at or beneath the ground surface within the project footprint. No further significant impacts on palaeontological heritage are anticipated during the operational and decommissioning phases of the developments.

Because the project areas lie within the gazetted Komsberg Renewable Energy Development Zone (REDZ 2) gazetted by the Minister of Environmental Affairs in Government Gazette 41445, Government Notice (GN) 114 on 16 February 2018 (*cf* Fourie *et al.* 2015), the proposed renewable energy projects will be subject to a Basic Assessment (BA) Process. The present combined Palaeontological Heritage Assessment Report will contribute to the three separate consolidated Basic Heritage Impact Assessments (HIAs) for the proposed solar PV facilities and their associated power lines, as listed above, in accordance with the latest requirements of the 2014 National Environmental Management Act (Act 107 of 1998, as amended in 2017) (NEMA) Environmental Impact Assessment (EIA) Regulations. The consolidated HIAs are being compiled by Dr Jayson Orton of ASHA Consulting (Pty) Ltd (Contact details: 40 Brassie Street, Lakeside, 7945, South Africa. Telephone: 021 783 0557. E-mail: jayson@asha-consulting.co.za).

Four separate BA Processes as listed in Section 1.1 are being conducted for the solar PV facility and power line developments on behalf of the proponent by the CSIR - Environmental Management Services, Durban (Contact details: Ms Rohaida Abed. CSIR - Environmental Management Services. P.O. Box 59081, Umbilo, Durban, 4075. Tel: 031 242 2318. Fax: 031 261 8172. E-mail: rabed@csir.co.za).

1.3. Terms of reference

The Terms of Reference for this palaeontological study, as specified by the CSIR, are as follows:

- Comply with the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, GN 320. This specifically includes Part A, which provides the Site Sensitivity Verification Requirements where a Specialist Assessment is required but no Specific Assessment Protocol has been prescribed.
- 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.
- Compile a Palaeontological Impact Assessment (PIA) in compliance with Appendix 6 of the 2014 NEMA EIA Regulations (as amended) and any additional relevant legislation and guidelines that may be deemed necessary.
- 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.
- 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.

- Provide review input on the preferred infrastructure layout following the sensitivity analysis and layout identification.
- Prepare and undertake a study on the palaeontology and fossil heritage within the proposed project area, based on:
    - Site visit (as required);
    - a review of all relevant palaeontological and geological literature, including
        - geological maps and previous reports,
        - location and examination of fossil collections from the study area (e.g. museums), and
        - data on the proposed development (e.g. location of footprint, depth and volume of bedrock excavation envisaged).
- Describe the type and location of known palaeontology and fossil heritage sites in the study area, and characterize all items that may be affected by the proposed project.
- Note fossils and associated sedimentological features of palaeontological relevance (photos, maps, aerial or satellite images, and stratigraphic columns).
- Evaluate the potential for occurrence of palaeontology and fossil heritage features within the study area.
- Identify and rate potential direct, indirect and cumulative impacts of the proposed project on the palaeontology and fossil heritage during the construction, operational and decommissioning phases of the project. Study the cumulative impacts of the project by considering the impacts of existing renewable energy plants within the area (as well as those proposed), together with the impact of the proposed project.
- Identify any protocols, legal and permit requirements that relevant to this project and the implications thereof.
- Provide recommendations and suggestions regarding fossil heritage management on site, including conservation measures, as well as promotion of local fossil heritage to ensure that the impacts are limited.
- 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.
- Incorporate and address all review comments made by the Project Team (CSIR and Project Applicant) during the various revisions of the specialist report.
- Incorporate and address relevant issues and concerns raised by Stakeholders (i.e. Heritage Western Cape and South African Heritage Resources Agency (SAHRA)), Competent Authority, Interested and Affected Parties (I&APs) and the public during the Public Participation Process (where relevant and applicable).
- Review the Generic Environmental Management Programme (EMPr) for 1) Power Lines and 2) Substations (GN 435).

2. STUDY APPROACH

The approach to this palaeontological heritage study can be briefly summarized as follows. Fossil bearing rock units occurring within the broader study area (including all relevant land parcels) are determined from geological maps and relevant geological sheet explanations as well as satellite images. Known fossil heritage associated with each rock unit is inventoried from published and unpublished scientific literature, previous PIAs of the broader study region, and the author's field

experience and palaeontological database (*cf* Almond & Pether 2008). Based on this data as well as field examination of representative exposures of all major sedimentary rock units present, both within and in the vicinity of the project footprint, the impact significance, including cumulative impacts, of the proposed developments is assessed using the methodology specified by the CSIR. Recommendations for any further studies or mitigation are outlined for inclusion within the EMPr for the development.

In the case of the present solar PV facility assessments, several transects across the stratigraphy underlying the three affected land parcels were made over the course of four days in order to gauge the levels of exposure, weathering, tectonic deformation and palaeontological sensitivity of each of the sedimentary rock units represented here. The power line corridors between the PV facility project areas and the Kappa Substation were mainly assessed on the basis of data from several relevant PIA reports by the author (notably Almond 2010a-c, 2016b) as well as additional field observations made for an adjoining renewable energy development in 2020.

Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have been published by SAHRA (2013) and by Heritage Western Cape (2016).

2.1. Information sources

The present combined desktop and field-based palaeontological heritage assessment for the solar PV facilities and associated power lines is based on:

- A brief project outline, kmz files and maps provided by CSIR - Environmental Management Services;
- A desktop review of (a) the relevant 1: 50 000 and 1: 250 000 scale topographic maps, (b) Google Earth© satellite imagery, (c) published geological and palaeontological literature, including 1: 250 000 geological maps and accompanying sheet explanations (Theron 1983, Theron et al. 1991, Gresse & Theron 1992, Almond 2008b) as well as (d) several previous and on-going fossil heritage assessments in the Ceres Karoo region by the author and colleagues (e.g. Almond 2010a, 2010b, 2010c, 2010d, 2015a, 2016a, 2016b, 2018, 2020, Almond in prep. and Butler 2018);
- The author's field experience with the formations concerned and their palaeontological heritage (cf Almond & Pether 2008, Almond 2008b and PIA reports listed in the References); and
- A four-day field assessment of the study area, including all land parcels involved, by the author and an experienced field assistant, Madelon Tusenius, during the period 7 to 10 September, 2020. The season in which the site visit took place has no bearing on the study.

2.2. Assumptions and limitations

The accuracy and reliability of palaeontological specialist studies as components of HIAs are generally limited by the following constraints:

- Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

- Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant ("mappable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil etc.), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.
- Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information;
- The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (e.g. of commercial mining companies) - that is not readily available for desktop studies;
- Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

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

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

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

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails inferring the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a PIA may be significantly enhanced through field assessment by a professional palaeontologist. In the present case, site visits to the study areas in some cases considerably modified our understanding of the rock units (and hence potential fossil heritage) represented there.

In the case of the present study area in the Ceres Karoo region near Touwsrivier (Western Cape) exposure of potentially fossiliferous bedrocks is very limited, due to extensive cover by superficial sediments and karroid *bossieveld* vegetation. However, sufficient exposures were examined to allow a realistic assessment of the palaeontological sensitivity of the key rock units (See Section 4), while a substantial amount of relevant geological and palaeontological data is available from previous PIAs in the region (See, for example, References under Almond). Confidence levels for this assessment are accordingly rated as Medium. Comparatively few academic palaeontological studies have been carried out in the region, so any new data from impact studies here are of scientific interest.

3. LEGISLATIVE CONTEXT AND PERMIT REQUIREMENTS

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

Where palaeontological mitigation of a development project in the Western Cape is required, the palaeontologist concerned with mitigation work would need a valid fossil collection permit from Heritage Western Cape (HWC). Any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for palaeontological studies developed by SAHRA (2013) and Heritage Western Cape (2016).

The present palaeontological heritage assessment falls under Sections 35 and 38 (Heritage Resources Management) of the South African Heritage Resources Act (Act No. 25 of 1999), and it will also inform the EMPr for this project. The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

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

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

(1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
(2) All archaeological objects, palaeontological material and meteorites are the property of the State.
(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.
(4) No person may, without a permit issued by the responsible heritage resources authority—
(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) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological

site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—
(a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
(b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;
(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
(d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

- **Legislative and Permit Requirements for potential specialist mitigation**

(1) Should professional palaeontological mitigation be necessary during the construction phase, the palaeontologist concerned will need to apply for a Fossil Collection Permit from Heritage Western Cape. (2) Palaeontological collection should comply with international best practice. (3) All fossil material collected must be deposited, together with key collection data, in an approved depository (museum / university). (4) Palaeontological mitigation work including the ensuing Fossil Collection reports should comply with the minimum standards specified by Heritage Western Cape (2016) and SAHRA (2013).

4. GEOLOGICAL SETTING

The combined proposed PV facility and power line project area is located in a low-lying, semi-arid extension of the Great Karoo region known as the Ceres Karoo or southern Tanqua Karoo. It is situated between the rugged Bontberg mountain range to the south – a west-east trending subunit of the Cape Fold Mountains - and the foothills of the Klein-Roggeveld Escarpment to the north. Topographic relief here is generally low (Figs. 5 to 7), with elevations between 600 and 700 m amsl (above mean sea level), since the area is largely underlain by readily-weathered, clay-rich sedimentary rocks and has experienced extensive, protracted weathering and denudation by post-Gondwana river systems during the Caenozoic Era. The area is drained by the non-perennial Grootrivier and its various tributaries (notably the Klein-Droëlaagte); the Grootrivier is itself a tributary of the extensive Doringrivier – Tanquarivier drainage system of the Ceres – Tanqua Karoo. Levels of bedrock exposure in the flatter-lying portions of the Ceres Karoo region are generally poor, except along larger water courses (Figs. 4, 14), because in most areas there is extensive cover by alluvial and colluvial deposits (*e.g.* river conglomerates, grits and sands as well as surface gravels, soils) and by karroid vegetation - Tanqua Karoo and Koedoesberg-Moordenaarskaroo bossieveld *plus* Tanqua Wash Riviere along drainage channels.

In geological terms the PV facility and transmission line project area lies along the south-western margin of the Main Karoo Basin of South Africa (Johnson *et al.* 2006). The bedrocks have been deformed during the Permo-Triassic Cape Orogeny (mountain building event) and thus lie within, and towards the northern margin of, the Cape Fold Belt (CFB), within or just to the east of the Cape syntaxis (*i.e.* junction of the N-S and E-W branches of the CFB). The geology of the study area is outlined on the four adjoining 1: 250 000 geology sheets Clanwilliam 3218, Sutherland 3220, Worcester 3319 and Ladismith 3320 (Council for Geoscience, Pretoria) (Fig. 2). A total of

seven mappable sedimentary rock units (formations) are represented within the study area, most of which are assigned to the **Karoo Supergroup** and are of Gondwanan (Permo-Carboniferous) age (See stratigraphic column in Fig. 3). Within the PV facility project area, the Karoo bedrock succession generally youngs to the north and northeast towards the Klein-Roggeveld Escarpment. The power line connection southwards to Kappa Substation traverses a broad anticline-syncline pair of Dwyka and Ecca Group bedrocks with WSW-ESE fold axes which is clearly picked out by the sinuous ridge of the more resistant-weathering Collingham Formation (marked by a pale band on satellite images) as well as cyclical banding within the dark Dwyka outcrop area. Nevertheless, given the gentle nature of the broad-scale folding, levels of tectonic deformation are generally low, with gentle bedding dips of 5º to 20° (occasionally higher dips are seen along the banks of the Grootrivier; Figs. 4, 14). A tectonic cleavage may be well-developed within finer-grained mudrocks, especially towards the Bontberg range in the south, while soe brittle rock units such as the cherty beds within the Collingham Formation show pronounced, closely spaced jointing (Fig. 13). Only very minor intrusions of the Karoo Dolerite suite - a single narrow but regionally persistent dolerite dyke (Fig. 19) - are mapped within the study area.

The geology and sedimentology of the various sedimentary rock units represented in the solar facility and power line project area has been covered in some detail, with extensive references, in previous PIAs for the Ceres Karoo region and southern margins of the Great Karoo by the author (*e.g.* Almond 2016a-b, 2018, 2020) and will not be repeated here.

4.1. Dwyka Group

Portions of the power line route on Die Brak 241 as well as in the vicinity of Kappa Substation on Platfontein 240 are underlain by Late Carboniferous to Early Permian glacial sediments of the **Dwyka Group** (**C-Pd**), namely the **Elandsvlei Formation** (Fig. 8). The Dwyka rocks here, with a brownish hue on satellite images, build the cores of WSW-ENE trending CFB mega-anticlines. They are generally poorly exposed, with the exception of several good sections of grey, clast-rich Dwyka tillite seen along larger water courses such as the Kareerivier to the east and north of Die Brak homestead (Almond 2016a). The tillites display well-developed tombstone weathering which clearly developed before deposition of the overlying pervasive mantle of gravelly to sandy alluvial sediments. Low hills and ridges of Dwyka rocks within the region probably represent the coarser basal portion of several deglaciation cycles which impart a colour-banded pattern to the Dwyka outcrop area. A series of several low, rocky outcrops of greyish, gritty to pebbly, locally cross-bedded or deformed quartzites and sandstones in the central portion of Die Brak probably represent glacial outwash fans or eskers within the Elandsvlei Formation. The quartzose bodies are only a few meters across and irregular in geometry (Almond 2016a).

4.2. Ecca Group

The remainder of the power line corridor as well as all the proposed PV project areas are underlain at depth by basinal "marine" to submarine fan sediments of the **Ecca Group** that were deposited within an extensive brackish to freshwater inland lake or Ecca Sea in Early to Middle Permian times (Cole & Basson 1991, Cole 2005, Viljoen 2005). Several lower Ecca Group formations, predominantly recessive-weathering mudrocks with subordinate fine-grained wackes (impure sandstones), crop out here around the flanks of the WSW-ENE trending mega-anticline. In order of decreasing age these are: the Prince Albert Formation (Pp/ Ppr), the Whitehill Formation (Pw), the Collingham Formation (Pc) and the Tierberg Formation (Pt / K2S1).

The **Prince Albert Formation** forms low-lying terrain of little relief that is largely blanketed in alluvial soils and fine surface gravels downwasted from the nearby Collingham outcrop area. Limited exposures on the northern edge of Die Brak 241 (Fig. 9) favour zones of thin, resistant-weathering but highly-jointed, grey-green to yellowish-weathering cherty bands or lenticles. Some of these beds are strongly mineralised with rusty iron and metallic-grey manganese ores associated with snuffbox weathering.

The **Whitehill Formation** is exposed in numerous small erosion gullies on the south- and west-facing flanks of the low range of hills that defines the border between Die Brak 241 and Witte Wall 171, curving southwards through Rietpoort RE/243 just to the east of the power line corridor. The originally thinly-laminated, dark, carbonaceous Whitehill mudrocks here are invariably highly altered through near-surface weathering to friable, white or cream saprolitic material traversed by veins of multi-hued secondary minerals. Large, boulder-sized, sphaeroidal concretions of greyish dolomite weather out in the lower part of the succession (Fig. 11).

The overlying **Collingham Formation** builds the crests and dip slopes of the sinuous range of low hills described earlier which runs to the south of the PV project areas but is followed or traversed by the power line corridor at several points (*e.g.* southern margins of Hoek Doornen 172 – Witte Wall 171 project areas; see satellite image Fig. 53). The Collingham exposures are dominated by several prominent-weathering, highly-jointed, tabular cherty beds between 20 and 50 cm in thickness that show local thrusting and small-scale folding (Figs. 12 & 13). These cherty layers are broadly equivalent to the **Matjiesfontein Member** identified within the Collingham Formation elsewhere along the southern Karoo margin; the presence of several chert bands is a special feature of the Collingham Formation in the Ceres Karoo region (*cf* Almond 2015a). Where they are not too intensely jointed, the Collingham cherts have been extensively exploited by Stone Age peoples as raw material for stone artefacts. These last often abound in the vicinity of the chert bands. For example, an unusually dark grey, hornfels-like chert bed along the Hoek Doornen fence line is associated with a carpet of anthropogenically flaked rubble while the *in situ* chert itself as well as large float blocks in the area show abundant evidence of flaking. The intervening grey hackly-weathering siltstone horizons are occasionally exposed in erosion gullies (*e.g.* on Witte Wall 171). The majority of the narrow Collingham outcrop area is typically mantled by angular, blocky colluvial gravels of grey, silicified mudrock that show up clearly as a pale brownish zone on satellite images. The cherty Collingham gravels also cover most of the lower-lying Whitehill Formation outcrop and the lower beds of the adjoining Tierberg Formation (Fig. 37).

The **Tierberg Formation** that underlies all the PV facility project areas on Witte Wall 171, Hoek Doornen 172 and Grootfontein 149 where it is almost entirely covered by a blanket of alluvial sediments and soils (Figs. 4, 14-18). There are occasional good exposures along the steep southern banks of the Grootrivier and much more limited ones in the beds of its shallow tributaries. Near-surface, as well seen along the northern bank of the Grootrivier on Karee Kolk 174 as well as in low pediment escarpment exposures north of the Grootrivier, the Tierberg mudrocks are usually weathered and crumbly with no bedding plane exposure and are in addition extensively veined by Late Caenozoic calcrete (Fig. 5). The Tierberg succession is dominated by laminated to thin-bedded, highly-tabular, dark grey to khaki mudrocks with zones of large, oblate sphaeroidal to flattened lenticular concretions and lenticular beds of rusty-brown, ferruginous carbonate or mudrock. The concretions are late diagenetic and often display superficially fossil-like cone-in-cone structures (Fig. 41). Pale, grey-green bands of friable, fine-grained clay-like material may be altered tuff bands (volcanic ashes).

4.3. Karoo Dolerite Suite

A straight SE-NW trending dyke of the Early Jurassic **Karoo dolerite suite** traversing the NE part of Die Brak 241 from Riet Poort 243 is mapped on 1: 250 000 sheet 3320 (Fig. 2). The same intrusion probably extends further to the NW into the PV project area since it re-appears along strike close to the intersection of farms Grootfontein 149, Hoekdoornen 172 and Karee Kolk 174. This subvertical dyke of rusty-brown dolerite reaches a thickness of 2.5 m to 6 m (but is often thinner) with narrower veins or apophyses extending into the Tierberg country rocks. It features impressive radiating fans of pale bladed sparry calcite (Fig. 19).

4.4. Late Caenozoic superficial deposits

As is apparent in satellite images, and especially in the field, the Palaeozoic sedimentary bedrocks in the Ceres Karoo region are extensively blanketed by a range of – mostly unconsolidated - superficial deposits. These include pedocretes (*e.g.* calcrete), colluvium (slope deposits such as scree and hillwash), sheetwash and alluvial (river) sediments, surface gravels as well as silty, sandy and gravelly / rocky soils of mainly Quaternary to Recent age. Of these younger sedimentary units, most are too thin to be mapped separately at 1: 250 000 scale.

A wide range of **Late Caenozoic alluvial deposits** are represented within PV facility and power line project area, especially along the Grootrivier and other larger drainage systems, as well as in the *vlaktes* to the north and south of the Grootrivier on Witte Wall 171, Hoek Doornen 172 and Grootfontein 149 (Figs. 20 to 37). The dominant geomorphological feature here, clearly seen on satellite images, are series of dissected, flat to very gently sloping **pediment surfaces** planed across the Tierberg Formation bedrocks by earlier phases of the Grootrivier (Fig. 53). There is a flight of at least three or more pediment surfaces which increase in elevation and age with distance from the modern rivier. Based on (*N.B.* very inaccurate) Google Earth spot heights, these surfaces lie at approximately 580 m amsl., 600 m amsl and 620-640 m amsl (the last outside and NE of the project area). The surfaces slope gently down in a downstream direction and even the lowest lies some 10-15 m or more above present day river level. The ages of these surfaces is uncertain but is likely to span at least the Late Neogene Period and Pleistocene Epoch. The key infrastructure for all the PV facilities will be situated on these almost level to stepped pediment surfaces (Fig. 53).

In contrast to their marginal scarps, where weathered and calcretised Tierberg Formation bedrocks are locally exposed, the pediment surfaces are widely mantled by alluvial gravels) of guesstimated Late Neogene to Pleistocene age (Figs. 6 & 29). The relict gravelly patches are mapped along the banks of the Grootrivier as so-called **High Level Gravels** and are provisionally assigned to the **Grahamstown Formation** (Tg), doubtless a misnomer since no *in situ* evidence of the extensive silcretisation typical of this latter rock unit is observed. The coarse, poorly-sorted alluvial to downwasted pediment gravels are generally dominated by angular to subrounded reddish-brown weathering Ecca wackes with subordinate ferruginised mudrock (often desert-varnished), pale grey Matjiesfontein Member chert, white Witteberg quartzite, rare pale yellowish-green, orange-patinated tuff or tuffite, vein quartz, polymict Dwyka erratics (*e.g.* Precambrian vesicular lavas, silicified breccias), occasional dolerite and small clasts of petrified wood. Larger, boulder-sized clasts may retain surface impact crescents. An interesting, locally abundant component to the pediment gravels are pale grey to buff or yellowish-green sandy to gritty silcretes whose provenance is currently unclear; they may have been derived from Neogene silcrete outcrops (the “real” Grahamstown Formation) further to the east within the Grootrivier catchement area that have since been completely denuded. A high proportion of the silcrete clasts are anthropogenically

flaked (Fig. 30). On satellite images the pediment surfaces are densely pock-marked by small round *heuweltjies* of possible termite and / or bush-clump origin. Away from the edges of the pediments, flat areas are often mantled with pale orange sandy to silty soils (possibly with aeolian reworking in places) with sparse gravels or unvegetated patches with fine sheetwash gravels (Figs. 31 to 33).

A well-developed, solid to rubbly or nodular **calcrete hardpan** up to a few meters thick typically crops out along the crests of the marginal scarp defining the relict pediment surfaces patches (Figs. 4, 5 & 20 to 22). This is well seen, for example, on Karee Kolk 174 on the northern bank of the Groootrivier. The underlying Tierberg mudrocks are weathered and calcrete veined. Excellent exposures of calcretised fluvial conglomerates up to several (3-10) meters-thick are seen along the south bank of the Grootrivier on Witte Wall 171 where they show a sharp basal angular unconformity overlying inclined Tierberg Formation bedrocks that may be elevated up to 10 m or more above the present river bed. The conglomerates are oligomict (dominated by Ecca wackes), poorly-sorted with local development of current-generated clast imbrication as well as interbedded lenticular to tabular packages of pale brownish to greyish, gritty, horizontally-bedded to cross-bedded, calcretised sands. These last sometimes cap or pass horizontally into coarse channel lag conglomerates incised into the bedrock representing perched tributaries of the ancient Grootrivier. The ruditic High Level Gravel alluvial deposits are in turn overlain by unconsolidated younger alluvial silts and sands as well as aeolian reworked sands. Dispersed angular clasts of pale greyish Matjiesfontein chert within the High Level Gravels are often marginal flaked but this might be natural damage rather than anthropogenic (Fig. 20).

Blocky **colluvial gravels** are well seen on the steep to gentle slopes of low hills capped by the Collingham Formation, as described earlier (Fig. 37). Extensive flat-lying portions of the study area, including parts of the pediment surfaces, feature sheetwashed **surface gravels** of various sorts that are best seen in unvegetated patches. The sheetwash gravels are fine, angular to subrounded and dominated by reistent-weathering lithologies such as cherts, silicified and ferruginised mudrocks with occasional small blocks of petrified wood (Figs. 31 & 32).

Coarse cobbly to bouldery modern gravels strongly dominated by Ecca wackes as well as finer alluvial sands occur along the present course of the Grootrivier. Distinctive coarse, multi-hued, oligomict gravels rich in silcrete clasts are seen along bed of Klein-Droëlaagte where they are exposed as low gravel bars and in stream banks beneath sandy alluvium (Figs. 24 to 26). As well as lots of silcrete, these gravels include clasts of Matjiesfontein cherts, highly patinated wacke, occasional quartzite, Dwyka erratics (vesicular lavas, silicified breccias) and weathered-out Tierberg ferruginous carbonate concretions (Fig. 41). The clasts are variously angular to well-rounded. They are of interest in that they are often (but not invariably) associated with abundant Early Stone Age (ESA) bifaces (Pleistocene) as well as occasional small blocks of petrified wood and rare small fossil logs (Section 5 and Fig. 44). The contrast between these polymict gravels and the local modern river gravels in terms of clast lithology, archaeology and palaeontology suggests that they may have a different provenance, perhaps reflecting different drainage patterns in Plio-Pleistocene times. They are largely buried beneath younger superficial sediments and only exposed where the modern and fossil drainage networks intersect.

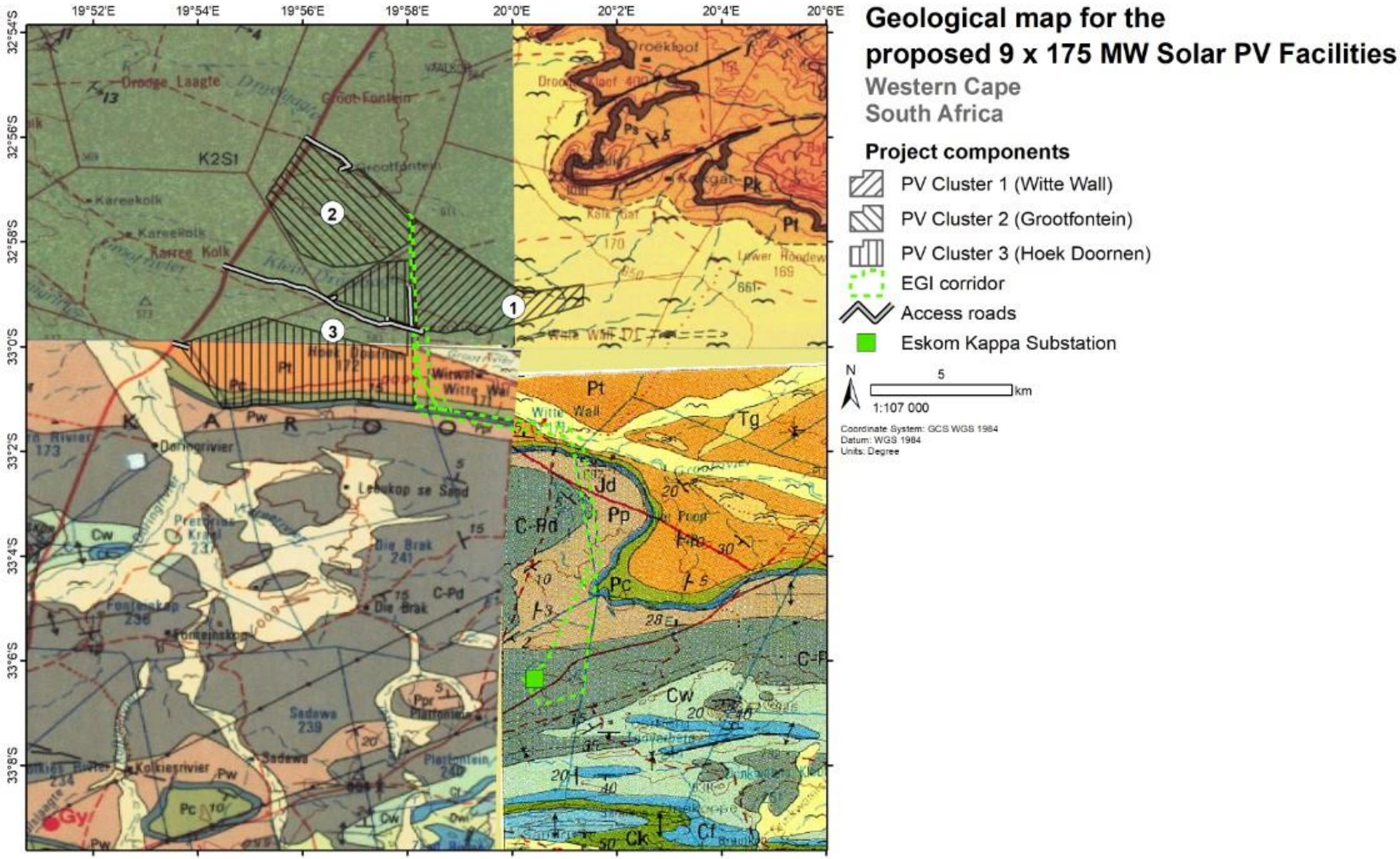
Thick deposits of alluvial sands along the course of the Grootrivier locally contain nodular calcrete hardpans. Locally they have been reworked into small **aeolian dunefields** characterised by well-sorted, orange-brown unconsolidated fine sands, locally displaying large scale dune cross-sets

(Fig. 35). Deflation of fine river sands up onto adjacent hillslopes is well seen in the southern portion of Hoek Doornen 172 where the dunes support a distinctive shrubby vegetation (Fig. 34).

Surface gravels overlying the Dwyka Group are typically highly polymict, *i.e.* composed of a wide range of rock types (cherts, carbonates, quartzites, lavas, granites *etc*), reflecting the range of glacial erratics enclosed by the underlying tillites. Fine pebbly gravels overlying the Prince Albert Formation are dominated by angular to subrounded cherty and siliceous mudrock clasts, many of which are ferruginised or with a well-developed patina of desert varnish (Fig. 10). **Calcrete hardpans** have developed within older sandy to silty alluvial deposits and soils, especially overlying the Dwyka Group, and are well exposed along the banks of drainage courses (*e.g.* near Die Brak homestead and along the banks of the Grootrivier) (Almond 2016a).

Figure 2 (following page): Extracts from four adjoining 1: 250 000 scale geology sheets Clanwilliam 3218, Sutherland 3220, Worcester 3319 and Ladismith 3320 (Council for Geoscience, Pretoria) showing the main stratigraphic units represented within the proposed solar PV facility and power line project area located *c.* 30 km north of Touwsrivier, Western Cape (black polygon). The dashed green polygon indicates the corridor for the power line connections to the existing Eskom Kappa Main Transmission Substation. The main geological units mapped within the study area include:

- **DWYKA GROUP: C-Pd (grey) = Elandsvlei Formation**
- **ECCA GROUP: Ppr, Pp (pale brown or buff) = Prince Albert Formation; Pw (dark blue) = Whitehill Formation; Pc (green, grey-green) = Collingham Formation; Pt, K2S1 (dark yellow, pale orange or grey) = Tierberg Formation**
- **KAROO DOLERITE SUITE: Jd (red line)**
- **SUPERFICIAL DEPOSITS: medium yellow (Tg with double flying bird symbol) = Tertiary or Quaternary High Level Gravels; pale yellow or white with single flying bird symbol = Quaternary to Recent alluvium**


Geological map for the proposed 9 x 175 MW Solar PV Facilities
Western Cape
South Africa
Project components
PV Cluster 1 (Witte Wall)
PV Cluster 2 (Grootfontein)
PV Cluster 3 (Hoek Doornen)
EGI corridor
Access roads
Eskom Kappa Substation
N
5
km
1:107 000
Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree
19°52'E
19°54'E
19°56'E
19°58'E
20°0'E
20°2'E
20°4'E
20°6'E
32°54'S
32°56'S
32°58'S
33°0'S
33°2'S
33°4'S
33°6'S
33°8'S
K2S1
Pt
Pk
Ps
Pw
Pp
Pc
Jd
Tg
C-Pd
Cw
Ck
Cf
Ppr
Gy

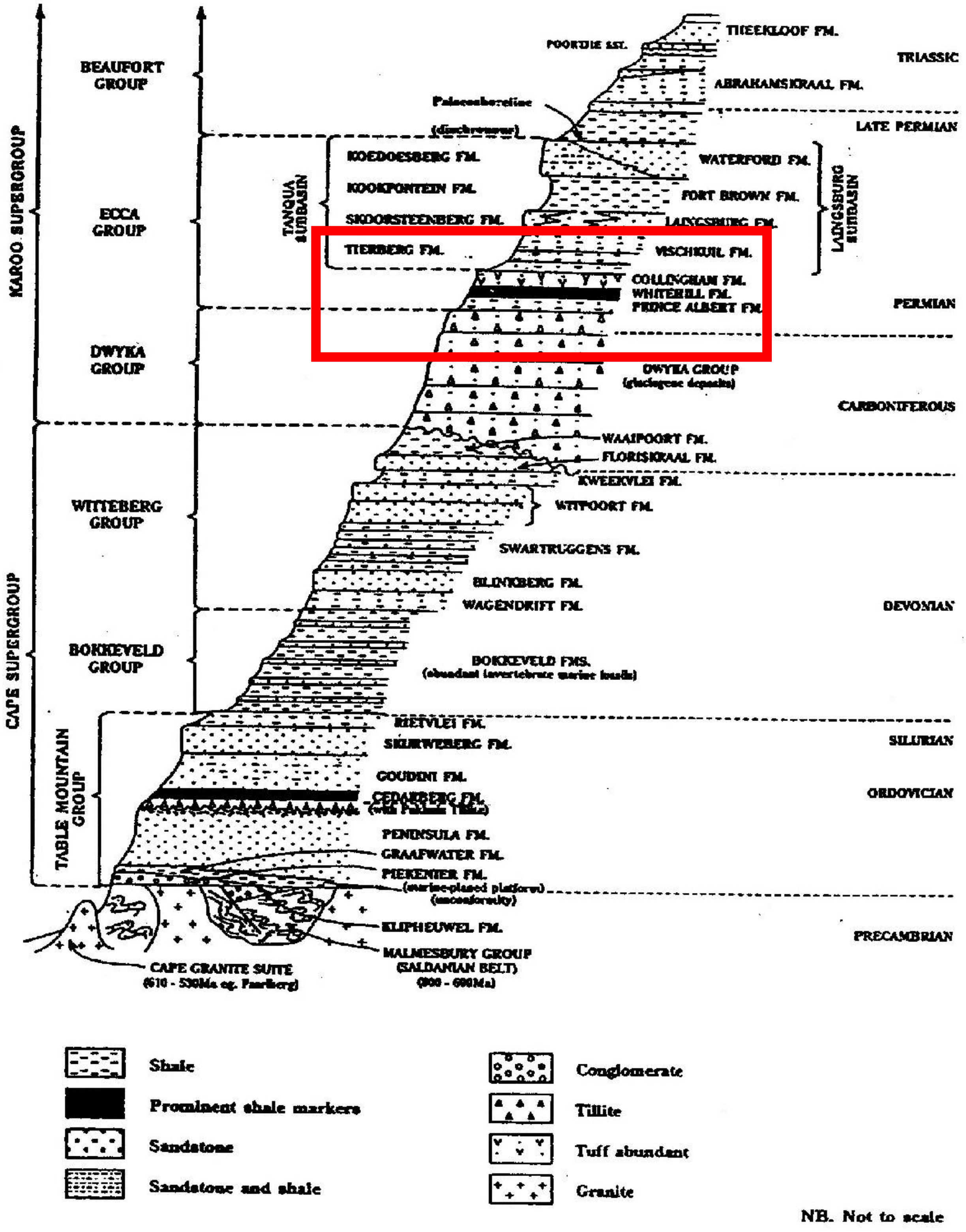


Figure 3: **Schematic stratigraphic column for the Western Cape, the red box outlining the Late Palaeozoic formations of Karoo Supergroup sedimentary rocks that crop out in the solar PV facility and power line project area (Modified from original figure by H. de V. Wickens).**

Figure 4: Riverine cliff exposure of eastward-dipping Tierberg Formation mudrocks unconformably capped by calcretised High Level Gravels with aeolian dune sands banked up against the cliff base, southern bank of the Grootrivier, Wittewall 171.

Figure 5: View eastwards along the low scarp marking the riverine edge of the lowest pediment surface on the northern side of the Grootrivier, Karee Kolk 174. The extensive flat-topped pediment is incised into weathered, khaki-hued Tierberg Formation mudrocks and its edge is heavily calcretised.

Figure 6: View southwards across the flat to gently sloping pediment surface on Grootfontein 149 with the Bontberg range in the background. The pediment surface here is mantled by poorly-sorted, downwasted alluvial gravels.

Figure 7: View of the low ridge of Ecca Group rocks running along the southern boundary of Witte Wall 171. The power line corridor runs along the ridge crest. Note thick sandy alluvial soils and dense *bossieveld* vegetation clothing the north-eastern sector of De Brak 241 in the foreground.

Figure 8: Typical appearance of the Elandsfontein Formation (Dwyka Group) outcrop area showing tombstone weathering of massive, grey-green tillites and polymict downwasted surface gravels derived from weathered-out glacial erratics, Die Brak 241 (From Almond 2016a).

Figure 9: Tabular-bedded, grey-green basinal mudrocks and fine-grained wackes of the Prince Albert Formation near the boundary between Die Brak 241 and Witte Wall 171 (From Almond 2016a). Good bedding plane exposures of this unit are rare.

Figure 10: Surface gravels overlying the Prince Albert Formation outcrop area, typically dominated by silicified mudrocks, cherts, vein quartz and other resistant-weathering rock types, with rare clasts of petrified wood of uncertain provenance, Die Brak 241 (Hammer = 30 cm).

Figure 11: Gullied exposure of highly-weathered, friable and mineralised mudrocks of the Whitehill Formation with boulder-sized dolomite concretions in the foreground, low hills along boundary between Witte Wall 171 and Die Brak 241 (From Almond 2016a).

Figure 12: Multiple tabular beds of prominent-weathering chert or silicified mudrocks assigned to the Matjiesfontein Member within the Collingham Formation, Witte Wall 171 (Hammer = 30 cm) (From Almond 2016a). The intervening mudrocks are mantled by downwasted cherty rubble.

Figure 13: Closely-spaced fracture set transecting brittle, silicified mudrock beds of the Collingham Formation, Witte Wall 171 (Hammer = 30 cm).

Figure 14: Eastward-dipping, laminated to thin-bedded, dark grey to khaki-weathering mudrocks with thin lenses and concretions of ferruginous carbonate as well as packages of brownish fine-grained wackes of the Tierberg Formation exposed along the southern banks of the Grootrivier, Witte Wall 171.

Figure 15: Stream gulley exposure of crumbly, weathered Tierberg Formation mudrocks with zone of prominent-weathering, rusty-brown, sphaeroidal diagenetic concretions of ferruginous carbonate, Witte Wall 171 (Hammer = 30 cm).

Figure 16: Stream bed exposure of gently-dipping, dark grey-green Tierberg Formation mudrocks along the Klein-Droëlaagte drainage line, northern margins of Hoek Doornen 172. The Ecca bedrocks here are mantled by oligomict alluvial gravels and younger sandy alluvium.

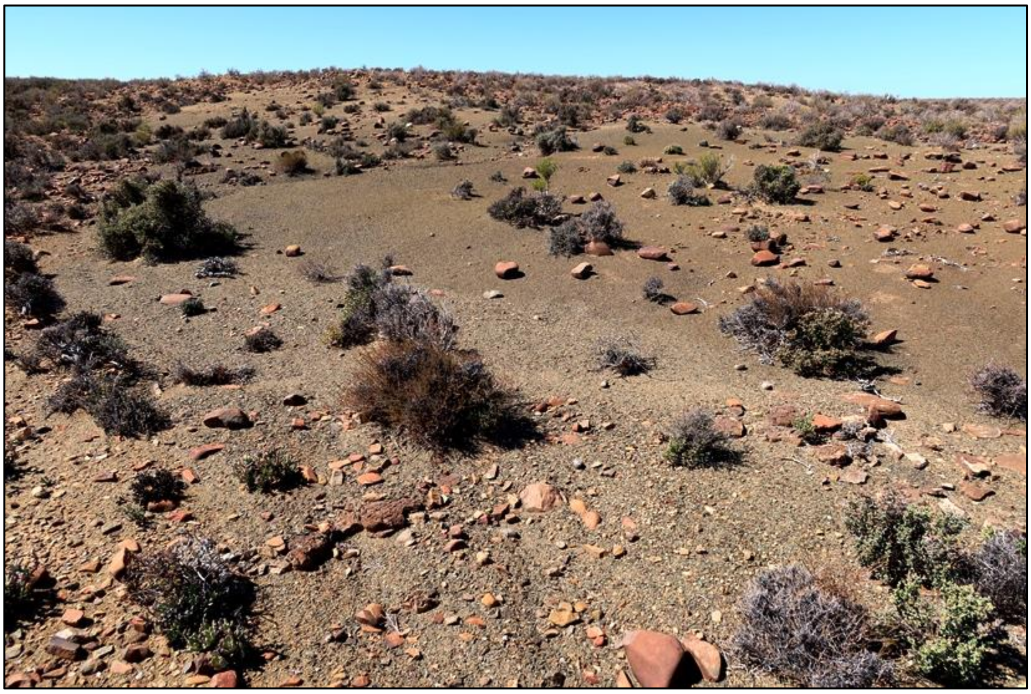


Figure 17: Friable weathered mudrocks with thin ferruginous carbonate lenses of the Tierberg Formation intermittently exposed along a low scarp between adjoining pediment surfaces, Hoek Doornen 172.

Figure 18: Limited exposure of weathered Tierberg Formation bedrocks along an erosion gulley through alluvial gravels and overlying sandy soils, southern margins of pediment surface on Hoek Doornen 172.

Figure 19: Narrow, rusty-brown, weathered dolerite dyke with pale veins of bladed sparry calcite extending across the boundary between Witte Wall 171 and Karee Kolk 174 (Hammer = 30 cm).

Figure 20: Thick, heavily-calcretised fluvial gravels with subordinate lenticular beds of gritty sandstone exposed along the southern bank of the Grootrivier on Witte Wall 171 (Hammer = 30 cm). The gravels contain sparse clasts of pale grey Matjiesfontein chert, some of which might be flaked artefacts, but this is equivocal.

Figure 21: Calcretised rubbly alluvial gravels along the edge of the lowermost pediment surface north of the Grootrivier on Karee Kolk 174 (Hammer = 30 cm). Many of the cobble-sized wacke clasts are moderately well-rounded.

Figure 22: Block-weathering, sparely-gravelly, pale brown calcretised alluvial sands locally capping the southern bank of the Grootrivier on Witte Wall 171 (Hammer = 30 cm). These sandy deposits pass downwards and laterally into coarse alluvial High Level Gravels.

Figure 23: Rubbly to nodular calcrete hardpan exposed along the crest of a low scarp between successive flat-topped pediment surfaces on Witte Wall 171.

Figure 24: Distinctive oligomict, coarse, unconsolidated gravels rich in chert clasts as well as ESA bifaces and occasional petrified wood blocks, Klein-Droëlaagte on Grootfontein 149. The gravels directly overlie Tierberg mudrocks and are mantled by unconsolidated sandy alluvium.

Figure 25: Close-up of oligomict gravels exposed along the Klein-Droëlaagte similar to those seen in previous figure (but here on Hoek Doornen 172) showing abundance of flaked ESA artefacts of brownish silcrete and grey Matjiesfontein chert (Scale is *c.* 15 cm long).

Figure 26: Calcretised, possibly cross-bedded lens of fine gravelly to gritty alluvium overlying Tierberg Formation bedrocks on the banks of the Klein-Droëlaagte, Grootfontein 149 (Hammer = 30 cm). These beds may be similar in age to the unconsolidated coarse oligomict gravels found along the same drainage line (*cf* Figure 24).

Figure 27: Pale, gullied, unconsolidated Recent sandy alluvium along the southern banks of the Klein-Droëlaagte on Hoek Doornen 172.

Figure 28: Section through the younger sandy alluvium with sparse dispersed gravel clasts overlying Tierberg Formation bedrocks, banks of the Klein-Droëlaagte on Hoek Doornen 172 (Hammer = 30 cm).

Figure 29: Poorly-sorted, oligomict downwasted surface gravels dominated by brownish-patinated Ecca wacke clasts and pale sandy soils that typically blanket the flat to gently-sloping pediment surfaces long the Grootrivier, seen here on Hoek Doornen 172.

Figure 30: Close-up of pediment gravels on Witte Wall 171 in an area showing a preponderance of pale grey to brownish silcrete clasts, many of which are anthropogenically flaked (Scale in cm). Small water-worn blocks or pebbles of silicified wood may occur in such areas (*cf* Figure 48).

Figure 31: Open, unvegetated area of pediment surface on Witte Wall 171 showing mantle of sandy alluvial soils and thin veneer of fine sheetwash gravels.

Figure 32: Close-up of angular to subrounded sheetwash gravels seen in the previous figure (Scale in cm and mm), Witte Wall 171. The clasts are largely of resistant-weathering lithologies including silicified mudrocks, cherts, occasional Dwyka erratics with sparse small blocks of petrified wood.

Figure 33: Patch of pale sandy soils on a pediment surface on Witte Wall 172 showing development of nodular calcrete and animal burrowing typical of these *heuweltjie* areas – possibly associated with ancient termite activity and / or bush clumps.

Figure 34: Patches of thick, fine sandy soils with distinctive shrubby vegetation and no gravels, such as seen here mantling gentle north-facing pediment slopes on Hoek Doornen 172, represent alluvial sands deflated from the bed of the Grootrivier by winds.

Figure 35: Large-scale sand dunes with typical low-angle aeolian cross-bedding exposed on the bed of the Grootrivier on Witte Wall 171.

Figure 36: Younger alluvial deposits exposed along the northern bank of the Grootrivier on Hoek Doornen 172, including well-rounded, cobbly to pebbly basal gravels and well-bedded overlying sandy deposits (Hammer = 30 cm).

Figure 37: Thin carpet of angular cherty colluvial gravels downwasted from the Collingham Formation and mantling a gently-sloping pediment surface on the southern sector of Hoek Doornen 172. The gravels include a sparse background scatter of flaked stone artefacts.

5. PALAEONTOLOGICAL HERITAGE

Fossil assemblages that have been recorded elsewhere from the various Karoo Supergroup and Late Caenozoic rock units represented within the proposed solar PV facility and power line project areas are outlined in Table 1 below. They have been treated, with extensive references, in several previous combined desktop and field-based palaeontological assessment studies for the Ceres Karoo region by the present author dealing with electrical infrastructure projects (*e.g.* Kappa Substation, Gamma – Omega transmission line) as well as renewable energy projects in the Ceres Karoo such as the Perdekraal Wind Energy Facility (WEF), Rietkloof WEF, Kolkies WEF and Karee WEF projects (See References under Almond). New fossil sites recorded during the recent palaeontological field survey of the proposed solar PV and power line facility project areas are listed together with GPS data and comments as well as proposed field ratings in Appendix A while numbered fossil localities are shown on the satellite maps in Figures 53 and 54. For sectors of the associated power line corridor between Witte Wall 171 and the Kappa Substation, field observations from several previous PIA studies by Almond (2010a-d, 2016a) have been taken into consideration as well as a recent site visit to Die Brak 241 for another renewable energy project (Almond in prep., 2020).

All of the sedimentary formations enumerated in Table 1 are potentially fossiliferous, although only three are considered to be generally or potentially of moderate to high palaeontological sensitivity (Theron *et al.,* 1991, Almond 2008a, 2008b, Almond & Pether 2008). Fossils within the glacially-influenced **Dwyka Group** succession are rare and mainly confined to thin interglacial or post-glacial facies, with the notable exception of occasional ice-rafted limestone or dolomite erratics, examples of which containing Cambrian archaeocyathids (fossil sponges) and trilobites have been recorded from the southern margins of the Great Karoo and Namibia. A small boulder of stromatolitic limestone or dolomite of probable Precambrian or Cambrian age from the Dwyka tillite is recorded from Sadawa 238, adjoining Platfontein 240 on the west, by Almond (2016a). No further fossiliferous carbonate erratics were encountered during recent fieldwork.

An important fossiliferous interval occurs within the lowermost **Prince Albert Formation**; fossil fish, molluscs and petrified wood have been recorded here in the Tanqua Karoo and the Northern Cape. A few small blocks of silicified wood displaying fine seasonal growth rings were recorded from surface gravels overlying the Prince Albert Formation in the Kolkies WEF study area by Almond (2016a) but their stratigraphic provenance is ambiguous; they have probably been reworked from younger Ecca Group formations. A fragment of a sizeable petrified trunk with fine growth rings from the SW Tanqua Karoo is displayed at the Doringrivier homestead (Pretorius Kraal 237) to the NW of Die Brak 241. The provenance is uncertain, but it probably also comes from the lower Ecca Group.

The **Whitehill Formation** is famous for its well-preserved skeletons of intact mesosaurid reptiles and palaeoniscoid bony fish, as well as prolific small crustaceans. However, these carbonaceous mudrocks are highly weathered and secondarily mineralised near-surface within the study area (Fig. 11), with little exposure of fresh bedding planes. No fossils were recorded from the Whitehill bedrocks, including the prominent-weathering, large dolomitic concretions and lenses, during the present field survey.

The overlying **Collingham Formation** along the southern Great Karoo margins is well-known for rare well-preserved petrified logs and trackways of giant eurypterids (water scorpions). Occasional small blocks of petrified wood occur among downwasted cherty Collingham gravels on Hoek

Doornen 172 (Fig. 47), close to exposures of the Matjiesfontein chert, although the Collingham Formation is not mapped here. Small cylindrical burrows infilled with pale ash that contrasts with the dark mudrock matrix are found along the contacts of thin tuff horizons on Witte Wall 171 (Fig. 43). The only other fossils seen this formation within the Ceres Karoo are dense but low-diversity assemblages of horizontal burrows that are widely recorded elsewhere along the southern Karoo margins (Fig. 42) (Almond 2016a).

The basinal and distal submarine fan mudrocks of the **Tierberg Formation** are characterised by a range of interesting trace fossils and drifted plant material of the *Glossopteris* Flora (*e.g.* stems, leaves and segmented roots of *Glossopteris* trees); animal body fossils (*e.g.* palaeoniscoid fish) are very rare, however. Apart from occasional fragmentary rusty-brown compressions of wood remains within siltstone exposed close to the Grootrivier (J. Orton., pers. comm. 2020), fossil plant material was not observed *in situ* in the PV facility project area. Low diversity assemblages of simple horizontal burrows can be seen within dark Tierberg mudrocks along the banks of the Grootrivier on Witte Wall 171 (Fig. 39) as well as along the Klein-Droëlaagte on Hoek Doornen 172 (Fig. 40). These trace fossils are widely-occurring forms of no special conservation significance, however. Complex cone-in-cone structures developed within diagenetic concretions of ferruginous carbonate in the Tierberg Formation have frequently been mistaken for fossil stromatolites but are actually pseudofossils (Fig. 41). The same applies to dendrites - moss- or fern-like growths of the manganese psilomelane commonly seen on bedding planes and fracture surfaces of Tierberg wackes.

Older **alluvial gravels,** such as the calcretised, downwasted and sheet-washed pediment gravels along the margins of the Grootrivier, contain a sparse background scatter of small blocks of resistant-weathering silicified wood reworked from the Ecca Group bedrocks (Figs. 46 & 48). The blocks are various angular to water-worn and are generally only a few cm in maximum diameter. The wood shows well-developed seasonal growth lines, as typically seen in the high-palaeolatitude Karoo Basin. Some, and perhaps the majority, of the silicified wood specimens encountered within surface gravels within the project area come from the Tierberg Formation. Given the extensive catchment area of the Grootrivier and its tributaries, it is possible that some of the petrified wood comes from the Mid-Permian Waterford Formation (Ecca Group) which is known to contain well-preserved fossil logs in the Klein-Roggeveldberge region (*cf* Almond 2018) or from the Collingham Formation as previously discussed. It is noted that a high proportion of the fossil wood blocks recorded during the recent field survey – including one small log - come from the distinctive coarse, oligomict alluvial gravels found along the Klein-Droëlaagle drainage line where they are associated with abundant silcrete clasts (including common ESA bifaces) (Figs. 44 & 45). Where concentrations of silcrete clasts are found on the pediment surfaces away from modern water courses, float blocks of petrified wood (and stone artefacts) often occur here as well, suggesting the possible presence of buried ancient channel conglomerates at these sites. Given its uncertain provenance and widespread occurrence within surface gravels in the region, the scientific and conservation value of the petrified wood material encountered is rated as low and no special mitigation measures are proposed for the known fossil sites. The sites along the Klein-Droëlaagle drainage line will be protected within the riverine buffer zone (Fig. 54).

Large (several dm diameter), sphaeroidal, calcretised subterranean termitaria (termite nests) with finely-spaced ribbing on the inner surface (marginal supports for the delicate fungus-garden combs) and porous outer walls have been reported from a number of localities in the semi-arid Western and Northern Cape where they may be embedded within saprolite (weathered bedrock) of

a wide range of ages. The complex wavy-laminated internal structure of the thick nest wall is well seen on fractured surfaces. Several partial specimens and broken fragments of fossil nests were recorded within or near the proposed project area in the Ceres Karoo where they are found weathering-out from weathered, calcrete-veined Tierberg Formation mudrocks and overlying calcretised pediment sediments close to the scarp edges (Figs. 49 to 52). Some of these nests may have originally been built several meters below the ground surface while the ill-defined calcrete "veins" in the vicinity might in part be fossilised termite tunnels. The age of the fossil nests is unclear; they may well reflect termite activity during cool, dry episodes within the Pleistocene Epoch which may have supported a more grassy vegetation than found locally today. The dense pattern of *heuweltjies* seen in satellite images of the Ceres Karoo pediment surfaces may be related to the activities the same termites. The preferential development of calcretised soils within the *heuweltjies* could be an indirect consequence of their biological activity.

Finer-grained **alluvium** may host Pleistocene to recent mammal bones, teeth and horn cores as well as distinctive calcretised fossil termite nests and other burrows. Fossils previously recorded within the superficial deposits in the Ceres Karoo region comprise (1) isolated small blocks of reworked petrified wood within surface gravels (see above), and (2) bioturbated horizons within calcretised sandy alluvium along the banks of the Grootrivier (Almond 2016a). The trace fossils concerned in the second case might be rhizoliths (calcretised root casts) and / or invertebrates; they are probably of Pleistocene age.

Given (1) the scarcity of unique or scientifically-valuable fossils recorded during the field-based scoping assessment of the proposed solar PV facility and power line project areas, as well as (2) the paucity of fossil remains recorded during previous PIA studies in the Ceres Karoo region (See References under Almond) it is concluded that these areas are of low palaeontological sensitivity. The fossil material recorded – principally (1) low-diversity trace fossil assemblages within the Ecca Group, (2) sparse, widely-dispersed and mostly small, reworked blocks of petrified wood of uncertain stratigraphic provenance within surface and alluvial gravels, and (3) calcretised termite nests of probable Pleistocene age – is of widespread occurrence along the SW Karoo margins and not of any special scientific or conservation value. No fossil sites of high palaeosensitivity of No-Go areas were identified during the field survey. No special mitigation measures are recommended for the recorded fossil sites, all of which are assigned a low provisional field rating (See table in Appendix A).

- **Palaeontological heritage site sensitivity verification**

The palaeosensitivity map generated by the Department of Environment, Forestry and Fisheries (DEFF) screening tool for the combined proposed solar PV facility and associated power line project area is provided in Figure 38. According to this map, the project area includes regions of (1) medium sensitivity towards the north, corresponding largely to the Tierberg Formation outcrop area, (2) high sensitivity towards the south, corresponding to the Dwyka Group outcrop area, and (3) a central band with unspecified sensitivity which corresponds to the folded Lower Ecca Group outcrop area.

On the basis of (1) the recent palaeontological field survey for the proposed solar and power line projects as well as (2) several desktop- and field-based previous PIA studies in the Ceres Karoo (notably Almond 2010a-c, 2016a, 2018, 2020), the screening tool map is disputed and *rejected* here as an accurate reflection of palaeosensitivity within the present study area. The main reasons for this are:

- The inaccurate overlay of the project area on the palaeosensitivity map (which is based primarily on the relevant 1: 250 000 geological maps);
- The Dwyka Group (indicated in red) is generally regarded as of LOW palaeosensitivity whereas the Tierberg Formation is of MEDIUM sensitivity, at most. Field data for the proposed project suggest a LOW palaeosensitivity for the Tierberg Formation outcrop area here due to weathering and extensive cover by low-sensitivity calcrete, gravels and soils.
- Potentially-sensitive rock units such as the basal Prince Albert Formation and Whitehill Formation are not rated on the map (Field data suggests these are generally of LOW palaeonsensivity in this region, mainly due to weathering and cleavage development).
- The map does not address the Late Caenozoic sediments that mantle the bedrocks in the project area, and in particular the pediment gravels (ancient alluvium) underlying almost the entire solar PV study areas as well as younger alluvium along the Grootrivier and its tributaries. Almost all the new fossil occurrences noted during the recent field survey were found in such settings. However, these fossils are generally of low conservation value and the palaeosensitivity of the Late Caenozoic sediments is according rated as LOW.

It is concluded that the entire combined project area for the proposed solar PV facilities and associated power line to Kappa Substation is in practice of LOW palaeosensivity. Potentially fossiliferous rock units such as the Prince Albert and Whitehill Formations are too weathered and tectonically deformed (cleaved) to contain scientifically valuable fossils in the project area. No significant, conservation-worthy fossil sites or palaeontological No-Go areas were recorded during the field survey.

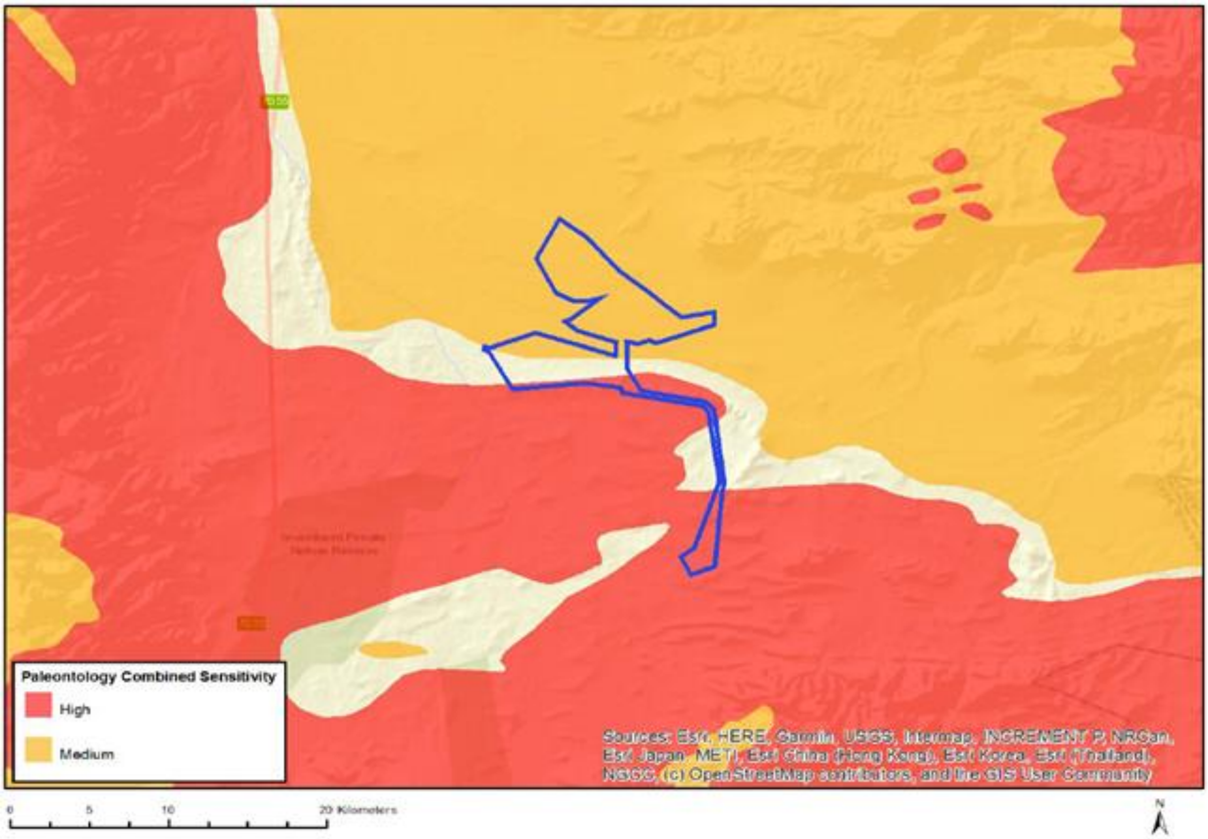


Figure 38: Palaeosensitivity map for the combined solar PV facility and associated power line project area (blue polygon) produced from the DEFF screening tool. Data from several recent field surveys as well as desktop studies indicate that in practice the project area is of LOW palaeosensitivity.

Figure 39: Low diversity assemblages of simple, straight to sinuous horizontal endichnial burrows (*c*. 4 mm wide) on rare bedding plane exposures of the Tierberg Formation, south bank of the Grootrivier, Witte Wall 171 (Loc. 149).

Figure 40: Cylindrical to flattened horizontal, straight to gently-curved burrows (1-2 cm wide, arrowed) with distinctive longitudinal surface ridges or wrinkles (*cf Palaeophycus*), Tierberg Formation exposures in bed of Klein-Droëlaagte, Hoek Doornen 172 (Loc. 122).

Figure 41: Weathered-out, oblate diagenetic concretions of ferruginous carbonate from the Tierberg Formation showing stromatolite-like cone-in-cone structures (pseudofossils), bed of the Klein-Droëlaagte on Hoek Doornen 172 (Scale *c*. 15 mm long).

Figure 42: Typical dense, low-diversity assemblage of horizontal burrows (*c*. 2-3 mm across) preserved within silicified mudrocks of the Collingham Formation (Witte Wall 171) (From Almond 2016a).

Figure 43: Small (1-2 mm diameter) ash-infilled invertebrate burrows (arrowed) close to the interface with a pale cream tuff horizon, Collingham Formation (Witte Wall 171) (From Almond 2016a).

Figure 44: Coarse silcrete gravels and associated reworked petrified wood block from the bed of the Klein-Droëlaagte on Grootfontein 149 (Loc. 165) (Scale in cm).

Figure 45: Portion of a small petrified log showing well-developed seasonal growth lines recorded among oligomict, silcrete gravels in the bed of the Klein-Droëlaagte on Grootfontein 149 (Loc. 169) (Scale in cm).

Figure 46: Collection of small angular to slightly rounded blocks of petrified wood from sheetwash surface gravels on Hoek Doornen 172 (Loc. 128) (Scale in cm and mm).

Figure 47: Small block of petrified wood showing prominent seasonal growth rings recorded close to an exposure of Matjiesfontein chert and so possibly from the Collingham Formation (not mapped here), Hoek Doornen 172 (Loc. 150) (Scale in cm and mm).

Figure 48: Small, well-rounded (water-worn) clasts of silicified wood from pediment surface gravels on Witte Wall 171 (Loc. 132) where they occur in possible association with silcrete-rich older alluvial gravels (Scale in cm and mm).

Figure 49: *In situ* large sphaeroidal calcretised termitarium (yellow dashed area) still largely buried within calcretised pediment gravels with detached blocks extending downslope in float, Grootfontein 149 (Loc. 158) (Scale is *c*. 15 cm long).

Figure 50: Close-up of fragment of calcretised termitarium wall showing the distinctive wavy or zigzag pattern of the fine internal lamination. Block is c. 10 cm across. Same locality as previous figure.

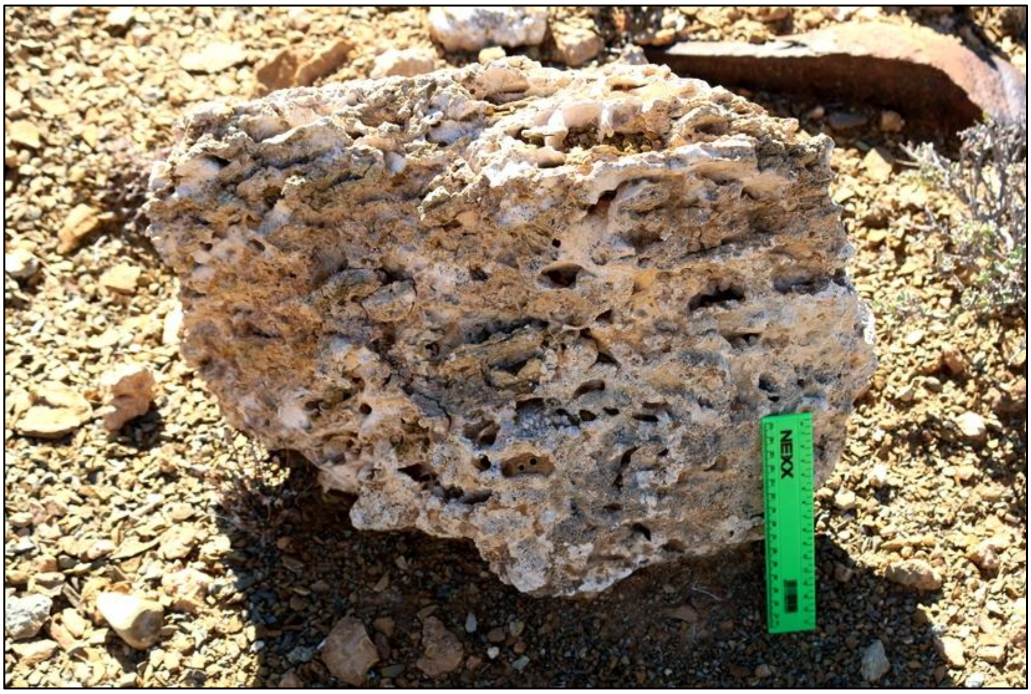


Figure 51: Porous outer surface of a partially weathered-out sphaeroidal termitarium originally embedded within weathered Tierberg Fromation mudrocks on the northern banks of the Grootrivier, Karee Kolk 174 (Scale is *c*. 15 cm long).

Figure 52: Finely-ribbed inner surface of the calcretised termitarium illustrated above (Scale is *c*. 15 cm long). The ribs would have originally supported closely-spaced shelves of the termite colony's fungus garden.

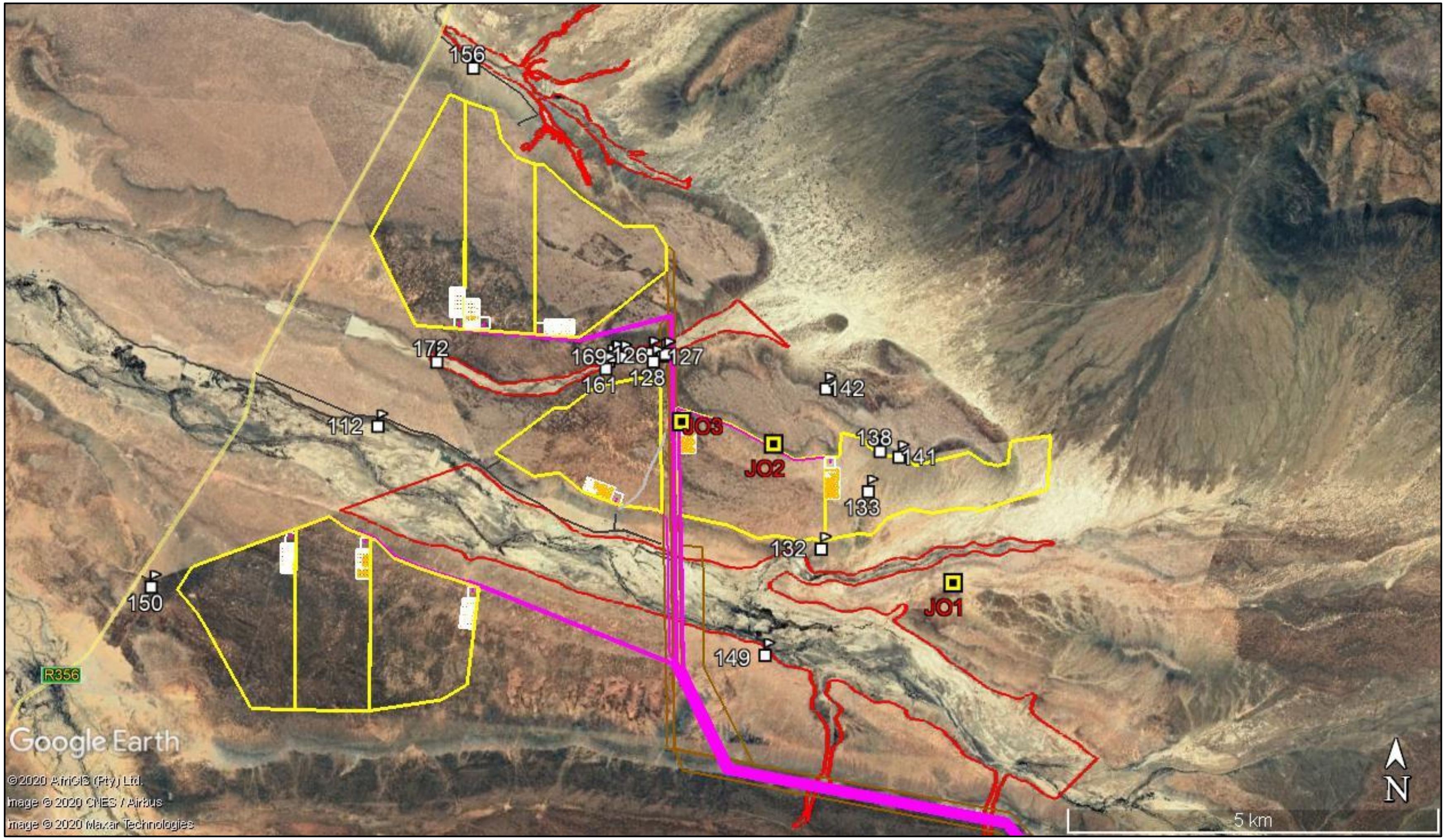


Figure 53: Google Earth© satellite image of the solar PV facility project areas (yellow polygons) with associated power lines (pink) in the corridor linking to the existing Eskom Kappa Substation. The numbered squares show new fossil sites, most of which are associated with drainage line exposures falling in No-Go areas *outside* the project footprint (See Appendix A for details of fossil sites). None of these sites (which represent only a small fraction of potential fossil sites in the area) are considered to be of high scientific or conservation value and no recommendations for their mitigation are proposed here.

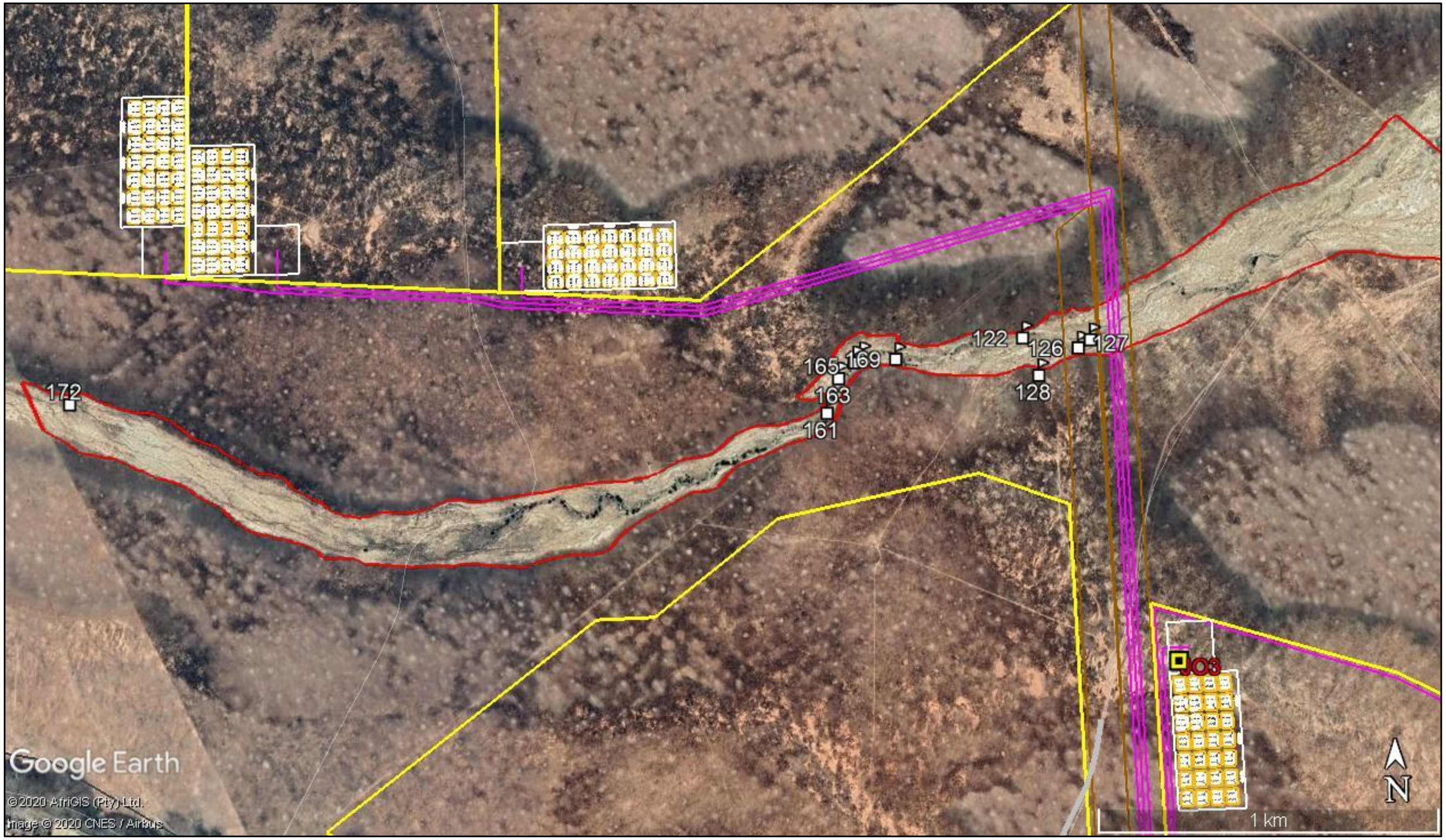


Figure 54: Google Earth© satellite image showing in more detail numbered fossil sites (reworked petrified wood, generally associated with gravels rich in ESA stone artefacts) along the Klein-Droëlaagte drainage line on Witte Wall 171 and Grootfontein 149. These sites lie within a designated No-Go area (identified by the Biodiversity Specialists) and should be protected within the anticipated buffer zone along drainage lines. No recommendations for their mitigation are therefore proposed here.

Table 1: Summary of known fossil record of the main sedimentary rock units represented in the proposed solar PV facility and power line study area. Note that palaeontological sensitivity is strongly dependent on local levels of bedrock weathering and tectonic deformation (*e.g.* cleavage).

GROUP	FORMATION & AGE	FOSSIL BIOTAS	PALAEONTOLOGICAL SENSITIVITY
SUPERFICIAL DEPOSITS	**High Level Gravels, alluvium, colluvium, pedocretes (*e.g.* calcrete)** **LATE TERTIARY TO RECENT**	Bones and teeth of wide range of mammals, including mammals (*e.g.* teeth & bones of mastodont proboscideans, rhinos, bovids, horses, micromammals), reptiles (crocodiles, tortoises), ostrich egg shells, fish, freshwater and terrestrial molluscs (unionid bivalves, gastropods), crabs, trace fossils (*e.g.* termitaria, horizontal invertebrate burrows, stone artefacts), reworked petrified wood, leaves, rhizoliths, diatom floras, peats and palynomorphs.	**LOW (but may be locally HIGH)**
ECCA GROUP	**Tierberg Formation** **E-M PERMIAN**	Rare palaeoniscoid fish, disarticulated microvertebrate remains (*e.g.* fish teeth, scales), sponge spicules, sparse vascular plants (esp. leaves, roots of glossopterids), silicified wood, low to moderate diversity trace fossil assemblages (*e.g.* large ribbed pellet burrows, arthropod scratch burrows, *Siphonichnus etc*).	**LOW-MODERATE**
	Collingham Formation **EARLY PERMIAN**	Low diversity but locally abundant ichnofaunas (horizontal "worm" burrows, arthropod trackways, including those of giant eurypterids), vascular plant remains (petrified and compressed wood, twigs, leaves *etc*).	**MODERATE**
	Whitehill Formation **EARLY PERMIAN**	Mesosaurid reptiles, rare cephalochordates, variety of palaeoniscoid fish, small eocarid crustaceans, insects, low diversity of trace fossils (*e.g.* king crab trackways, possible shark coprolites), palynomorphs, petrified wood and other sparse vascular plant remains (*Glossopteris* leaves, lycopods *etc*).	**HIGH**
	Prince Albert Formation **EARLY PERMIAN**	Low diversity marine invertebrates (bivalves, nautiloids, brachiopods), palaeoniscoid fish, sharks, fish coprolites, protozoans (foraminiferans, radiolarians), petrified wood, palynomorphs (spores, acritarchs), non-marine trace fossils (especially arthropods, fish, also various "worm" burrows), possible stromatolites, oolites.	**MODERATE**
DWYKA GROUP	**Elandsfontein Formation** **LATE CARBONIFEROUS TO EARLY PERMIAN**	Interglacial mudrocks occasionally with low diversity marine fauna of invertebrates (molluscs, starfish, brachiopods, coprolites *etc*), palaeoniscoid fish, petrified wood, leaves (rare) and palynomorphs of *Glossopteris* Flora. Well-preserved non-marine ichnofauna (traces of fish, arthropods) in laminated mudrocks. Possible stromatolites, oolites at top of succession. Limestone erratics with Cambrian archaeocyathid sponges, trilobites, small stromatolites.	**LOW**

6. PALAEONTOLOGICAL HERITAGE IMPACT ASSESSMENT

The anticipated impact significance of the proposed solar PV facilities and associated power lines on local fossil heritage resources is evaluated in Table 3 below. The assessment applies equally to all nine of the 175 MW Solar Photovoltaic (PV) power generation facilities as well as to the associated power lines.

The *key impacts* on local palaeontological heritage resources considered here are *direct* and concern:

- the potential disturbance, damage, destruction or sealing-in of scientifically-important and legally-protected fossils preserved at or beneath the surface of the ground due to construction phase excavations (*e.g.* PV module footings, building foundations, power line pylon footings, underground cables, stormwater channels), and ground clearance (*e.g.* access roads, solar arrays).

This assessment applies only to the *construction phase* of the developments since further significant impacts on fossil heritage during the planning, operational and decommissioning phases of the facilities are not anticipated.

In general, the destruction, damage or disturbance out of context of fossils preserved at the ground surface or below ground that may occur during construction represents a *direct*, *negative* impact that is limited to the development footprint (*site specific*). Such impacts can usually be mitigated but cannot be fully rectified or reversed (*i.e. permanent, irreversible*). Most of the sedimentary formations represented within the study area contain fossils of some sort, so impacts *at some level* on fossil heritage are *very likely*. However, most fossil occurrences encountered within the project footprint occur widely within the study region (*i.e. not unique / irreplaceable*) and are not considered to be of great scientific significance. Exceptional fossils such as well-preserved, well-articulated vertebrate skeletons, vertebrate trackways or substantial petrified logs that are scientifically valuable and conservation-worthy appear to be very rare in the study area. The probability of loss of such conservation-worthy fossil heritage due to the proposed development is considered to be *low*. This is because of (a) the very sparsely-scattered distribution of exceptional, well-preserved fossils within the bedrocks as well as within the overlying superficial sediments (*e.g.* older alluvium, surface gravels), (b) the mantling of the bedrocks with thick superficial sediments in most areas, so that major impacts on potentially-fossiliferous fresh (*i.e.* unweathered) bedrock are limited. The consequence of the anticipated impacts on palaeontological heritage is therefore assessed as *slight* without mitigation. The significance of slight but high (i.e. very likely) probability impacts on fossil heritage resources that are restricted to the development footprint and of permanent duration is rated as *very low (negative)* without mitigation.

Levels of confidence for this impact assessment are *medium* given (1) the unpredictable occurrence of well-preserved, scientifically-valuable fossils, (2) the limited scope and number of field-based palaeontological studies carried out in the broader region and (3) the low levels of bedrock exposure within the development footprint.

It should be noted that, should the recommended mitigation measures for the construction phase of the solar PV and power line developments (Section 7) be fully and consistently

implemented, the impact significance would remain *very low* but would entail both positive and negative impacts (Table 3). Residual negative impacts from inevitable loss of some fossil heritage would be partially offset by an improved palaeontological database for the study region as a direct result of appropriate mitigation. This is a *positive* outcome because any new, well-recorded and suitably-curated fossil material from this palaeontologically little-known region would constitute a useful addition to our scientific understanding of South African fossil heritage.

6.1. Assessment of cumulative impacts

A number of renewable energy and electrical infrastructure projects have been proposed for the Ceres Karoo region within a radius of 30 km of the project areas for the proposed solar PV facility and power line projects. Field-based palaeontological heritage assessments for these projects have been conducted by the author and palaeontological colleagues (*cf* PIAS for the Perdekraal East, Kolkies, Karee, Rietkloof / Indyebo, Tooverberg WEFs by Almond 2015, 2016a, 2016b, 2018 and Butler 2018). In addition, several further new solar energy facility and WEF project proposals (*e.g.* Pienaarspoort 1 WEF and Pienaarspoort 2 WEF) are currently being assessed in the Ceres Karoo area (Almond 2020 and two additional solar facility studies in progress). A tentative assessment of the potential cumulative impacts of the proposed projects in the context of these other developments (not all of which may be granted environmental authorisation) is provided in Table 4. This assessment provided here applies equally to all of the Veronica project components (PV solar facilities, power lines) considered individually and in conjunction.

It is noted that cumulative impact assessments only have real meaning if comparable resources are considered (*e.g.* fossil assemblages in the same geological formations), while developments other than renewable energy projects (*e.g.* borrow pits, roads, power lines) are also relevant (*cf* Almond 2010a-c for the Eskom Gamma-Omega 765kV transmission line and Kappa Substation). Several renewable energy developments in the Klein Roggeveldberge and Cape Fold Mountains which respectively affect Permian continental fossils within the Lower Beaufort Group and Devonian marine fossils within the Cape Supergroup are *not* considered to be relevant here. Furthermore, the cumulative impact assessment assumes – rather optimistically - that all the relevant palaeontological mitigation measures recommended for the authorised renewable energy projects considered are fully implemented.

Given the generally Low, but not negligible, impact significance assigned to the various *relevant* renewable energy developments in the Ceres Karoo listed above, as well as the Very Low impact significance assessed here for each of the nine proposed PV and power line developments themselves, a LOW (negative) cumulative impact significance for the latter projects is suggested in the absence of mitigation. Should the various mitigation measures proposed for these projects be fully implemented, the cumulative impact significance may fall to VERY LOW (negative). It is concluded that as far as fossil heritage resources are concerned, the proposed solar facility and power line projects, whether considered individually or together, will *not* result in an unacceptable loss or unacceptable additional impacts, considering all the authorised renewable energy projects proposed in the area.

6.2. Impact Assessment Summary

A summary of the overall impact significance findings (following mitigation) for the proposed solar facility and power line projects is provided in Table 2 below.

Table 2: Overall Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	Very Low
Operational	Not applicable
Decommissioning	Not applicable
Loss of palaeontological heritage	**Overall Impact Significance**
Cumulative - Construction	Very Low
Cumulative - Operational	Not applicable
Cumulative - Decommissioning	Not applicable

Table 3: Impact assessment summary table for the Construction Phase of each solar PV facility and associated power line [No further impacts anticipated during operational and decommissioning phases]

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Disturbance, damage or destruction of fossils within the development footprint due to excavations and surface clearance	***Status***	**Negative**	**Very low impact (5)**	**Monitoring for fossil remains on on-going basis by the Environmental Control Officer (ECO) during the construction phase. See Chance Fossil Finds Procedure (Appendix C and EMPr)**	**Very low impact (5)**	**Medium**
	Spatial Extent	**Site specific**				
	Duration	**Permanent**				
	Consequence	**Slight**				
	Probability	**Very likely**				
	Reversibility	**Non-reversible**				
	Irreplaceability	**Low**				

Table 4: Cumulative impact assessment summary table for each solar PV facility and associated power line in the context of the other proposed solar projects as well as other renewable energy developments in the area (≤ 30 km radius)

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Disturbance, damage or destruction of fossils within the development footprint due to excavations and surface clearance	***Status***	**Negative**	**Low impact (4)**	**Monitoring for fossil remains on on-going basis by the ECO during the construction phase. See Chance Fossil Finds Procedure (Appendix C and EMPr)**	**Very low impact (5)**	**Medium**
	Spatial Extent	**Site specific**				
	Duration	**Permanent**				
	Consequence	**Moderate**				
	Probability	**Very likely**				
	Reversibility	**Non-reversible**				
	Irreplaceability	**Low**				

7. MONITORING AND MITIGATION MEASURES FOR INCLUSION IN THE EMPr

Since unique, scientifically-valuable, conservation-worthy fossils are rare within the proposed solar facility and power line project areas, no further specialist palaeontological studies, monitoring or mitigation is recommended for this development, pending the potential discovery of significant new fossil material during the construction phase.

The following monitoring and mitigation measures are recommended for the construction phase of the developments, for inclusion in the EMPrs:

- Monitoring for fossil material of all major surface clearance and deeper (>1m) excavations by the Environmental Control Officer (ECO) on an on-going basis during the construction phase.

- Significant fossil finds should be safeguarded and reported at the earliest opportunity to Heritage Western Cape for recording and sampling by a professional palaeontologist (Contact details: Heritage Western Cape. Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 086-142 142. Fax: 021-483 9842. Email: hwc@pgwc.gov.za).

- Professional mitigation, involving the recording and judicious sampling of fossil material together with pertinent field data (stratigraphy, taphonomy), should conform to best practice. Fossil material collected must be curated within an approved repository (university or museum collection).

A tabulated summary of recommendations regarding palaeontological heritage for the construction phase of the proposed solar facility and power line developments is provided in Table 5 below. This table applies equally to all proposed solar PV facilities and associated power lines, as well as the grid connection at the Kappa Substation.

A general protocol for Chance Fossil Finds for this project is appended to this report (Appendix C).

There are no palaeontological monitoring or mitigation requirements for the operational and decommissioning phases of the developments.

7.1. Generic EMPr for Power Lines and Substations

Section 5.12 (Protection of Heritage Resources) in the Generic EMPr for Power Lines and Substations (GN 435), gazetted in 2019, adequately covers the generic palaeontological heritage monitoring and mitigation measures appropriate for the proposed solar PV facility power line and substation projects. There are no specific palaeontological heritage management actions that are important and not included in GN 435.

Table 5: Management Plan for the Construction Phase (Including pre- and post-construction activities) [This table applies equally to all solar PV facilities, power lines and substation grid connection]

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Palaeontological heritage					
Disturbance, damage, destruction or sealing-in of scientifically valuable fossil material embedded within bedrock or exposed at ground surface within development footprint.	Safeguarding, recording and sampling of scientifically-important fossil material encountered or exposed during development (Chance Fossil Finds)	a. Monitoring of all bedrock excavations and cleared sites for fossil remains during construction phase. Safeguarding of chance fossil finds.	Regular visual inspection of substantial excavations and cleared areas for fossil remains. Chance fossil finds to be safeguarded (site taped-off or fossils set aside) and reported to Heritage Western Cape (HWC) for possible mitigation.	Ongoing during Construction Phase	ECO
		b. Recording and judicious sampling of exceptional new fossil material and relevant geological data from the development footprint.	Standard palaeontological recording and collection methods (GPS / photos / field notes / careful wrapping of specimens for transport)	Following report of significant new fossil finds by ECO	Professional palaeontologist assisted by ECO
		c. Curation of fossil specimens at an approved repository (e.g. museum).	Cataloging and safe storage of fossils *plus* key field data in an approved repository (museum / university)	Following mitigation	Professional palaeontologist
		d. Final technical report on palaeontological heritage within study area submitted to HWC.	Minimum reporting requirements specified by heritage resources agency (*e.g.* SAHRA / HWC)	Following mitigation and preliminary analysis of fossil finds	Professional palaeontologist

8. CONCLUSIONS AND RECOMMENDATIONS

Given the very similar geological and palaeontological context and scale of each of the nine proposed solar PV facilities and the associated power lines, the impact assessments and mitigation recommendations for each project are identical.

The solar PV facility project area is situated on a flat to gently-sloping pediment surface of Late Caenozoic (Neogene – Pleistocene) age on the flanks of the Grootrivier Valley which drains this sector of the Ceres Karoo. The pediment surface has been planed-off by river erosion into the underlying fine-grained, non-marine, basinal to distal submarine fan sediments of the Tierberg Formation (Ecca Group) that are Middle Permian in age. Field surveys show that the Tierberg bedrocks beneath the thin (few dm to few meters maximum) capping of alluvial gravels, calcrete hardpans, sandy soils and downwasted surface gravels capping the pediment surface are weathered, folded and often tectonically-cleaved. The only fossil remains recorded from such pediment settings in the Ceres Karoo comprise (1) sparse, generally small blocks of reworked silicified fossil wood within alluvial and surface gravels of uncertain provenance (probably Ecca Group) and (2) occasional calcretised fossil termite nests of probable Pleistocene age that are found embedded within calcretised superficial sediments as well as weathered, calcrete-veined bedrocks. The majority of fossil sites recorded fall within designated No-Go areas lying *outside* the project footprint. These fossils are of widespread occurrence within the Ceres Karoo region and are not of high scientific interest or conservation value. No fossil sites of high sensitivity or No-Go areas were identified within the solar PV project areas during the palaeontological field survey and the palaeontological sensitivity of the project area is assessed as generally LOW.

The power line corridor between the solar PV sites and the existing Kappa Substation on Platfontein 240 traverses the outcrop areas of the Permo-Carboniferous, glacial-related Dwyka Group as well as the lower Ecca Group (Prince Albert, Whitehill and Collingham Formations). The potentially-fossiliferous Prince Albert, Whitehill Formations and Collingham Formations are highly weathered and cleaved in this region. No sensitive fossil sites have been recorded within or close to the proposed corridor on Die Brak 241 and Platfontein 240 during the present field survey or several previous field studies in the vicinity by Almond (2010a-c, 2016a) and the palaeontological sensitivity of the corridor is assessed as LOW.

As a consequence of (1) the paucity of irreplaceable, unique or rare fossil remains within the development footprint, as well as (2) the extensive superficial sediment cover overlying most potentially-fossiliferous bedrocks within the solar PV facility and power line project area, the overall impact significance of the construction phase of the proposed solar PV facility regarding legally-protected palaeontological heritage resources is assessed as *VERY LOW* (*negative status*), with and without mitigation. This assessment applies to all the associated solar PV facility and power line infrastructure within the project area. No significant further impacts on fossil heritage are anticipated during the operational and decommissioning phases of the solar PV energy facility and associated infrastructure. The No-Go alternative (*i.e.* no solar PV facility and power line development) will probably have a neutral impact on palaeontological heritage. Confidence levels for this assessment are MEDIUM, given the generally low exposure levels of potentially-fossiliferous bedrocks.

Anticipated cumulative impacts in the context of other renewable energy projects in the Ceres Karoo region – *including* the nine proposed solar PV facilities and power lines - are assessed as *LOW (negative)* without mitigation but *VERY LOW (negative)* with mitigation. It is concluded that as far as fossil heritage resources are concerned, the proposed solar facility and power line projects, whether considered individually or together, will *not* result in an unacceptable loss or unacceptable additional impacts, considering all the renewable energy projects proposed in the area. This analysis only applies *provided that* all the proposed monitoring and mitigation recommendations made for all these various projects are consistently and fully implemented.

No specialist palaeontological monitoring or mitigation is recommended for this development, pending the potential discovery of significant new fossil material here during the construction phase. The ECO should be made aware of the possibility of important fossil remains (bones, teeth, petrified wood, plant-rich horizons, fossil termitaria *etc.*) being found or unearthed during the construction phase of the development. Monitoring for fossil material of all major surface clearance and deeper (>1m) excavations by the ECO on an on-going basis during the construction phase is therefore recommended. Significant fossil finds should be safeguarded and reported at the earliest opportunity to Heritage Western Cape for recording and sampling by a professional palaeontologist. The palaeontologist concerned will need a Fossil Collection Permit from Heritage Western Cape and all fossil material collected must be properly curated in an approved repository (museum / university collection). These recommendations must be included within the EMPr for the proposed solar PV facility and power line developments. A protocol for Chance Fossil Finds is appended to this report (Appendix C).

There are no identified fatal flaws and no objections on palaeontological heritage grounds to authorisation of the proposed solar PV facilities with its associated power line connections to the Kappa Substation.

9. ACKNOWLEDGEMENTS

I am grateful to Ms Rohaida Abed of the CSIR- Environmental Management Services for commissioning this PIA project, for providing the relevant background information as well as indefatigable editorial and heritage management input. Ms Luanita Snyman van der Walt is thanked for drafting the consolidated geological map of the Ceres Karoo project area. Mnr Claude Bosman of Veroniva (Pty) Ltd is thanked for facilitating the fieldwork very effectively and Dr Jayson Orton of ASHA for helpful discussions regarding heritage management as well as providing additional fossil locality data and photographs. As always, logistical support, companionship and assistance in the field from Ms Madelon Tusenius is greatly appreciated.

10. KEY REFERENCES

N*.B. An extensive list of literature relevant to the palaeontology of the Ceres Karoo / southern Tanqua Karoo region has been provided by Almond (1015a, 2016a, 2018ë).*

ALMOND, J.E. 1998. Trace fossils from the Cape Supergroup (Early Ordovician – Early Carboniferous) of South Africa. Journal of African Earth Sciences 27 (1A): 4-5.

ALMOND, J.E. 2008a. Fossil record of the Loeriesfontein sheet area. Unpublished report for the Council for Geoscience, Pretoria, 32pp.

ALMOND, J.E. 2008b. Palaeozoic fossil record of the Clanwilliam sheet area. Unpublished report for the Council for Geoscience, Pretoria, 49pp.

ALMOND, J.E. 2010a. Eskom Gamma-Omega 765kV transmission line: Phase 2 palaeontological impact assessment. Sector 1, Tanqua Karoo to Omega Substation (Western and Northern Cape Provinces), 95 pp + appendix. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010b. Proposed Kappa electrical substation on Platfontein Outspan 240, Ceres Magesterial District, Western Cape Province, 17 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010c. Eskom Gamma-Omega 765kV transmission line: Phase 2 palaeontological impact assessment. Sector 2, Omega to Kappa Substation (Western Cape Province), 100 pp + appendix. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010d. Proposed Mainstream wind farm at Perdekraal, Ceres Karoo, Ceres Magisterial District, Western Cape Province. Palaeontological impact assessment: pre-scoping desktop study, 22 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010e. Proposed Mainstream wind farm at Konstabel near Touwsrivier, Laingsburg Magisterial District, Western Cape. Palaeontological impact assessment: pre-scoping desktop study, 19 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015a. Proposed Perdekraal East Wind & Solar Renewable Energy Facility near Touwsrivier, Ceres Magisterial District, Western Cape Province. Palaeontological impact assessment: field study, 68 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015b. Proposed 75 MW photovoltaic solar facility and associated infrastructure on remainder of Farm 34 Vredefort near Touwsrivier, Breede River District Municipality, Western Cape. Palaeontological heritage assessment: combined desktop & field study, 44 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2016a. Proposed Kolkies Wind Energy Facility near Touwsrivier, Witzenberg Local Municipality, Western Cape. Palaeontological input to heritage scoping assessment, 30 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2016b. Proposed Karee Wind Energy Facility near Touwsrivier, Witzenberg Local Municipality, Western Cape. Palaeontological input to heritage scoping assessment, 33 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2018. Proposed Rietkloof Wind Energy Facility near Laingsburg, Laingsburg Local Municipality, Western Cape. Palaeontological heritage assessment: combined desktop & field-based study, 85 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2019a. Upgrade of the N1 (Section 4) between Monument River (km 46.0) and Doornfontein (km 63.0), Laingsburg Local Municipality, Western Cape Province, 53 pp. Natura Viva cc for CTS Heritage, Cape Town.

ALMOND, J.E. 2019b. Proposed SANSA Space Operations on Portion 8 of Farm 148 near Matjiesfontein, Laingsburg Local Municipality, Western Cape Province. Palaeontological specialist study, 40 pp. Natura Viva cc for CTS Heritage, Cape Town.

ALMOND, J.E. 2020. Proposed Pienaarspoort 1 and Pienaarspoort 2 Wind Energy Facilities in the Ceres Karoo region (Boland District Municipality) near Touwsrivier, Western Cape. Palaeontological heritage: combined desktop & field-based assessment, 50 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. & PETHER, J. 2008. Palaeontological heritage of the Western Cape. Interim SAHRA technical report, 20 pp. Natura Viva cc., Cape Town.

ANDERSON, A.M. & McLACHLAN, I.R. 1976. The plant record in the Dwyka and Ecca Series (Permian) of the south-western half of the Great Karoo Basin, South Africa. Palaeontologia africana 19: 31-42.

ANDERSON, J.M. & ANDERSON, H.M. 1985. Palaeoflora of southern Africa. Prodromus of South African megafloras, Devonian to Lower Cretaceous, 423 pp. Botanical Research Institute, Pretoria & Balkema, Rotterdam.

BUTLER, E. 2018. Palaeontological impact assessment of the proposed construction of the 140MW Tooverberg Wind Energy Facility (WEF) and associated grid connection near Touws River in the Western Cape Province, 75 pp. Banzai Environmental (Pty) Ltd.

COLE, D.I. 2005. Prince Albert Formation. SA Committee for Stratigraphy, Catalogue of South African Lithostratigraphic Units 8: 33-36.

COLE, D.I. & BASSON, W.A. 1991. Whitehill Formation. Catalogue of South African Lithostratigraphic Units 3, 51-52. Council for Geoscience, Pretoria.

FOURIE, W., ALMOND, J. & ORTON, J. 2015. Heritage scoping assessment specialist report. Strategic environmental assessment for wind and solar photovoltaic energy in South Africa. Appendix 3, 79 pp. CSIR and Department of Environmental Affairs, RSA.

HERITAGE WESTERN CAPE 2016. Guide for minimum standards for archaeology and palaeontology reports submitted to Heritage Western Cape, 4 pp.

GRESSE, P.G. & THERON, J.N. 1992. The geology of the Worcester area. Explanation of geological Sheet 3319. 79 pp, tables. Council for Geoscience, Pretoria.

JOHNSON, M.R., VAN VUUREN, C.J., VISSER, J.N.J., COLE, D.I., WICKENS, H. DE V., CHRISTIE, A.D.M., ROBERTS, D.L. & BRANDL, G. 2006a. Sedimentary rocks of the Karoo Supergroup. In: Johnson. M.R., Anhaeusser, C.R. & Thomas, R.J. (eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Johannesburg & the Council for Geoscience, Pretoria.

KLEIN, R.G. 1984. The large mammals of southern Africa: Late Pliocene to Recent. In: Klein, R.G. (Ed.) Southern African prehistory and paleoenvironments, pp 107-146. Balkema, Rotterdam.

MACRAE, C. 1999. Life etched in stone. Fossils of South Africa, 305 pp. The Geological Society of South Africa, Johannesburg.

McCARTHY, T. & RUBIDGE, B. 2005. The story of Earth and life: a southern African perspective on a 4.6-billion-year journey. 334pp. Struik, Cape Town.

McLACHLAN, I.R. & ANDERSON, A. 1973. A review of the evidence for marine conditions in southern Africa during Dwyka times. Palaeontologia africana 15: 37-64.

OELOFSEN, B.W. 1987. The biostratigraphy and fossils of the Whitehill and Iratí Shale Formations of the Karoo and Paraná Basins. In: McKenzie, C.D. (Ed.) Gondwana Six: stratigraphy, sedimentology and paleontology. Geophysical Monograph, American Geophysical Union 41: 131-138.

PARTRIDGE, T.C., BOTHA, G.A. & HADDON, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.

SAHRA 2013. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.

SKEAD, C.J. 1980. Historical mammal incidence in the Cape Province. Volume 1: The Western and Northern Cape, 903pp. Department of Nature and Environmental Conservation, Cape Town.

THERON, J.N. 1983. Die geologie van die gebied Sutherland. Explanation of 1: 250 000 geological Sheet 3220, 29 pp. Council for Geoscience, Pretoria.

THERON, J.N., WICKENS, H. DE V. & GRESSE, P.G. 1991. Die geologie van de gebied Ladismith. Explanation of Sheet 3320. 99 pp. Geological Survey / Council for Geoscience, Pretoria.

VILJOEN, J.H.A. 1992. Lithostratigraphy of the Collingham Formation (Ecca Group), including the Zoute Kloof, Buffels River and Wilgehout River Members and the Matjiesfontein Chert Bed. South African Committee for Stratigraphy, Lithostratigraphic Series No. 22, 10 pp.

VILJOEN, J.H.A. 1994. Sedimentology of the Collingham Formation, Karoo Supergroup. South African Journal of Geology 97: 167-183.

VILJOEN, J.H.A. 2005. Tierberg Formation. SA Committee for Stratigraphy, Catalogue of South African Lithostratigraphic Units 8: 37-40.

VISSER, J.N.J. 1992. Deposition of the Early to Late Permian Whitehill Formation during a sea-level highstand in a juvenile foreland basin. South African Journal of Geology 95: 181-193.

VISSER, J.N.J. 1994. A Permian argillaceous syn- to post-glacial foreland sequence in the Karoo Basin, South Africa. In Deynoux, M., Miller, J.M.G., Domack, E.W., Eyles, N. & Young, G.M. (Eds.) Earth's Glacial Record. International Geological Correlation Project Volume 260, pp. 193-203. Cambridge University Press, Cambridge.

VISSER, J.N.J. 1997. Deglaciation sequences in the Permo-Carboniferous Karoo and Kalahari Basins of southern Africa: a tool in the analysis of cyclic glaciomarine basin fills. Sedimentology 44: 507-521.

VISSER, J.N.J. 2003. Lithostratigraphy of the Elandsvlei Formation (Dwyka Group). South African Committee for Stratigraphy, Lithostratigraphic Series No. 39, 11 pp.

VISSER, J.N.J., VON BRUNN, V. & JOHNSON, M.R. 1990. Dwyka Group. South African Committee for Stratigraphy Catalogue of South African Lithostratigraphic Units 2, 15-17. Council for Geoscience, Pretoria.

WICKENS, H. DE V. 1984. Die stratigraphie en sedimentologie van die Group Ecca wes van Sutherland. Unpublished MSc thesis, University of Port Elizabeth, viii + 86 pp.

WICKENS, H. DE V. 1994. Submarine fans of the Ecca Group. Unpublished PhD thesis, University of Port Elizabeth. 350 pp.

WICKENS, H. DE V. 1996. Die stratigraphie en sedimentologie van die Ecca Groep wes van Sutherland. Council for Geosciences, Pretoria Bulletin 107, 49pp.

11. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

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 in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. 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 palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest Province, Mupumalanga and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as a long-standing 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).

APPENDIX A: GPS FOSSIL LOCALITY DATA

All GPS readings were taken in the field using a hand-held Garmin GPSmap 64s instrument. The datum used is WGS 84. Please note that:

- The fossil sites recorded here represent only a small sample of potential sites present at or beneath the ground surface within the project area.
- This palaeontological site data is *not* for public release, due to conservation concerns.

LOC.	GPS DATA	COMMENTS
112	[redacted]	Karee Kolk 174. Partially *in situ*, sphaeroidal calcretised termitarium (fossil termite nest) embedded within weathered and calcrete-veined Tierberg Fm mudrocks exposed along steep pediment edge on N. banks of Grootrivier. Fragments downwasted further down slope. Proposed Field Rating IIIB Local Resource.
122		Hoek Doornen 172 (northern area). Locally common cylindrical to flattened horizontal, straight to gently-curved burrows (1-2 cm wide) with distinctive longitudinal surface ridges or wrinkles (*cf Palaeophycus*). Tierberg Formation exposures in bed of Klein-Droëlaagte. Proposed Field Rating IIIC Local Resource.
126		Hoek Doornen 172 (northern area). Oligomict coarse, silcrete-rich alluvial gravels along the bed of the Klein-Droëlaagte with sparse small blocks of silicified wood (probably reworked from the Tierberg Fm). Proposed Field Rating IIIC Local Resource.
127		Hoek Doornen 172 (northern area). Oligomict coarse, silcrete-rich alluvial gravels along the bed of the Klein-Droëlaagte with sparse small blocks of silicified wood (probably reworked from the Tierberg Fm). Proposed Field Rating IIIC Local Resource.
128		Hoek Doornen 172 (northern area). Sandy alluvium, possible heuweljie sands with sheetwash surface gravels on floodplain of Klein-Droëlaagte. Sparse scatter of small angular to slightly water-worn blocks of silicified wood. Proposed Field Rating IIIC Local Resource.
132		Witte Wall 171. Pediment surface gravels including abundant buff to yellowish-grey sandy to gritty silcrete, often flaked (ESA, MSA). Occasional small rolled clasts of petrified wood in same area. Possible trace of ancient coarse alluvial deposits. Proposed Field Rating IIIC Local Resource.
133		Witte Wall 171. Open patch with fine sheetwash gravels dominated by resistant cherty lithologies, occasional exotic Dwyka erratics, sparse small blocks of petrified wood. Proposed Field Rating IIIC Local Resource.
138		Witte Wall 171. Calcretised crest of upper pediment surface. Occasional small float blocks of petrified wood. Proposed Field Rating IIIC Local Resource.
141		Witte Wall 171. Detached angular blocks of large calcretised termitarium blocks reworked from calcretised crest of pediment surface nearby and extending downslope in float. Proposed Field Rating IIIC Local Resource.
142		Witte Wall 171. Fine surface gravels below elevation of upper pediment surface forming desert pavement (serir), with sparse small blocks of petrified wood. Proposed Field Rating IIIC Local Resource.
149		Witte Wall 171. Well-exposed Tierberg Formation siltstones with bedding plane assemblages of simple, sinuous, cross-cutting horizontal burrows with softer ferruginous mineral infill. Proposed Field Rating IIIC Local Resource.

LOC.	GPS DATA	COMMENTS
150	[redacted]	Hoek Doornen 172. Isolated small float block of petrified wood with well-developed seasonal growth lines. Mapped as Tierberg Fm but Collingham Fm outcrop with Matjiesfontein chert v. close by. Proposed Field Rating IIIC Local Resource.
156	[redacted]	Grootfontein 149. Sandy alluvial soils with fine surface gravels, including sparse small angular to subrounded blocks of petrified wood. Proposed Field Rating IIIC Local Resource.
158	[redacted]	Grootfontein 149. Calcretised soils near pediment escarpment edge. Largely embedded sphaeroidal calcretised termitarium with detached blocks extending downslope in float. Proposed Field Rating IIIC Local Resource.
161	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood and ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
163	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood and ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
165	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood and ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
166	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood and ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
169	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood, rare small petrified logs and ESA stone artefacts. Proposed Field Rating IIIB Local Resource.
172	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood, ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
JO1	[redacted]	Small block of petrified wood in surface gravels. Proposed Field Rating IIIC Local Resource.
JO2	[redacted]	Small block of petrified wood in surface gravels. Proposed Field Rating IIIC Local Resource.
JO3	[redacted]	Small block of petrified wood in surface gravels. Proposed Field Rating IIIC Local Resource.
JO4	[redacted]	Small block of petrified wood in surface gravels. Proposed Field Rating IIIC Local Resource.

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

Basic Assessments for the Proposed Development of two 175 MW Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure (i.e. Witte Wall 1 and Witte Wall 2), near Touws River, Western 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:	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)			
Professional affiliation/registration:	Palaeontolgical Society of Southern Africa, Association of Professional Heritage Practitioners (W Cape)			
Physical address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN			
Postal address:	PO Box 12410 Mill Street, Cape Town			
Postal code:	8010	Cell:	n/a	
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.

John E Almond

Signature of the Specialist

Natura Viva cc

Name of Company:

24th Oct 2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

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.

J.E. Almond

Signature of the Specialist

NATURA VIVA CC

Name of Company

24th October 2020

Date

Signature of the Commissioner of Oaths

2020-10-24

Date

SOUTH AFRICAN POLICE SERVICE
STATION COMMANDER
CAPE TOWN
2020 -10- 24
CAPE TOWN
STATION COMMANDER
SOUTH AFRICAN POLICE SERVICE

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

Basic Assessments for the Proposed Development of three 175 MW Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure (i.e. Grootfontein 1; Grootfontein 2; and Grootfontein 3), near Touws River, Western 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:	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)			
Professional affiliation/registration:	Palaeontolgical Society of Southern Africa, Association of Professional Heritage Practitioners (W Cape)			
Physical address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN			
Postal address:	PO Box 12410 Mill Street, Cape Town			
Postal code:	8010	Cell:	n/a	
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.

John E. Almond

Signature of the Specialist

Natura Viva cc

Name of Company:

29th October 2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

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

24th October 2020

Date

Signature of the Commissioner of Oaths

2020-10-24

Date

SOUTH AFRICAN POLICE SERVICE
STATION COMMANDER
CAPE TOWN
2020 -10- 24
CAPE TOWN
STATION COMMANDER
SOUTH AFRICAN POLICE SERVICE

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:	
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

Basic Assessments for the Proposed Development of four 175 MW Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure (i.e. Hoek Doornen 1; Hoek Doornen 2; Hoek Doornen 3; and Hoek Doornen 4), near Touws River, Western 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:	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)			
Professional affiliation/registration:	Palaeontolgical Society of Southern Africa, Association of Professional Heritage Practitioners (W Cape)			
Physical address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN			
Postal address:	PO Box 12410 Mill Street, Cape Town			
Postal code:	8010	Cell:	n/a	
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.

John E Almond

Signature of the Specialist

Natura Viva cc

Name of Company:

24th [illegible] 2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

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

24th October 2020

Date

Signature of the Commissioner of Oaths

2020-10-24

Date

SOUTH AFRICAN POLICE SERVICE
STATION COMMANDER
CAPE TOWN
2020 -10- 24
CAPE TOWN
STATION COMMANDER
SOUTH AFRICAN POLICE SERVICE

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

<table>
<tr><td colspan="3">APPENDIX C: CHANCE FOSSIL FINDS PROCEDURE: Proposed solar PV facilities and associated power lines to Kappa Substation, Ceres Karoo</td></tr>
<tr><td>Province & region:</td><td colspan="2">Western Cape: Cape Winelands District Municipality / Witzenberg Local Municipality</td></tr>
<tr><td>Responsible Heritage Resources Agency</td><td colspan="2">HERITAGE WESTERN CAPE (Contact details: Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 086-142 142. Fax: 021-483 9842. Email: hwc@pgwc.gov.za)</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Dwyka Group, Ecca Group (Prince Albert, Whitehill, Collingham & Tierberg Formations), Late Caenozoic colluvium and alluvium.</td></tr>
<tr><td>Potential fossils</td><td colspan="2">In bedrocks: fossil fish, mesosaurid reptiles, shelly invertebrates, vascular plants (incl. petrified wood), trace fossil assemblages. In colluvium and alluvium: teeth, bones and horn cores of mammals, non-marine molluscs, calcretised trace fossils (e.g. termitaria), reworked fossil wood.</td></tr>
<tr><td rowspan="5">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 D: SITE SENSITIVITY VERIFICATION

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 for the proposed solar PV facility and associated power line projects was undertaken in order to confirm the current palaeontological heritage sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool) (Figure D1).

The details of the site sensitivity verification are noted below:

Date of Site Visit	7-10 September 2020
Specialist Name	Dr John E. Almond
Professional Registration Number	Not registered
Specialist Affiliation / Company	*Natura Viva* cc

- **Information sources**

The palaeontological heritage site sensitivity verification is based on the following information sources:

1. Site paleosensitivity map produced by the DEFF screening tool (Figure D1);

2. A brief project outline, kmz files and maps provided by CSIR - Environmental Management Services;

3. A desktop review of (a) the relevant 1: 50 000 and 1: 250 000 scale topographic maps, (b) Google Earth© satellite imagery, (c) published geological and palaeontological literature, including 1: 250 000 geological maps and accompanying sheet explanations as well as (d) several previous and on-going fossil heritage assessments in the Ceres Karoo region by the author and colleagues;

4. The author’s field experience with the formations concerned and their palaeontological heritage;

5. A four-day field assessment of the study area, including all land parcels involved, by the author and an experienced field assistant.

- **Outcome of the site sensitivity verification**

On the basis of information sources listed previously the screening tool palaeosensitivity map in Figure D1 is disputed and *rejected* here as an accurate reflection of palaeosensitivity within the present study area. The main reasons for this are:

1. The inaccurate overlay of the project area on the palaeosensitivity map (which is based primarily on the relevant geological maps);

2. The Dwyka Group (indicated in red) is generally regarded as of LOW palaeosensitivity whereas the Tierberg Formation is of MEDIUM sensitivity, at most. Field data for the proposed project suggest a LOW palaeosensitivity for the Tierberg Formation outcrop area here due to weathering and extensive cover by low-sensitivity calcrete, gravels and soils.

3. Potentially-sensitive rock units such as the basal Prince Albert Formation and Whitehill Formation are not rated as high sensitivity on the map (Field data suggests these are generally of LOW palaeosensivity in this region, mainly due to weathering and cleavage development).

4. The map does not address the Late Caenozoic sediments that mantle the bedrocks in the project area, and in particular the pediment gravels (ancient alluvium) underlying almost the entire solar PV study areas as well as younger alluvium along the Grootrivier and its tributaries. Almost all the new fossil occurrences noted during the recent field survey were found in such settings. However, these fossils are of low conservation value and the palaeosensitivity of the Late Caenozoic sediments is according rated as LOW.

As motivated in the relevant palaeontological heritage Basic Assessment report, it is concluded that the entire combined project area for the proposed solar PV facilities and associated power line to Kappa Substation is in practice of LOW palaeosensivity. Potentially fossiliferous rock units underlying the project footprint such as the Prince Albert and Whitehill Formations are too weathered and tectonically deformed (cleaved) to contain scientifically valuable fossils in the project area. No significant, conservation-worthy fossil sites or palaeontological No-Go areas were recorded during the field survey.

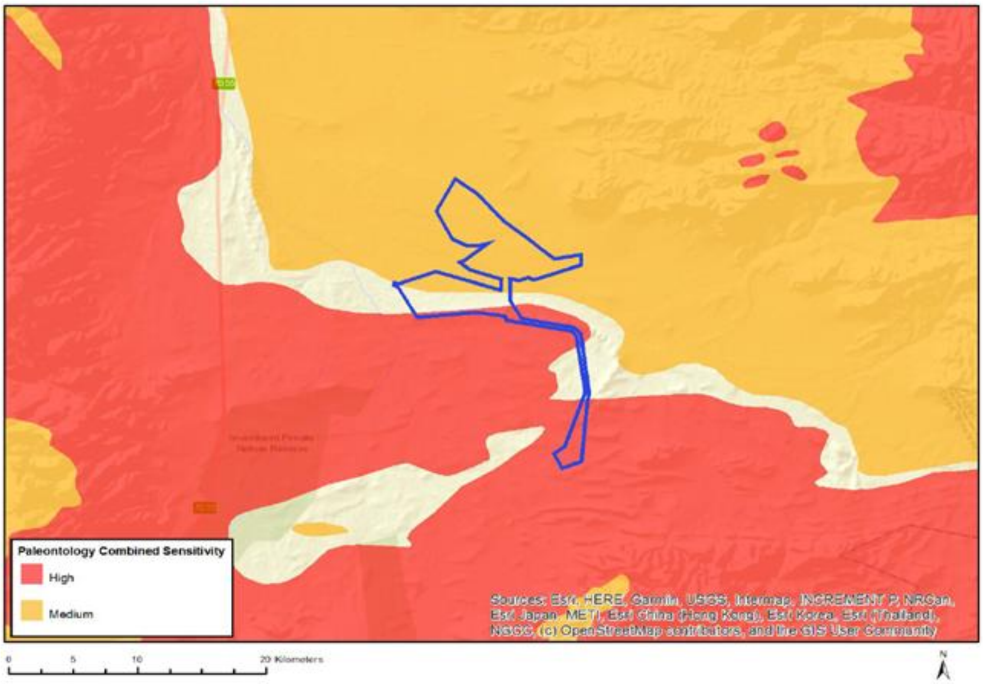


Figure D1: Palaeosensitivity map for the combined proposed solar PV facility and associated power line project area (blue polygon) produced from the DEFF screening tool. Data from several recent field surveys in the Ceres Karoo as well as desktop studies indicate that in practice the entire project area is of LOW palaeosensitivity.

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 11***
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 base data used for the specialist report;	***Section 2.1***
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	***Sections 4 to 6***
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	***Section 2.1***
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;	***Sections 4 & 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;	***Figs. 53 & 54***
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	***Section 2.2***
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	***Sections 4, 5 & 6***
k) any mitigation measures for inclusion in the EMPr;	***Sections 7 & 8***
l) any conditions for inclusion in the environmental authorisation;	***Section 8***
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	***Sections 7 & 8***
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***	***Section 8***

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***
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	***N/A (Refer to BA Report)***
q) any other information requested by the competent authority.	***N/A (Refer to BA 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.	***Part A of the Assessment Protocols published in GN 320 on 20 March 2020 are applicable (i.e. Site sensitivity verification requirements where a specialist assessment is required but no specific assessment protocol has been prescribed). See Appendix D***

APPENDIX 5 – Visual Impact Assessment

Refer to Appendix C.2 of the BA Report for the Visual Impact Assessment.

Basic Assessment for the Proposed Development of Electrical Grid Infrastructure to support the proposed nine 175 MW Solar Photovoltaic Facilities and associated Infrastructure (i.e. Witte Wall PV 1, Witte Wall PV 2, Grootfontein PV 1, Grootfontein PV 2, Grootfontein PV 3, Hoek Doornen PV 1, Hoek Doornen PV 2, Hoek Doornen PV 3, and Hoek Doornen PV 4), near Touws River, Western Cape

APPENDIX C.3.2

Heritage Impact Assessment (Archaeology, Cultural Landscape and Palaeontology) for Grootfontein

HERITAGE IMPACT ASSESSMENT:

Basic Assessment for the Proposed Development of three 175 MW Solar Photovoltaic (PV) Facilities (Grootfontein PV 1 - PV 3) and associated Electrical Grid Infrastructure, near Touws River, Western Cape

HWC Case No.: 20081908SB0821E

Required under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999).

Report for:

CSIR – Environmental Management Services
P.O. Box 320, Stellenbosch, 7599
Tel: 031 242 2318
Email: rabed@csir.co.za

On behalf of:

Veroniva (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: 10 October 2020
Draft for comment: 16 October 2020
Final report: 17 November 2020

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

Basic Assessments for the Proposed Development of three 175 MW Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure (i.e. Grootfontein 1; Grootfontein 2; and Grootfontein 3), near Touws River, Western 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:	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:

11-10-2020

Date

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

11-10-2020

Date

72347058
N BACA CST C

Signature of the Commissioner of Oaths

2020-10-11

Date

SOUTH AFRICAN POLICE SERVICE
KIRSTENHOF SAPS
2020 -10- 11
CSC
SUID AFRIKAANSE POLISIEDIENS

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

EXECUTIVE SUMMARY

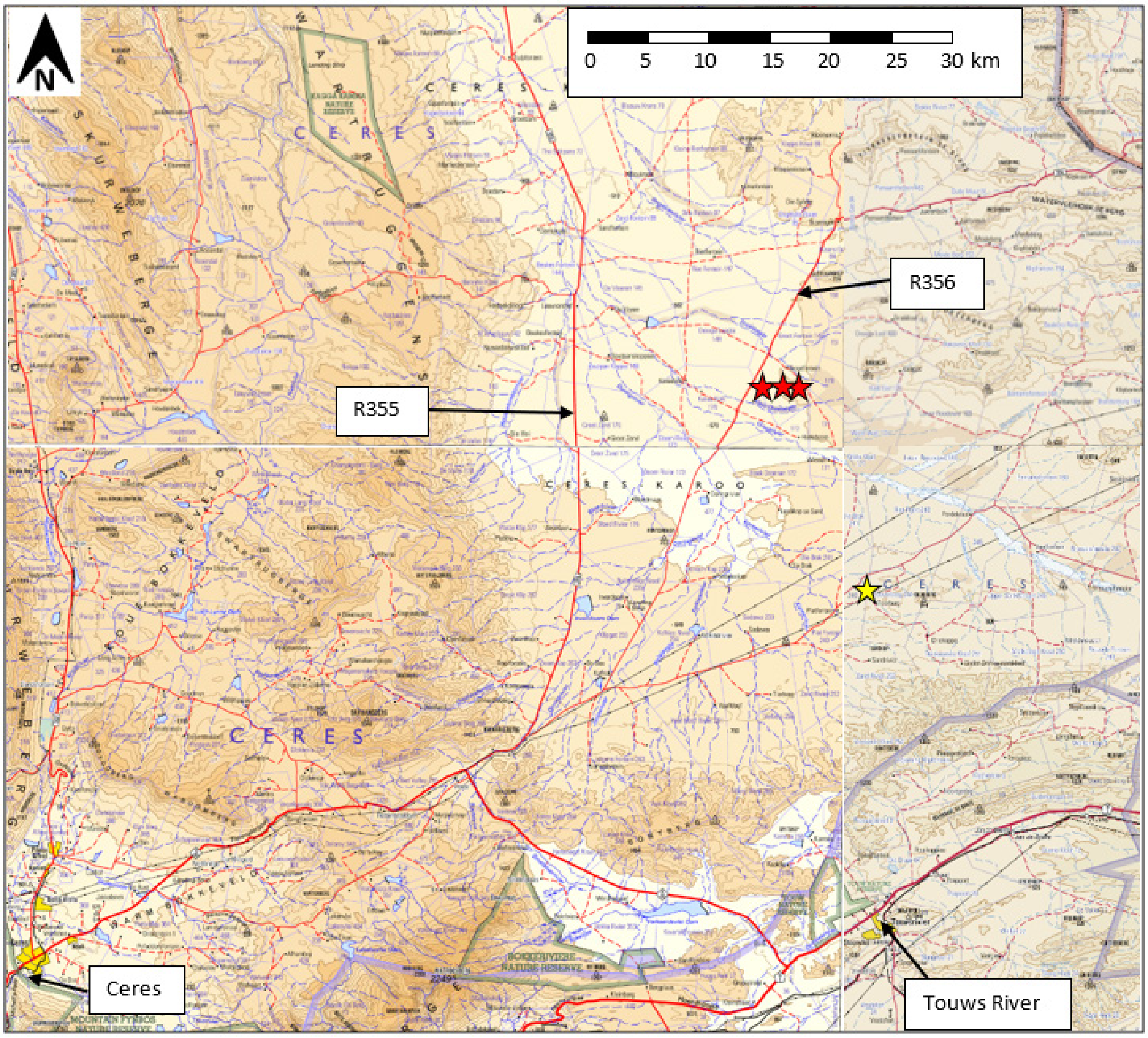
1. Site Name

Grootfontein

2. Location

Address: Off R356
Farms: Three photovoltaic (PV) facilities to be on Grootfontein 149/rem & 149/5 and three powerlines (within an assessed corridor) over farms Witte Wall 171, Die Brak 241 and Platfontein 240.
Centre of PV study area: S32° 57' 25" E19° 56' 30"
Southern end of powerline corridor: S33° 06' 36" E20° 00' 45"

3. Locality Plan



PV facilities at red stars, southern end of power line corridor at yellow star.

4. Description of Proposed Development

The proposed project includes three solar fields of 250 ha each and up to 10 m high, operation and maintenance buildings, three power lines and substations (i.e. electricity grid infrastructure (EGI)), access roads, battery energy storage systems (BESS), fencing, and other associated and supporting infrastructure.

5. Heritage Resources Identified

Palaeontological resources were found to be very sparsely distributed across the landscape and the impacts to fossils are considered to be of generally low significance. Archaeological resources were widespread but very strongly dominated by background scatter. Four Early Stone Age handaxes were seen amongst the background scatter. Dense areas of artefacts were rare and often associated with the river margins that are excluded from the development footprint area. Included here were two very large Later Stone Age sites, one of which also had colonial period glass and ceramic items on it. The other included possible graves. The cultural landscape (largely a natural landscape with aesthetic significance) was also identified as a heritage resource, but the location of the site within a Renewable Energy Development Zone (REDZ) was noted. The site abuts the R356 but this road is not frequently used and is not considered a scenic route.

6. Anticipated Impacts on Heritage Resources

Fossils are sparse and difficult to locate. Impacts cannot be readily predicted but the chance of impacting significant fossils is low. The layout has been designed to avoid sensitive archaeological sites. Nevertheless, large numbers of background scatter artefacts would likely be lost during development. Due to space constraints, the layout has not avoided the slope break between the terraces on site which will, in the present specialist's opinion, increase the visibility of the PV facilities. The Visual Impact Assessment (VIA), however, considers this impact to be of low significance. Given (1) the VIA findings, (2) the location of the facilities within a REDZ and (3) the existence of a wind energy facility, large substation and power lines nearby, significant new impacts to the landscape are not expected.

7. Recommendations

Grootfontein PV 1

It is recommended that the proposed Grootfontein PV 1 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- No activity is to happen north of the existing farm fence alongside waypoint 177; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

Grootfontein PV 2

It is recommended that the proposed Grootfontein PV 2 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- No activity is to happen north of the existing farm fence alongside waypoint 177; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

Grootfontein PV 3

It is recommended that the proposed Grootfontein PV 3 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- No activity is to happen north of the existing farm fence alongside waypoint 177; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

EGI

It is recommended that the proposed EGI development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) whether any areas of background scatter artefacts should be sampled;
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

8. Author/s and Date

Heritage Impact Assessment: Jayson Orton, ASHA Consulting (Pty) Ltd, 17 November 2020
Archaeological specialist study: Jayson Orton, ASHA Consulting (Pty) Ltd, 09 October 2020
Palaeontological specialist study: John Almond, Natura Viva cc, October 2020
Visual Impact Assessment: Quinton Lawson and Bernard Oberholzer, QARC and BOLA, 16 October 2020

Glossary

Background scatter: Artefacts whose spatial position is conditioned more by natural forces than by human agency

Brakdak: A roof building technique in which large beams are covered by smaller poles, bamboo or reeds and finally a layer of mud.

Early Stone Age: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.

Handaxe: A bifacially flaked, pointed stone tool type typical of the Early Stone Age.

Holocene: The geological period spanning the last approximately 10-12 000 years.

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.

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

DMR: Department of Mineral Resources

ECO: Environmental Control Officer

EGI: Electricity Grid Infrastructure

EIA: Environmental Impact Assessment

EMPR: Environmental Management Programme

ESA: Early Stone Age

GPS: Global Positioning System

GP: General Protection

HIA: Heritage Impact Assessment

HWC: Heritage Western Cape

LSA: Later Stone Age

MSA: Middle Stone Age

NCW: Not Conservation Worthy

NEMA: National Environmental Management Act (No. 107 of 1998)

NHRA: National Heritage Resources Act (No. 25) of 1999

NID: Notification of Intent to Develop

PHS: Provincial Heritage Site

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 3.1
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 7.4, 7.1.4, 7.5
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;	Section 1.1.3, Section 5, Appendix 3
g) an identification of any areas to be avoided, including buffers;	Section 13
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 13
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.5
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 10
l) any conditions for inclusion in the environmental authorisation;	Section 14
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;	Section 13.1
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 12
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 12
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.

Contents

1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by Veroniva (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed development of three 175 MW photovoltaic (PV) solar energy facilities on the farms Grootfontein 149/rem and 149/5 and three power lines (within an assessed corridor) stretching over farms Witte Wall 171, Die Brak 241 and Platfontein 240 to end at the existing Eskom Kappa Substation located on the latter farm. The centre of the PV study area is at S32° 57' 25" E19° 56' 30", while the Kappa Substation at the southern end of the powerline corridor is at S33° 06' 36" E20° 00' 45". The study area lies off the R356 in the Ceres Karoo with the proposed PV area being some 42 km north of Touws River and 35 km northeast of Karoo Poort (Figures 1 & 2).

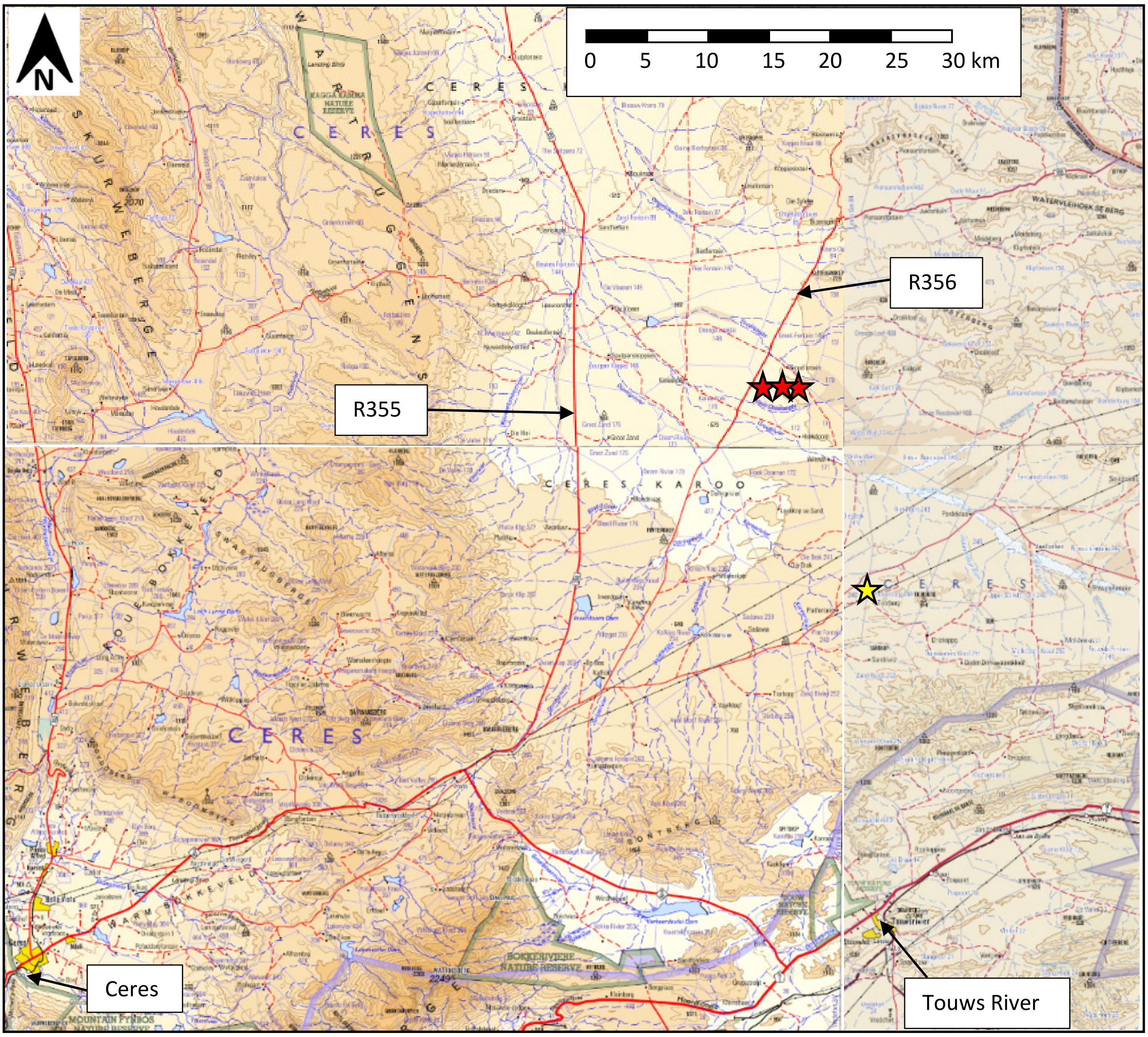


Figure 1: *Composite of the 3218, 3220, 3319, and 3320 1:250 000 topographic maps showing the approximate location of the PV sites (red stars) and the existing Eskom Kappa Substation (yellow star). Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.*

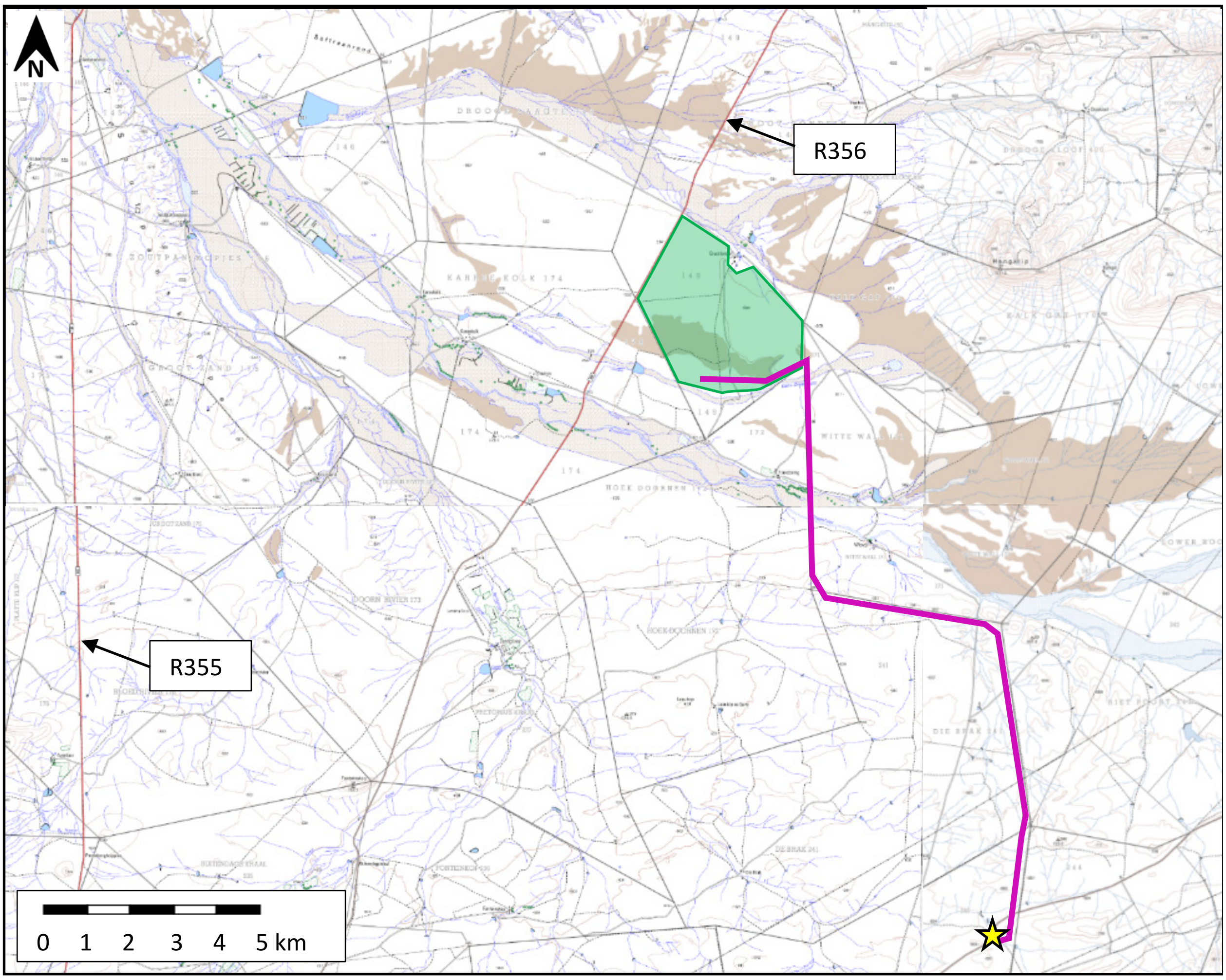


Figure 2: *Extract from 1:50 000 mapsheets 3219DD, 3319BB, 3220CC & 3220AA showing the approximate location of the PV study area (green shaded polygon), power line corridor (purple line) and Eskom Kappa Substation (yellow star).*

The Applicant is proposing to develop nine solar PV facilities and nine power lines and associated infrastructure to link the PV facilities to the Eskom Kappa Substation. Two PV facilities are being proposed on the farm Witte Wall 171; three PV Facilities are being proposed on the farm Grootfontein 149; and four PV Facilities will be constructed on the Farm Hoek Doornen 172. This Heritage Impact Assessment (HIA) deals with the Grootfontein projects to be known as Grootfontein PV 1, Grootfontein PV 2 and Grootfontein PV 3.

1.1. The proposed project

1.1.1. Project description

Each PV project would comprise of the following components (Figure 3 shows the PV layout area and powerline corridor):

- Solar Field, comprising Solar Arrays with a maximum height of 10 m and maximum footprint of 250 hectares per project, including the following:
    - PV Modules;

    - Single Axis Tracking structures (aligned north-south), Fixed Axis Tracking (aligned east-west), Dual Axis Tracking (aligned east-west and north-south), Fixed Tilt Mounting Structure or Bifacial Solar Modules;
    - Solar module mounting structures comprised of galvanised steel and aluminium; and
    - Foundations which will likely be drilled and concreted into the ground.
- Building Infrastructure
    - Offices (maximum height 7 m and footprint of 1000 m^2);
    - Operational and maintenance control centre (maximum height 7 m and footprint 500 m^2);
    - Warehouse/workshop (maximum height 7 m and footprint 500 m^2);
    - Ablution facilities (maximum height 7 m and footprint 50 m^2);
    - Converter/inverter stations (height from 2.5 m to 7 m (maximum) and footprint 2500 m^2);
    - On-site substation and/or a switching substation (footprint 20 000 m^2); and
    - Guard Houses (height 3 m, footprint 40 m^2).
- Associated Infrastructure
    - 132 kV overhead power line to connect to the existing Eskom Kappa Substation to be located within a corridor of approximately 300 m wide that has been assessed as part the Basic Assessment (BA) Process. The specific power line will have the following specifications:
        - Height = 22.5 m to 30 m.
        - The servitude for the 132 kV power line will be 33 m wide.
        - Length from the PV site to the Eskom Substation:
            - Grootfontein PV 1 Power Line: Approximately 22 km
            - Grootfontein PV 2 Power Line: Approximately 23 km
            - Grootfontein PV 3 Power Line: Approximately 23 km
    - Associated electrical infrastructure at the Eskom Kappa Substation (including but not limited to feeders, Busbars, new transformer bay (up to 500 MVA) and extension to the platform at the Eskom Kappa Substation);
    - On-site substation and/or a switching substation;
    - Internal 33 kV power lines/underground cables (either underground to maximum depth of 1.6 m or above ground with height of 9 m);
    - A Lithium Ion battery storage facility for each Solar PV project, which may cover an area of up to 8 hectares and a height of up to 5 – 10 m (to be constructed within the proposed laydown area);
    - Underground low voltage cables or cable trays (underground to maximum depth of 1.4 m);
    - Access roads:
        - Width ranging between 4 - 8 m.
        - Total Length: Approximately 2 km for the Grootfontein Project.
        - Internal gravel roads and service road below the power line (width of 4 m);

- Fencing (between 2 – 3 m high) around the PV Facilities - Access points will be managed and monitored by an appointed security service provider. The type of fencing will either be of palisade, mesh type or a fully electrified option;
- Fencing for the power corridors: game fences will be constructed along the power line route to fence off the servitudes across the farms Witte Wall and Die Brak. No fencing will be constructed along the power line where it traverses the Platfontein Farm;
- Panel maintenance and cleaning area;
- Stormwater channels;
- Construction work area (i.e. laydown area of maximum 13 ha);

It is proposed that panel cleaning will take place quarterly; however, this may be revised should the site conditions warrant more frequent cleaning. It is estimated that the panel washing process will require approximately 5 million to 8 million litres of water per year during operations; this is to be sourced from the Municipality. At this stage, no water is planned to be abstracted from or discharged to any surface water systems.

The construction phase for each proposed project is expected to extend 12 to 14 months.

The total maximum project footprint of each PV facility will be approximately 250 hectares including the PV facility and infrastructure such as internal roads for each PV facility. Some of the main access roads will fall outside of the 250 hectares. Therefore, overall the PV facility and associated infrastructure including access roads will cover an estimated area of 260 hectares.

1.1.2. Identification of alternatives

No site alternatives are being considered. However, the layout was designed after provision of sensitivity data by the specialists to ensure that it would have the least possible overall impact. One EGI corridor has been proposed but this is wide enough to allow some micrositing of the alignment to reduce impacts.

1.1.3. Aspects of the project 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.

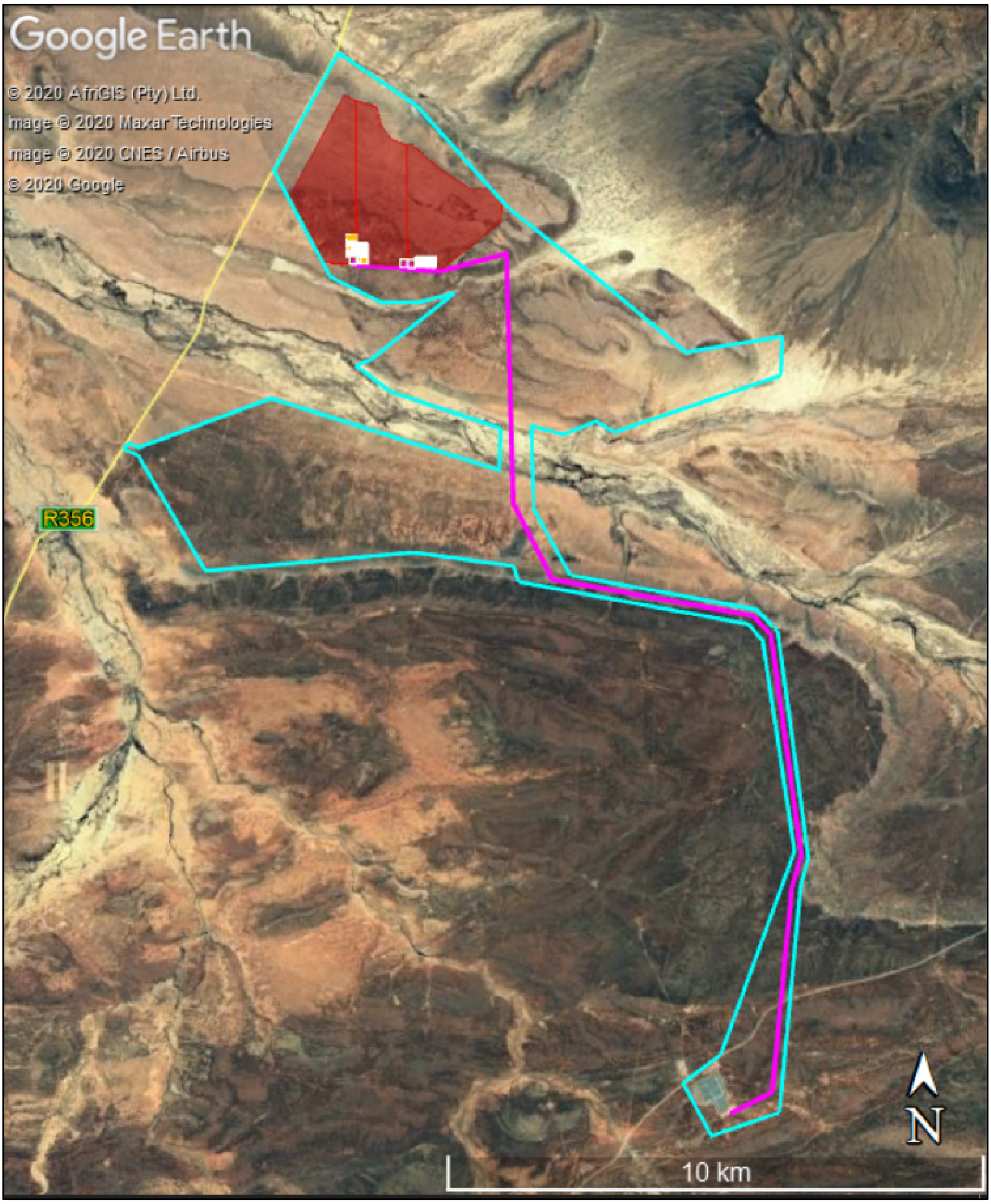


Figure 3: *Aerial view of the greater project area for all nine PV facilities and the associated Electricity Grid Infrastructure (EGI) corridor (turquoise) showing the location of the proposed Grootfontein PV 1, PV 2 & PV 3 facilities (red shading) and their associated powerlines (pink lines).*

1.2. Terms of reference

ASHA Consulting was asked to compile a Heritage Impact Assessment (HIA) that would meet the requirements of Heritage Western Cape (HWC) and that included assessments for each of the three proposed PV facilities, power lines and their associated infrastructure. The study also needed to include the following aspects:

- Comply with the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, Government Notice (GN) 320. This specifically includes Part A, which provides the Site Sensitivity Verification Requirements where a Specialist Assessment is required but no Specific Assessment Protocol has been prescribed.
- 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.
- Comply with Appendix 6 of the 2014 National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations (as amended), as well as any additional relevant legislation and guidelines that may be deemed necessary.
- The specialist must undertake a site visit in order to identify the level of sensitivity assigned to the project area on the National Web-Based Environmental Screening Tool (Screening Tool), and to verify and confirm this sensitivity and land-use.
- 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.
- Provide sensitivities in KMZ or similar GIS format.
- Provide review input on the preferred infrastructure layout following the sensitivity analysis and layout identification.
- Describe and map the heritage and features of the site and surrounding area based on desktop reviews, fieldwork, available databases, findings of the Renewable Energy Development Zones (REDZs) Phase 1 Strategic Environmental Assessment (SEA) (DEA 2015), and findings from other heritage studies in the area, where relevant. Include reference to the grade of heritage feature and any heritage status the feature may have been awarded. The assessment must also consider the maps generated by the Screening Tool.
- Map heritage sensitivity for the site. Clearly show any “no-go” areas in terms of heritage and provide recommended buffers or set-back distances. Indicate which very high sensitivity areas are regarded as complete no-go areas.
- Identify and assess the potential direct, indirect and cumulative impacts of the proposed development on the full scope of heritage features, including archaeology, palaeontology and the cultural-historical landscape, as required by heritage legislation. Impact significance must be rated both without and with mitigation, and must cover the construction, operational and decommissioning phases of the project.
- Liaise with the relevant authorities (i.e. HWC) in order to obtain a letter of approval, comments or a Permit in terms of National Heritage Resources Act, 1999 (Act No. 25 of 1999), including Regulations issued thereunder, as necessary. This also includes submitting a Notice of Intent to Develop to HWC and meeting the requirements of HWC.
- 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 Environmental Management Programme (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).
- Review the Generic EMPr for 1) Power Lines and 2) 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 are not included in the pre-approved generic EMPr (Part B – Section 1). If so, provide a list of these specific impact management outcomes and actions.

As part of the process a Notification of Intent to Develop (NID) form was submitted to HWC. They responded on 14th September 2020 with the following requirements for the HIA:

> Heritage Western Cape is in receipt of your application for the above matter received. This matter was discussed at the Heritage Officers meeting held on 7 September 2020.
>
> You are hereby notified that, since there is reason to believe that the proposed construction of three 115 MW Solar Photovoltaic (PV) power generation facilities on Ptn 149/rem, Grootfontein 149/5, Witte Wall 171, Farm Die Brak 241, Farm Platfontein 240, Grootfontein, Witte Wall, Die Brak,Witzenberg will impact on heritage resources, HWC requires that a Heritage Impact Assessment (HIA) that satisfies the provisions of section 38(3) of the NHRA be submitted. This HIA must have specific reference to the following:
>
> - A Visual Impact Assessment;
> - An Archaeological Impact Assessment; and
> - A Palaeontological Impact Assessment.
>
> The required HIA must have an integrated set of recommendations.
> Please note, should you require the HIA to be submitted as a Phased HIA, a written request must be submitted to HWC prior to submission. HWC reserves the right to determine whether a phased HIA is acceptable on a case by case Basis.
>
> The comments of relevant registered conservation bodies; all Interested and Affected parties; and the relevant Municipality must be requested and included in the HIA where provided. Proof of these requests must be supplied.

It should also be noted, however, that following S.38(3) of the National Heritage Resources Act (No. 25 of 1999), even though certain specialist studies may be specifically requested, all heritage resources should be identified and assessed.

1.3. Scope, purpose and objectives of the report

An HIA is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued by them for consideration by the Department of Environment, Forestry and Fisheries (DEFF) who will review the BA and grant or refuse authorisation. The HIA report outlines 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

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting HIAs and archaeological specialist studies in 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) Cultural Resources Management (CRM) section (Member #233) as follows:

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

2. HERITAGE LEGISLATION

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

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old 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.

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 NEMA (No. 107 of 1998), as amended, the project is subject to a BA. The present report provides the heritage component. HWC is required to provide comment on the proposed project in order to facilitate decision making by the DEFF.

3. APPROACH AND METHODOLOGY

3.1. Literature survey and information sources

Table 1 lists the sources of information used in this report.

Table 1: *Sources of information.*

Data / Information	Source	Date	Type	Description
1:50 000 map 3219DD	Chief Directorate: National Geo-Spatial Information	1960, 1987, 2003	Topographic maps	1:50 000 maps
1:50 000 map 3319BB	Chief Directorate: National Geo-Spatial Information	1969, 1987, 1997	Topographic maps	1:50 000 maps
3220CC	Chief Directorate: National Geo-Spatial Information	1968, 1986, 2005	Topographic maps	1:50 000 maps
3220AA	Chief Directorate: National Geo-Spatial Information	1967, 1986, 2005	Topographic maps	1:50 000 maps
1:250 000 map 3218	Chief Directorate: National Geo-Spatial Information	2003	Topographic map	1:250 000 maps
1:250 000 map 3220	Chief Directorate: National Geo-Spatial Information	2005	Topographic map	1:250 000 maps
1:250 000 map 3319	Chief Directorate: National Geo-Spatial Information	1997	Topographic map	1:250 000 maps
1:250 000 map 3320	Chief Directorate: National Geo-Spatial Information	2006	Topographic map	1:250 000 maps
Cadastral details	CapeFarmMapper	current	Cadastral map	Cadastral map
Descriptions of heritage resources	South African Heritage Resources Information System	Various	Unpublished reports	Commercial impact assessment reports listing heritage resources recorded during their compilation
Descriptions of heritage resources	Books	Various	Published books	Books on various aspects of local history

3.2. Field survey

The PV site was subjected to a foot survey on 10th and 11th September 2020. Sections of the EGI corridor in the north were surveyed on 8th and 9th September 2020, while other parts further to the south were also visited briefly on 28 January 2020 (Figure 4). These surveys were in spring and summer but, in this very dry area, the season makes no meaningful difference to vegetation covering and hence the ground visibility for the archaeological survey. Other heritage resources are not affected by seasonality. During the survey the positions of finds and survey tracks were recorded on a hand-held Global Positioning System (GPS) receiver set to the WGS84 datum. Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

It should be noted that amount of time between the dates of the field inspection and final report do not materially affect the outcome of the report.

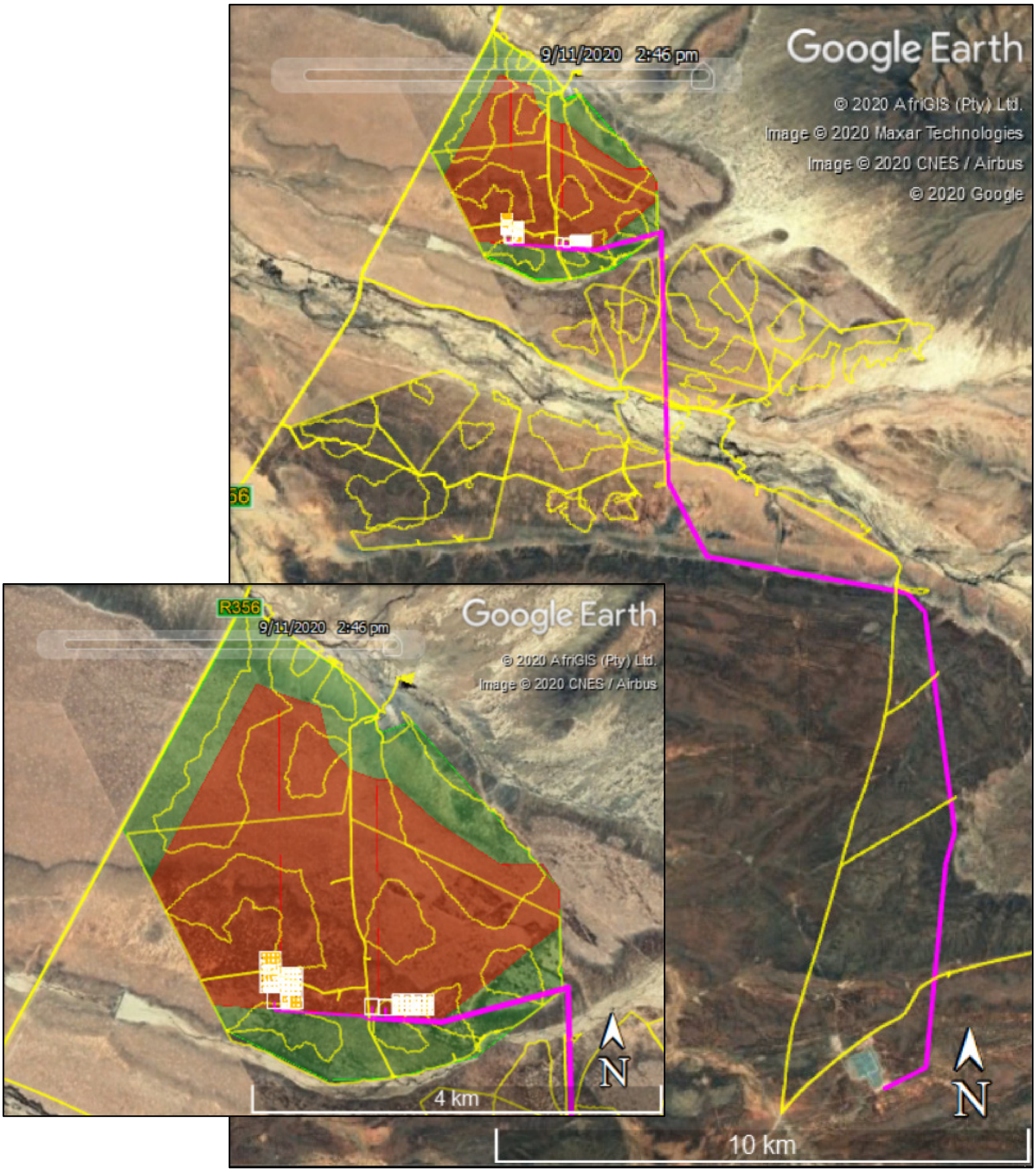


Figure 4: *Aerial view showing the survey tracks (yellow lines). The red shading shows the PV footprints and the green shading the broader study area considered for development. The approximate alignment of the power line is shown in purple.*

3.3. Impact assessment

For consistency among specialist studies, the impact assessment was conducted through application of a scale supplied by the CSIR. The methodology is presented in full in the BA report.

3.4. Grading

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

It is intended that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. Heritage Western Cape (2016), however, uses a system in which resources of local significance are divided into Grade 3A, 3B and 3C. These approximately equate to high, medium and low local significance respectively, while sites of very low or no significance (and generally not requiring mitigation or other interventions) are referred to as Not Conservation Worthy (NCW).

3.5. 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. Due to the size of the site it was not possible to examine every part of it in detail. The focus was on understanding the distribution and types of heritage resources present and it was assumed that this distribution would be broadly true throughout the study area.

Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 30 km radius. The existing and proposed developments that were taken into consideration for cumulative impacts are shown in Figure 5[1]. Note that the cumulative impact assessment also takes into consideration the proposed Ceres PV development, i.e. nine solar PV and nine power lines.

[1] Please note that the map shows affected farms Witte Wall and Karrekolk, however it must be noted that there are no approved Renewable Energy projects on these farm portions. An updated map will be included in the BA Report.

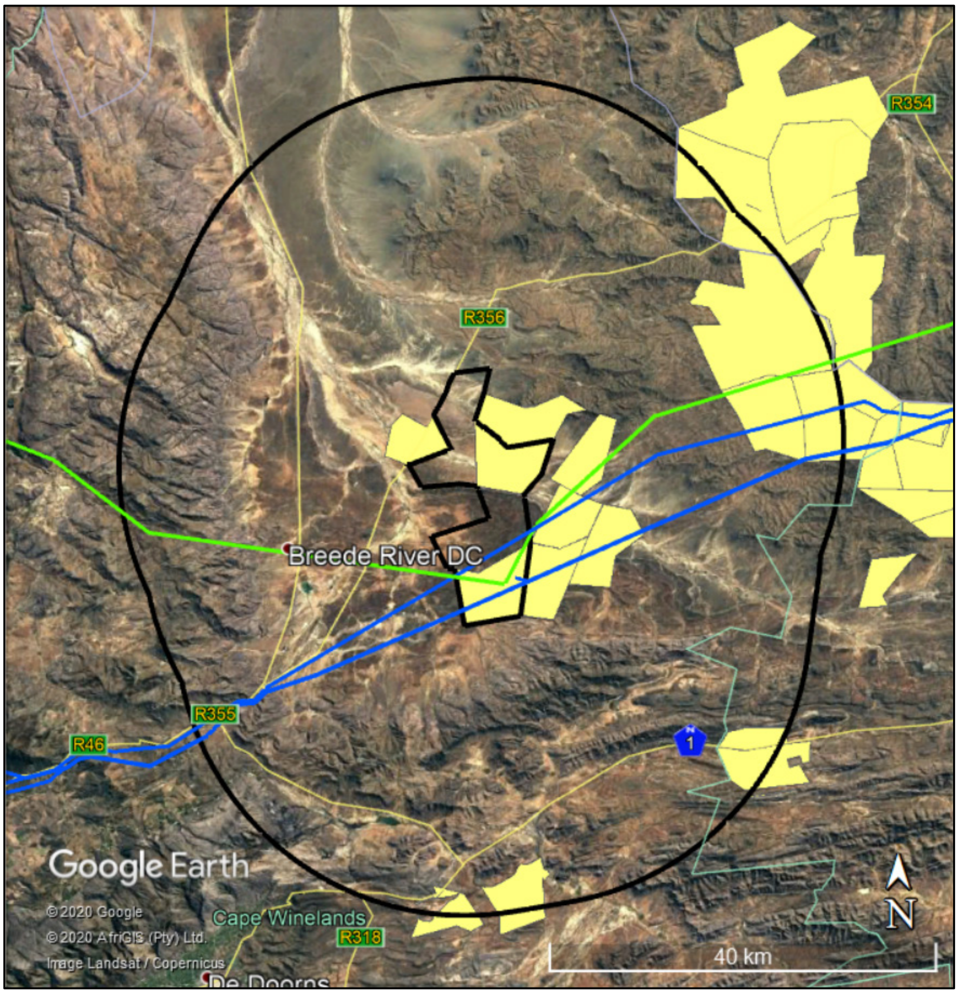


Figure 5: *Aerial view of the broader study area (black polygon) showing other existing and proposed renewable energy and electrical developments within a 30 km radius (black oval). Yellow shading denotes renewable energy facilities (but please see footnote 1), while the green and blue lines are large power lines (either existing or proposed).*

3.6. Consultation processes undertaken

The draft HIA was submitted to relevant interested and affected parties as required by HWC in their response to the NID application (Section 1.2). The report was also included in the main public participation process (PPP) required under NEMA as part of the EIA.

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The site is in a remote location in the Ceres Karoo. It lies off the R356 gravel road. Although the area is currently only used for the grazing of livestock and game, it does lie within the Komsberg REDZ and one wind energy facility has already been developed between 14 km and 20 km to the southeast. The large Eskom Kappa Substation and several power lines occur in the south. Other infrastructure, aside from farm buildings and wind pumps, is largely absent from the local landscape.

4.2. Site description

The broader study area is a wide, flat plain bisected by the Groot River and its tributaries, one of which passes the southern border of the Grootfontein site. The Grootfontein PV area is to the north of the Klein-Droëlaagte River on older river terraces. A slight slope break passes from west to east through the PV area. The ground is coated in sand and gravel with only very low vegetation (Figures 6 to 8), but denser low bushes do occur in places (Figures 9 & 10). The exception is close to the rivers where trees occur. Some naturally denuded areas afforded excellent ground visibility, especially close to the rivers (Figure 10).

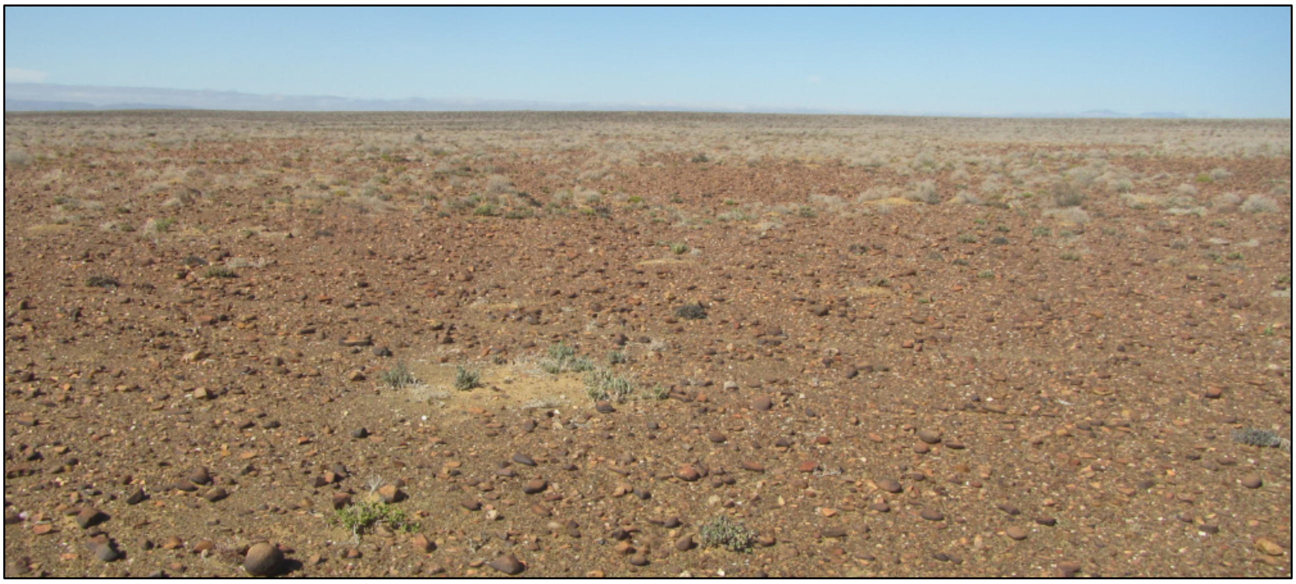


Figure 6: *View towards the southeast across the area to the north of the Grootfontein PV 1 site showing the gravel surface.*

Figure 7: *View towards the northwest within the Grootfontein PV 1 site and showing sparse vegetation.*

Figure 8: *View towards the north across the northern part of the Grootfontein PV 2 site.*

Figure 9: *View towards the south from the centre of the Grootfontein PV 1 site. The Klein-Droëlaagte River is just visible by some trees at the left (arrowed).*

Figure 10: *View towards the north from the Klein-Droëlaagte River across the Grootfontein PV 1 site. The road to the right parallels the river.*

The powerline corridor was mostly visited in the north where it passed through the various PV study areas. However, during an earlier survey, parts of the corridor were visited and can be briefly described. Figure 11 shows a view towards the west along the west-east section of the power line corridor. It shows the ridge containing the Matjiesfontein Chert band. And the plains to its south. Figure 12 shows an example of one of the patches of fractured chert debris that occur along the ridge in places. The southernmost part of the corridor is very flat and ends at the large Eskom Kappa Substation (Figure 13).

Figure 11: *View towards the west from the eastern end of the west-east section of the power line corridor. The dashed line shows the approximate centre of the corridor until it passes over the ridge in the distance. The yellow arrow marks the location of Figure 12. Photographed 28 January 2020.*

Figure 12: *View of the southern base of the Matjiesfontein Chert ridge showing the fractured debris that has accumulated from weathering of the ridge. Figure 11 was photographed from the skyline in mid-picture. Photographed 28 January 2020.*

Figure 13: *View towards the south of the Kappa Substation from within the southern end of the power line corridor. Photographed 28 January 2020.*

5. FINDINGS OF THE HERITAGE STUDY

This section describes the heritage resources recorded in the study area during the course of the project. Note that mapping has been included in Appendix 3.

5.1. Palaeontology

The South African Heritage Resources Information System (SAHRIS) Palaeosensitivity map shows the study area to be of medium to high sensitivity with a very narrow band of very high sensitivity along the west-east section of the power line corridor.

Almond (2020) notes that the project area is situated on a pediment surface of Neogene to Pleistocene age that has been planed off by river erosion. Beneath a thin capping of alluvial gravels, calcrete hardpans, sandy soils and downwasted surface gravels are Tierberg Formation (Ecca Group) sediments of Middle Permian age. They are weathered, folded and often tectonically-cleaved. Almond (2020:1) comments that "the only fossil remains recorded from such pediment settings in the Ceres Karoo comprise (1) sparse, generally small blocks of reworked silicified fossil wood within alluvial and surface gravels of uncertain provenance (probably Ecca Group) and (2) occasional calcretised fossil termite nests of probable Pleistocene age that are found embedded within calcretised superficial sediments as well as weathered, calcrete-veined bedrocks. … These fossils are of widespread occurrence within the Ceres Karoo region and are not of high scientific interest or conservation value." He notes that most fossil occurrences found in the field were outside of the PV footprint areas.

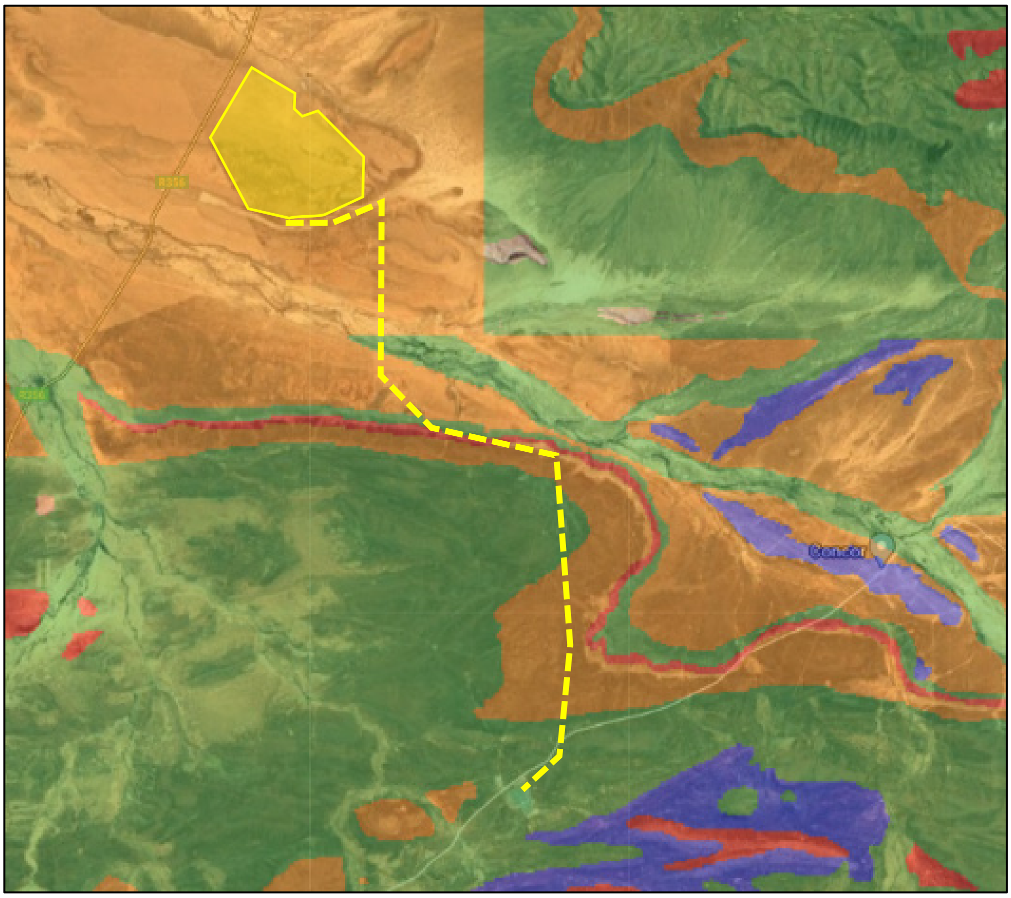


Figure 14: *Extract from the SAHRIS Palaeosensitivity map showing the study area to be of largely medium and high palaeontological sensitivity (green and orange shading respectively). A strip along the power line route is of very high sensitivity (red).*

The power line corridor overlies rocks of the Permo-Carboniferous, glacial-related Dwyka Group and the lower Ecca Group (Prince Albert, Whitehill and Collingham Formations). The potentially-fossiliferous Prince Albert, Whitehill and Collingham Formations were found to be highly weathered and cleaved in the study area and no sensitive fossil sites have been found along the corridor (Almond 2020).

The full palaeontological specialist study is included in Appendix 4.

5.2. Archaeology

5.2.1. Desktop study

Some other studies have been done in the area but few are available on SAHRIS. Halkett and Webley (2011) located many light scatters of artefacts in an area to the southeast of the present study area and focused along the margins of streams. The vast majority were considered to be Middle Stone Age (MSA) with far fewer relating to either the Early (ESA) or Late (LSA) Stone Ages. A few bifacial pieces seemed likely to be ESA handaxes though. Orton (2008) worked at the southern end of the present power line corridor and located a number of light scatters of artefacts. Most were MSA artefacts (e.g. Figure 15) but one small scatter was strongly dominated by LSA artefacts (Figure 16). A single willow pattern ceramic (plate) fragment was also found.

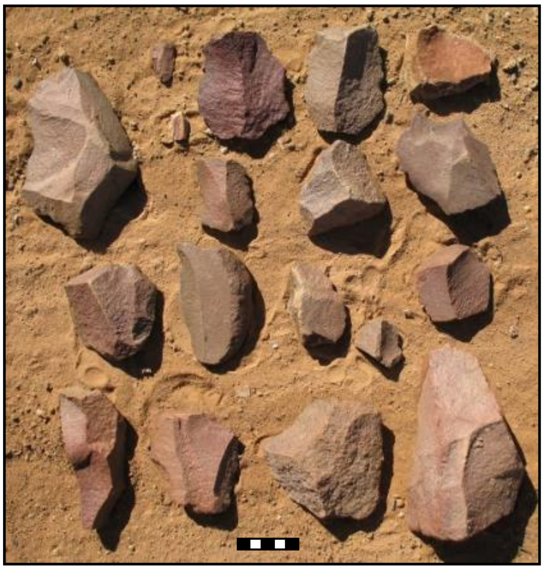


Figure 15: *Artefacts from PFN2008/007. Scale in cm. Source: Orton 2008: fig. 63.*

Figure 16: *A selection of artefacts from PFN2008/004. Note the inclusion of quartz and absence of quartzite. The dark rock is unweathered hornfels. Scale in cm. Source: Orton 2008: fig. 65.*

Towards the east and into the foothills of the escarpment, Smuts (2018) found stone artefacts to be far rarer than out on the plains but also noted that what was present was focused along rivers. Smuts (2018) also recorded a rock shelter with finger paintings and a single pot sherd. A subsequent visit to this site by the present author showed it to contain a good deposit with many stone artefacts, some grindstones, a grooved stone, many finger-painted images on the rear wall and a string of five *Nassarius kraussianus* shell beads. These are estuarine shells that had to have been brought to the site from the coast. Two other rock art sites – one a fine line painting and another a set of geometric paintings – have been seen by the present author some 14 km north of the PV study area.

5.2.2. Site visit

Table 1 provides a list and description of all heritage resources recorded during the ground survey. Not recorded are the very large number of isolated Stone Age artefacts seen throughout the study area (except for ESA bifaces and LSA lower grindstones which were recorded). These isolated artefacts are what are commonly referred to as background scatter, their distribution having been conditioned more by natural forces than anthropogenic ones (Orton 2016). They are dominated by MSA artefacts but ESA and LSA artefacts were also frequently seen. Figure 17 shows a selection of such isolated finds from the Grootfontein farm, while Figure 18 shows the four ESA bifacial artefacts (handaxes) seen. The palaeontologist reported finding ESA materials within the river gravels along the margins of the Klein-Droëlaagte River in and just beyond the south-eastern part of the study area (and outside the PV footprint area). Figure 19 shows artefacts from a slightly denser area of background scatter, while Figure 20 shows a very light scatter of chert artefacts of more recent origin but with background scatter also present. Figure 21 shows four large blades and a large flake all found at the same location; with no other artefacts present it seems they may have been left in that area but are too few in number to be a site. Background scatter artefacts were seen in all of the few locations visited along the power line corridor, while some denser scatters of artefacts were recorded by Orton (2008) in the very southern end of the corridor alongside the Kappa Substation. The artefacts along the power line corridor seem to be largely

MSA, as occurs elsewhere, but a number of ESA items have been seen by both the archaeologist and palaeontologist in close proximity to the Matjiesfontein Chert ridge.

Table 1: *List of heritage resources recorded during the survey.*

Waypoint	Location	Description	Significance	Grade
173	S32 56.483 E19 56.488	An ephemeral scatter of chert artefacts on the edge of the raised terrace overlooking a river floodplain.	Very low	NCW
174	S32 56.590 E19 56.730	A patch of elevated density background scatter on the edge of the raised river terrace.	Very low	NCW
175	S32 56.285 E19 56.639	An enormous LSA scatter on the river floodplain that has artefacts of cherts, hornfels, crypoto-crustalline silica (CCS)and quartz. There are a number of bladelets present and at least one hammerstone and one lower grindstone. There are also plenty of ostrich eggshell, one fragment of which was seemingly engraved. It and several others were lightly burnt. One fragment of pottery with quite a thick wall (c. 8 mm). There are also several fragments of coarse porcelain and willow pattern refined white earthenware. Occasional hand-painted and sponge-printed wares also noted, along with some bottle glass. The scatter is about 100 m by 40 m.	High	IIIA
176	S32 56.270 E19 56.621			
177	S32 56.276 E19 56.610			
178	S32 56.284 E19 56.615			
179	S32 56.287 E19 56.626			
180	S32 56.264 E19 56.614			
181	S32 56.259 E19 56.598			
182	S32 56.261 E19 56.587			
183	S32 56.272 E19 56.588			
184	S32 56.274 E19 56.599			
185	S32 56.283 E19 56.609			
186	S32 56.364 E19 57.089	An enormous LSA scatter on the river floodplain that has artefacts of cherts, hornfels, CCS and quartz. Also a fragment of river mussel (*Unio caffer*). There is a vast quantity of ostrich eggshell fragments across the site with several extremely dense clusters that must represent shells that broke in those locations. No flask mouth fragments were seen though. There is a very large stone mound/cluster at waypoint 193 that includes a lower grindstone – this might be a grave. There is also a smaller stone cluster nearby that also could represent a grave. The whole site is about 120 m by 40 m but might have extended further towards the east where it was interrupted by the construction of a dam.	High	IIIA
187	S32 56.368 E19 57.072			
188	S32 56.357 E19 57.080			
189	S32 56.355 E19 57.091			
190	S32 56.351 E19 57.100			
191	S32 56.348 E19 57.110			
192	S32 56.356 E19 57.109			
193	S32 56.367 E19 57.108			
194	S32 56.364 E19 57.097			
195	S32 56.371 E19 57.064			
196	S32 56.355 E19 57.062			
197	S32 56.362 E19 57.053			

Waypoint	Location	Description	Significance	Grade
198	S32 56.358 E19 57.045			
199	S32 56.365 E19 57.039			
200	S32 56.376 E19 57.051			
201	S32 56.572 E19 56.884	Grootfontein Farm complex. The main house is a modern house probably dating to the 1950s but has an attractive 1930s/1940s window incorporated into its north-facing façade. The other windows are steel framed. An older structure lies to the south but has been altered and added to. It appears that new outer skins have been built to support the older walls and modern cement has been sprayed onto the old sun-dried brick walls to prevent their erosion. There is a toilet room outside which looks far newer but has been built using traditional materials and methods.	Low	IIIC
202	S32 56.606 E19 56.813	A small one-roomed structure of mixed materials. Includes sun-dried bricks, modern bricks and cement blocks on a stone plinth. There is an internal hearth in one corner. There are corrugated iron additions on two sides.	Very low	NCW
203	S32 56.552 E19 57.048	A cottage of mixed materials but built in traditional style with sun-dried bricks, modern bricks and corrugated iron on a stone plinth. The exterior walls show evidence of having been sprayed with modern cement but this has almost all fallen off. There is an internal corner hearth that has a metal pipe as its lintel. One end wall is of corrugated iron.	Very low	NCW
204	S32 56.596 E19 57.102	An area of elevated density background scatter.	Very low	NCW
205	S32 56.951 E19 57.390	A handaxe of 120 x 71 x 38 mm.	Very low	NCW
206	S32 57.055 E19 57.615	A 1 m diameter circle of small stones with quartz fragments in the middle and a cleared ‘pathway’ through the gravel. Undoubtedly relatively recent.	---	---
207	S32 57.095 E19 57.664	A handaxe of 148 x 84 x 38 mm.	Very low	NCW
208	S32 57.345 E19 57.201	A handaxe of 146 x 95 x 40 mm. Made on a silcrete flake.	Very low	NCW
209	S32 58.217 E19 57.646	An area of high density background scatter with artefacts of hornfels, CCS and chert on the river floodplain. Seems to be a mixture of LSA and MSA artefacts. Potential sample location.	Very low	IIIC
210	S32 58.252 E19 57.547	As for waypoint 209, but slightly less dense. Potential sample location.	Very low	IIIC
211	S32 58.270 E19 57.534	As for waypoint 209, but slightly less dense. Potential sample location.	Very low	IIIC
212	S32 58.043 E19 57.397	There is widespread background scatter that has a high proportion of grey silcrete in it over a wide area on this farm.	Very low	NCW
213	S32 58.144 E19 57.207	An area of high density background scatter. Potential sample location.	Very low	NCW
214	S32 58.463 E19 56.987	A stone foundation/feature of unknown function. A few glass and bone fragments occur around the feature and some olive green bottle glass occurs	Very low	NCW

Waypoint	Location	Description	Significance	Grade
		about 20 m to the north.		
215	S32 58.457 E19 57.010	A stone feature/pile of unknown function.	Very low	NCW
216	S32 57.840 E19 56.844	Two north-south oriented stone features of unknown function about 6 m and 10 m long and about 25 m apart.	Very low	NCW
217	S32 57.782 E19 57.197	A silcrete handaxe of 154 x 97 x 54 mm.	Very low	NCW
218	S32 57.490 E19 56.450	A scatter of chert artefacts with red cobble cortex. Also other background scatter artefacts in the area.	Very low	NCW
219	S32 57.670 E19 55.819	An isolated lower grindstone found face up.	Very low	NCW
220	S32 56.805 E19 56.625	An area of background scatter with four large blades within a few meters of one another.	Very low	NCW
670	S33 05.494 E20 01.541	Low density background scatter on Dwyka Tillite gravel.	Very low	NCW
671	S33 02.423 E20 01.424	Low density background scatter on Dwyka Tillite gravel.	Very low	NCW
672	S33 01.542 E20 00.936	Background scatter along the edge of the Collingwood Formation which has several chert bands, including the well-known Matjiesfontein Chert. The scatter was low density but it was interesting to note the variety of items present. These includes material likely to be of all three Stone Ages. Notably, many artefacts were simply natural pieces of stone, often diamond-shaped in cross-section), that had been modified slightly for further use. This included many small slabs of rock with abundant edge-damage as well as well-weathered handaxes that were made with around 3 to 5 removals. Although outside the powerline route, it likely serves as a representative sample of what would be present in those places where the route crosses this geology elsewhere.	Low	IIIC
003	33° 06 41.9 S 20° 00 59.6 E	Deflated area with LSA and MSA artefacts on hornfels and quartzite. Recorded by Orton (2008).	Very low	NCW
004	33° 06 43.4 S 20° 00 50.7 E	Good scatter of LSA artefacts over an area about 5 m across, no evidence of organics, just two MSA. Recorded by Orton (2008).	Low	IIIC **Sample**
005	33° 06 37.4 S 20° 00 59.0 E	MSA background scatter artefacts in quartzite and hornfels. Recorded by Orton (2008).	Very low	NCW
006	33° 06 38.2 S 20° 01 03.1 E	MSA background scatter artefacts in quartzite and hornfels. Recorded by Orton (2008).	Very low	NCW
007	33° 06 35.6 S 20° 00 53.8 E	Widespread MSA background scatter artefacts in quartzite and hornfels. One LSA artefact. Recorded by Orton (2008).	Very low	NCW
kraal 1	33° 06 51.5 S 20° 01 27.6 E	Historical stone-built kraal built on a north-facing hill slope. Also many LSA stone artefacts noted in the vicinity. Recorded by Orton (2008).	Medium	IIIB
kraal 2	33° 06 54.0 S 20° 01 31.0 E	Historical stone-built kraal built on a south-facing hill slope (same hill as kraal 1). Visible on aerial photography.	Medium	IIIB

Two very impressive LSA sites were found on Grootfontein, both of them along the Droëlaagte River in the north. One of them (represented by waypoint 177) was right outside the edge of the initial study area alongside the access road, while the second (represented by waypoint 187) was across the river to the north and hence a short distance away from the study area. Both sites had large numbers of stone artefacts in various materials and plenty of ostrich eggshell. The southern site included one fragment of engraved ostrich eggshell and one piece of precolonial pottery. Also present here were a number of sherds of historical ceramics including coarse porcelain and willow pattern refined white earthenware. Figures 21 to 27 show the site and various artefacts from it. The northern site lacked historical materials but had many stone artefacts and vast quantities of ostrich eggshell. Figures 28 to 30 show views of the site and its content, while Figures 31 and 32 show two clusters of rocks that may represent graves. The one is especially large and included a lower grindstone.

Figure 17: *Selection of background scatter artefacts from the Grootontein farm. They include mostly ESA and MSA artefacts with only rare LSA materials.*

Figure 18: *ESA bifaces (handaxes) from Grootfontein. From top to bottom they are from waypoints 217, 208, 207, 205.*

Figure 19: *Background scatter artefacts from waypoint 204.*

Figure 20: *Background scatter artefacts from waypoint 218.*

Figure 21: *Four large blades and a flake from waypoint 220.*

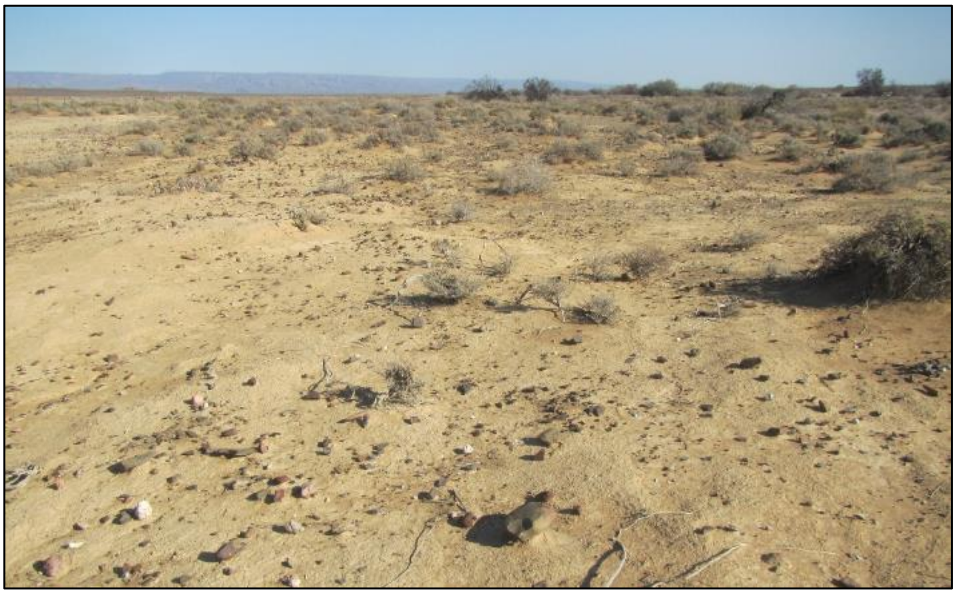


Figure 21: *The context of the LSA site at waypoint 177. The Droëlaagte River lies in the distance to the right among the larger bushes.*

Figure 22: *An example of the surface artefact scatter at waypoint 177. A lower grindstone is visible at the bottom of the picture. There are many non-artefactual stones also present amongst the artefacts.*

Figure 23: *Potsherd, engraved ostrich eggshell fragment and silcrete blade at waypoint 177.*

Figure 24: *Fragment of the base of a wine bottle at waypoint 177.*

Figure 25: *Hand-painted (red) and transfer-printed (blue) white refined earthenwares. The lower three sherds are willow pattern.*

Figure 26: *Chert artefacts, ostrich eggshell fragments and oriental coarse porcelain at waypoint 177.*

Figure 27: *Transfer- and sponge-printed wares, a glass fragment and chert artefacts at waypoint 177.*

Figure 28: *View across the site at waypoint 187.*

Figure 29: *Artefacts on the surface at waypoint 187.*

Figure 30: *A stone cluster with many ostrich eggshell fragments. The tape is extended 54 cm.*

Figure 31: *A cluster of rocks at waypoint 187. It may represent a grave.*

Figure 32: *A large cluster of rocks at waypoint 187. It may represent a grave. The dam wall that truncates the site is visible in the background.*

Historical archaeological materials were found in one place in the far southern edge of the broader study area and very close to the river. A pair of stone walls or plinths lay immediately alongside a farm track (Figure 33) and a few glass and ceramic items lay nearby (Figure 34). A short distance away was a loose cluster of rocks of unknown function (Figure 35).

Figure 33: *Stone walls or plinths at waypoint 214.*

Figure 34: *Ceramic and glass artefacts at waypoint 214.*

Figure 35: *Stone mound at waypoint 215.*

5.3. Graves

Aside from the possible graves seen at the northern LSA site (waypoint 187) and described above, no other graves were seen in the Grootfontein study area.

5.4. Historical aspects and the Built environment

5.4.1. Desktop study

In addition to standing structures, Halkett and Webley (2011) found many small stone ruins. They were from a variety of features including houses, kraals, ovens, a possible threshing floor and a well. Smuts (2018) also noted many stone structures and ruins. To the south of the Kappa Substation and some 450 m outside the proposed power line corridor, a large stone-built kraal was recorded on a north-facing slope by Orton (2008; Figures 36 & 37). A second one lies over the hill about 100 m further to the southeast.

Figure 36: *View across the Platfontein site towards the kraal. The study area extends approximately as far as the power lines visible in the photograph and the kraal is some 350 m beyond its edge. Source: Orton (2008: fig. 66).*

Figure 37: *Close up view of the kraal looking southwards. Source: Orton (2008: fig. 67).*

Karoo Poort is an important historical passage that hosts a Provincial Heritage Site (PHS), the Karoopoort Outspan. The poort is located some 35 km southwest of the PV study area. The PHS buildings and grounds are sadly run down and the "mile-long row of ancient fig trees" mentioned by Mossop (1927:182) is now largely dead. The old road, or 'Forgotten Highway', to the diamond fields used to pass through Karoo Poort (also once known as Bokkeveld's Poort) on its way to Sutherland. Figure 38 shows Mossop's (1927: facing page 168) map of the area. The historical road approximately equates to the R356 of today with the latter simply being a straightened and modernised version. After passing the study area, the road makes its way below a prominent landmark hill known as Hanglip, for the slightly overhanging cliff visible in profile from the southwest and northeast. The original road lay closer to the foot of Hanglip (as shown by a photograph in Mossop (1927)). There was also an outspan at the foot of the hill.

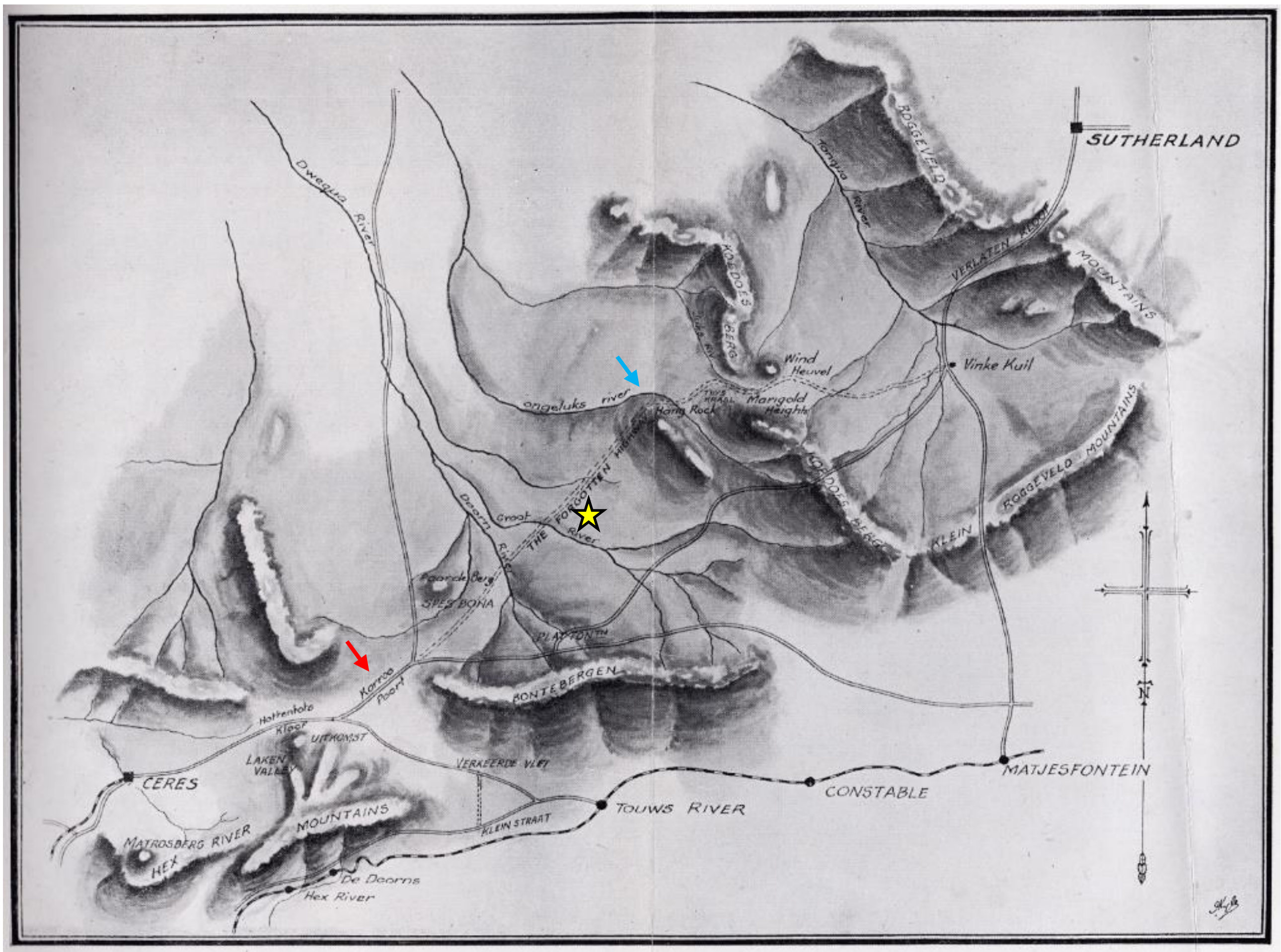


Figure 38: *Map of the Ceres Karoo showing the 'Forgotten Highway' leading past the study area (yellow star). The important landmarks of Karoo Poort (red arrow) and Hanglip (blue arrow) are indicated.*

5.4.2. Site visit

The Grootfontein farmhouse is a mid-20th century structure with no heritage value (Figure 39). A few outbuildings occur and are of mixed old and new materials. An outdoor toilet appears to be relatively new but built in traditional fashion with stone and mud mortar (Figure 40). A shed has some sun-dried mud brick walls but has had newer materials added including a garage door, a new roof with new bricks to raise the level and cement sprayed on the walls in an attempt to stabilise the eroding mud bricks (Figure 41). A nearby labourer's cottage and another outbuilding located further away also show a mix of old and new materials (Figures 42 to 46). It is difficult to date the oldest components of these structures on Grootfonein.

***Figure 39:** The Grootfontein farmhouse at waypoint 201.*

***Figure 40:** View of the outside toilet at waypoint 201.*

***Figure 41:** Outbuilding at waypoint 201 showing a combination of traditional and modern materials.*

***Figure 42:** A small labourer's cottage at waypoint 202 with combined traditional and modern materials.*

***Figure 43:** Interior of the labourer's cottage at waypoint 202 showing construction materials.*

***Figure 44:** Cottage at waypoint 203 showing a combination of traditional and modern materials.*

Figure 45: *Detail of door frame and metal pipes supporting the internal hearth inside the cottage at waypoint 203.*

Figure 46: *Wall detail showing weathered sun-dried bricks with the window frame having fallen out at waypoint 203.*

5.5. Cultural landscapes and scenic routes

The landscape is very strongly a natural one which has a distinctive aesthetic appeal to lovers of South Africa's dry landscapes. Figures 6 to 12 provide an impression of the landscape, showing its expansiveness and, within the Ceres Karoo basin, lack of steep topography. The triangular basin is ringed by mountains: the Swatruggens lie in the west, the Bontberg and other small unnamed mountains form the southern edge, and the Roggeveld Mountains lead up to the escarpment in the northeast. Although the area is very remote and has no paved roads, it has been included in the Komsberg REDZ which means that wind and solar farms can be expected to be developed in the area (Figure 47). The REDZ already hosts several wind farms, including one located to the southeast of the present study area. The Kappa Substation occurs at the southern end of the proposed power line corridor and several large power lines already traverse the Ceres Karoo going in and out of the substation (Figures 5 & 13).

Although Winter and Oberholzer (2013) list Karoo Poort as a Grade II scenic resource for its historical and architectural value and the uplands (Koedoesberge) to the north of the project area as a Grade III scenic resource rising from the flat plain, they ascribe no scenic value to the plain itself and the R356 that traverses it. The road is nevertheless considered by the present specialist to have at least some value as a local scenic route, especially given its historical role.

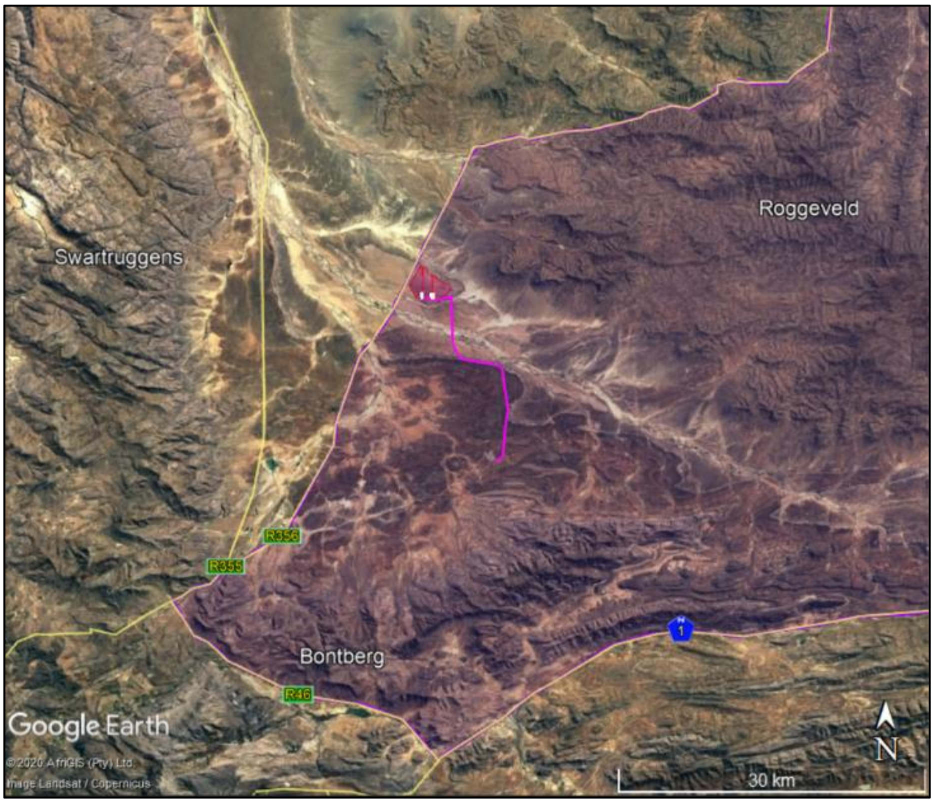


Figure 47: *Aerial view of the Ceres Karoo showing project site (PV Areas for Grootfontein PV 1 to PV 3 and power lines to the Eskom Kappa Substation) relative to the western part of the Komsberg REDZ (purple shading) and surrounding mountains (labelled).*

As already noted in Section 5.4.1, the Ceres Karoo hosted an important historical travel route. The small mountain known as Hanglip was a crucial landmark in the landscape as it signalled the end of the Ceres Karoo crossing and also arrival at an outspan. Hanglip is very prominent and forms a key component of the cultural landscape (Figure 48). For the rest, the natural landscape is marked only by rare houses, often accompanied by gum or other trees, farm fences and tracks and water infrastructure (earthen dams, round cement reservoirs and wind pumps). The anthropogenic imprint on the landscape is thus very light. Karoo Poort is also an important component of the wider cultural landscape but, owing to its distance from the project area, is not of concern here.

Figure 48: *View along the R356 northwards towards Hanglip, the small peak at the left end of the middle ground mountain.*

5.6. Visual impact assessment

A specialist visual assessment has been carried out by Oberholzer and Lawson (2020; see Appendix 5). They note that the viewshed extends up to 5 km but that the visual exposure is medium because some areas fall within a view shadow. They note that scenic resources are absent from the immediate area with only farmsteads serving as visual receptors. The landscape integrity is considered to be low with powerlines and the Perdekraal wind energy facility having disturbed the landscape. Figure 49 shows that the R356 could be significantly affected by the PV projects, while Figure 50 shows that the EGI would not visually impact this road. Figure 51 shows that, despite a 500 m buffer, the PV panels would be highly visible from the R356 alongside the site. The power lines would be visible from the road passing the Kappa Substation but much other electrical infrastructure already occurs in that area.

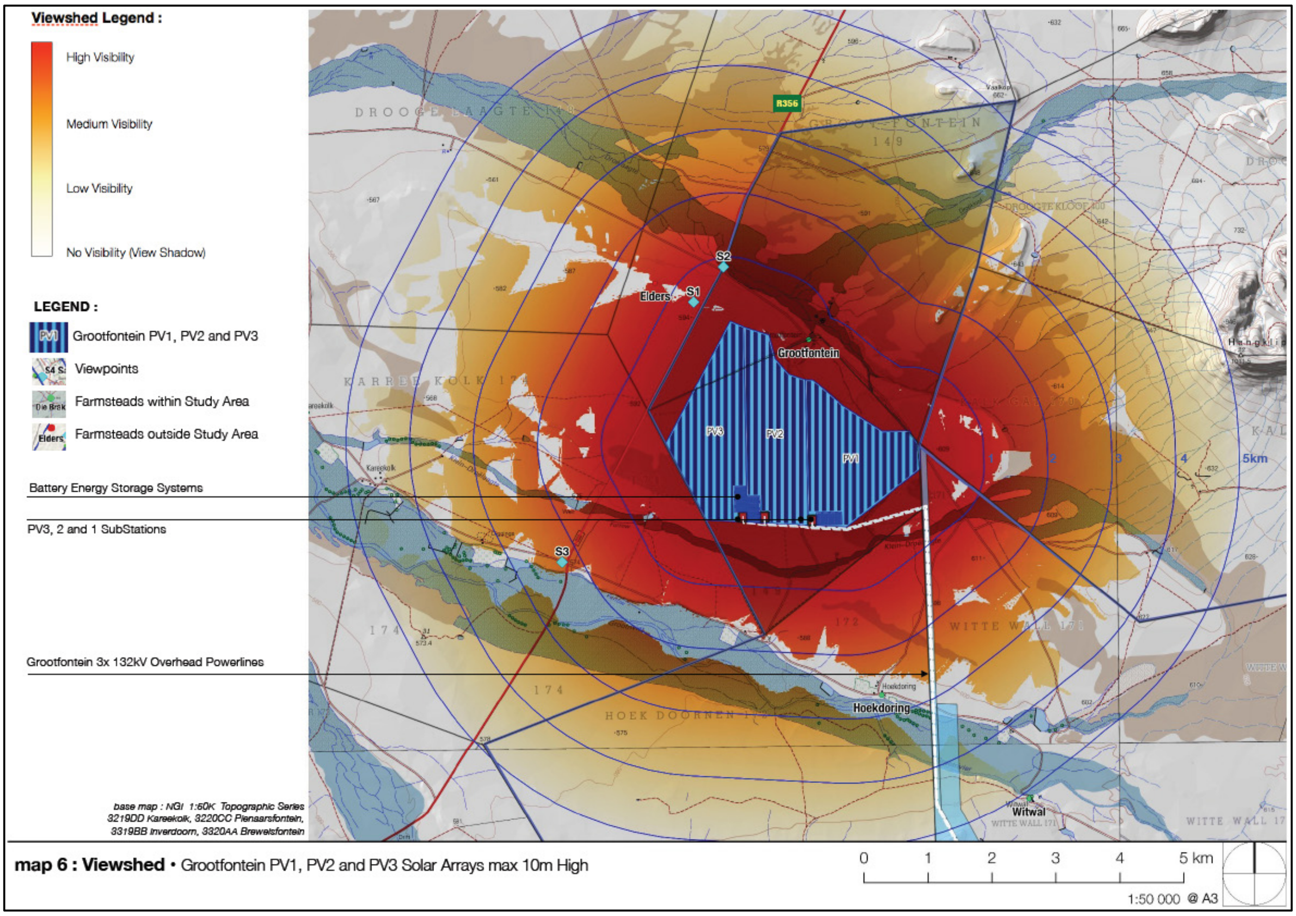


Figure 49: *Viewshed map for the three Grootfontein PV projects.*

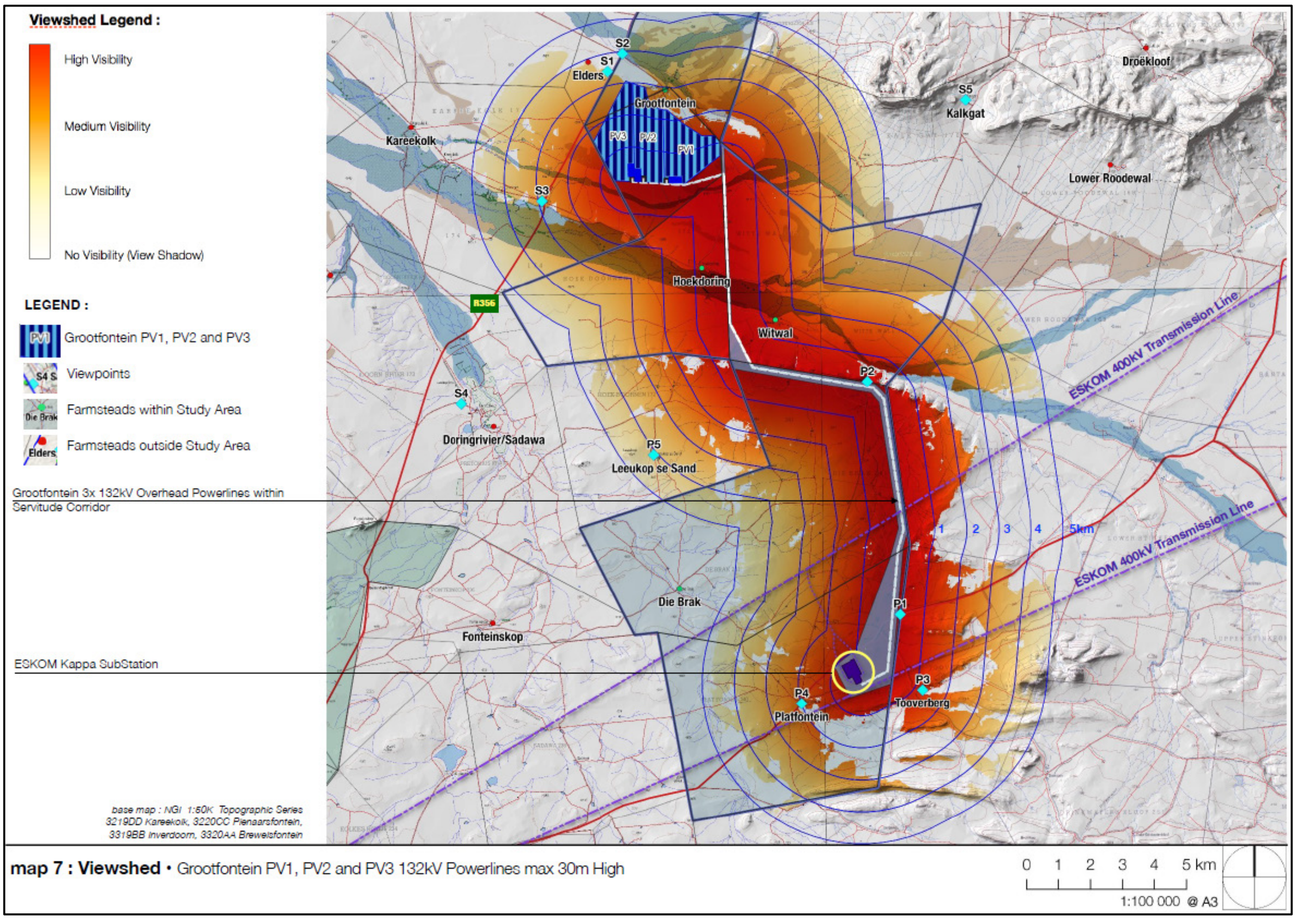


Figure 50: *Viewshed map for the Grootfontein EGI.*

Figure 51: *Photomontage looking south-eastwards from the R356 (at the Grootfontein entrance). Source: Lawson & Oberholzer 2020: fig. P1).*

5.7. 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 palaeontological resources are deemed to have low cultural significance for their scientific value. Any fossils found are likely to be in the Grade IIIB to NCW range.

The archaeological resources within the Grootfontein PV 1 to PV 3 and power line study areas are deemed to have generally low cultural significance for their scientific value. The vast majority are rated as NCW but in a few instances grades of IIIC have been assigned. It should be noted that two sites of high significance (Grade IIIA) were found to the north of the study area (Figure 52). There are no historical archaeological resources within the PV study area but one site to the south was rated NCW. The two stone kraals just outside the power line corridor are given Grade IIIB.

Graves are deemed to have high cultural significance for their social value and are considered Grade IIIA resources. None are known within the development areas.

There are no buildings within the PV sites but the farm complex is considered to have low cultural significance for its architectural and social values and is allocated a grade of IIIC.

The cultural landscape, despite already hosting significant electrical infrastructure, is considered to be of at least medium significance worthy of a IIIB grading. Certain iconic views, for example within Karoo Poort or of Hanglip can be considered as of high significance and worthy of grade IIIA.

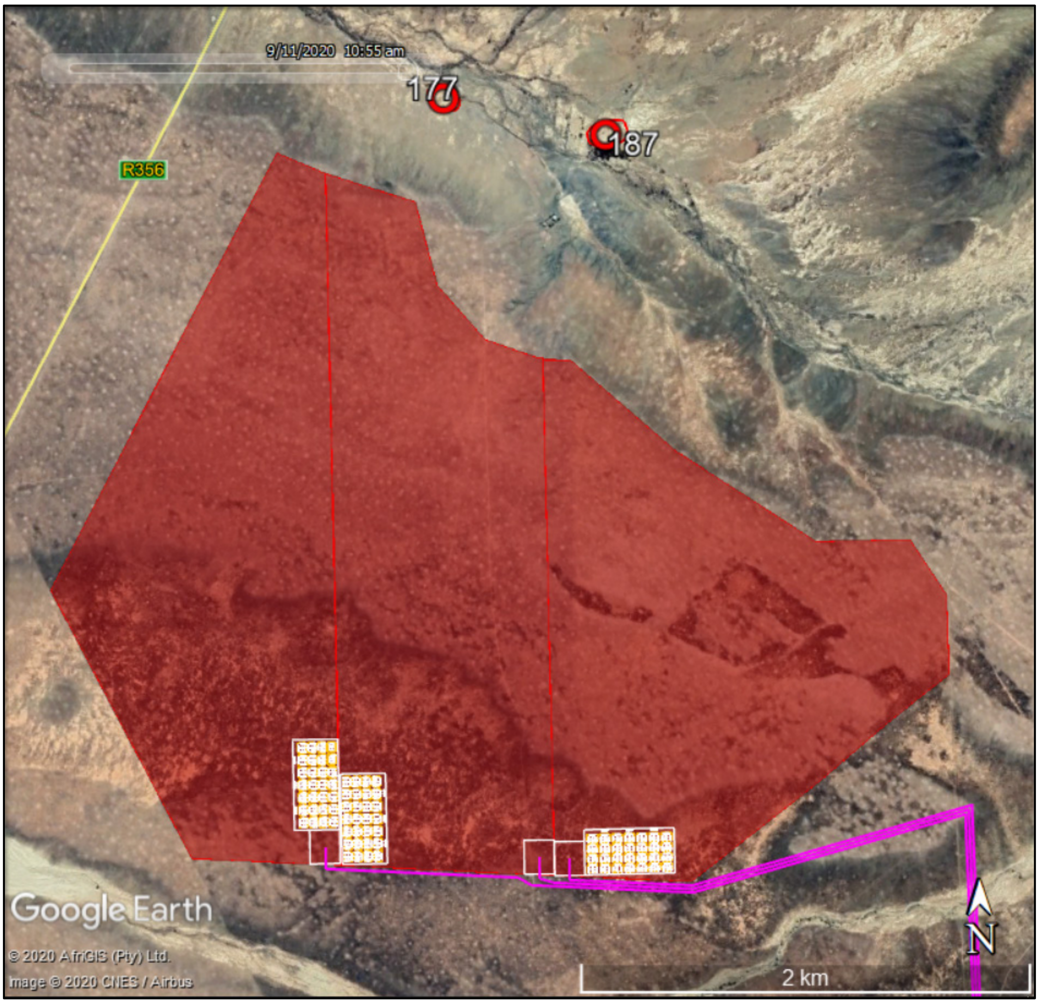


Figure 52: *Aerial view of the PV study area (red shading) and northern part of the power line corridor (pink lines) showing the two heritage resources of Grade IIIA (red circles).*

5.8. Summary of heritage indicators

Fossils can be present in the landscape and are easily damaged or destroyed during development.

- Indicator: Significant fossils should not be damaged or destroyed.

Archaeological resources and graves are generally very fragile and vulnerable to damage or disturbance.

- Indicator: Significant archaeological resources and graves should not be damaged or destroyed.

The cultural landscape can be very easily spoiled by insensitive developments that dominate from many viewpoints.

- Indicator: The cultural landscape should not be visually dominated by the proposed development.
- Indicator: Steep slopes should be avoided for the PV layouts and BESS.

6. ISSUES, RISKS AND IMPACTS

6.1. Issues, risks and impacts

The potential impacts identified during the assessment are the **same** for **the Grootfontein PV 1, PV 2 and PV 3 projects (i.e. including the PV Facilities, Power Lines and Associated Infrastructure)**. They are:

Construction Phase

- Potential impacts to palaeontological resources
- Potential impacts to archaeological resources and graves
- Potential visual impacts to the cultural landscape

Operational Phase

- Potential visual impacts to the cultural landscape

Decommissioning Phase

- Potential visual impacts to the cultural landscape

Cumulative impacts

- Potential impacts to palaeontological resources
- Potential impacts to archaeological resources
- Potential impacts to the cultural landscape

7. IMPACT ASSESSMENT: GROOTFONTEIN PV 1 TO PV 3

The impact assessments for all three projects are expected to be the same. Please note that the assessments for palaeontology have been provided in the attached palaeontological specialist study (Appendix 4) and are not repeated here, save to note that the impacts would occur during the construction phase and their significance would be **very low negative** both before and after mitigation.

The impacts below apply to the **PV Facilities, Power Lines and Associated Infrastructure**.

7.1. Direct Impacts

7.1.1. Construction Phase

Potential Impacts to archaeology and graves

Impacts to archaeology and graves would be direct impacts that might occur during construction when these resources are damaged or destroyed during excavation work. Although the impacts would be permanent and are very likely to happen, the moderate consequence means that significance before mitigation is **low negative** (Table 2). A detailed pre-construction survey of the final layouts (PVs and power lines) should be undertaken in order to determine appropriate sample areas from which to collect artefacts. There is a small possibility that more significant sites or even graves may be found. While background scatter artefacts occur widely and in variable densities across the landscape, it is suggested that one area per PV project footprint could be collected from in order to record some of the variability across the wider project area. Collection along the power line route can also be contemplated if necessary but, because of the limited footprint associated with the power lines, this is likely to not be needed, especially since micrositing of pylons and the service track should be fairly straightforward. The ECO should also ensure that all staff are alerted to the possibility of finding archaeological resources and instructed to report any unusual finds. With mitigation the impact significance is expected to be **very low negative**, although it is noted that new data from an otherwise poorly understood area could contribute some scientific benefit.

***Table 2:** Impacts to archaeology & graves – construction phase.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Impacts to archaeology & graves	Status	*Negative*	*Low (4)*	*Pre-construction survey. Sample artefacts. Educate staff on possible finds.*	*Very low (5)*	*High*
	Spatial Extent	*Site specific*				
	Duration	*Permanent*				
	Consequence	*Moderate*				
	Probability	*Very likely*				
	Reversibility	*Non-reversible*				
	Irreplaceability	*High*				

Potential Impacts to the cultural landscape

Impacts to the cultural landscape would be direct impacts that might occur during construction when much machinery and equipment is on site and there is plenty of activity in what is an otherwise very quiet and tranquil landscape with minimal traffic. The impacts would be medium term (as long as construction takes) and are very likely to happen. The substantial consequence means that the significance before mitigation is **moderate negative** (Table 3). Mitigation would entail minimising the disturbance footprint, utilising dust suppression measures, ensuring effective rehabilitation of areas not needed during operation, locating the laydown area and batching plant (if needed) as far from public roads as possible and using natural colours and finishes on buildings. With mitigation the impact significance is expected to be **low negative**. It is noted that Lawson and Oberholzer (2020) have rated the significance of visual impacts as **low negative** both before and after mitigation.

Table 3: *Impacts to the cultural landscape – construction phase.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Impacts to cultural landscape	Status	*Negative*	*Moderate (3)*	*Minimise disturbance footprint. Employ dust suppression measures. Ensure effective rehabilitation. Locate laydown, batching plant and buildings far from public road. Natural colours and finishes on buildings.*	*Low (4)*	*High*
	Spatial Extent	*Local*				
	Duration	*Medium term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Non-reversible*				
	Irreplaceability	*High*				

7.1.2. Operation Phase

Potential Impacts to the cultural landscape

Impacts to the cultural landscape would be direct impacts that might occur during operation through the visual intrusion of an industrial-type facility on the otherwise rural cultural landscape. Because the facility layout has responded to the landscape character and will sit quite low in the landscape, the extent of impacts is expected to be local. The impacts would be long term and are very likely to happen. The moderate consequence means that significance before mitigation is **low negative** (Table 4). Once construction is over, there are only minor mitigation measures that can be applied. Security lighting should be directed to minimise light pollution and signage should be as small and unobtrusive as possible. These will not change the overall visual intrusion much and the post-mitigation significance thus remains **low negative**. It is noted that Lawson and Oberholzer (2020) have rated the significance of visual impacts as **low negative** both before and after mitigation.

Table 4: *Impacts to the cultural landscape – operation phase.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
OPERATION PHASE						
Impacts to cultural landscape	Status	*Negative*	*Low (4)*	*Minimise light pollution. Signage to be small and unobtrusive.*	*Low (4)*	*High*
	Spatial Extent	*Local*				
	Duration	*Long term*				
	Consequence	*Moderate*				
	Probability	*Very likely*				
	Reversibility	*Non-reversible*				
	Irreplaceability	*High*				

7.1.3. Decommissioning Phase

Potential Impacts to the cultural landscape

Impacts to the cultural landscape would be direct impacts that might occur during decommissioning when much machinery and equipment is on site and there is plenty of activity. The impacts would be long term because rehabilitation is likely to take decades to be completed. Impacts are very likely to happen. The substantial consequence means that significance before mitigation is **moderate** (Table 5). Mitigation would largely entail employing best practice i.e. minimising the disturbance footprint, utilising dust suppression measures, and ensuring effective rehabilitation of all areas. With mitigation the impact significance is expected to be **low**. It is noted that Lawson and Oberholzer (2020) have rated the significance of visual impacts before mitigation as **low negative** and after mitigation as **very low negative**.

Table 5: *Impacts to the cultural landscape – decommissioning phase.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
DECOMMISSIONING PHASE						
Impacts to archaeology & graves	Status	*Negative*	*Moderate (3)*	*Minimise disturbance footprint. Employ dust suppression measures. Ensure effective rehabilitation.*	*Low (4)*	*High*
	Spatial Extent	*Local*				
	Duration	*Long term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Non-reversible*				
	Irreplaceability	*High*				

7.1.4. Cumulative Impacts

Cumulative impacts relate to the loss of archaeological resources over wide areas and the presence of multiple electrical facilities in the landscape. Because significant archaeological sites are generally located and protected from development – and so few significant sites exist in developable areas – the cumulative impacts are driven mainly by the visual impacts to the cultural landscape. In this regard, wind turbines have the greatest impact, followed perhaps by power lines, although the latter reduce in visibility more quickly than turbines do. It is expected that the cumulative impacts to heritage will be **moderate negative**. Mitigation measures would be the same as proposed for the present projects but, because visual mitigation measures can never screen these large developments, the post-mitigation impacts are expected to remain **moderate negative**. Note that because the various facilities in the landscape will be built, operated and decommissioned at different times, there is no distinction made between the project phases for cumulative impacts.

__Table 6:__ Cumulative impacts to heritage resources.

<table>
<tr><th>Impact</th><th colspan="2">Impact Criteria</th><th>Significance and Ranking (Pre-Mitigation)</th><th>Potential mitigation measures</th><th>Significance and Ranking (Post-Mitigation)</th><th>Confidence Level</th></tr>
<tr><td colspan="7">ALL PHASES</td></tr>
<tr><td rowspan="7">Impacts to all heritage resources</td><td>Status</td><td>Negative</td><td rowspan="7">Moderate (3)</td><td rowspan="7">Pre-construction archaeological surveys with sampling as needed.
Minimise areas disturbed.
Minimise light pollution and signage.
Effective rehabilitation.</td><td rowspan="7">Moderate (3)</td><td rowspan="7">High</td></tr>
<tr><td>Spatial Extent</td><td>Regional</td></tr>
<tr><td>Duration</td><td>Long term</td></tr>
<tr><td>Consequence</td><td>Substantial</td></tr>
<tr><td>Probability</td><td>Very likely</td></tr>
<tr><td>Reversibility</td><td>Reversible</td></tr>
<tr><td>Irreplaceability</td><td>High</td></tr>
</table>

7.2. Indirect Impacts

No indirect impacts are anticipated.

7.3. The No-Go alternative

The No-Go alternative would entail not developing the projects and the landscape would remain in its present undeveloped state. Not developing the projects would not result in any new impacts to heritage resources. Existing natural erosion and weathering of artefacts, ruins and buildings would continue but at a very slow rate. Impact significance from the No-Go alternative is thus expected to be **very low negative** for all aspects of heritage.

7.4. 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 will affect archaeological materials, ruins and structures. Trampling from grazing animals and/or farm/other vehicles may also affect artefacts.

7.5. 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 vantage points is undesirable.

8. IMPACT ASSESSMENT SUMMARY

Table 7 provides a summary of the expected impacts after mitigation.

Table 7: *Overall Impact Significance (Post Mitigation)*

Phase	Overall Impact Significance
Construction	Low
Operational	Low
Decommissioning	Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Moderate
Cumulative - Operational	Moderate
Cumulative - Decommissioning	Moderate

9. LEGISLATIVE AND PERMIT REQUIREMENTS

This report and the proposed recommendations will need to be approved by HWC. There are no further legislative requirements for the approval process but if archaeological mitigation is needed then the appointed archaeologist will need to submit a Workplan to HWC to do the work. This must be carried out well in advance of construction to ensure that there is enough time for HWC to approve the mitigation work before construction commences.

10. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

EMPr inputs for palaeontology and visual concerns are provided in the separate palaeontological and visual specialist reports. This section deals only with archaeology as this was the specialist aspect conducted by the present author.

There are three main recommendations to be included in the EMPrs for all project components. The first is to commission a pre-construction survey of the approved PV layouts and power line routes. Further recommendations will stem from the results of that survey. The survey should be done well in advance of construction (preferably at least 6 months) in order to allow time for:

- The field survey;
- Reporting to HWC and application for Workplan approval;
- Conducting the mitigation fieldwork;
- Analysis and reporting; and
- Final approval by HWC

The project developer should ensure that this appointment is made or, if an Environmental Control Officer (ECO) is already appointed, they can see that the requirements are met.

The second measure is for the ECO to ensure that all project staff are aware of the possibility of finding buried heritage materials and that they know the procedure to protect and report such finds. Workers must keep a watch for such items during work.

The third is that the ECO must conduct formal monitoring site visits to (1) verify that all work is remaining within the authorised area and (2) check for any fossils or artefact concentrations that might be revealed.

One specific measure that is required is to ensure the protection of the archaeological site at waypoint 177. The existing farm fence must be retained in its current location and all project activities kept to the south of it.

The generic EMPrs for substations and power lines (GN 435) make provision for general monitoring by project staff and protection and reporting of any chance finds.

11. 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 projects will result in an improved electricity supply for South Africa which can have extensive benefits in terms of improving the economic outlook and investment potential in the country. At the local scale, it is likely that between about 90 and 150 skilled and between 400 and 460 unskilled employment opportunities will be created during the construction phase per project, while approximately 20 skilled and 40 unskilled employment opportunities would be created over the 20-year operational lifespan of the proposed facility. These unskilled jobs will be linked to services such as panel cleaning, maintenance and security. The heritage resources are not of such a significance that they outweigh the socio-economic benefits of the proposed developments.

12. CONSULTATION WITH HERITAGE CONSERVATION BODIES

This report[2] was submitted to the Witzenberg Municipality for comment as required by the HWC NID response. In addition, and because there are no conservation bodies registered in the area, the report was also sent to Hex Valley Tourism Association and the Touws River Heritage and Conservation Society as the next closest registered organisations. This was on 16 October 2020. By the time of finalising this report on 17 November 2020, only the Hex Valley Tourism Association had responded as shown below. They were in support of the project, the assessment and the recommendations of the HIA. The BA with all specialist studies is due to undergo full public participation shortly.

[2] Please note that since submission to the I&APs, the laydown areas for each project have been increased from 5 ha to 13 ha.

Re: Re[6]: Ceres Karoo heritage consultation

GA From Graham Abrahams
to Jayson and copy to Hex Valley Tourism, christiaan@netandmail.com, david@witzenberg.gov.za, RAbed@csir.co.za

Mon 2020/11/16 12:20

⚠ Download pictures or always download pictures from this sender. To preserve privacy, external content was not downloaded.

Hi Jayson

I trust that you, your family and colleagues are all well?

Thank you for making the effort to connect with our society through your email, and for meeting with me. Thank you for sharing your work and findings and the supporting documents, in terms HWC Case No: 20081910SB0825E, in regard to the three heritage impact assessments for solar projects in the Tankwa Karoo region, that I received from you and which I have now read through.

I have definitely benefited (and am enlightened) from reading through your Impact Assessment papers. They certainly provided me with a fresh perspective on the content and quality of the detail that goes into a report such as this. Well done on providing such detailed and comprehensive content.
I respect your professional opinion in this regard in relation to all of the planned PV and associated EGI projects, and therefore support your findings and recommendations, since I am satisfied that they cover all of the issues that are contained in Appendix 6.

I have made copies of the general compliance requirements (Appendix 6) to distribute among my own committee members so that they too can have a better understanding of everything that is considered, such as the "Chance Find Procedure" you mention, and appropriate steps to take in terms of Impact Assessments from the Conservation standpoint.

Then, I have also spoken to my colleague, Melanie Esterhuyse (CEO of Hex River Valley Tourism), regarding your and my discussions on inviting you to address local Stakeholders and Media on Conservation issues in our valley. I think they will find this very interesting. Melanie suggested that one of the evenings of the Media Educational Tour, which at this stage is scheduled for the week 15th to 19th Feb 2021, would be most suitable. She is busy with logistics arrangements (due to limited accommodation in the valley) so I await to hear from her as to which date would be best, and I will let you know asap.

Once again thank you for making contact with us, and we look forward to seeing you next year!

Kind regards,

Graham
G.N.Abrahams: Chairman - Hex River Valley Heritage & Conservation Society
Cell: +27(0)61-583-4269

13. CONCLUSIONS

Table 8 lists the heritage indicators identified for these projects and shows the responses. Some are design responses but others will only be met later through the application of mitigation measures. There are no remaining concerns and it is considered that the proposed developments will not result in significant impacts to heritage resources. There are currently no areas within the PV layouts or power line corridors that require avoidance, but it should be noted that a highly significant archaeological site lies immediately beyond the northern study area boundary at waypoint 177. Although the current farm road crosses the edge of the 30 m buffer mapped in

Figure 52 & Figure A3.6, it is acceptable that this road may be used by the project so long as the fence is not moved.

Table 8: *Heritage indicators and design responses.*

Indicator	Project Response
Significant fossils should not be damaged or destroyed.	No design response possible but a Chance Finds Procedure will be implemented under the EMPr to ensure that any chance finds are recorded and/or collected as required.
Significant archaeological resources and graves should not be damaged or destroyed.	Known significant sites have been avoided by the PV layout and a pre-construction survey is recommended to (1) ascertain whether any further sites are present within the footprint and (2) choose the densest areas of background scatter for formal sampling.
The cultural landscape should not be visually dominated by the proposed development.	Because the PV developments are relatively low to the ground and the power lines lack significant mass, they should only be visible from relatively close to the sites.
Steep slopes should be avoided for the PV layouts and BESS.	Due to space restrictions on site, the PV layout has used the upper and middle terraces with only the lowest one close to the river avoided. The slope between the terraces has also been used for the PV panels, but the PV1 and PV2 BESS locations have both been changed from their original positions so as to be accommodated below the slope break. Using the slope for the PV panels is not ideal but the visual specialists have rated the impacts as of low significance and the overall layout is thus accepted by the heritage specialist. It is noted that the site is remote and the R356 used by relatively few people. The R356 has been given a 500 m buffer which will reduce the visibility of the project to road users.

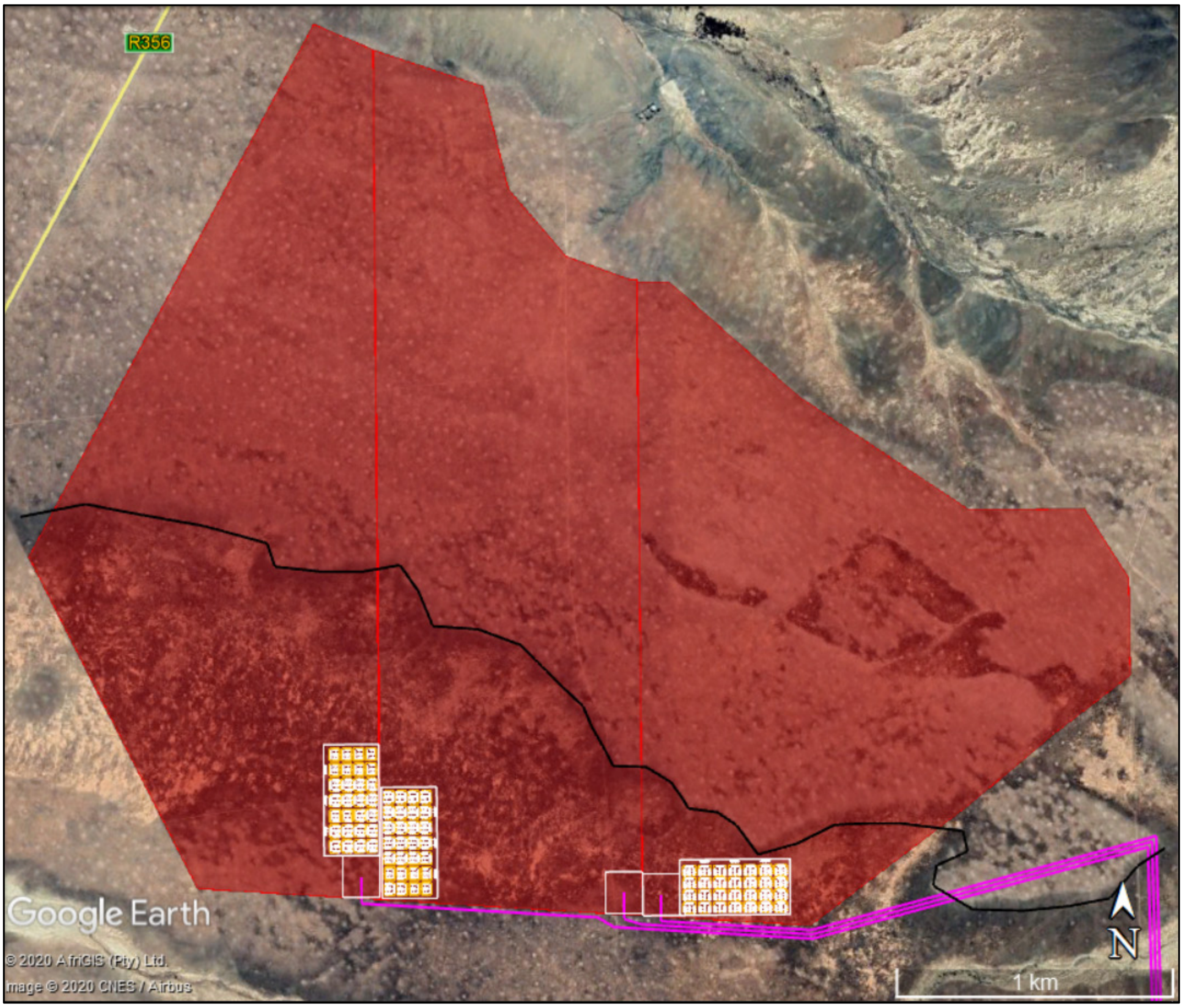


Figure 53: *Aerial view of the Grootfontein PV 1 to PV 3 footprints (red shading) and BESS's (white blocks). The black line indicates the slope break below (south of) which it was indicated that the BESS be accommodated.*

13.1. Statement and reasoned opinion of the specialist

Because no significant impacts to culturally significant heritage resources are anticipated and impacts of low significance can be easily managed or mitigated, all three of the proposed Grootfontein PV developments and their associated EGI should be authorised in full.

14. RECOMMENDATIONS

14.1. Grootfontein PV 1

It is recommended that the proposed Grootfontein PV 1 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;

- No activity is to happen north of the existing farm fence alongside waypoint 177; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

14.2. Grootfontein PV 2

It is recommended that the proposed Grootfontein PV 2 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- No activity is to happen north of the existing farm fence alongside waypoint 177; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

14.3. Grootfontein PV 3

It is recommended that the proposed Grootfontein PV 3 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- No activity is to happen north of the existing farm fence alongside waypoint 177; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

14.4. EGI

It is recommended that the proposed EGI development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) whether any areas of background scatter artefacts should be sampled;
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

15. REFERENCES

Almond, J.E. 2020. Palaeontological input to Heritage Impact Assessment: proposed development of nine 175 Mw Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure near Touwsriver, Witzenberg Local Municipality, Western Cape. Unpublished report prepared for Veroniva (Pty) Ltd, Cape Town: Natura Viva.

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.

Halkett, D. & Webley, L. 2011. Heritage Impact Assessment: proposed Perdekraal Wind and Solar Energy Facility, Western Cape Province. Unpublished report prepared for ERM Southern Africa. St James: ACO Associates cc.

Heritage Western Cape. 2016. Grading: purpose and management implications. Document produced by Heritage Western Cape, 16 March 2016.

Mossop, E.E. 1927. *Old Cape Highways*. Cape Town: Maskew Miller Limited.

Orton, J. 2008. Heritage impact assessment of three sites for the proposed Kappa Substation, Ceres Magisterial District, Western Cape. Unpublished report prepared for Zitholele Consulting. Archaeology Contracts Office, University of Cape Town.

Orton, J. 2016. Prehistoric cultural landscapes in South Africa: a typology and discussion. *South African Archaeological Bulletin* 71: 119-129.

Smuts, K. 2018. Archaeological Impact Assessment Basic Assessment for the Proposed Development of the 325MW Kudusberg Wind Energy Facility and associated infrastructure, between Matjiesfontein and Sutherland in the Western and Northern Cape Provinces: BA report. Unpublished report prepared for CSIR – Environmental Management Services. Stanford: Katie Smuts.

Winter, S. & Oberholzer, B. 2013. Heritage and Scenic Resources: Inventory and Policy Framework for the Western Cape. Report prepared for the Provincial Government of the Western Cape Department of Environmental Affairs and Development Planning. Sarah Winter Heritage Planner, and Bernard Oberholzer Landscape Architect / Environmental Planner, in association with Setplan.

APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

Address: 40 Brassie Street, Lakeside, 7945
Telephone: (021) 789 0327
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. The details of the site sensitivity verification are noted below:

Date of Site Visit	10 and 11 September 2020
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

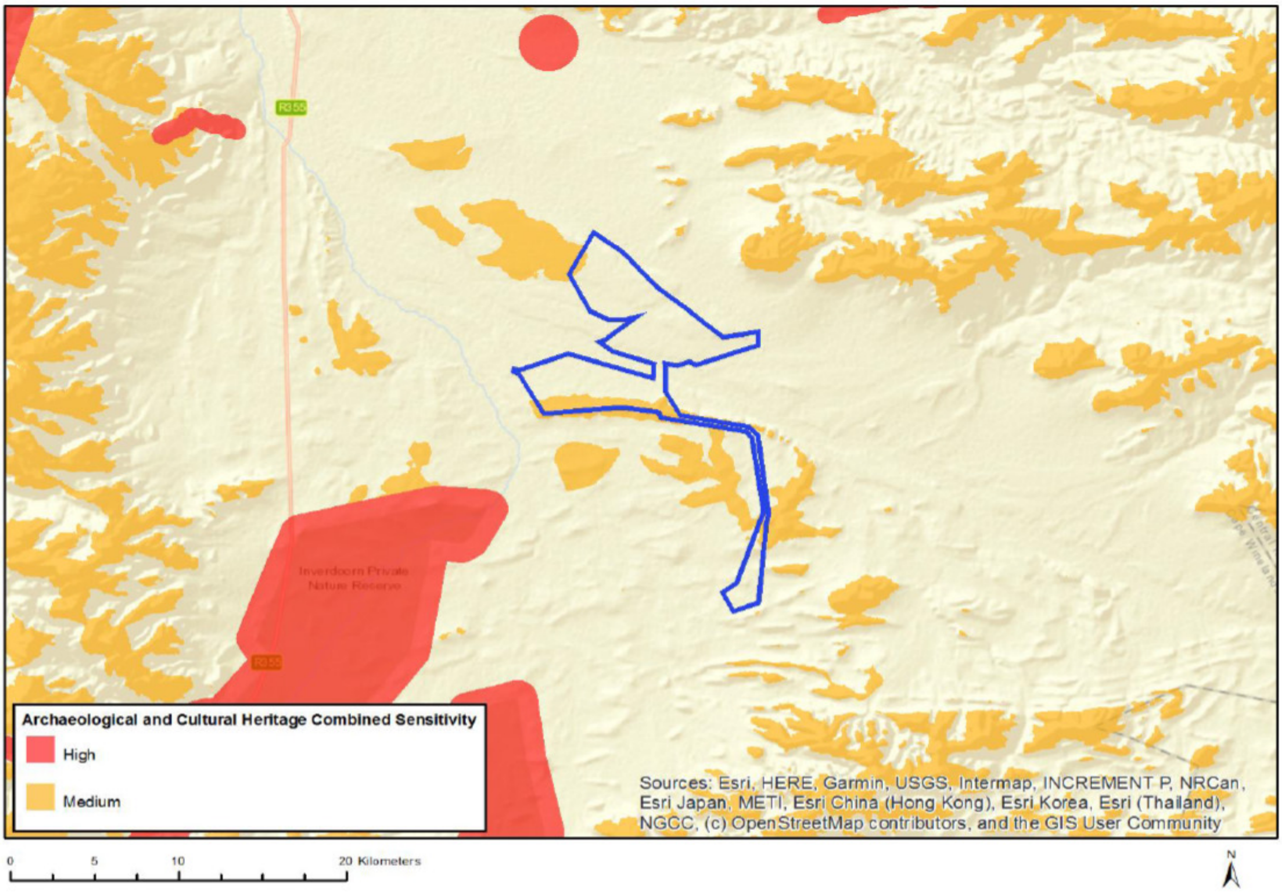
- Provide a description on how the site sensitivity verification was undertaken using the following means:
(a) desk top analysis, using satellite imagery;
(b) preliminary on -site inspection; and
(c) any other available and relevant information.

Initial work was carried out using satellite aerial photography in combination with the author's accumulated knowledge of the broader landscape. This was used to determine areas that should be targeted for fieldwork. Subsequent fieldwork then 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 all presented in the report (Section 5).

Outcome

- Provide a description of the outcome of the site sensitivity verification in order to:
(a) confirm or dispute 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.; and
(b) include a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity.

The map below is extracted from the screening tool report and shows the archaeological and heritage sensitivity to be low throughout the Grootfontein PV 1 to PV 3 study areas. The site visit confirms that the majority of the PV sites are of low sensitivity. Small pockets of higher sensitivity (where heritage resources occurred) were present elsewhere, but these were all closer to the Droëlaagte River and outside of the PV development areas. Figure 52 in the report shows the areas considered to be archaeologically sensitive. They have high heritage significance. A photographic record and description of the relevant heritage resources is contained within the impact assessment report with further photographs on record with the specialist. The screening tool map shows parts of the power line corridor to be of medium sensitivity. This is disputed, however, since only sites of low cultural significance were found in the areas examined and there is little reason to believe that this would change with further survey. The nature of the archaeological resources along the area shown in the screening tool map as of medium sensitivity is such that it is an extensive resource with low cultural significance.



The screening tool map for palaeontology has been included and discussed in the palaeontological specialist report (Appendix 4 of the present HIA).

APPENDIX 3 – Mapping

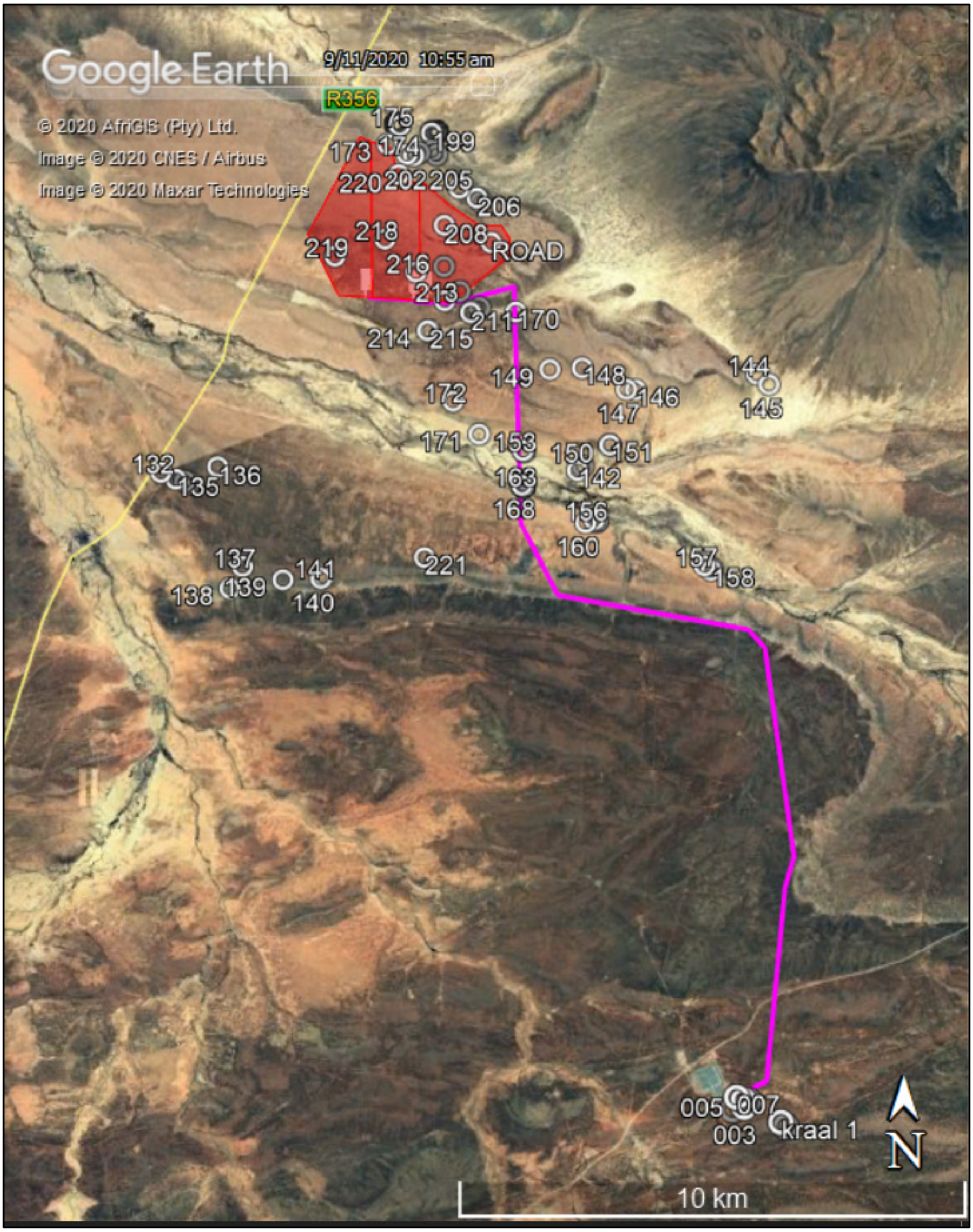


Figure A3.1: *Aerial view of entire study area showing all heritage resources recorded.*

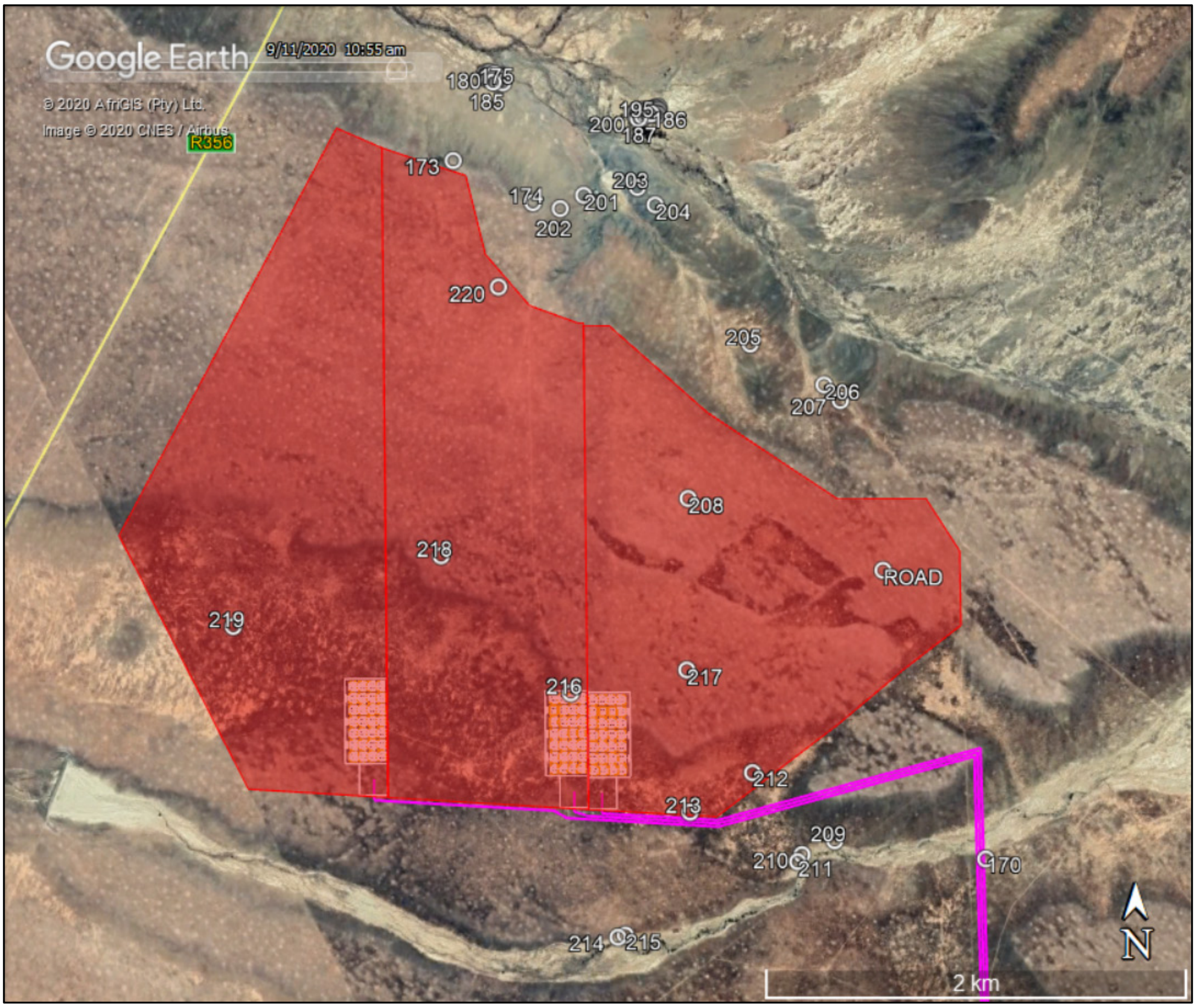


Figure A3.2: *Aerial view of the PV site (red shading) showing all heritage resources recorded.*

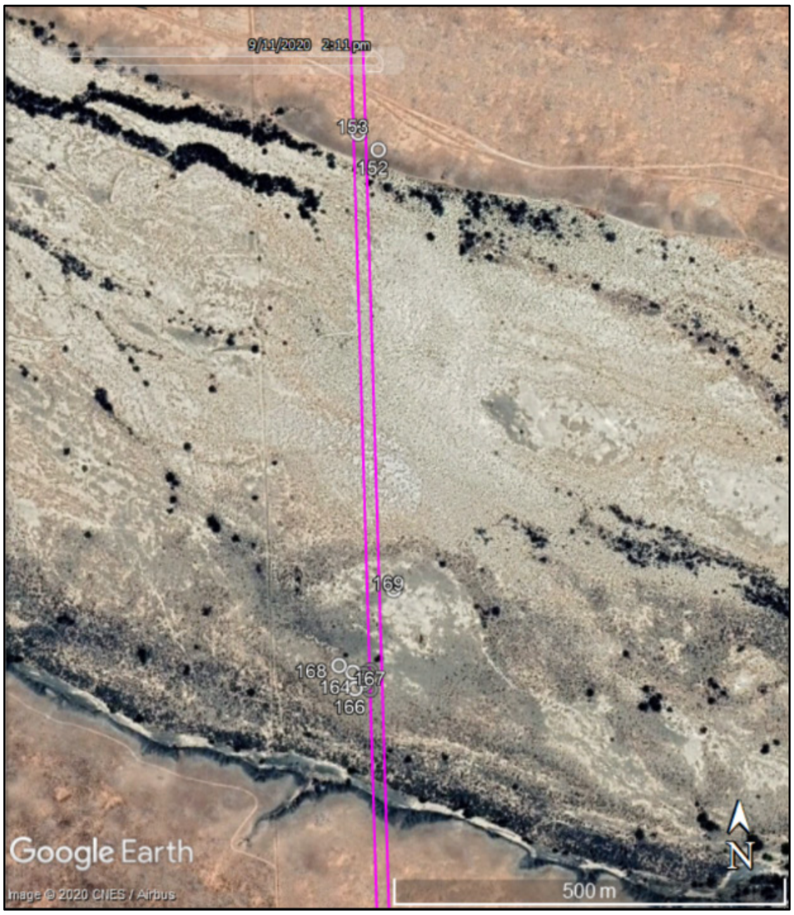


Figure A3.3: *Aerial view of the area where the power lines cross the river showing all heritage resources recorded.*

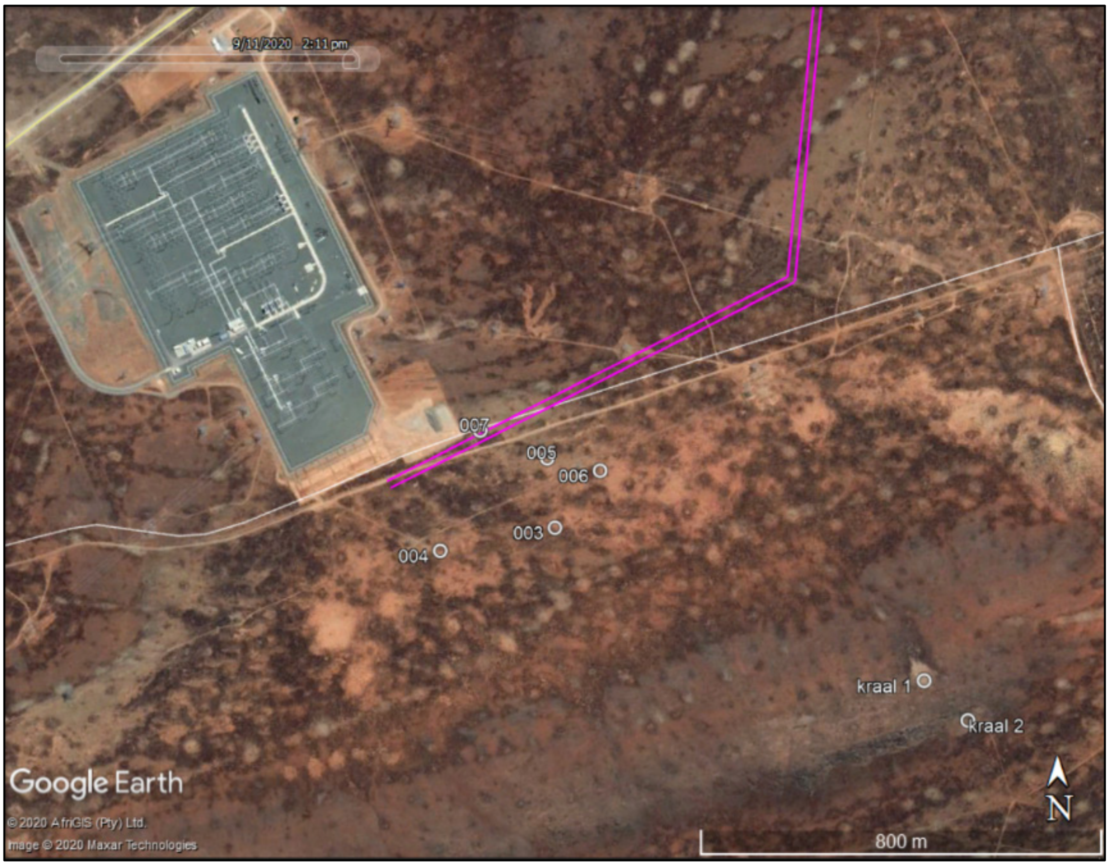


Figure A3.4: *Aerial view of the southern end of the power line corridor showing all heritage resources recorded.*

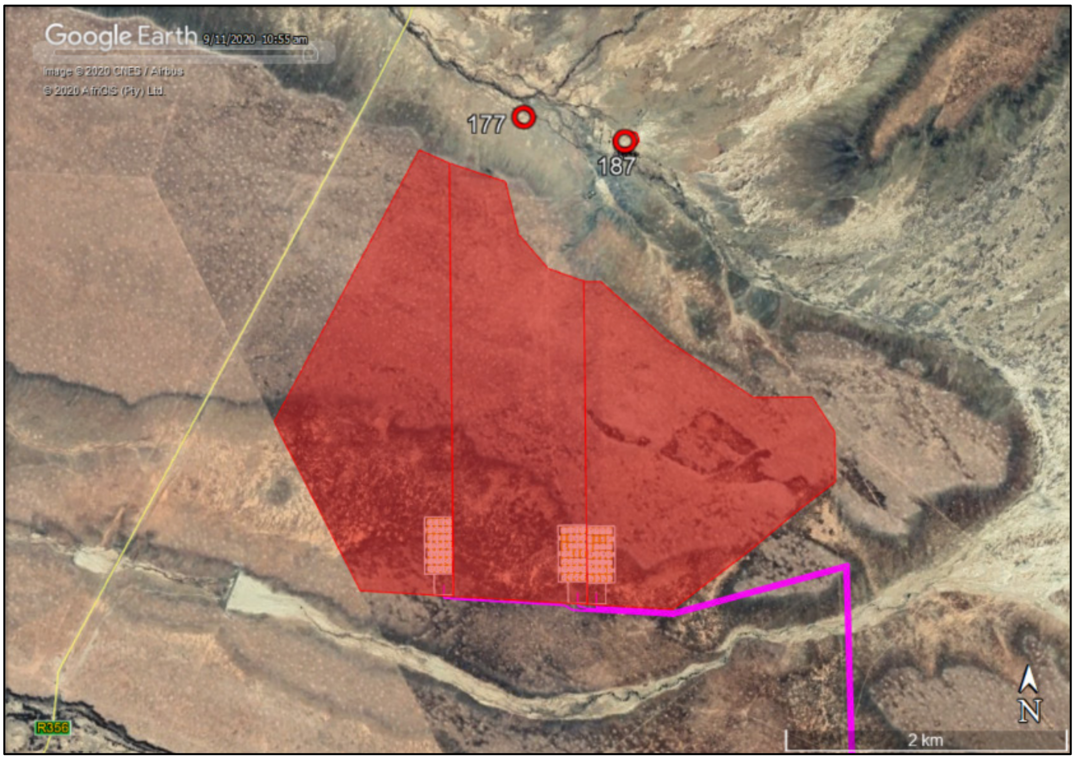


Figure A3.5: *Aerial view of the PV site and surrounds showing the two Grade IIIA heritage resources (red numbered symbols).*

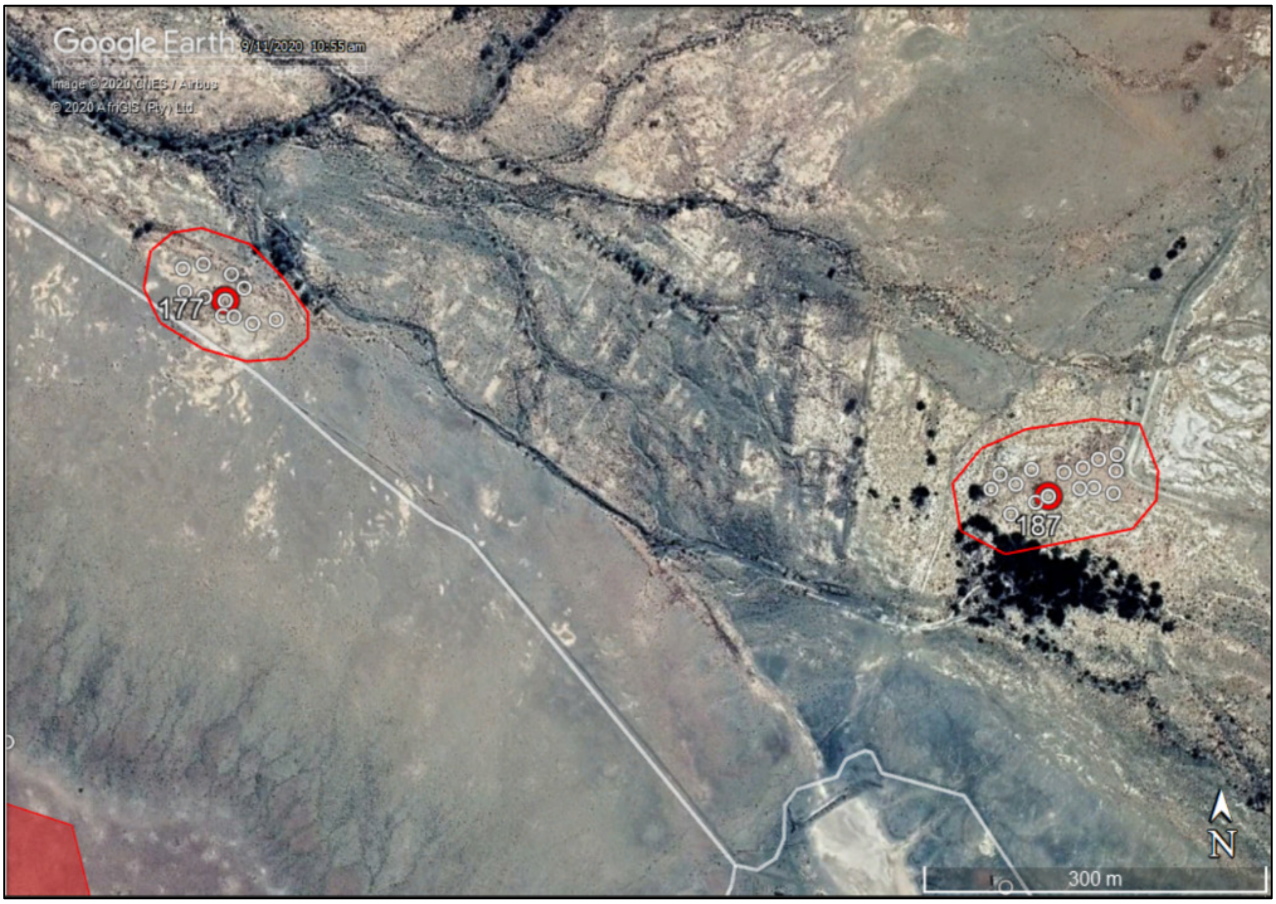


Figure A3.6: *Aerial view of the area to the north of the PV sites showing the locations of the two Grade IIIA archaeological sites. The white circles show the distribution of artefacts and the red polygons are 30 m buffers. It is acceptable for the farm road through the edge of the buffer at 177 to be used so long as the fence is not moved.*

Figure A3.7: *Aerial view of the southern end of the power line corridor showing the Grade IIIC heritage resource requiring mitigation.*

APPENDIX 4 – Palaeontological study

Refer to separately attached document.

APPENDIX 4 OF THE HERITAGE IMPACT ASSESSMENT: PALAEONTOLOGICAL INPUT TO HERITAGE IMPACT ASSESSMENT

PROPOSED DEVELOPMENT OF NINE 175 MW SOLAR PHOTOVOLTAIC FACILITIES AND ASSOCIATED ELECTRICAL GRID INFRASTRUCTURE NEAR TOUWSRIVER, WITZENBERG LOCAL MUNICIPALITY, WESTERN CAPE

Dr John E. Almond
***Natura Viva* cc**
PO Box 12410 Mill Street
CAPE TOWN 8010, RSA

October 2020

EXECUTIVE SUMMARY

The Project Applicant is proposing to develop nine 175 MW Solar Photovoltaic (PV) power generation facilities in the Ceres Karoo region near Touwsrivier, situated in the Witzenberg Local Municipality of the Western Cape Province. Each solar PV facility will have a range of associated infrastructure, including an on-site substation with Battery Energy Storage System (BESS), and will connect to the existing Eskom Kappa Substation *via* a dedicated 132 kV power line. The proposed PV facilities will be constructed on the following farm portions: Remainder of Grootfontein Farm 149; Portion 5 of Grootfontein Farm 149; Remainder of Witte Wall Farm 171; and Portion 1 of Hoek Doornen Farm 172. The power lines will traverse these farm portions, as well as the farms Die Brak 241 and Platfontein 240. Given the very similar geological and palaeontological context and scale of each of the nine proposed solar PV facilities and its associated power lines, the impact assessments and mitigation recommendations for each project are identical and can be summarized as follows:

The solar PV facility project area is situated on a flat to gently-sloping pediment surface of Late Caenozoic (Neogene – Pleistocene) age on the flanks of the Grootrivier Valley which drains this sector of the Ceres Karoo. The pediment surface has been planed-off by river erosion into underlying fine-grained, non-marine, basinal to distal submarine fan sediments of the Tierberg Formation (Ecca Group) that are Middle Permian in age. Field surveys show that the Tierberg bedrocks beneath the thin (few dm to few meters maximum) capping of alluvial gravels, calcrete hardpans, sandy soils and downwasted surface gravels capping the pediment surface are weathered, folded and often tectonically-cleaved. The only fossil remains recorded from such pediment settings in the Ceres Karoo comprise (1) sparse, generally small blocks of reworked silicified fossil wood within alluvial and surface gravels of uncertain provenance (probably Ecca Group) and (2) occasional calcretised fossil termite nests of probable Pleistocene age that are found embedded within calcretised superficial sediments as well as weathered, calcrete-veined bedrocks. The majority of fossil sites recorded fall within designated No-Go areas lying *outside* the project footprint. These fossils are of widespread occurrence within the Ceres Karoo region and are not of high scientific interest or conservation value. No fossil sites of high sensitivity or No-Go areas were identified within the solar PV project areas during the palaeontological field survey and the palaeontological sensitivity of the project area is assessed as generally LOW.

The power line corridor between the solar PV sites and the existing Kappa Substation on Platfontein 240 traverses the outcrop areas of the Permo-Carboniferous, glacial-related Dwyka Group as well as the lower Ecca Group (Prince Albert, Whitehill and Collingham Formations). The potentially-fossiliferous Prince Albert, Whitehill and Collingham Formations are highly weathered and cleaved in this region. No sensitive fossil sites have been recorded within or close to the proposed corridor on Die Brak 241 and Platfontein 240 during the present field survey or several previous field studies in the vicinity by Almond (2010a-c, 2016a) and the palaeontological sensitivity of the corridor is assessed as LOW.

As a consequence of (1) the paucity of irreplaceable, unique or rare fossil remains within the development footprint, as well as (2) the extensive superficial sediment cover overlying most potentially-fossiliferous bedrocks within the solar PV facility and power line project area, the overall impact significance of the construction phase of the proposed solar PV facility regarding legally-protected palaeontological heritage resources is assessed as *VERY LOW* (*negative status*), with and without mitigation. This assessment applies to all the associated solar PV facility and power line infrastructure within the project area. No significant further impacts on fossil heritage are anticipated during the operational and decommissioning phases of the solar PV energy facility and associated infrastructure. The No-Go alternative (*i.e.* no solar PV facility and power line development) will probably have a neutral impact on palaeontological heritage. Confidence levels for this assessment are MEDIUM, given the generally low exposure levels of potentially-fossiliferous bedrocks.

Anticipated cumulative impacts in the context of other renewable energy projects in the Ceres Karoo region – *including* the nine solar PV facilities - are assessed as *LOW (negative)* without mitigation but *VERY LOW (negative)* with mitigation. It is concluded that as far as fossil heritage resources are concerned, the proposed solar facility and power line projects, whether considered individually or together, will *not* result in an unacceptable loss or unacceptable additional impacts, considering all the renewable energy projects proposed in the area. This analysis only applies *provided that* all the proposed monitoring and mitigation recommendations made for all these various projects are consistently and fully implemented.

No specialist palaeontological monitoring or mitigation is recommended for this development, pending the potential discovery of significant new fossil material here during the construction phase. The ECO should be made aware of the possibility of important fossil remains (bones, teeth, petrified wood, plant-rich horizons, fossil termitaria *etc.*) being found or unearthed during the construction phase of the development. Monitoring for fossil material of all major surface clearance and deeper (>1m) excavations by the Environmental Control Officer on an on-going basis during the construction phase is therefore recommended. Significant fossil finds should be safeguarded and reported at the earliest opportunity to Heritage Western Cape for recording and sampling by a professional palaeontologist. The palaeontologist concerned will need a Fossil Collection Permit from Heritage Western Cape and all fossil material collected must be properly curated in an approved repository (museum / university collection). These recommendations must be included within the Environmental Management Programme (EMPr) for the solar PV facility and power line developments. A protocol for Chance Fossil Finds is appended to this report (Appendix C).

There are no identified fatal flaws and no objections on palaeontological heritage grounds to authorisation of the proposed solar PV facilities with its associated power line connections to the Kappa Substation.

1. INTRODUCTION & BRIEF

1.1. Project outline

The Project Applicant is proposing to design, construct and operate nine 175 MW solar photovoltaic (PV) power generation facilities in the Ceres Karoo region near Touwsrivier, situated in the Witzenberg Local Municipality of the Western Cape Province. Each solar PV facility will have a range of associated infrastructure, including an on-site substation with a Battery Energy Storage System (BESS), and will connect to the Eskom Kappa Substation *via* a dedicated 132 kV power line. The proposed PV facilities will be constructed on the following farm portions (Fig. 1):

- Remainder of Grootfontein Farm 149;
- Portion 5 of Grootfontein Farm 149;
- Remainder of Witte Wall Farm 171; and
- Portion 1 of Hoek Doornen Farm 172.

The power lines will traverse these farm portions, as well as the farms Die Brak 241 and Platfontein 240 (Fig. 1).

A total of four separate Basic Assessment processes are being conducted for the following projects (Fig. 1):

- Witte Wall Farm 171: 2 PV Facilities (*i.e.* **Witte Wall PV 1 and PV 2**) and Associated Infrastructure;

- Grootfontein Farm 149: 3 PV Facilities (*i.e.* **Grootfontein PV 1, PV 2 and PV 3**) and Associated Infrastructure;

- Hoek Doornen Farm 172: 4 PV Facilities (*i.e.* **Hoek Doornen PV 1, PV 2, PV 3 and PV 4**) and Associated Infrastructure; and

- Electrical Grid Infrastructure for each PV Plant (*i.e.* 9 Power Lines and 9 onsite substations) and Associated Infrastructure.

A detailed description of each PV project is supplied in the Heritage Impact Assessment reports.

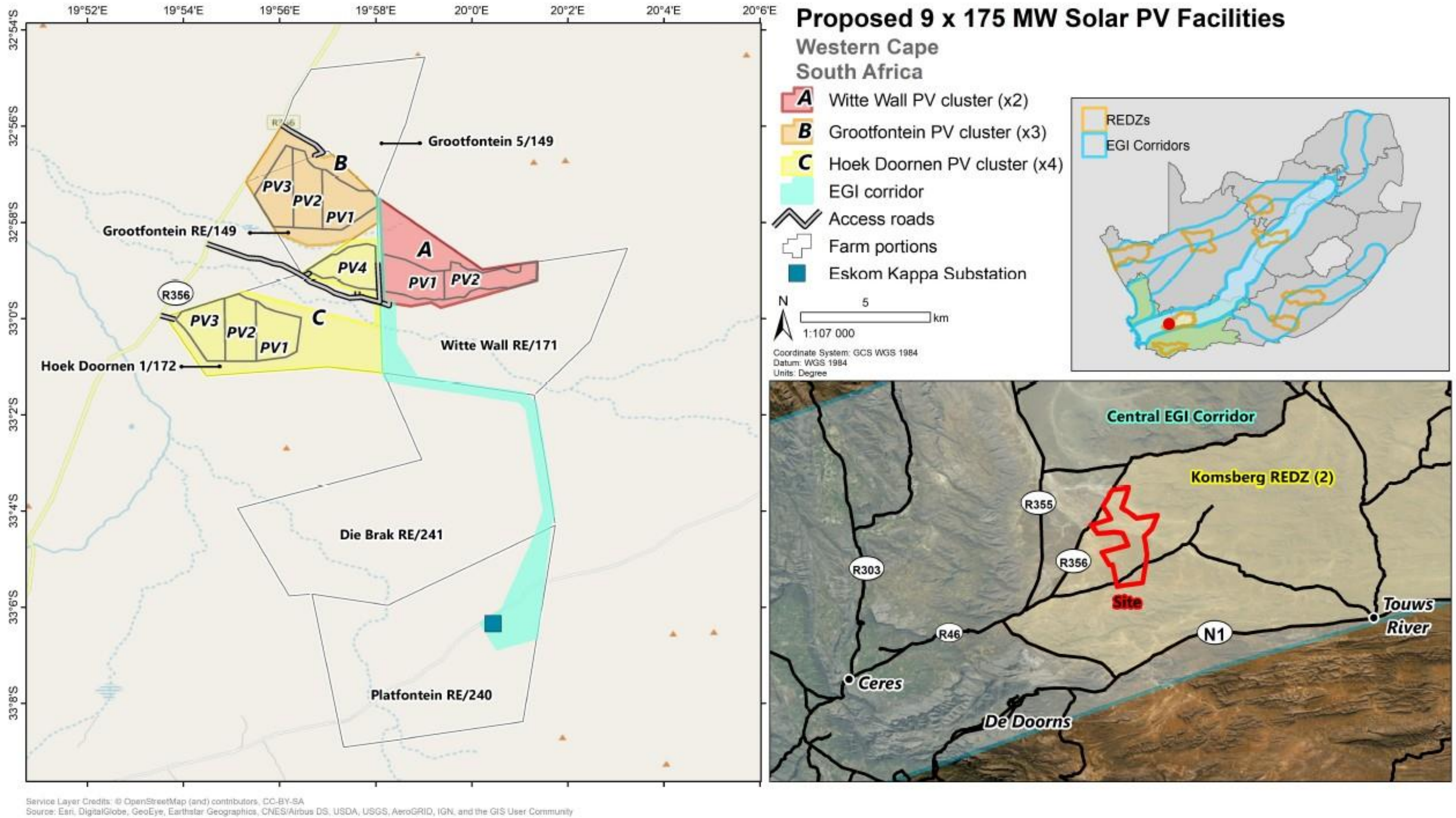


Figure 1: Maps showing the location of the solar PV facility project area in the Ceres Karoo region, *c*. 40 km north of Touwsrivier, Witzenberg Local Municipality, Western Cape Province (Image supplied by CSIR - Environmental Management Services). The project area lies within the Komsberg Renewable Energy Development Zone 2 (REDZ 2).

1.2. Purpose of report

The project area for the proposed solar PV facilities and associated power lines is underlain by potentially-fossiliferous sedimentary bedrocks of the Karoo Supergroup (Dwyka and Ecca Groups) as well as Late Caenozoic superficial deposits (Sections 4 & 5). The construction phase of the developments may entail the disturbance, damage, destruction or sealing-in of scientifically valuable and legally protected palaeontological heritage resources preserved at or beneath the ground surface within the project footprint. No further significant impacts on palaeontological heritage are anticipated during the operational and decommissioning phases of the developments.

Because the project areas lie within the gazetted Komsberg Renewable Energy Development Zone (REDZ 2) gazetted by the Minister of Environmental Affairs in Government Gazette 41445, Government Notice (GN) 114 on 16 February 2018 (*cf* Fourie *et al.* 2015), the proposed renewable energy projects will be subject to a Basic Assessment (BA) Process. The present combined Palaeontological Heritage Assessment Report will contribute to the three separate consolidated Basic Heritage Impact Assessments (HIAs) for the proposed solar PV facilities and their associated power lines, as listed above, in accordance with the latest requirements of the 2014 National Environmental Management Act (Act 107 of 1998, as amended in 2017) (NEMA) Environmental Impact Assessment (EIA) Regulations. The consolidated HIAs are being compiled by Dr Jayson Orton of ASHA Consulting (Pty) Ltd (Contact details: 40 Brassie Street, Lakeside, 7945, South Africa. Telephone: 021 783 0557. E-mail: jayson@asha-consulting.co.za).

Four separate BA Processes as listed in Section 1.1 are being conducted for the solar PV facility and power line developments on behalf of the proponent by the CSIR - Environmental Management Services, Durban (Contact details: Ms Rohaida Abed. CSIR - Environmental Management Services. P.O. Box 59081, Umbilo, Durban, 4075. Tel: 031 242 2318. Fax: 031 261 8172. E-mail: rabed@csir.co.za).

1.3. Terms of reference

The Terms of Reference for this palaeontological study, as specified by the CSIR, are as follows:

- Comply with the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, GN 320. This specifically includes Part A, which provides the Site Sensitivity Verification Requirements where a Specialist Assessment is required but no Specific Assessment Protocol has been prescribed.
- 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.
- Compile a Palaeontological Impact Assessment (PIA) in compliance with Appendix 6 of the 2014 NEMA EIA Regulations (as amended) and any additional relevant legislation and guidelines that may be deemed necessary.
- 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.
- 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.

- Provide review input on the preferred infrastructure layout following the sensitivity analysis and layout identification.
- Prepare and undertake a study on the palaeontology and fossil heritage within the proposed project area, based on:
    - Site visit (as required);
    - a review of all relevant palaeontological and geological literature, including
        - geological maps and previous reports,
        - location and examination of fossil collections from the study area (e.g. museums), and
        - data on the proposed development (e.g. location of footprint, depth and volume of bedrock excavation envisaged).
- Describe the type and location of known palaeontology and fossil heritage sites in the study area, and characterize all items that may be affected by the proposed project.
- Note fossils and associated sedimentological features of palaeontological relevance (photos, maps, aerial or satellite images, and stratigraphic columns).
- Evaluate the potential for occurrence of palaeontology and fossil heritage features within the study area.
- Identify and rate potential direct, indirect and cumulative impacts of the proposed project on the palaeontology and fossil heritage during the construction, operational and decommissioning phases of the project. Study the cumulative impacts of the project by considering the impacts of existing renewable energy plants within the area (as well as those proposed), together with the impact of the proposed project.
- Identify any protocols, legal and permit requirements that relevant to this project and the implications thereof.
- Provide recommendations and suggestions regarding fossil heritage management on site, including conservation measures, as well as promotion of local fossil heritage to ensure that the impacts are limited.
- 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.
- Incorporate and address all review comments made by the Project Team (CSIR and Project Applicant) during the various revisions of the specialist report.
- Incorporate and address relevant issues and concerns raised by Stakeholders (i.e. Heritage Western Cape and South African Heritage Resources Agency (SAHRA)), Competent Authority, Interested and Affected Parties (I&APs) and the public during the Public Participation Process (where relevant and applicable).
- Review the Generic Environmental Management Programme (EMPr) for 1) Power Lines and 2) Substations (GN 435).

2. STUDY APPROACH

The approach to this palaeontological heritage study can be briefly summarized as follows. Fossil bearing rock units occurring within the broader study area (including all relevant land parcels) are determined from geological maps and relevant geological sheet explanations as well as satellite images. Known fossil heritage associated with each rock unit is inventoried from published and unpublished scientific literature, previous PIAs of the broader study region, and the author's field

experience and palaeontological database (*cf* Almond & Pether 2008). Based on this data as well as field examination of representative exposures of all major sedimentary rock units present, both within and in the vicinity of the project footprint, the impact significance, including cumulative impacts, of the proposed developments is assessed using the methodology specified by the CSIR. Recommendations for any further studies or mitigation are outlined for inclusion within the EMPr for the development.

In the case of the present solar PV facility assessments, several transects across the stratigraphy underlying the three affected land parcels were made over the course of four days in order to gauge the levels of exposure, weathering, tectonic deformation and palaeontological sensitivity of each of the sedimentary rock units represented here. The power line corridors between the PV facility project areas and the Kappa Substation were mainly assessed on the basis of data from several relevant PIA reports by the author (notably Almond 2010a-c, 2016b) as well as additional field observations made for an adjoining renewable energy development in 2020.

Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have been published by SAHRA (2013) and by Heritage Western Cape (2016).

2.1. Information sources

The present combined desktop and field-based palaeontological heritage assessment for the solar PV facilities and associated power lines is based on:

- A brief project outline, kmz files and maps provided by CSIR - Environmental Management Services;
- A desktop review of (a) the relevant 1: 50 000 and 1: 250 000 scale topographic maps, (b) Google Earth© satellite imagery, (c) published geological and palaeontological literature, including 1: 250 000 geological maps and accompanying sheet explanations (Theron 1983, Theron et al. 1991, Gresse & Theron 1992, Almond 2008b) as well as (d) several previous and on-going fossil heritage assessments in the Ceres Karoo region by the author and colleagues (e.g. Almond 2010a, 2010b, 2010c, 2010d, 2015a, 2016a, 2016b, 2018, 2020, Almond in prep. and Butler 2018);
- The author's field experience with the formations concerned and their palaeontological heritage (cf Almond & Pether 2008, Almond 2008b and PIA reports listed in the References); and
- A four-day field assessment of the study area, including all land parcels involved, by the author and an experienced field assistant, Madelon Tusenius, during the period 7 to 10 September, 2020. The season in which the site visit took place has no bearing on the study.

2.2. Assumptions and limitations

The accuracy and reliability of palaeontological specialist studies as components of HIAs are generally limited by the following constraints:

- Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

- Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant ("mappable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil etc.), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.
- Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information;
- The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (e.g. of commercial mining companies) - that is not readily available for desktop studies;
- Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

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

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

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

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails inferring the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a PIA may be significantly enhanced through field assessment by a professional palaeontologist. In the present case, site visits to the study areas in some cases considerably modified our understanding of the rock units (and hence potential fossil heritage) represented there.

In the case of the present study area in the Ceres Karoo region near Touwsrivier (Western Cape) exposure of potentially fossiliferous bedrocks is very limited, due to extensive cover by superficial sediments and karroid *bossieveld* vegetation. However, sufficient exposures were examined to allow a realistic assessment of the palaeontological sensitivity of the key rock units (See Section 4), while a substantial amount of relevant geological and palaeontological data is available from previous PIAs in the region (See, for example, References under Almond). Confidence levels for this assessment are accordingly rated as Medium. Comparatively few academic palaeontological studies have been carried out in the region, so any new data from impact studies here are of scientific interest.

3. LEGISLATIVE CONTEXT AND PERMIT REQUIREMENTS

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

Where palaeontological mitigation of a development project in the Western Cape is required, the palaeontologist concerned with mitigation work would need a valid fossil collection permit from Heritage Western Cape (HWC). Any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for palaeontological studies developed by SAHRA (2013) and Heritage Western Cape (2016).

The present palaeontological heritage assessment falls under Sections 35 and 38 (Heritage Resources Management) of the South African Heritage Resources Act (Act No. 25 of 1999), and it will also inform the EMPr for this project. The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

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

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

(1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
(2) All archaeological objects, palaeontological material and meteorites are the property of the State.
(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.
(4) No person may, without a permit issued by the responsible heritage resources authority—
(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) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological

site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—
(a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
(b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;
(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
(d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

- **Legislative and Permit Requirements for potential specialist mitigation**

(1) Should professional palaeontological mitigation be necessary during the construction phase, the palaeontologist concerned will need to apply for a Fossil Collection Permit from Heritage Western Cape. (2) Palaeontological collection should comply with international best practice. (3) All fossil material collected must be deposited, together with key collection data, in an approved depository (museum / university). (4) Palaeontological mitigation work including the ensuing Fossil Collection reports should comply with the minimum standards specified by Heritage Western Cape (2016) and SAHRA (2013).

4. GEOLOGICAL SETTING

The combined proposed PV facility and power line project area is located in a low-lying, semi-arid extension of the Great Karoo region known as the Ceres Karoo or southern Tanqua Karoo. It is situated between the rugged Bontberg mountain range to the south – a west-east trending subunit of the Cape Fold Mountains - and the foothills of the Klein-Roggeveld Escarpment to the north. Topographic relief here is generally low (Figs. 5 to 7), with elevations between 600 and 700 m amsl (above mean sea level), since the area is largely underlain by readily-weathered, clay-rich sedimentary rocks and has experienced extensive, protracted weathering and denudation by post-Gondwana river systems during the Caenozoic Era. The area is drained by the non-perennial Grootrivier and its various tributaries (notably the Klein-Droëlaagte); the Grootrivier is itself a tributary of the extensive Doringrivier – Tanquarivier drainage system of the Ceres – Tanqua Karoo. Levels of bedrock exposure in the flatter-lying portions of the Ceres Karoo region are generally poor, except along larger water courses (Figs. 4, 14), because in most areas there is extensive cover by alluvial and colluvial deposits (*e.g.* river conglomerates, grits and sands as well as surface gravels, soils) and by karroid vegetation - Tanqua Karoo and Koedoesberg-Moordenaarskaroo bossieveld *plus* Tanqua Wash Riviere along drainage channels.

In geological terms the PV facility and transmission line project area lies along the south-western margin of the Main Karoo Basin of South Africa (Johnson *et al.* 2006). The bedrocks have been deformed during the Permo-Triassic Cape Orogeny (mountain building event) and thus lie within, and towards the northern margin of, the Cape Fold Belt (CFB), within or just to the east of the Cape syntaxis (*i.e.* junction of the N-S and E-W branches of the CFB). The geology of the study area is outlined on the four adjoining 1: 250 000 geology sheets Clanwilliam 3218, Sutherland 3220, Worcester 3319 and Ladismith 3320 (Council for Geoscience, Pretoria) (Fig. 2). A total of

seven mappable sedimentary rock units (formations) are represented within the study area, most of which are assigned to the **Karoo Supergroup** and are of Gondwanan (Permo-Carboniferous) age (See stratigraphic column in Fig. 3). Within the PV facility project area, the Karoo bedrock succession generally youngs to the north and northeast towards the Klein-Roggeveld Escarpment. The power line connection southwards to Kappa Substation traverses a broad anticline-syncline pair of Dwyka and Ecca Group bedrocks with WSW-ESE fold axes which is clearly picked out by the sinuous ridge of the more resistant-weathering Collingham Formation (marked by a pale band on satellite images) as well as cyclical banding within the dark Dwyka outcrop area. Nevertheless, given the gentle nature of the broad-scale folding, levels of tectonic deformation are generally low, with gentle bedding dips of 5º to 20° (occasionally higher dips are seen along the banks of the Grootrivier; Figs. 4, 14). A tectonic cleavage may be well-developed within finer-grained mudrocks, especially towards the Bontberg range in the south, while soe brittle rock units such as the cherty beds within the Collingham Formation show pronounced, closely spaced jointing (Fig. 13). Only very minor intrusions of the Karoo Dolerite suite - a single narrow but regionally persistent dolerite dyke (Fig. 19) - are mapped within the study area.

The geology and sedimentology of the various sedimentary rock units represented in the solar facility and power line project area has been covered in some detail, with extensive references, in previous PIAs for the Ceres Karoo region and southern margins of the Great Karoo by the author (*e.g.* Almond 2016a-b, 2018, 2020) and will not be repeated here.

4.1. Dwyka Group

Portions of the power line route on Die Brak 241 as well as in the vicinity of Kappa Substation on Platfontein 240 are underlain by Late Carboniferous to Early Permian glacial sediments of the **Dwyka Group** (**C-Pd**), namely the **Elandsvlei Formation** (Fig. 8). The Dwyka rocks here, with a brownish hue on satellite images, build the cores of WSW-ENE trending CFB mega-anticlines. They are generally poorly exposed, with the exception of several good sections of grey, clast-rich Dwyka tillite seen along larger water courses such as the Kareerivier to the east and north of Die Brak homestead (Almond 2016a). The tillites display well-developed tombstone weathering which clearly developed before deposition of the overlying pervasive mantle of gravelly to sandy alluvial sediments. Low hills and ridges of Dwyka rocks within the region probably represent the coarser basal portion of several deglaciation cycles which impart a colour-banded pattern to the Dwyka outcrop area. A series of several low, rocky outcrops of greyish, gritty to pebbly, locally cross-bedded or deformed quartzites and sandstones in the central portion of Die Brak probably represent glacial outwash fans or eskers within the Elandsvlei Formation. The quartzose bodies are only a few meters across and irregular in geometry (Almond 2016a).

4.2. Ecca Group

The remainder of the power line corridor as well as all the proposed PV project areas are underlain at depth by basinal “marine” to submarine fan sediments of the **Ecca Group** that were deposited within an extensive brackish to freshwater inland lake or Ecca Sea in Early to Middle Permian times (Cole & Basson 1991, Cole 2005, Viljoen 2005). Several lower Ecca Group formations, predominantly recessive-weathering mudrocks with subordinate fine-grained wackes (impure sandstones), crop out here around the flanks of the WSW-ENE trending mega-anticline. In order of decreasing age these are: the Prince Albert Formation (Pp/ Ppr), the Whitehill Formation (Pw), the Collingham Formation (Pc) and the Tierberg Formation (Pt / K2S1).

The **Prince Albert Formation** forms low-lying terrain of little relief that is largely blanketed in alluvial soils and fine surface gravels downwasted from the nearby Collingham outcrop area. Limited exposures on the northern edge of Die Brak 241 (Fig. 9) favour zones of thin, resistant-weathering but highly-jointed, grey-green to yellowish-weathering cherty bands or lenticles. Some of these beds are strongly mineralised with rusty iron and metallic-grey manganese ores associated with snuffbox weathering.

The **Whitehill Formation** is exposed in numerous small erosion gullies on the south- and west-facing flanks of the low range of hills that defines the border between Die Brak 241 and Witte Wall 171, curving southwards through Rietpoort RE/243 just to the east of the power line corridor. The originally thinly-laminated, dark, carbonaceous Whitehill mudrocks here are invariably highly altered through near-surface weathering to friable, white or cream saprolitic material traversed by veins of multi-hued secondary minerals. Large, boulder-sized, sphaeroidal concretions of greyish dolomite weather out in the lower part of the succession (Fig. 11).

The overlying **Collingham Formation** builds the crests and dip slopes of the sinuous range of low hills described earlier which runs to the south of the PV project areas but is followed or traversed by the power line corridor at several points (*e.g.* southern margins of Hoek Doornen 172 – Witte Wall 171 project areas; see satellite image Fig. 53). The Collingham exposures are dominated by several prominent-weathering, highly-jointed, tabular cherty beds between 20 and 50 cm in thickness that show local thrusting and small-scale folding (Figs. 12 & 13). These cherty layers are broadly equivalent to the **Matjiesfontein Member** identified within the Collingham Formation elsewhere along the southern Karoo margin; the presence of several chert bands is a special feature of the Collingham Formation in the Ceres Karoo region (*cf* Almond 2015a). Where they are not too intensely jointed, the Collingham cherts have been extensively exploited by Stone Age peoples as raw material for stone artefacts. These last often abound in the vicinity of the chert bands. For example, an unusually dark grey, hornfels-like chert bed along the Hoek Doornen fence line is associated with a carpet of anthropogenically flaked rubble while the *in situ* chert itself as well as large float blocks in the area show abundant evidence of flaking. The intervening grey hackly-weathering siltstone horizons are occasionally exposed in erosion gullies (*e.g.* on Witte Wall 171). The majority of the narrow Collingham outcrop area is typically mantled by angular, blocky colluvial gravels of grey, silicified mudrock that show up clearly as a pale brownish zone on satellite images. The cherty Collingham gravels also cover most of the lower-lying Whitehill Formation outcrop and the lower beds of the adjoining Tierberg Formation (Fig. 37).

The **Tierberg Formation** that underlies all the PV facility project areas on Witte Wall 171, Hoek Doornen 172 and Grootfontein 149 where it is almost entirely covered by a blanket of alluvial sediments and soils (Figs. 4, 14-18). There are occasional good exposures along the steep southern banks of the Grootrivier and much more limited ones in the beds of its shallow tributaries. Near-surface, as well seen along the northern bank of the Grootrivier on Karee Kolk 174 as well as in low pediment escarpment exposures north of the Grootrivier, the Tierberg mudrocks are usually weathered and crumbly with no bedding plane exposure and are in addition extensively veined by Late Caenozoic calcrete (Fig. 5). The Tierberg succession is dominated by laminated to thin-bedded, highly-tabular, dark grey to khaki mudrocks with zones of large, oblate sphaeroidal to flattened lenticular concretions and lenticular beds of rusty-brown, ferruginous carbonate or mudrock. The concretions are late diagenetic and often display superficially fossil-like cone-in-cone structures (Fig. 41). Pale, grey-green bands of friable, fine-grained clay-like material may be altered tuff bands (volcanic ashes).

4.3. Karoo Dolerite Suite

A straight SE-NW trending dyke of the Early Jurassic **Karoo dolerite suite** traversing the NE part of Die Brak 241 from Riet Poort 243 is mapped on 1: 250 000 sheet 3320 (Fig. 2). The same intrusion probably extends further to the NW into the PV project area since it re-appears along strike close to the intersection of farms Grootfontein 149, Hoekdoornen 172 and Karee Kolk 174. This subvertical dyke of rusty-brown dolerite reaches a thickness of 2.5 m to 6 m (but is often thinner) with narrower veins or apophyses extending into the Tierberg country rocks. It features impressive radiating fans of pale bladed sparry calcite (Fig. 19).

4.4. Late Caenozoic superficial deposits

As is apparent in satellite images, and especially in the field, the Palaeozoic sedimentary bedrocks in the Ceres Karoo region are extensively blanketed by a range of – mostly unconsolidated - superficial deposits. These include pedocretes (*e.g.* calcrete), colluvium (slope deposits such as scree and hillwash), sheetwash and alluvial (river) sediments, surface gravels as well as silty, sandy and gravelly / rocky soils of mainly Quaternary to Recent age. Of these younger sedimentary units, most are too thin to be mapped separately at 1: 250 000 scale.

A wide range of **Late Caenozoic alluvial deposits** are represented within PV facility and power line project area, especially along the Grootrivier and other larger drainage systems, as well as in the *vlaktes* to the north and south of the Grootrivier on Witte Wall 171, Hoek Doornen 172 and Grootfontein 149 (Figs. 20 to 37). The dominant geomorphological feature here, clearly seen on satellite images, are series of dissected, flat to very gently sloping **pediment surfaces** planed across the Tierberg Formation bedrocks by earlier phases of the Grootrivier (Fig. 53). There is a flight of at least three or more pediment surfaces which increase in elevation and age with distance from the modern rivier. Based on (*N.B.* very inaccurate) Google Earth spot heights, these surfaces lie at approximately 580 m amsl., 600 m amsl and 620-640 m amsl (the last outside and NE of the project area). The surfaces slope gently down in a downstream direction and even the lowest lies some 10-15 m or more above present day river level. The ages of these surfaces is uncertain but is likely to span at least the Late Neogene Period and Pleistocene Epoch. The key infrastructure for all the PV facilities will be situated on these almost level to stepped pediment surfaces (Fig. 53).

In contrast to their marginal scarps, where weathered and calcretised Tierberg Formation bedrocks are locally exposed, the pediment surfaces are widely mantled by alluvial gravels) of guesstimated Late Neogene to Pleistocene age (Figs. 6 & 29). The relict gravelly patches are mapped along the banks of the Grootrivier as so-called **High Level Gravels** and are provisionally assigned to the **Grahamstown Formation** (Tg), doubtless a misnomer since no *in situ* evidence of the extensive silcretisation typical of this latter rock unit is observed. The coarse, poorly-sorted alluvial to downwasted pediment gravels are generally dominated by angular to subrounded reddish-brown weathering Ecca wackes with subordinate ferruginised mudrock (often desert-varnished), pale grey Matjiesfontein Member chert, white Witteberg quartzite, rare pale yellowish-green, orange-patinated tuff or tuffite, vein quartz, polymict Dwyka erratics (*e.g.* Precambrian vesicular lavas, silicified breccias), occasional dolerite and small clasts of petrified wood. Larger, boulder-sized clasts may retain surface impact crescents. An interesting, locally abundant component to the pediment gravels are pale grey to buff or yellowish-green sandy to gritty silcretes whose provenance is currently unclear; they may have been derived from Neogene silcrete outcrops (the “real” Grahamstown Formation) further to the east within the Grootrivier catchement area that have since been completely denuded. A high proportion of the silcrete clasts are anthropogenically

flaked (Fig. 30). On satellite images the pediment surfaces are densely pock-marked by small round *heuweltjies* of possible termite and / or bush-clump origin. Away from the edges of the pediments, flat areas are often mantled with pale orange sandy to silty soils (possibly with aeolian reworking in places) with sparse gravels or unvegetated patches with fine sheetwash gravels (Figs. 31 to 33).

A well-developed, solid to rubbly or nodular **calcrete hardpan** up to a few meters thick typically crops out along the crests of the marginal scarp defining the relict pediment surfaces patches (Figs. 4, 5 & 20 to 22). This is well seen, for example, on Karee Kolk 174 on the northern bank of the Groootrivier. The underlying Tierberg mudrocks are weathered and calcrete veined. Excellent exposures of calcretised fluvial conglomerates up to several (3-10) meters-thick are seen along the south bank of the Grootrivier on Witte Wall 171 where they show a sharp basal angular unconformity overlying inclined Tierberg Formation bedrocks that may be elevated up to 10 m or more above the present river bed. The conglomerates are oligomict (dominated by Ecca wackes), poorly-sorted with local development of current-generated clast imbrication as well as interbedded lenticular to tabular packages of pale brownish to greyish, gritty, horizontally-bedded to cross-bedded, calcretised sands. These last sometimes cap or pass horizontally into coarse channel lag conglomerates incised into the bedrock representing perched tributaries of the ancient Grootrivier. The ruditic High Level Gravel alluvial deposits are in turn overlain by unconsolidated younger alluvial silts and sands as well as aeolian reworked sands. Dispersed angular clasts of pale greyish Matjiesfontein chert within the High Level Gravels are often marginal flaked but this might be natural damage rather than anthropogenic (Fig. 20).

Blocky **colluvial gravels** are well seen on the steep to gentle slopes of low hills capped by the Collingham Formation, as described earlier (Fig. 37). Extensive flat-lying portions of the study area, including parts of the pediment surfaces, feature sheetwashed **surface gravels** of various sorts that are best seen in unvegetated patches. The sheetwash gravels are fine, angular to subrounded and dominated by reistent-weathering lithologies such as cherts, silicified and ferruginised mudrocks with occasional small blocks of petrified wood (Figs. 31 & 32).

Coarse cobbly to bouldery modern gravels strongly dominated by Ecca wackes as well as finer alluvial sands occur along the present course of the Grootrivier. Distinctive coarse, multi-hued, oligomict gravels rich in silcrete clasts are seen along bed of Klein-Droëlaagte where they are exposed as low gravel bars and in stream banks beneath sandy alluvium (Figs. 24 to 26). As well as lots of silcrete, these gravels include clasts of Matjiesfontein cherts, highly patinated wacke, occasional quartzite, Dwyka erratics (vesicular lavas, silicified breccias) and weathered-out Tierberg ferruginous carbonate concretions (Fig. 41). The clasts are variously angular to well-rounded. They are of interest in that they are often (but not invariably) associated with abundant Early Stone Age (ESA) bifaces (Pleistocene) as well as occasional small blocks of petrified wood and rare small fossil logs (Section 5 and Fig. 44). The contrast between these polymict gravels and the local modern river gravels in terms of clast lithology, archaeology and palaeontology suggests that they may have a different provenance, perhaps reflecting different drainage patterns in Plio-Pleistocene times. They are largely buried beneath younger superficial sediments and only exposed where the modern and fossil drainage networks intersect.

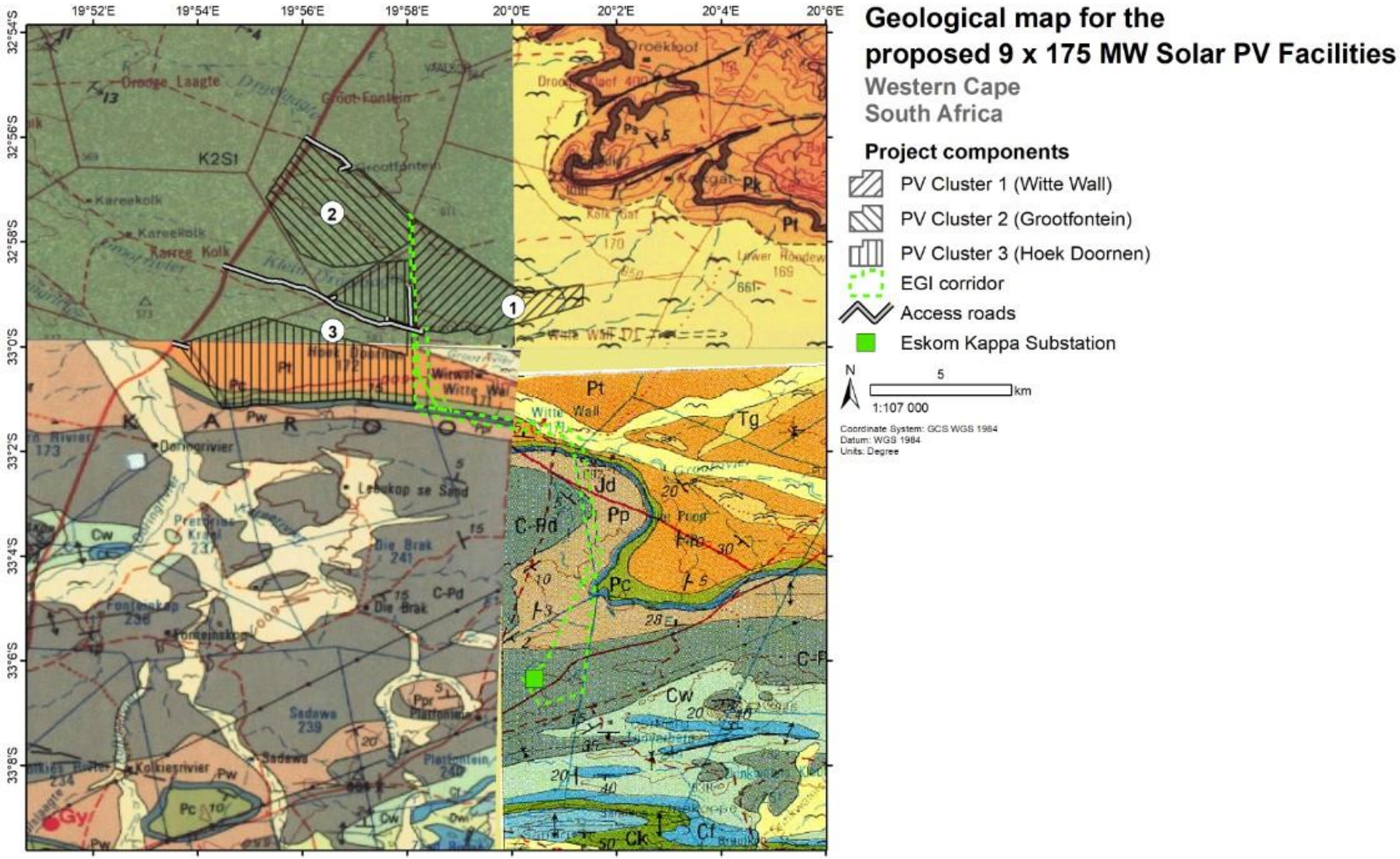
Thick deposits of alluvial sands along the course of the Grootrivier locally contain nodular calcrete hardpans. Locally they have been reworked into small **aeolian dunefields** characterised by well-sorted, orange-brown unconsolidated fine sands, locally displaying large scale dune cross-sets

(Fig. 35). Deflation of fine river sands up onto adjacent hillslopes is well seen in the southern portion of Hoek Doornen 172 where the dunes support a distinctive shrubby vegetation (Fig. 34).

Surface gravels overlying the Dwyka Group are typically highly polymict, *i.e.* composed of a wide range of rock types (cherts, carbonates, quartzites, lavas, granites *etc*), reflecting the range of glacial erratics enclosed by the underlying tillites. Fine pebbly gravels overlying the Prince Albert Formation are dominated by angular to subrounded cherty and siliceous mudrock clasts, many of which are ferruginised or with a well-developed patina of desert varnish (Fig. 10). **Calcrete hardpans** have developed within older sandy to silty alluvial deposits and soils, especially overlying the Dwyka Group, and are well exposed along the banks of drainage courses (*e.g.* near Die Brak homestead and along the banks of the Grootrivier) (Almond 2016a).

Figure 2 (following page): Extracts from four adjoining 1: 250 000 scale geology sheets Clanwilliam 3218, Sutherland 3220, Worcester 3319 and Ladismith 3320 (Council for Geoscience, Pretoria) showing the main stratigraphic units represented within the proposed solar PV facility and power line project area located *c.* 30 km north of Touwsrivier, Western Cape (black polygon). The dashed green polygon indicates the corridor for the power line connections to the existing Eskom Kappa Main Transmission Substation. The main geological units mapped within the study area include:

- **DWYKA GROUP: C-Pd (grey) = Elandsvlei Formation**
- **ECCA GROUP: Ppr, Pp (pale brown or buff) = Prince Albert Formation; Pw (dark blue) = Whitehill Formation; Pc (green, grey-green) = Collingham Formation; Pt, K2S1 (dark yellow, pale orange or grey) = Tierberg Formation**
- **KAROO DOLERITE SUITE: Jd (red line)**
- **SUPERFICIAL DEPOSITS: medium yellow (Tg with double flying bird symbol) = Tertiary or Quaternary High Level Gravels; pale yellow or white with single flying bird symbol = Quaternary to Recent alluvium**



Geological map for the proposed 9 x 175 MW Solar PV Facilities
Western Cape
South Africa
Project components
PV Cluster 1 (Witte Wall)
PV Cluster 2 (Grootfontein)
PV Cluster 3 (Hoek Doornen)
EGI corridor
Access roads
Eskom Kappa Substation
N
5
km
1:107 000
Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree
19°52'E
19°54'E
19°56'E
19°58'E
20°0'E
20°2'E
20°4'E
20°6'E
32°54'S
32°56'S
32°58'S
33°0'S
33°2'S
33°4'S
33°6'S
33°8'S
K2S1
Pt
Pk
Ps
Tg
Jd
Pp
Pc
C-Pd
Cw
Ck
Cf
Pw
Ppr
Gy

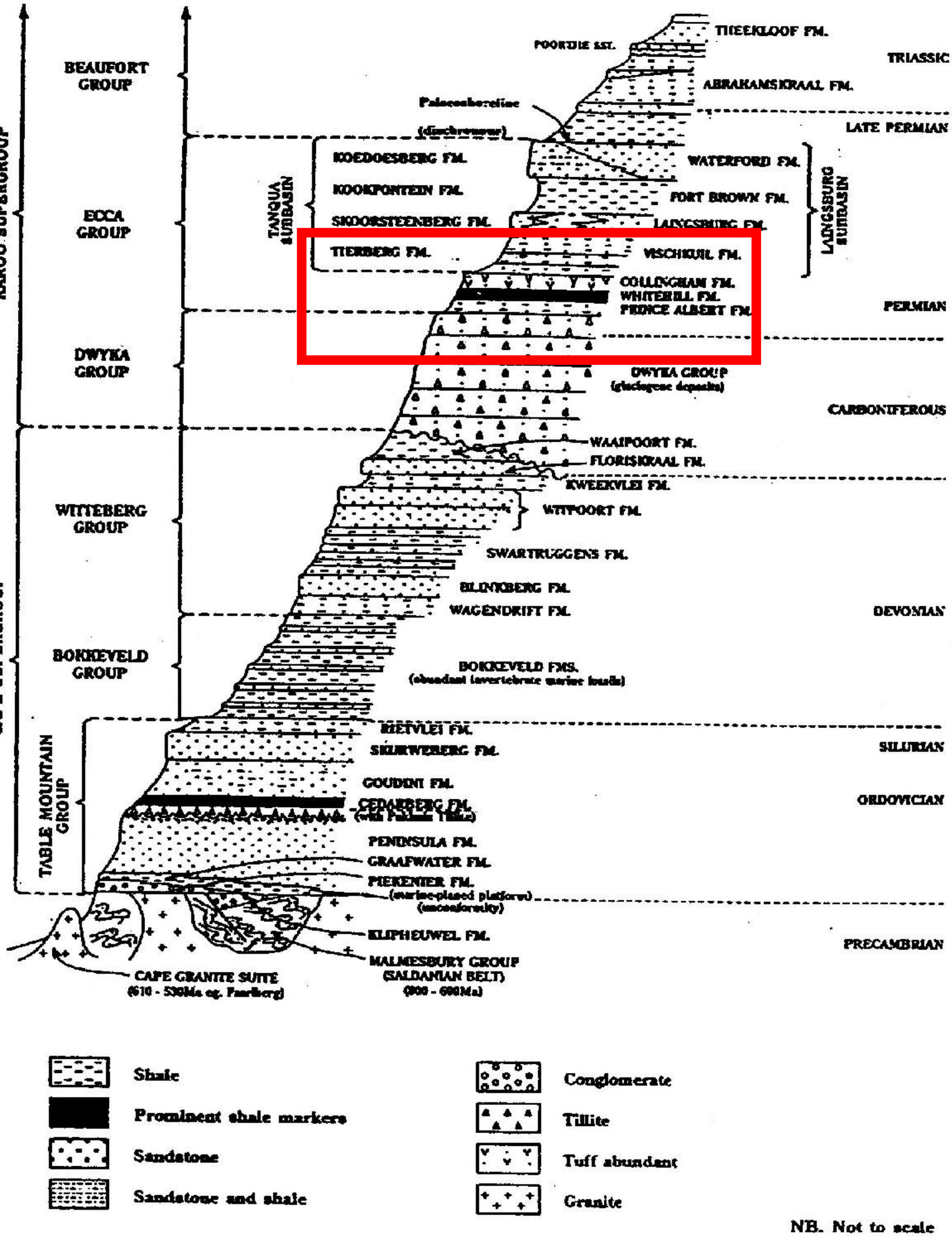


Figure 3: **Schematic stratigraphic column for the Western Cape, the red box outlining the Late Palaeozoic formations of Karoo Supergroup sedimentary rocks that crop out in the solar PV facility and power line project area (Modified from original figure by H. de V. Wickens).**

Figure 4: Riverine cliff exposure of eastward-dipping Tierberg Formation mudrocks unconformably capped by calcretised High Level Gravels with aeolian dune sands banked up against the cliff base, southern bank of the Grootrivier, Wittewall 171.

Figure 5: View eastwards along the low scarp marking the riverine edge of the lowest pediment surface on the northern side of the Grootrivier, Karee Kolk 174. The extensive flat-topped pediment is incised into weathered, khaki-hued Tierberg Formation mudrocks and its edge is heavily calcretised.

Figure 6: View southwards across the flat to gently sloping pediment surface on Grootfontein 149 with the Bontberg range in the background. The pediment surface here is mantled by poorly-sorted, downwasted alluvial gravels.

Figure 7: View of the low ridge of Ecca Group rocks running along the southern boundary of Witte Wall 171. The power line corridor runs along the ridge crest. Note thick sandy alluvial soils and dense *bossieveld* vegetation clothing the north-eastern sector of De Brak 241 in the foreground.

Figure 8: Typical appearance of the Elandsfontein Formation (Dwyka Group) outcrop area showing tombstone weathering of massive, grey-green tillites and polymict downwasted surface gravels derived from weathered-out glacial erratics, Die Brak 241 (From Almond 2016a).

Figure 9: Tabular-bedded, grey-green basinal mudrocks and fine-grained wackes of the Prince Albert Formation near the boundary between Die Brak 241 and Witte Wall 171 (From Almond 2016a). Good bedding plane exposures of this unit are rare.

Figure 10: Surface gravels overlying the Prince Albert Formation outcrop area, typically dominated by silicified mudrocks, cherts, vein quartz and other resistant-weathering rock types, with rare clasts of petrified wood of uncertain provenance, Die Brak 241 (Hammer = 30 cm).

Figure 11: Gullied exposure of highly-weathered, friable and mineralised mudrocks of the Whitehill Formation with boulder-sized dolomite concretions in the foreground, low hills along boundary between Witte Wall 171 and Die Brak 241 (From Almond 2016a).

Figure 12: Multiple tabular beds of prominent-weathering chert or silicified mudrocks assigned to the Matjiesfontein Member within the Collingham Formation, Witte Wall 171 (Hammer = 30 cm) (From Almond 2016a). The intervening mudrocks are mantled by downwasted cherty rubble.

Figure 13: Closely-spaced fracture set transecting brittle, silicified mudrock beds of the Collingham Formation, Witte Wall 171 (Hammer = 30 cm).

Figure 14: Eastward-dipping, laminated to thin-bedded, dark grey to khaki-weathering mudrocks with thin lenses and concretions of ferruginous carbonate as well as packages of brownish fine-grained wackes of the Tierberg Formation exposed along the southern banks of the Grootrivier, Witte Wall 171.

Figure 15: Stream gulley exposure of crumbly, weathered Tierberg Formation mudrocks with zone of prominent-weathering, rusty-brown, sphaeroidal diagenetic concretions of ferruginous carbonate, Witte Wall 171 (Hammer = 30 cm).

Figure 16: Stream bed exposure of gently-dipping, dark grey-green Tierberg Formation mudrocks along the Klein-Droëlaagte drainage line, northern margins of Hoek Doornen 172. The Ecca bedrocks here are mantled by oligomict alluvial gravels and younger sandy alluvium.

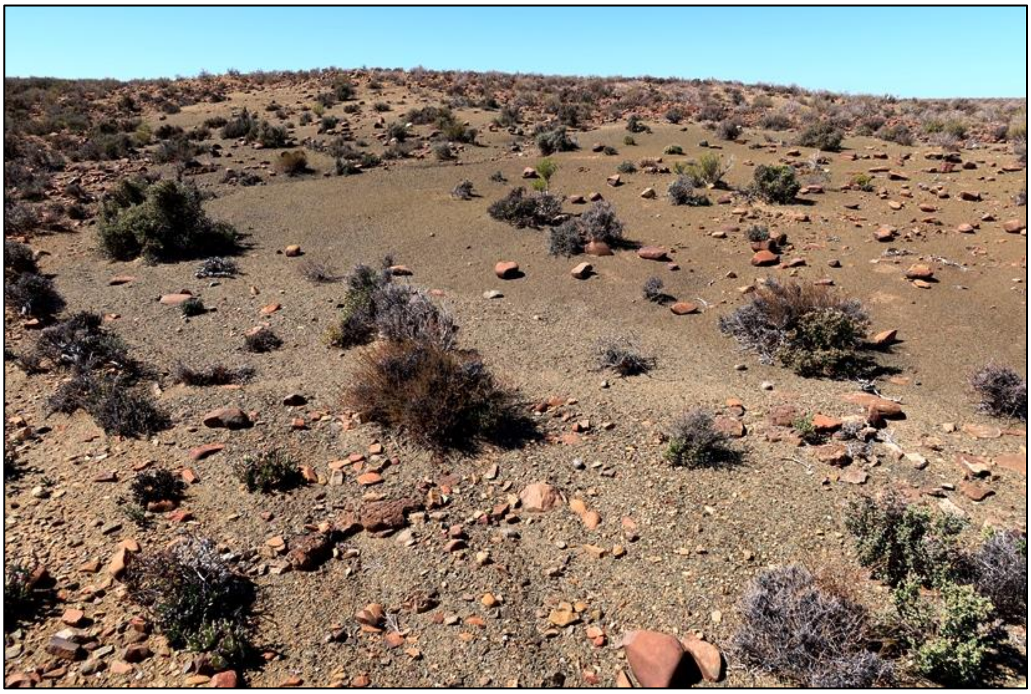


Figure 17: Friable weathered mudrocks with thin ferruginous carbonate lenses of the Tierberg Formation intermittently exposed along a low scarp between adjoining pediment surfaces, Hoek Doornen 172.

Figure 18: Limited exposure of weathered Tierberg Formation bedrocks along an erosion gulley through alluvial gravels and overlying sandy soils, southern margins of pediment surface on Hoek Doornen 172.

Figure 19: Narrow, rusty-brown, weathered dolerite dyke with pale veins of bladed sparry calcite extending across the boundary between Witte Wall 171 and Karee Kolk 174 (Hammer = 30 cm).

Figure 20: Thick, heavily-calcretised fluvial gravels with subordinate lenticular beds of gritty sandstone exposed along the southern bank of the Grootrivier on Witte Wall 171 (Hammer = 30 cm). The gravels contain sparse clasts of pale grey Matjiesfontein chert, some of which might be flaked artefacts, but this is equivocal.

Figure 21: Calcretised rubbly alluvial gravels along the edge of the lowermost pediment surface north of the Grootrivier on Karee Kolk 174 (Hammer = 30 cm). Many of the cobble-sized wacke clasts are moderately well-rounded.

Figure 22: Block-weathering, sparely-gravelly, pale brown calcretised alluvial sands locally capping the southern bank of the Grootrivier on Witte Wall 171 (Hammer = 30 cm). These sandy deposits pass downwards and laterally into coarse alluvial High Level Gravels.

Figure 23: Rubbly to nodular calcrete hardpan exposed along the crest of a low scarp between successive flat-topped pediment surfaces on Witte Wall 171.

Figure 24: Distinctive oligomict, coarse, unconsolidated gravels rich in chert clasts as well as ESA bifaces and occasional petrified wood blocks, Klein-Droëlaagte on Grootfontein 149. The gravels directly overlie Tierberg mudrocks and are mantled by unconsolidated sandy alluvium.

Figure 25: Close-up of oligomict gravels exposed along the Klein-Droëlaagte similar to those seen in previous figure (but here on Hoek Doornen 172) showing abundance of flaked ESA artefacts of brownish silcrete and grey Matjiesfontein chert (Scale is *c.* 15 cm long).

Figure 26: Calcretised, possibly cross-bedded lens of fine gravelly to gritty alluvium overlying Tierberg Formation bedrocks on the banks of the Klein-Droëlaagte, Grootfontein 149 (Hammer = 30 cm). These beds may be similar in age to the unconsolidated coarse oligomict gravels found along the same drainage line (*cf* Figure 24).

Figure 27: Pale, gullied, unconsolidated Recent sandy alluvium along the southern banks of the Klein-Droëlaagte on Hoek Doornen 172.

Figure 28: Section through the younger sandy alluvium with sparse dispersed gravel clasts overlying Tierberg Formation bedrocks, banks of the Klein-Droëlaagte on Hoek Doornen 172 (Hammer = 30 cm).

Figure 29: Poorly-sorted, oligomict downwasted surface gravels dominated by brownish-patinated Ecca wacke clasts and pale sandy soils that typically blanket the flat to gently-sloping pediment surfaces long the Grootrivier, seen here on Hoek Doornen 172.

Figure 30: Close-up of pediment gravels on Witte Wall 171 in an area showing a preponderance of pale grey to brownish silcrete clasts, many of which are anthropogenically flaked (Scale in cm). Small water-worn blocks or pebbles of silicified wood may occur in such areas (*cf* Figure 48).

Figure 31: Open, unvegetated area of pediment surface on Witte Wall 171 showing mantle of sandy alluvial soils and thin veneer of fine sheetwash gravels.

Figure 32: Close-up of angular to subrounded sheetwash gravels seen in the previous figure (Scale in cm and mm), Witte Wall 171. The clasts are largely of resistant-weathering lithologies including silicified mudrocks, cherts, occasional Dwyka erratics with sparse small blocks of petrified wood.

Figure 33: Patch of pale sandy soils on a pediment surface on Witte Wall 172 showing development of nodular calcrete and animal burrowing typical of these *heuweltjie* areas – possibly associated with ancient termite activity and / or bush clumps.

Figure 34: Patches of thick, fine sandy soils with distinctive shrubby vegetation and no gravels, such as seen here mantling gentle north-facing pediment slopes on Hoek Doornen 172, represent alluvial sands deflated from the bed of the Grootrivier by winds.

Figure 35: Large-scale sand dunes with typical low-angle aeolian cross-bedding exposed on the bed of the Grootrivier on Witte Wall 171.

Figure 36: Younger alluvial deposits exposed along the northern bank of the Grootrivier on Hoek Doornen 172, including well-rounded, cobbly to pebbly basal gravels and well-bedded overlying sandy deposits (Hammer = 30 cm).

Figure 37: Thin carpet of angular cherty colluvial gravels downwasted from the Collingham Formation and mantling a gently-sloping pediment surface on the southern sector of Hoek Doornen 172. The gravels include a sparse background scatter of flaked stone artefacts.

5. PALAEONTOLOGICAL HERITAGE

Fossil assemblages that have been recorded elsewhere from the various Karoo Supergroup and Late Caenozoic rock units represented within the proposed solar PV facility and power line project areas are outlined in Table 1 below. They have been treated, with extensive references, in several previous combined desktop and field-based palaeontological assessment studies for the Ceres Karoo region by the present author dealing with electrical infrastructure projects (*e.g.* Kappa Substation, Gamma – Omega transmission line) as well as renewable energy projects in the Ceres Karoo such as the Perdekraal Wind Energy Facility (WEF), Rietkloof WEF, Kolkies WEF and Karee WEF projects (See References under Almond). New fossil sites recorded during the recent palaeontological field survey of the proposed solar PV and power line facility project areas are listed together with GPS data and comments as well as proposed field ratings in Appendix A while numbered fossil localities are shown on the satellite maps in Figures 53 and 54. For sectors of the associated power line corridor between Witte Wall 171 and the Kappa Substation, field observations from several previous PIA studies by Almond (2010a-d, 2016a) have been taken into consideration as well as a recent site visit to Die Brak 241 for another renewable energy project (Almond in prep., 2020).

All of the sedimentary formations enumerated in Table 1 are potentially fossiliferous, although only three are considered to be generally or potentially of moderate to high palaeontological sensitivity (Theron *et al.,* 1991, Almond 2008a, 2008b, Almond & Pether 2008). Fossils within the glacially-influenced **Dwyka Group** succession are rare and mainly confined to thin interglacial or post-glacial facies, with the notable exception of occasional ice-rafted limestone or dolomite erratics, examples of which containing Cambrian archaeocyathids (fossil sponges) and trilobites have been recorded from the southern margins of the Great Karoo and Namibia. A small boulder of stromatolitic limestone or dolomite of probable Precambrian or Cambrian age from the Dwyka tillite is recorded from Sadawa 238, adjoining Platfontein 240 on the west, by Almond (2016a). No further fossiliferous carbonate erratics were encountered during recent fieldwork.

An important fossiliferous interval occurs within the lowermost **Prince Albert Formation**; fossil fish, molluscs and petrified wood have been recorded here in the Tanqua Karoo and the Northern Cape. A few small blocks of silicified wood displaying fine seasonal growth rings were recorded from surface gravels overlying the Prince Albert Formation in the Kolkies WEF study area by Almond (2016a) but their stratigraphic provenance is ambiguous; they have probably been reworked from younger Ecca Group formations. A fragment of a sizeable petrified trunk with fine growth rings from the SW Tanqua Karoo is displayed at the Doringrivier homestead (Pretorius Kraal 237) to the NW of Die Brak 241. The provenance is uncertain, but it probably also comes from the lower Ecca Group.

The **Whitehill Formation** is famous for its well-preserved skeletons of intact mesosaurid reptiles and palaeoniscoid bony fish, as well as prolific small crustaceans. However, these carbonaceous mudrocks are highly weathered and secondarily mineralised near-surface within the study area (Fig. 11), with little exposure of fresh bedding planes. No fossils were recorded from the Whitehill bedrocks, including the prominent-weathering, large dolomitic concretions and lenses, during the present field survey.

The overlying **Collingham Formation** along the southern Great Karoo margins is well-known for rare well-preserved petrified logs and trackways of giant eurypterids (water scorpions). Occasional small blocks of petrified wood occur among downwasted cherty Collingham gravels on Hoek

Doornen 172 (Fig. 47), close to exposures of the Matjiesfontein chert, although the Collingham Formation is not mapped here. Small cylindrical burrows infilled with pale ash that contrasts with the dark mudrock matrix are found along the contacts of thin tuff horizons on Witte Wall 171 (Fig. 43). The only other fossils seen this formation within the Ceres Karoo are dense but low-diversity assemblages of horizontal burrows that are widely recorded elsewhere along the southern Karoo margins (Fig. 42) (Almond 2016a).

The basinal and distal submarine fan mudrocks of the **Tierberg Formation** are characterised by a range of interesting trace fossils and drifted plant material of the *Glossopteris* Flora (*e.g.* stems, leaves and segmented roots of *Glossopteris* trees); animal body fossils (*e.g.* palaeoniscoid fish) are very rare, however. Apart from occasional fragmentary rusty-brown compressions of wood remains within siltstone exposed close to the Grootrivier (J. Orton., pers. comm. 2020), fossil plant material was not observed *in situ* in the PV facility project area. Low diversity assemblages of simple horizontal burrows can be seen within dark Tierberg mudrocks along the banks of the Grootrivier on Witte Wall 171 (Fig. 39) as well as along the Klein-Droëlaagte on Hoek Doornen 172 (Fig. 40). These trace fossils are widely-occurring forms of no special conservation significance, however. Complex cone-in-cone structures developed within diagenetic concretions of ferruginous carbonate in the Tierberg Formation have frequently been mistaken for fossil stromatolites but are actually pseudofossils (Fig. 41). The same applies to dendrites - moss- or fern-like growths of the manganese psilomelane commonly seen on bedding planes and fracture surfaces of Tierberg wackes.

Older **alluvial gravels,** such as the calcretised, downwasted and sheet-washed pediment gravels along the margins of the Grootrivier, contain a sparse background scatter of small blocks of resistant-weathering silicified wood reworked from the Ecca Group bedrocks (Figs. 46 & 48). The blocks are various angular to water-worn and are generally only a few cm in maximum diameter. The wood shows well-developed seasonal growth lines, as typically seen in the high-palaeolatitude Karoo Basin. Some, and perhaps the majority, of the silicified wood specimens encountered within surface gravels within the project area come from the Tierberg Formation. Given the extensive catchment area of the Grootrivier and its tributaries, it is possible that some of the petrified wood comes from the Mid-Permian Waterford Formation (Ecca Group) which is known to contain well-preserved fossil logs in the Klein-Roggeveldberge region (*cf* Almond 2018) or from the Collingham Formation as previously discussed. It is noted that a high proportion of the fossil wood blocks recorded during the recent field survey – including one small log - come from the distinctive coarse, oligomict alluvial gravels found along the Klein-Droëlaagle drainage line where they are associated with abundant silcrete clasts (including common ESA bifaces) (Figs. 44 & 45). Where concentrations of silcrete clasts are found on the pediment surfaces away from modern water courses, float blocks of petrified wood (and stone artefacts) often occur here as well, suggesting the possible presence of buried ancient channel conglomerates at these sites. Given its uncertain provenance and widespread occurrence within surface gravels in the region, the scientific and conservation value of the petrified wood material encountered is rated as low and no special mitigation measures are proposed for the known fossil sites. The sites along the Klein-Droëlaagle drainage line will be protected within the riverine buffer zone (Fig. 54).

Large (several dm diameter), sphaeroidal, calcretised subterranean termitaria (termite nests) with finely-spaced ribbing on the inner surface (marginal supports for the delicate fungus-garden combs) and porous outer walls have been reported from a number of localities in the semi-arid Western and Northern Cape where they may be embedded within saprolite (weathered bedrock) of

a wide range of ages. The complex wavy-laminated internal structure of the thick nest wall is well seen on fractured surfaces. Several partial specimens and broken fragments of fossil nests were recorded within or near the proposed project area in the Ceres Karoo where they are found weathering-out from weathered, calcrete-veined Tierberg Formation mudrocks and overlying calcretised pediment sediments close to the scarp edges (Figs. 49 to 52). Some of these nests may have originally been built several meters below the ground surface while the ill-defined calcrete "veins" in the vicinity might in part be fossilised termite tunnels. The age of the fossil nests is unclear; they may well reflect termite activity during cool, dry episodes within the Pleistocene Epoch which may have supported a more grassy vegetation than found locally today. The dense pattern of *heuweltjies* seen in satellite images of the Ceres Karoo pediment surfaces may be related to the activities the same termites. The preferential development of calcretised soils within the *heuweltjies* could be an indirect consequence of their biological activity.

Finer-grained **alluvium** may host Pleistocene to recent mammal bones, teeth and horn cores as well as distinctive calcretised fossil termite nests and other burrows. Fossils previously recorded within the superficial deposits in the Ceres Karoo region comprise (1) isolated small blocks of reworked petrified wood within surface gravels (see above), and (2) bioturbated horizons within calcretised sandy alluvium along the banks of the Grootrivier (Almond 2016a). The trace fossils concerned in the second case might be rhizoliths (calcretised root casts) and / or invertebrates; they are probably of Pleistocene age.

Given (1) the scarcity of unique or scientifically-valuable fossils recorded during the field-based scoping assessment of the proposed solar PV facility and power line project areas, as well as (2) the paucity of fossil remains recorded during previous PIA studies in the Ceres Karoo region (See References under Almond) it is concluded that these areas are of low palaeontological sensitivity. The fossil material recorded – principally (1) low-diversity trace fossil assemblages within the Ecca Group, (2) sparse, widely-dispersed and mostly small, reworked blocks of petrified wood of uncertain stratigraphic provenance within surface and alluvial gravels, and (3) calcretised termite nests of probable Pleistocene age – is of widespread occurrence along the SW Karoo margins and not of any special scientific or conservation value. No fossil sites of high palaeosensitivity of No-Go areas were identified during the field survey. No special mitigation measures are recommended for the recorded fossil sites, all of which are assigned a low provisional field rating (See table in Appendix A).

- **Palaeontological heritage site sensitivity verification**

The palaeosensitivity map generated by the Department of Environment, Forestry and Fisheries (DEFF) screening tool for the combined proposed solar PV facility and associated power line project area is provided in Figure 38. According to this map, the project area includes regions of (1) medium sensitivity towards the north, corresponding largely to the Tierberg Formation outcrop area, (2) high sensitivity towards the south, corresponding to the Dwyka Group outcrop area, and (3) a central band with unspecified sensitivity which corresponds to the folded Lower Ecca Group outcrop area.

On the basis of (1) the recent palaeontological field survey for the proposed solar and power line projects as well as (2) several desktop- and field-based previous PIA studies in the Ceres Karoo (notably Almond 2010a-c, 2016a, 2018, 2020), the screening tool map is disputed and *rejected* here as an accurate reflection of palaeosensitivity within the present study area. The main reasons for this are:

- The inaccurate overlay of the project area on the palaeosensitivity map (which is based primarily on the relevant 1: 250 000 geological maps);
- The Dwyka Group (indicated in red) is generally regarded as of LOW palaeosensitivity whereas the Tierberg Formation is of MEDIUM sensitivity, at most. Field data for the proposed project suggest a LOW palaeosensitivity for the Tierberg Formation outcrop area here due to weathering and extensive cover by low-sensitivity calcrete, gravels and soils.
- Potentially-sensitive rock units such as the basal Prince Albert Formation and Whitehill Formation are not rated on the map (Field data suggests these are generally of LOW palaeonsensivity in this region, mainly due to weathering and cleavage development).
- The map does not address the Late Caenozoic sediments that mantle the bedrocks in the project area, and in particular the pediment gravels (ancient alluvium) underlying almost the entire solar PV study areas as well as younger alluvium along the Grootrivier and its tributaries. Almost all the new fossil occurrences noted during the recent field survey were found in such settings. However, these fossils are generally of low conservation value and the palaeosensitivity of the Late Caenozoic sediments is according rated as LOW.

It is concluded that the entire combined project area for the proposed solar PV facilities and associated power line to Kappa Substation is in practice of LOW palaeosensivity. Potentially fossiliferous rock units such as the Prince Albert and Whitehill Formations are too weathered and tectonically deformed (cleaved) to contain scientifically valuable fossils in the project area. No significant, conservation-worthy fossil sites or palaeontological No-Go areas were recorded during the field survey.

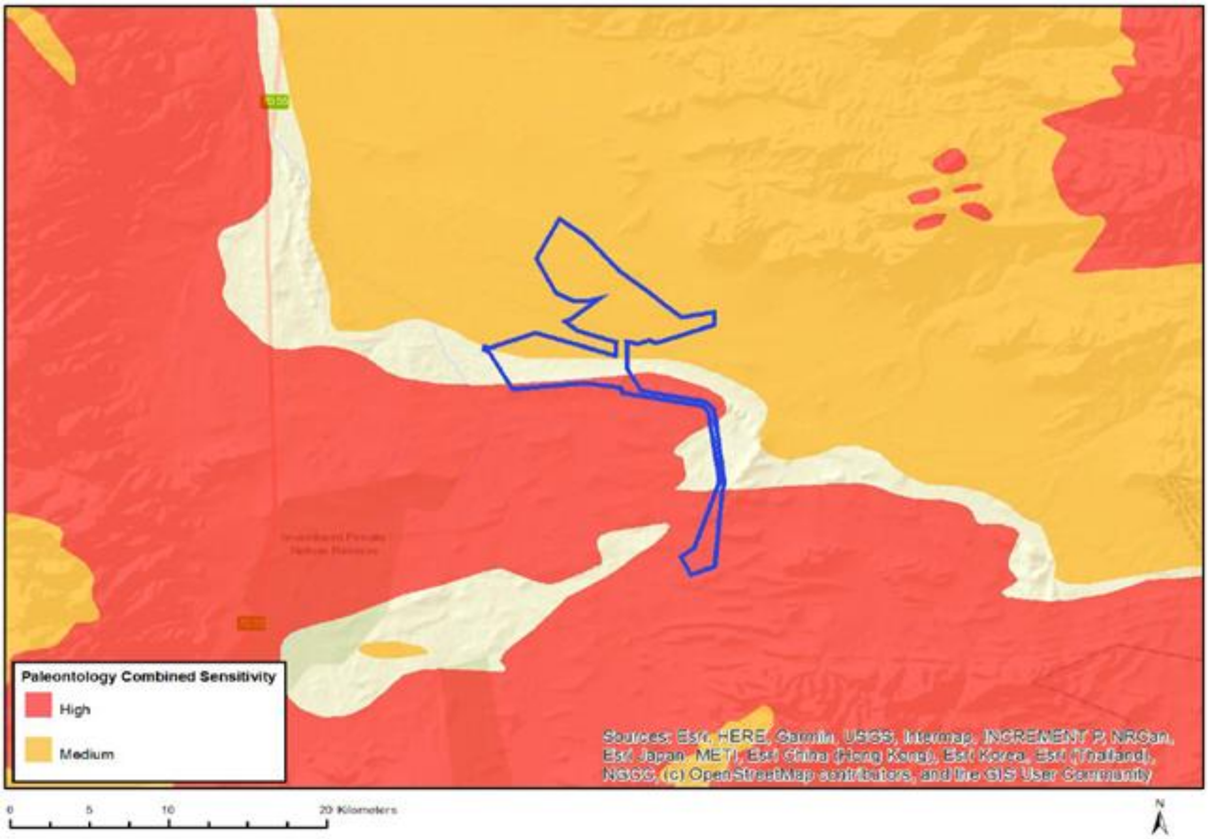


Figure 38: Palaeosensitivity map for the combined solar PV facility and associated power line project area (blue polygon) produced from the DEFF screening tool. Data from several recent field surveys as well as desktop studies indicate that in practice the project area is of LOW palaeosensitivity.

Figure 39: Low diversity assemblages of simple, straight to sinuous horizontal endichnial burrows (*c*. 4 mm wide) on rare bedding plane exposures of the Tierberg Formation, south bank of the Grootrivier, Witte Wall 171 (Loc. 149).

Figure 40: Cylindrical to flattened horizontal, straight to gently-curved burrows (1-2 cm wide, arrowed) with distinctive longitudinal surface ridges or wrinkles (*cf Palaeophycus*), Tierberg Formation exposures in bed of Klein-Droëlaagte, Hoek Doornen 172 (Loc. 122).

Figure 41: Weathered-out, oblate diagenetic concretions of ferruginous carbonate from the Tierberg Formation showing stromatolite-like cone-in-cone structures (pseudofossils), bed of the Klein-Droëlaagte on Hoek Doornen 172 (Scale *c*. 15 mm long).

Figure 42: Typical dense, low-diversity assemblage of horizontal burrows (*c*. 2-3 mm across) preserved within silicified mudrocks of the Collingham Formation (Witte Wall 171) (From Almond 2016a).

Figure 43: Small (1-2 mm diameter) ash-infilled invertebrate burrows (arrowed) close to the interface with a pale cream tuff horizon, Collingham Formation (Witte Wall 171) (From Almond 2016a).

Figure 44: Coarse silcrete gravels and associated reworked petrified wood block from the bed of the Klein-Droëlaagte on Grootfontein 149 (Loc. 165) (Scale in cm).

Figure 45: Portion of a small petrified log showing well-developed seasonal growth lines recorded among oligomict, silcrete gravels in the bed of the Klein-Droëlaagte on Grootfontein 149 (Loc. 169) (Scale in cm).

Figure 46: Collection of small angular to slightly rounded blocks of petrified wood from sheetwash surface gravels on Hoek Doornen 172 (Loc. 128) (Scale in cm and mm).

Figure 47: Small block of petrified wood showing prominent seasonal growth rings recorded close to an exposure of Matjiesfontein chert and so possibly from the Collingham Formation (not mapped here), Hoek Doornen 172 (Loc. 150) (Scale in cm and mm).

Figure 48: Small, well-rounded (water-worn) clasts of silicified wood from pediment surface gravels on Witte Wall 171 (Loc. 132) where they occur in possible association with silcrete-rich older alluvial gravels (Scale in cm and mm).

Figure 49: *In situ* large sphaeroidal calcretised termitarium (yellow dashed area) still largely buried within calcretised pediment gravels with detached blocks extending downslope in float, Grootfontein 149 (Loc. 158) (Scale is *c*. 15 cm long).

Figure 50: Close-up of fragment of calcretised termitarium wall showing the distinctive wavy or zigzag pattern of the fine internal lamination. Block is c. 10 cm across. Same locality as previous figure.

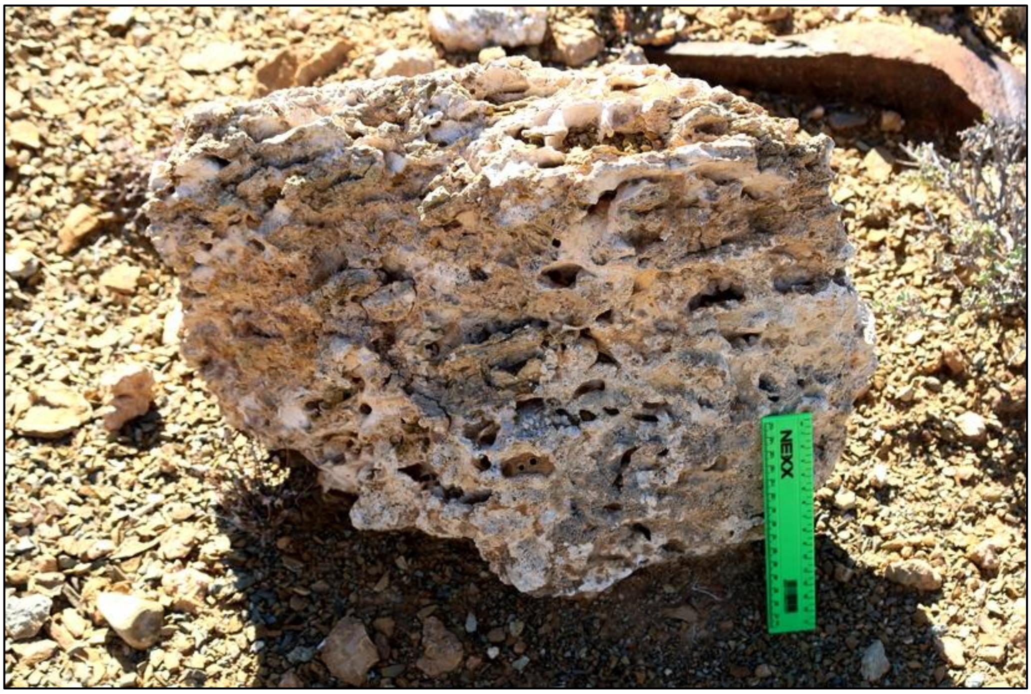


Figure 51: Porous outer surface of a partially weathered-out sphaeroidal termitarium originally embedded within weathered Tierberg Fromation mudrocks on the northern banks of the Grootrivier, Karee Kolk 174 (Scale is *c*. 15 cm long).

Figure 52: Finely-ribbed inner surface of the calcretised termitarium illustrated above (Scale is *c*. 15 cm long). The ribs would have originally supported closely-spaced shelves of the termite colony's fungus garden.

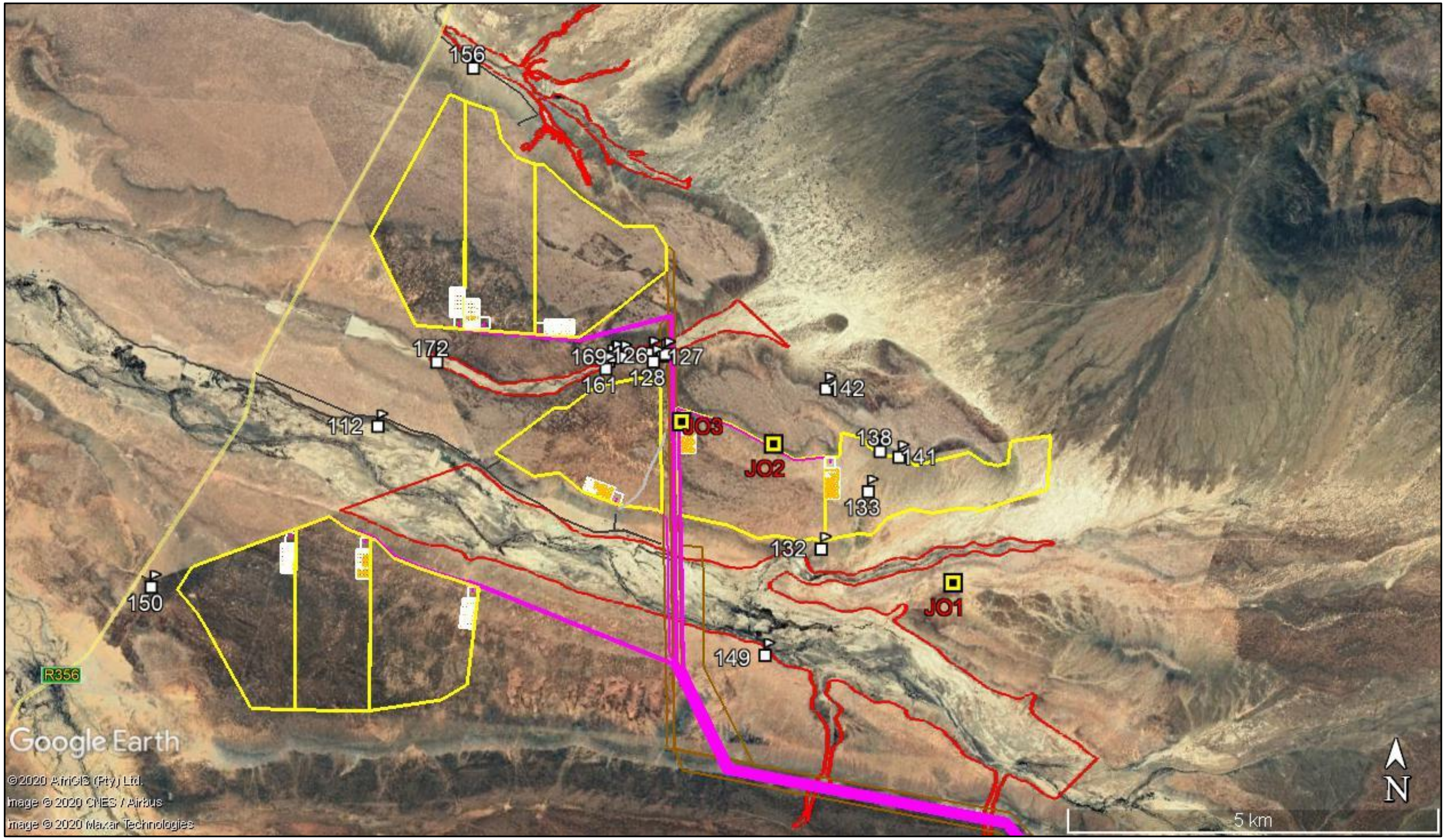


Figure 53: Google Earth© satellite image of the solar PV facility project areas (yellow polygons) with associated power lines (pink) in the corridor linking to the existing Eskom Kappa Substation. The numbered squares show new fossil sites, most of which are associated with drainage line exposures falling in No-Go areas *outside* the project footprint (See Appendix A for details of fossil sites). None of these sites (which represent only a small fraction of potential fossil sites in the area) are considered to be of high scientific or conservation value and no recommendations for their mitigation are proposed here.

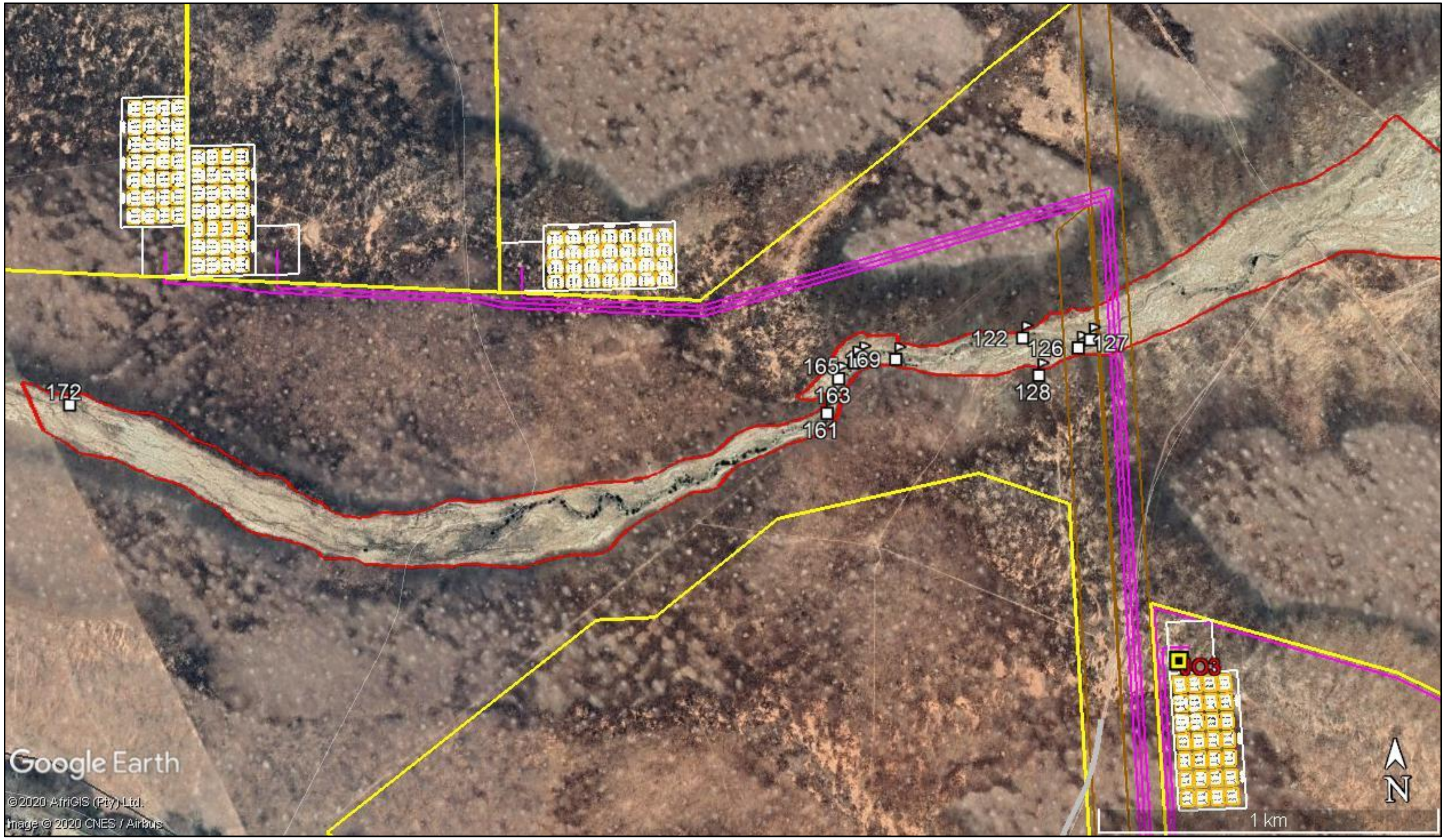


Figure 54: Google Earth© satellite image showing in more detail numbered fossil sites (reworked petrified wood, generally associated with gravels rich in ESA stone artefacts) along the Klein-Droëlaagte drainage line on Witte Wall 171 and Grootfontein 149. These sites lie within a designated No-Go area (identified by the Biodiversity Specialists) and should be protected within the anticipated buffer zone along drainage lines. No recommendations for their mitigation are therefore proposed here.

Table 1: Summary of known fossil record of the main sedimentary rock units represented in the proposed solar PV facility and power line study area. Note that palaeontological sensitivity is strongly dependent on local levels of bedrock weathering and tectonic deformation (*e.g.* cleavage).

GROUP	FORMATION & AGE	FOSSIL BIOTAS	PALAEONTOLOGICAL SENSITIVITY
SUPERFICIAL DEPOSITS	**High Level Gravels, alluvium, colluvium, pedocretes (*e.g.* calcrete)** **LATE TERTIARY TO RECENT**	Bones and teeth of wide range of mammals, including mammals (*e.g.* teeth & bones of mastodont proboscideans, rhinos, bovids, horses, micromammals), reptiles (crocodiles, tortoises), ostrich egg shells, fish, freshwater and terrestrial molluscs (unionid bivalves, gastropods), crabs, trace fossils (*e.g.* termitaria, horizontal invertebrate burrows, stone artefacts), reworked petrified wood, leaves, rhizoliths, diatom floras, peats and palynomorphs.	**LOW (but may be locally HIGH)**
ECCA GROUP	**Tierberg Formation** **E-M PERMIAN**	Rare palaeoniscoid fish, disarticulated microvertebrate remains (*e.g.* fish teeth, scales), sponge spicules, sparse vascular plants (esp. leaves, roots of glossopterids), silicified wood, low to moderate diversity trace fossil assemblages (*e.g.* large ribbed pellet burrows, arthropod scratch burrows, *Siphonichnus etc*).	**LOW-MODERATE**
	Collingham Formation **EARLY PERMIAN**	Low diversity but locally abundant ichnofaunas (horizontal "worm" burrows, arthropod trackways, including those of giant eurypterids), vascular plant remains (petrified and compressed wood, twigs, leaves *etc*).	**MODERATE**
	Whitehill Formation **EARLY PERMIAN**	Mesosaurid reptiles, rare cephalochordates, variety of palaeoniscoid fish, small eocarid crustaceans, insects, low diversity of trace fossils (*e.g.* king crab trackways, possible shark coprolites), palynomorphs, petrified wood and other sparse vascular plant remains (*Glossopteris* leaves, lycopods *etc*).	**HIGH**
	Prince Albert Formation **EARLY PERMIAN**	Low diversity marine invertebrates (bivalves, nautiloids, brachiopods), palaeoniscoid fish, sharks, fish coprolites, protozoans (foraminiferans, radiolarians), petrified wood, palynomorphs (spores, acritarchs), non-marine trace fossils (especially arthropods, fish, also various "worm" burrows), possible stromatolites, oolites.	**MODERATE**
DWYKA GROUP	**Elandsfontein Formation** **LATE CARBONIFEROUS TO EARLY PERMIAN**	Interglacial mudrocks occasionally with low diversity marine fauna of invertebrates (molluscs, starfish, brachiopods, coprolites *etc*), palaeoniscoid fish, petrified wood, leaves (rare) and palynomorphs of *Glossopteris* Flora. Well-preserved non-marine ichnofauna (traces of fish, arthropods) in laminated mudrocks. Possible stromatolites, oolites at top of succession. Limestone erratics with Cambrian archaeocyathid sponges, trilobites, small stromatolites.	**LOW**

6. PALAEONTOLOGICAL HERITAGE IMPACT ASSESSMENT

The anticipated impact significance of the proposed solar PV facilities and associated power lines on local fossil heritage resources is evaluated in Table 3 below. The assessment applies equally to all nine of the 175 MW Solar Photovoltaic (PV) power generation facilities as well as to the associated power lines.

The *key impacts* on local palaeontological heritage resources considered here are *direct* and concern:

- the potential disturbance, damage, destruction or sealing-in of scientifically-important and legally-protected fossils preserved at or beneath the surface of the ground due to construction phase excavations (*e.g.* PV module footings, building foundations, power line pylon footings, underground cables, stormwater channels), and ground clearance (*e.g.* access roads, solar arrays).

This assessment applies only to the *construction phase* of the developments since further significant impacts on fossil heritage during the planning, operational and decommissioning phases of the facilities are not anticipated.

In general, the destruction, damage or disturbance out of context of fossils preserved at the ground surface or below ground that may occur during construction represents a *direct*, *negative* impact that is limited to the development footprint (*site specific*). Such impacts can usually be mitigated but cannot be fully rectified or reversed (*i.e. permanent, irreversible*). Most of the sedimentary formations represented within the study area contain fossils of some sort, so impacts *at some level* on fossil heritage are *very likely*. However, most fossil occurrences encountered within the project footprint occur widely within the study region (*i.e. not unique / irreplaceable*) and are not considered to be of great scientific significance. Exceptional fossils such as well-preserved, well-articulated vertebrate skeletons, vertebrate trackways or substantial petrified logs that are scientifically valuable and conservation-worthy appear to be very rare in the study area. The probability of loss of such conservation-worthy fossil heritage due to the proposed development is considered to be *low*. This is because of (a) the very sparsely-scattered distribution of exceptional, well-preserved fossils within the bedrocks as well as within the overlying superficial sediments (*e.g.* older alluvium, surface gravels), (b) the mantling of the bedrocks with thick superficial sediments in most areas, so that major impacts on potentially-fossiliferous fresh (*i.e.* unweathered) bedrock are limited. The consequence of the anticipated impacts on palaeontological heritage is therefore assessed as *slight* without mitigation. The significance of slight but high (i.e. very likely) probability impacts on fossil heritage resources that are restricted to the development footprint and of permanent duration is rated as *very low (negative)* without mitigation.

Levels of confidence for this impact assessment are *medium* given (1) the unpredictable occurrence of well-preserved, scientifically-valuable fossils, (2) the limited scope and number of field-based palaeontological studies carried out in the broader region and (3) the low levels of bedrock exposure within the development footprint.

It should be noted that, should the recommended mitigation measures for the construction phase of the solar PV and power line developments (Section 7) be fully and consistently

implemented, the impact significance would remain *very low* but would entail both positive and negative impacts (Table 3). Residual negative impacts from inevitable loss of some fossil heritage would be partially offset by an improved palaeontological database for the study region as a direct result of appropriate mitigation. This is a *positive* outcome because any new, well-recorded and suitably-curated fossil material from this palaeontologically little-known region would constitute a useful addition to our scientific understanding of South African fossil heritage.

6.1. Assessment of cumulative impacts

A number of renewable energy and electrical infrastructure projects have been proposed for the Ceres Karoo region within a radius of 30 km of the project areas for the proposed solar PV facility and power line projects. Field-based palaeontological heritage assessments for these projects have been conducted by the author and palaeontological colleagues (*cf* PIAS for the Perdekraal East, Kolkies, Karee, Rietkloof / Indyebo, Tooverberg WEFs by Almond 2015, 2016a, 2016b, 2018 and Butler 2018). In addition, several further new solar energy facility and WEF project proposals (*e.g.* Pienaarspoort 1 WEF and Pienaarspoort 2 WEF) are currently being assessed in the Ceres Karoo area (Almond 2020 and two additional solar facility studies in progress). A tentative assessment of the potential cumulative impacts of the proposed projects in the context of these other developments (not all of which may be granted environmental authorisation) is provided in Table 4. This assessment provided here applies equally to all of the Veronica project components (PV solar facilities, power lines) considered individually and in conjunction.

It is noted that cumulative impact assessments only have real meaning if comparable resources are considered (*e.g.* fossil assemblages in the same geological formations), while developments other than renewable energy projects (*e.g.* borrow pits, roads, power lines) are also relevant (*cf* Almond 2010a-c for the Eskom Gamma-Omega 765kV transmission line and Kappa Substation). Several renewable energy developments in the Klein Roggeveldberge and Cape Fold Mountains which respectively affect Permian continental fossils within the Lower Beaufort Group and Devonian marine fossils within the Cape Supergroup are *not* considered to be relevant here. Furthermore, the cumulative impact assessment assumes – rather optimistically - that all the relevant palaeontological mitigation measures recommended for the authorised renewable energy projects considered are fully implemented.

Given the generally Low, but not negligible, impact significance assigned to the various *relevant* renewable energy developments in the Ceres Karoo listed above, as well as the Very Low impact significance assessed here for each of the nine proposed PV and power line developments themselves, a LOW (negative) cumulative impact significance for the latter projects is suggested in the absence of mitigation. Should the various mitigation measures proposed for these projects be fully implemented, the cumulative impact significance may fall to VERY LOW (negative). It is concluded that as far as fossil heritage resources are concerned, the proposed solar facility and power line projects, whether considered individually or together, will *not* result in an unacceptable loss or unacceptable additional impacts, considering all the authorised renewable energy projects proposed in the area.

6.2. Impact Assessment Summary

A summary of the overall impact significance findings (following mitigation) for the proposed solar facility and power line projects is provided in Table 2 below.

Table 2: Overall Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	Very Low
Operational	Not applicable
Decommissioning	Not applicable
Loss of palaeontological heritage	**Overall Impact Significance**
Cumulative - Construction	Very Low
Cumulative - Operational	Not applicable
Cumulative - Decommissioning	Not applicable

Table 3: Impact assessment summary table for the Construction Phase of each solar PV facility and associated power line [No further impacts anticipated during operational and decommissioning phases]

<table>
<tr><th>Impact</th><th colspan="2">Impact Criteria</th><th>Significance and Ranking (Pre-Mitigation)</th><th>Potential mitigation measures</th><th>Significance and Ranking (Post-Mitigation)</th><th>Confidence Level</th></tr>
<tr><td colspan="7">CONSTRUCTION PHASE</td></tr>
<tr><td rowspan="7">Disturbance, damage or destruction of fossils within the development footprint due to excavations and surface clearance</td><td>Status</td><td>Negative</td><td rowspan="7">Very low impact (5)</td><td rowspan="7">Monitoring for fossil remains on on-going basis by the Environmental Control Officer (ECO) during the construction phase. See Chance Fossil Finds Procedure (Appendix C and EMPr)</td><td rowspan="7">Very low impact (5)</td><td rowspan="7">Medium</td></tr>
<tr><td>Spatial Extent</td><td>Site specific</td></tr>
<tr><td>Duration</td><td>Permanent</td></tr>
<tr><td>Consequence</td><td>Slight</td></tr>
<tr><td>Probability</td><td>Very likely</td></tr>
<tr><td>Reversibility</td><td>Non-reversible</td></tr>
<tr><td>Irreplaceability</td><td>Low</td></tr>
</table>

Table 4: Cumulative impact assessment summary table for each solar PV facility and associated power line in the context of the other proposed solar projects as well as other renewable energy developments in the area (≤ 30 km radius)

<table>
<tr><th>Impact</th><th colspan="2">Impact Criteria</th><th>Significance and Ranking (Pre-Mitigation)</th><th>Potential mitigation measures</th><th>Significance and Ranking (Post-Mitigation)</th><th>Confidence Level</th></tr>
<tr><td colspan="7">CONSTRUCTION PHASE</td></tr>
<tr><td rowspan="7">Disturbance, damage or destruction of fossils within the development footprint due to excavations and surface clearance</td><td>Status</td><td>Negative</td><td rowspan="7">Low impact (4)</td><td rowspan="7">Monitoring for fossil remains on on-going basis by the ECO during the construction phase. See Chance Fossil Finds Procedure (Appendix C and EMPr)</td><td rowspan="7">Very low impact (5)</td><td rowspan="7">Medium</td></tr>
<tr><td>Spatial Extent</td><td>Site specific</td></tr>
<tr><td>Duration</td><td>Permanent</td></tr>
<tr><td>Consequence</td><td>Moderate</td></tr>
<tr><td>Probability</td><td>Very likely</td></tr>
<tr><td>Reversibility</td><td>Non-reversible</td></tr>
<tr><td>Irreplaceability</td><td>Low</td></tr>
</table>

7. MONITORING AND MITIGATION MEASURES FOR INCLUSION IN THE EMPr

Since unique, scientifically-valuable, conservation-worthy fossils are rare within the proposed solar facility and power line project areas, no further specialist palaeontological studies, monitoring or mitigation is recommended for this development, pending the potential discovery of significant new fossil material during the construction phase.

The following monitoring and mitigation measures are recommended for the construction phase of the developments, for inclusion in the EMPrs:

- Monitoring for fossil material of all major surface clearance and deeper (>1m) excavations by the Environmental Control Officer (ECO) on an on-going basis during the construction phase.

- Significant fossil finds should be safeguarded and reported at the earliest opportunity to Heritage Western Cape for recording and sampling by a professional palaeontologist (Contact details: Heritage Western Cape. Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 086-142 142. Fax: 021-483 9842. Email: hwc@pgwc.gov.za).

- Professional mitigation, involving the recording and judicious sampling of fossil material together with pertinent field data (stratigraphy, taphonomy), should conform to best practice. Fossil material collected must be curated within an approved repository (university or museum collection).

A tabulated summary of recommendations regarding palaeontological heritage for the construction phase of the proposed solar facility and power line developments is provided in Table 5 below. This table applies equally to all proposed solar PV facilities and associated power lines, as well as the grid connection at the Kappa Substation.

A general protocol for Chance Fossil Finds for this project is appended to this report (Appendix C).

There are no palaeontological monitoring or mitigation requirements for the operational and decommissioning phases of the developments.

7.1. Generic EMPr for Power Lines and Substations

Section 5.12 (Protection of Heritage Resources) in the Generic EMPr for Power Lines and Substations (GN 435), gazetted in 2019, adequately covers the generic palaeontological heritage monitoring and mitigation measures appropriate for the proposed solar PV facility power line and substation projects. There are no specific palaeontological heritage management actions that are important and not included in GN 435.

Table 5: Management Plan for the Construction Phase (Including pre- and post-construction activities) [This table applies equally to all solar PV facilities, power lines and substation grid connection]

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Palaeontological heritage					
Disturbance, damage, destruction or sealing-in of scientifically valuable fossil material embedded within bedrock or exposed at ground surface within development footprint.	Safeguarding, recording and sampling of scientifically-important fossil material encountered or exposed during development (Chance Fossil Finds)	a. Monitoring of all bedrock excavations and cleared sites for fossil remains during construction phase. Safeguarding of chance fossil finds.	Regular visual inspection of substantial excavations and cleared areas for fossil remains. Chance fossil finds to be safeguarded (site taped-off or fossils set aside) and reported to Heritage Western Cape (HWC) for possible mitigation.	Ongoing during Construction Phase	ECO
		b. Recording and judicious sampling of exceptional new fossil material and relevant geological data from the development footprint.	Standard palaeontological recording and collection methods (GPS / photos / field notes / careful wrapping of specimens for transport)	Following report of significant new fossil finds by ECO	Professional palaeontologist assisted by ECO
		c. Curation of fossil specimens at an approved repository (e.g. museum).	Cataloging and safe storage of fossils *plus* key field data in an approved repository (museum / university)	Following mitigation	Professional palaeontologist
		d. Final technical report on palaeontological heritage within study area submitted to HWC.	Minimum reporting requirements specified by heritage resources agency (*e.g.* SAHRA / HWC)	Following mitigation and preliminary analysis of fossil finds	Professional palaeontologist

8. CONCLUSIONS AND RECOMMENDATIONS

Given the very similar geological and palaeontological context and scale of each of the nine proposed solar PV facilities and the associated power lines, the impact assessments and mitigation recommendations for each project are identical.

The solar PV facility project area is situated on a flat to gently-sloping pediment surface of Late Caenozoic (Neogene – Pleistocene) age on the flanks of the Grootrivier Valley which drains this sector of the Ceres Karoo. The pediment surface has been planed-off by river erosion into the underlying fine-grained, non-marine, basinal to distal submarine fan sediments of the Tierberg Formation (Ecca Group) that are Middle Permian in age. Field surveys show that the Tierberg bedrocks beneath the thin (few dm to few meters maximum) capping of alluvial gravels, calcrete hardpans, sandy soils and downwasted surface gravels capping the pediment surface are weathered, folded and often tectonically-cleaved. The only fossil remains recorded from such pediment settings in the Ceres Karoo comprise (1) sparse, generally small blocks of reworked silicified fossil wood within alluvial and surface gravels of uncertain provenance (probably Ecca Group) and (2) occasional calcretised fossil termite nests of probable Pleistocene age that are found embedded within calcretised superficial sediments as well as weathered, calcrete-veined bedrocks. The majority of fossil sites recorded fall within designated No-Go areas lying *outside* the project footprint. These fossils are of widespread occurrence within the Ceres Karoo region and are not of high scientific interest or conservation value. No fossil sites of high sensitivity or No-Go areas were identified within the solar PV project areas during the palaeontological field survey and the palaeontological sensitivity of the project area is assessed as generally LOW.

The power line corridor between the solar PV sites and the existing Kappa Substation on Platfontein 240 traverses the outcrop areas of the Permo-Carboniferous, glacial-related Dwyka Group as well as the lower Ecca Group (Prince Albert, Whitehill and Collingham Formations). The potentially-fossiliferous Prince Albert, Whitehill Formations and Collingham Formations are highly weathered and cleaved in this region. No sensitive fossil sites have been recorded within or close to the proposed corridor on Die Brak 241 and Platfontein 240 during the present field survey or several previous field studies in the vicinity by Almond (2010a-c, 2016a) and the palaeontological sensitivity of the corridor is assessed as LOW.

As a consequence of (1) the paucity of irreplaceable, unique or rare fossil remains within the development footprint, as well as (2) the extensive superficial sediment cover overlying most potentially-fossiliferous bedrocks within the solar PV facility and power line project area, the overall impact significance of the construction phase of the proposed solar PV facility regarding legally-protected palaeontological heritage resources is assessed as *VERY LOW* (*negative status*), with and without mitigation. This assessment applies to all the associated solar PV facility and power line infrastructure within the project area. No significant further impacts on fossil heritage are anticipated during the operational and decommissioning phases of the solar PV energy facility and associated infrastructure. The No-Go alternative (*i.e.* no solar PV facility and power line development) will probably have a neutral impact on palaeontological heritage. Confidence levels for this assessment are MEDIUM, given the generally low exposure levels of potentially-fossiliferous bedrocks.

Anticipated cumulative impacts in the context of other renewable energy projects in the Ceres Karoo region – *including* the nine proposed solar PV facilities and power lines - are assessed as *LOW (negative)* without mitigation but *VERY LOW (negative)* with mitigation. It is concluded that as far as fossil heritage resources are concerned, the proposed solar facility and power line projects, whether considered individually or together, will *not* result in an unacceptable loss or unacceptable additional impacts, considering all the renewable energy projects proposed in the area. This analysis only applies *provided that* all the proposed monitoring and mitigation recommendations made for all these various projects are consistently and fully implemented.

No specialist palaeontological monitoring or mitigation is recommended for this development, pending the potential discovery of significant new fossil material here during the construction phase. The ECO should be made aware of the possibility of important fossil remains (bones, teeth, petrified wood, plant-rich horizons, fossil termitaria *etc.*) being found or unearthed during the construction phase of the development. Monitoring for fossil material of all major surface clearance and deeper (>1m) excavations by the ECO on an on-going basis during the construction phase is therefore recommended. Significant fossil finds should be safeguarded and reported at the earliest opportunity to Heritage Western Cape for recording and sampling by a professional palaeontologist. The palaeontologist concerned will need a Fossil Collection Permit from Heritage Western Cape and all fossil material collected must be properly curated in an approved repository (museum / university collection). These recommendations must be included within the EMPr for the proposed solar PV facility and power line developments. A protocol for Chance Fossil Finds is appended to this report (Appendix C).

There are no identified fatal flaws and no objections on palaeontological heritage grounds to authorisation of the proposed solar PV facilities with its associated power line connections to the Kappa Substation.

9. ACKNOWLEDGEMENTS

I am grateful to Ms Rohaida Abed of the CSIR- Environmental Management Services for commissioning this PIA project, for providing the relevant background information as well as indefatigable editorial and heritage management input. Ms Luanita Snyman van der Walt is thanked for drafting the consolidated geological map of the Ceres Karoo project area. Mnr Claude Bosman of Veroniva (Pty) Ltd is thanked for facilitating the fieldwork very effectively and Dr Jayson Orton of ASHA for helpful discussions regarding heritage management as well as providing additional fossil locality data and photographs. As always, logistical support, companionship and assistance in the field from Ms Madelon Tusenius is greatly appreciated.

10. KEY REFERENCES

N.*B. An extensive list of literature relevant to the palaeontology of the Ceres Karoo / southern Tanqua Karoo region has been provided by Almond (1015a, 2016a, 2018ë).*

ALMOND, J.E. 1998. Trace fossils from the Cape Supergroup (Early Ordovician – Early Carboniferous) of South Africa. Journal of African Earth Sciences 27 (1A): 4-5.

ALMOND, J.E. 2008a. Fossil record of the Loeriesfontein sheet area. Unpublished report for the Council for Geoscience, Pretoria, 32pp.

ALMOND, J.E. 2008b. Palaeozoic fossil record of the Clanwilliam sheet area. Unpublished report for the Council for Geoscience, Pretoria, 49pp.

ALMOND, J.E. 2010a. Eskom Gamma-Omega 765kV transmission line: Phase 2 palaeontological impact assessment. Sector 1, Tanqua Karoo to Omega Substation (Western and Northern Cape Provinces), 95 pp + appendix. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010b. Proposed Kappa electrical substation on Platfontein Outspan 240, Ceres Magesterial District, Western Cape Province, 17 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010c. Eskom Gamma-Omega 765kV transmission line: Phase 2 palaeontological impact assessment. Sector 2, Omega to Kappa Substation (Western Cape Province), 100 pp + appendix. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010d. Proposed Mainstream wind farm at Perdekraal, Ceres Karoo, Ceres Magisterial District, Western Cape Province. Palaeontological impact assessment: pre-scoping desktop study, 22 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010e. Proposed Mainstream wind farm at Konstabel near Touwsrivier, Laingsburg Magisterial District, Western Cape. Palaeontological impact assessment: pre-scoping desktop study, 19 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015a. Proposed Perdekraal East Wind & Solar Renewable Energy Facility near Touwsrivier, Ceres Magisterial District, Western Cape Province. Palaeontological impact assessment: field study, 68 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015b. Proposed 75 MW photovoltaic solar facility and associated infrastructure on remainder of Farm 34 Vredefort near Touwsrivier, Breede River District Municipality, Western Cape. Palaeontological heritage assessment: combined desktop & field study, 44 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2016a. Proposed Kolkies Wind Energy Facility near Touwsrivier, Witzenberg Local Municipality, Western Cape. Palaeontological input to heritage scoping assessment, 30 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2016b. Proposed Karee Wind Energy Facility near Touwsrivier, Witzenberg Local Municipality, Western Cape. Palaeontological input to heritage scoping assessment, 33 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2018. Proposed Rietkloof Wind Energy Facility near Laingsburg, Laingsburg Local Municipality, Western Cape. Palaeontological heritage assessment: combined desktop & field-based study, 85 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2019a. Upgrade of the N1 (Section 4) between Monument River (km 46.0) and Doornfontein (km 63.0), Laingsburg Local Municipality, Western Cape Province, 53 pp. Natura Viva cc for CTS Heritage, Cape Town.

ALMOND, J.E. 2019b. Proposed SANSA Space Operations on Portion 8 of Farm 148 near Matjiesfontein, Laingsburg Local Municipality, Western Cape Province. Palaeontological specialist study, 40 pp. Natura Viva cc for CTS Heritage, Cape Town.

ALMOND, J.E. 2020. Proposed Pienaarspoort 1 and Pienaarspoort 2 Wind Energy Facilities in the Ceres Karoo region (Boland District Municipality) near Touwsrivier, Western Cape. Palaeontological heritage: combined desktop & field-based assessment, 50 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. & PETHER, J. 2008. Palaeontological heritage of the Western Cape. Interim SAHRA technical report, 20 pp. Natura Viva cc., Cape Town.

ANDERSON, A.M. & McLACHLAN, I.R. 1976. The plant record in the Dwyka and Ecca Series (Permian) of the south-western half of the Great Karoo Basin, South Africa. Palaeontologia africana 19: 31-42.

ANDERSON, J.M. & ANDERSON, H.M. 1985. Palaeoflora of southern Africa. Prodromus of South African megafloras, Devonian to Lower Cretaceous, 423 pp. Botanical Research Institute, Pretoria & Balkema, Rotterdam.

BUTLER, E. 2018. Palaeontological impact assessment of the proposed construction of the 140MW Tooverberg Wind Energy Facility (WEF) and associated grid connection near Touws River in the Western Cape Province, 75 pp. Banzai Environmental (Pty) Ltd.

COLE, D.I. 2005. Prince Albert Formation. SA Committee for Stratigraphy, Catalogue of South African Lithostratigraphic Units 8: 33-36.

COLE, D.I. & BASSON, W.A. 1991. Whitehill Formation. Catalogue of South African Lithostratigraphic Units 3, 51-52. Council for Geoscience, Pretoria.

FOURIE, W., ALMOND, J. & ORTON, J. 2015. Heritage scoping assessment specialist report. Strategic environmental assessment for wind and solar photovoltaic energy in South Africa. Appendix 3, 79 pp. CSIR and Department of Environmental Affairs, RSA.

HERITAGE WESTERN CAPE 2016. Guide for minimum standards for archaeology and palaeontology reports submitted to Heritage Western Cape, 4 pp.

GRESSE, P.G. & THERON, J.N. 1992. The geology of the Worcester area. Explanation of geological Sheet 3319. 79 pp, tables. Council for Geoscience, Pretoria.

JOHNSON, M.R., VAN VUUREN, C.J., VISSER, J.N.J., COLE, D.I., WICKENS, H. DE V., CHRISTIE, A.D.M., ROBERTS, D.L. & BRANDL, G. 2006a. Sedimentary rocks of the Karoo Supergroup. In: Johnson. M.R., Anhaeusser, C.R. & Thomas, R.J. (eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Johannesburg & the Council for Geoscience, Pretoria.

KLEIN, R.G. 1984. The large mammals of southern Africa: Late Pliocene to Recent. In: Klein, R.G. (Ed.) Southern African prehistory and paleoenvironments, pp 107-146. Balkema, Rotterdam.

MACRAE, C. 1999. Life etched in stone. Fossils of South Africa, 305 pp. The Geological Society of South Africa, Johannesburg.

McCARTHY, T. & RUBIDGE, B. 2005. The story of Earth and life: a southern African perspective on a 4.6-billion-year journey. 334pp. Struik, Cape Town.

McLACHLAN, I.R. & ANDERSON, A. 1973. A review of the evidence for marine conditions in southern Africa during Dwyka times. Palaeontologia africana 15: 37-64.

OELOFSEN, B.W. 1987. The biostratigraphy and fossils of the Whitehill and Iratí Shale Formations of the Karoo and Paraná Basins. In: McKenzie, C.D. (Ed.) Gondwana Six: stratigraphy, sedimentology and paleontology. Geophysical Monograph, American Geophysical Union 41: 131-138.

PARTRIDGE, T.C., BOTHA, G.A. & HADDON, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.

SAHRA 2013. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.

SKEAD, C.J. 1980. Historical mammal incidence in the Cape Province. Volume 1: The Western and Northern Cape, 903pp. Department of Nature and Environmental Conservation, Cape Town.

THERON, J.N. 1983. Die geologie van die gebied Sutherland. Explanation of 1: 250 000 geological Sheet 3220, 29 pp. Council for Geoscience, Pretoria.

THERON, J.N., WICKENS, H. DE V. & GRESSE, P.G. 1991. Die geologie van de gebied Ladismith. Explanation of Sheet 3320. 99 pp. Geological Survey / Council for Geoscience, Pretoria.

VILJOEN, J.H.A. 1992. Lithostratigraphy of the Collingham Formation (Ecca Group), including the Zoute Kloof, Buffels River and Wilgehout River Members and the Matjiesfontein Chert Bed. South African Committee for Stratigraphy, Lithostratigraphic Series No. 22, 10 pp.

VILJOEN, J.H.A. 1994. Sedimentology of the Collingham Formation, Karoo Supergroup. South African Journal of Geology 97: 167-183.

VILJOEN, J.H.A. 2005. Tierberg Formation. SA Committee for Stratigraphy, Catalogue of South African Lithostratigraphic Units 8: 37-40.

VISSER, J.N.J. 1992. Deposition of the Early to Late Permian Whitehill Formation during a sea-level highstand in a juvenile foreland basin. South African Journal of Geology 95: 181-193.

VISSER, J.N.J. 1994. A Permian argillaceous syn- to post-glacial foreland sequence in the Karoo Basin, South Africa. In Deynoux, M., Miller, J.M.G., Domack, E.W., Eyles, N. & Young, G.M. (Eds.) Earth's Glacial Record. International Geological Correlation Project Volume 260, pp. 193-203. Cambridge University Press, Cambridge.

VISSER, J.N.J. 1997. Deglaciation sequences in the Permo-Carboniferous Karoo and Kalahari Basins of southern Africa: a tool in the analysis of cyclic glaciomarine basin fills. Sedimentology 44: 507-521.

VISSER, J.N.J. 2003. Lithostratigraphy of the Elandsvlei Formation (Dwyka Group). South African Committee for Stratigraphy, Lithostratigraphic Series No. 39, 11 pp.

VISSER, J.N.J., VON BRUNN, V. & JOHNSON, M.R. 1990. Dwyka Group. South African Committee for Stratigraphy Catalogue of South African Lithostratigraphic Units 2, 15-17. Council for Geoscience, Pretoria.

WICKENS, H. DE V. 1984. Die stratigraphie en sedimentologie van die Group Ecca wes van Sutherland. Unpublished MSc thesis, University of Port Elizabeth, viii + 86 pp.

WICKENS, H. DE V. 1994. Submarine fans of the Ecca Group. Unpublished PhD thesis, University of Port Elizabeth. 350 pp.

WICKENS, H. DE V. 1996. Die stratigraphie en sedimentologie van die Ecca Groep wes van Sutherland. Council for Geosciences, Pretoria Bulletin 107, 49pp.

11. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

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 in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. 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 palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest Province, Mupumalanga and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as a long-standing 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).

APPENDIX A: GPS FOSSIL LOCALITY DATA

All GPS readings were taken in the field using a hand-held Garmin GPSmap 64s instrument. The datum used is WGS 84. Please note that:

- The fossil sites recorded here represent only a small sample of potential sites present at or beneath the ground surface within the project area.
- This palaeontological site data is *not* for public release, due to conservation concerns.

LOC.	GPS DATA	COMMENTS
112	[redacted]	Karee Kolk 174. Partially *in situ*, sphaeroidal calcretised termitarium (fossil termite nest) embedded within weathered and calcrete-veined Tierberg Fm mudrocks exposed along steep pediment edge on N. banks of Grootrivier. Fragments downwasted further down slope. Proposed Field Rating IIIB Local Resource.
122		Hoek Doornen 172 (northern area). Locally common cylindrical to flattened horizontal, straight to gently-curved burrows (1-2 cm wide) with distinctive longitudinal surface ridges or wrinkles (*cf Palaeophycus*). Tierberg Formation exposures in bed of Klein-Droëlaagte. Proposed Field Rating IIIC Local Resource.
126		Hoek Doornen 172 (northern area). Oligomict coarse, silcrete-rich alluvial gravels along the bed of the Klein-Droëlaagte with sparse small blocks of silicified wood (probably reworked from the Tierberg Fm). Proposed Field Rating IIIC Local Resource.
127		Hoek Doornen 172 (northern area). Oligomict coarse, silcrete-rich alluvial gravels along the bed of the Klein-Droëlaagte with sparse small blocks of silicified wood (probably reworked from the Tierberg Fm). Proposed Field Rating IIIC Local Resource.
128		Hoek Doornen 172 (northern area). Sandy alluvium, possible heuweljie sands with sheetwash surface gravels on floodplain of Klein-Droëlaagte. Sparse scatter of small angular to slightly water-worn blocks of silicified wood. Proposed Field Rating IIIC Local Resource.
132		Witte Wall 171. Pediment surface gravels including abundant buff to yellowish-grey sandy to gritty silcrete, often flaked (ESA, MSA). Occasional small rolled clasts of petrified wood in same area. Possible trace of ancient coarse alluvial deposits. Proposed Field Rating IIIC Local Resource.
133		Witte Wall 171. Open patch with fine sheetwash gravels dominated by resistant cherty lithologies, occasional exotic Dwyka erratics, sparse small blocks of petrified wood. Proposed Field Rating IIIC Local Resource.
138		Witte Wall 171. Calcretised crest of upper pediment surface. Occasional small float blocks of petrified wood. Proposed Field Rating IIIC Local Resource.
141		Witte Wall 171. Detached angular blocks of large calcretised termitarium blocks reworked from calcretised crest of pediment surface nearby and extending downslope in float. Proposed Field Rating IIIC Local Resource.
142		Witte Wall 171. Fine surface gravels below elevation of upper pediment surface forming desert pavement (serir), with sparse small blocks of petrified wood. Proposed Field Rating IIIC Local Resource.
149		Witte Wall 171. Well-exposed Tierberg Formation siltstones with bedding plane assemblages of simple, sinuous, cross-cutting horizontal burrows with softer ferruginous mineral infill. Proposed Field Rating IIIC Local Resource.

LOC.	GPS DATA	COMMENTS
150	[redacted]	Hoek Doornen 172. Isolated small float block of petrified wood with well-developed seasonal growth lines. Mapped as Tierberg Fm but Collingham Fm outcrop with Matjiesfontein chert v. close by. Proposed Field Rating IIIC Local Resource.
156	[redacted]	Grootfontein 149. Sandy alluvial soils with fine surface gravels, including sparse small angular to subrounded blocks of petrified wood. Proposed Field Rating IIIC Local Resource.
158	[redacted]	Grootfontein 149. Calcretised soils near pediment escarpment edge. Largely embedded sphaeroidal calcretised termitarium with detached blocks extending downslope in float. Proposed Field Rating IIIC Local Resource.
161	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood and ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
163	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood and ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
165	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood and ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
166	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood and ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
169	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood, rare small petrified logs and ESA stone artefacts. Proposed Field Rating IIIB Local Resource.
172	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood, ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
JO1	[redacted]	Small block of petrified wood in surface gravels. Proposed Field Rating IIIC Local Resource.
JO2	[redacted]	Small block of petrified wood in surface gravels. Proposed Field Rating IIIC Local Resource.
JO3	[redacted]	Small block of petrified wood in surface gravels. Proposed Field Rating IIIC Local Resource.
JO4	[redacted]	Small block of petrified wood in surface gravels. Proposed Field Rating IIIC Local Resource.

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

Basic Assessments for the Proposed Development of two 175 MW Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure (i.e. Witte Wall 1 and Witte Wall 2), near Touws River, Western 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:	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)			
Professional affiliation/registration:	Palaeontolgical Society of Southern Africa, Association of Professional Heritage Practitioners (W Cape)			
Physical address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN			
Postal address:	PO Box 12410 Mill Street, Cape Town			
Postal code:	8010	Cell:	n/a	
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.

John E Almond

Signature of the Specialist

Natura Viva cc

Name of Company:

24th April 2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

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.

Signature of the Specialist

NATURA VIVA CC

Name of Company

24th October 2020

Date

Signature of the Commissioner of Oaths

2020-10-24

Date

SOUTH AFRICAN POLICE SERVICE
STATION COMMANDER
CAPE TOWN
2020 -10- 24
CAPE TOWN
STATION COMMANDER
SOUTH AFRICAN POLICE SERVICE

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:	
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

Basic Assessments for the Proposed Development of three 175 MW Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure (i.e. Grootfontein 1; Grootfontein 2; and Grootfontein 3), near Touws River, Western 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:	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)			
Professional affiliation/registration:	Palaeontolgical Society of Southern Africa, Association of Professional Heritage Practitioners (W Cape)			
Physical address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN			
Postal address:	PO Box 12410 Mill Street, Cape Town			
Postal code:	8010	Cell:	n/a	
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.

John E. Almond

Signature of the Specialist

Natura Viva cc

Name of Company:

29th October 2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

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

24th October 2020

Date

Signature of the Commissioner of Oaths

2020-10-24

Date

SOUTH AFRICAN POLICE SERVICE
STATION COMMANDER
CAPE TOWN
2020 -10- 24
CAPE TOWN
STATION COMMANDER
SOUTH AFRICAN POLICE SERVICE

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:	
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

Basic Assessments for the Proposed Development of four 175 MW Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure (i.e. Hoek Doornen 1; Hoek Doornen 2; Hoek Doornen 3; and Hoek Doornen 4), near Touws River, Western 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:	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)			
Professional affiliation/registration:	Palaeontolgical Society of Southern Africa, Association of Professional Heritage Practitioners (W Cape)			
Physical address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN			
Postal address:	PO Box 12410 Mill Street, Cape Town			
Postal code:	8010	Cell:	n/a	
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.

John E Almond

Signature of the Specialist

Natura Viva cc

Name of Company:

24th [illegible] 2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

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.

Signature of the Specialist

NATURA VIVA CC

Name of Company

24th October 2020

Date

Signature of the Commissioner of Oaths

2020-10-24

Date

SOUTH AFRICAN POLICE SERVICE
STATION COMMANDER
CAPE TOWN
2020 -10- 24
CAPE TOWN
STATION COMMANDER
SOUTH AFRICAN POLICE SERVICE

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

<table>
<tr><td colspan="3">APPENDIX C: CHANCE FOSSIL FINDS PROCEDURE: Proposed solar PV facilities and associated power lines to Kappa Substation, Ceres Karoo</td></tr>
<tr><td>Province & region:</td><td colspan="2">Western Cape: Cape Winelands District Municipality / Witzenberg Local Municipality</td></tr>
<tr><td>Responsible Heritage Resources Agency</td><td colspan="2">HERITAGE WESTERN CAPE (Contact details: Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 086-142 142. Fax: 021-483 9842. Email: hwc@pgwc.gov.za)</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Dwyka Group, Ecca Group (Prince Albert, Whitehill, Collingham & Tierberg Formations), Late Caenozoic colluvium and alluvium.</td></tr>
<tr><td>Potential fossils</td><td colspan="2">In bedrocks: fossil fish, mesosaurid reptiles, shelly invertebrates, vascular plants (incl. petrified wood), trace fossil assemblages. In colluvium and alluvium: teeth, bones and horn cores of mammals, non-marine molluscs, calcretised trace fossils (e.g. termitaria), reworked fossil wood.</td></tr>
<tr><td rowspan="5">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 D: SITE SENSITIVITY VERIFICATION

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 for the proposed solar PV facility and associated power line projects was undertaken in order to confirm the current palaeontological heritage sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool) (Figure D1).

The details of the site sensitivity verification are noted below:

Date of Site Visit	7-10 September 2020
Specialist Name	Dr John E. Almond
Professional Registration Number	Not registered
Specialist Affiliation / Company	*Natura Viva* cc

- **Information sources**

The palaeontological heritage site sensitivity verification is based on the following information sources:

1. Site paleosensitivity map produced by the DEFF screening tool (Figure D1);

2. A brief project outline, kmz files and maps provided by CSIR - Environmental Management Services;

3. A desktop review of (a) the relevant 1: 50 000 and 1: 250 000 scale topographic maps, (b) Google Earth© satellite imagery, (c) published geological and palaeontological literature, including 1: 250 000 geological maps and accompanying sheet explanations as well as (d) several previous and on-going fossil heritage assessments in the Ceres Karoo region by the author and colleagues;

4. The author's field experience with the formations concerned and their palaeontological heritage;

5. A four-day field assessment of the study area, including all land parcels involved, by the author and an experienced field assistant.

- **Outcome of the site sensitivity verification**

On the basis of information sources listed previously the screening tool palaeosensitivity map in Figure D1 is disputed and *rejected* here as an accurate reflection of palaeosensitivity within the present study area. The main reasons for this are:

1. The inaccurate overlay of the project area on the palaeosensitivity map (which is based primarily on the relevant geological maps);

2. The Dwyka Group (indicated in red) is generally regarded as of LOW palaeosensitivity whereas the Tierberg Formation is of MEDIUM sensitivity, at most. Field data for the proposed project suggest a LOW palaeosensitivity for the Tierberg Formation outcrop area here due to weathering and extensive cover by low-sensitivity calcrete, gravels and soils.

3. Potentially-sensitive rock units such as the basal Prince Albert Formation and Whitehill Formation are not rated as high sensitivity on the map (Field data suggests these are generally of LOW palaeosensivity in this region, mainly due to weathering and cleavage development).

4. The map does not address the Late Caenozoic sediments that mantle the bedrocks in the project area, and in particular the pediment gravels (ancient alluvium) underlying almost the entire solar PV study areas as well as younger alluvium along the Grootrivier and its tributaries. Almost all the new fossil occurrences noted during the recent field survey were found in such settings. However, these fossils are of low conservation value and the palaeosensitivity of the Late Caenozoic sediments is according rated as LOW.

As motivated in the relevant palaeontological heritage Basic Assessment report, it is concluded that the entire combined project area for the proposed solar PV facilities and associated power line to Kappa Substation is in practice of LOW palaeosensivity. Potentially fossiliferous rock units underlying the project footprint such as the Prince Albert and Whitehill Formations are too weathered and tectonically deformed (cleaved) to contain scientifically valuable fossils in the project area. No significant, conservation-worthy fossil sites or palaeontological No-Go areas were recorded during the field survey.

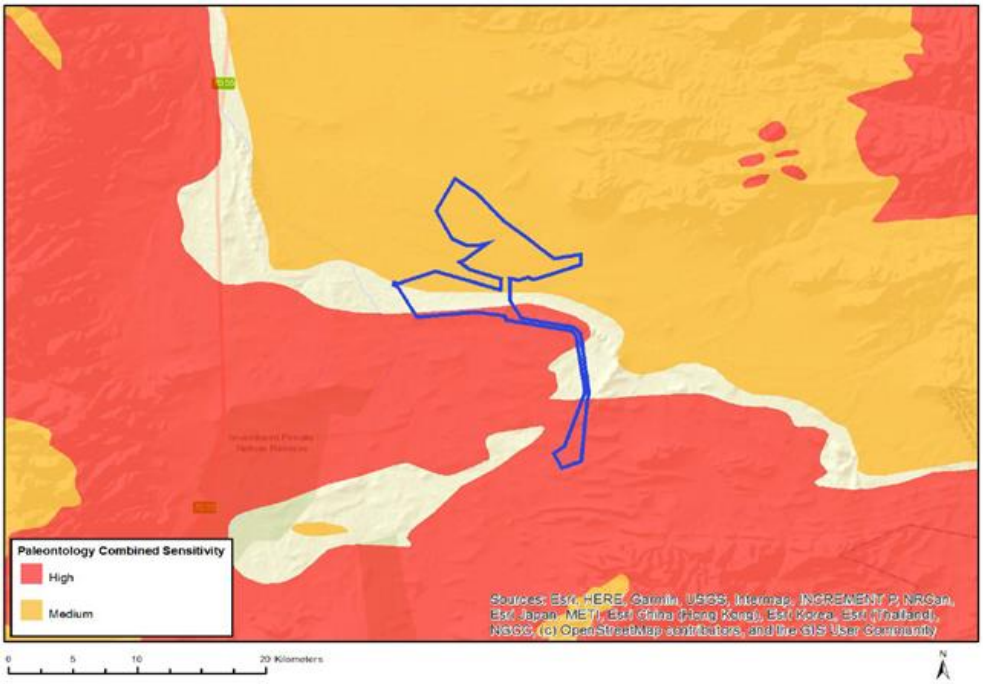


Figure D1: Palaeosensitivity map for the combined proposed solar PV facility and associated power line project area (blue polygon) produced from the DEFF screening tool. Data from several recent field surveys in the Ceres Karoo as well as desktop studies indicate that in practice the entire project area is of LOW palaeosensitivity.

APPENDIX E: COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

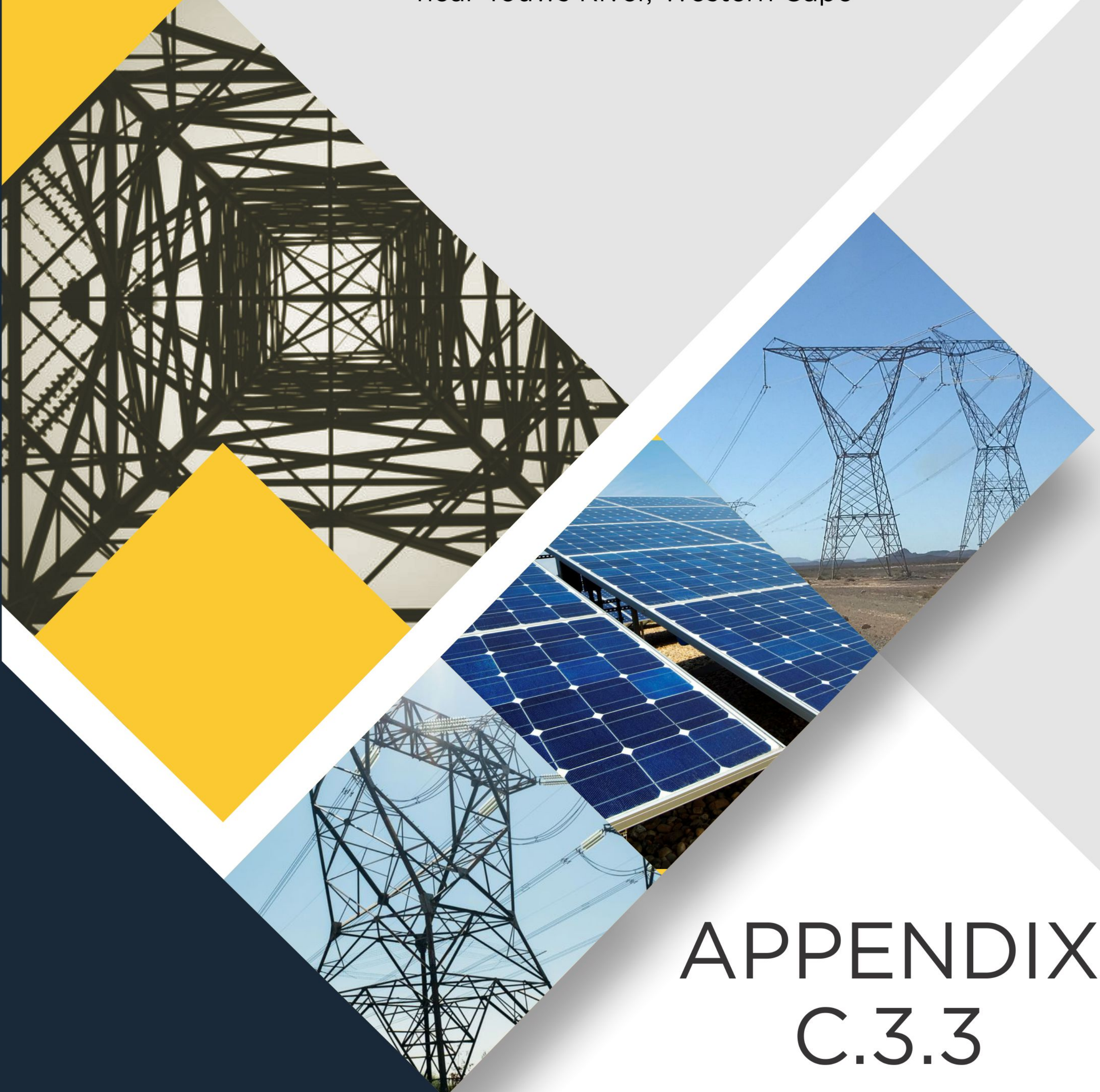
Requirements of Appendix 6 (Specialist Reports) of Government Notice R326 (Environmental Impact Assessment (EIA) Regulations of 2014, as amended)	*Section where this has been addressed in the Specialist Report*
1. (1) A specialist report prepared in terms of these Regulations must contain - ***a) details 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 11***
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 base data used for the specialist report;	***Section 2.1***
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	***Sections 4 to 6***
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	***Section 2.1***
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;	***Sections 4 & 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;	***Figs. 53 & 54***
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	***Section 2.2***
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	***Sections 4, 5 & 6***
k) any mitigation measures for inclusion in the EMPr;	***Sections 7 & 8***
l) any conditions for inclusion in the environmental authorisation;	***Section 8***
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	***Sections 7 & 8***
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***	***Section 8***

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***
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	***N/A (Refer to BA Report)***
q) any other information requested by the competent authority.	***N/A (Refer to BA 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.	***Part A of the Assessment Protocols published in GN 320 on 20 March 2020 are applicable (i.e. Site sensitivity verification requirements where a specialist assessment is required but no specific assessment protocol has been prescribed). See Appendix D***

APPENDIX 5 – Visual Impact Assessment

Refer to Appendix C.2 of the BA Report for the Visual Impact Assessment.

Basic Assessment for the Proposed Development of Electrical Grid Infrastructure to support the proposed nine 175 MW Solar Photovoltaic Facilities and associated Infrastructure (i.e. Witte Wall PV 1, Witte Wall PV 2, Grootfontein PV 1, Grootfontein PV 2, Grootfontein PV 3, Hoek Doornen PV 1, Hoek Doornen PV 2, Hoek Doornen PV 3, and Hoek Doornen PV 4), near Touws River, Western Cape



APPENDIX C.3.3

Heritage Impact Assessment (Archaeology, Cultural Landscape and Palaeontology) for Hoek Doornen

HERITAGE IMPACT ASSESSMENT:

Basic Assessment for the Proposed Development of Four 175 MW Solar Photovoltaic (PV) Facilities (Hoek Doornen PV 1 - PV 4) and associated Electrical Grid Infrastructure, near Touws River, Western Cape

HWC Case No.: 20081909SB0825E

Required under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999).

Report for:

CSIR – Environmental Management Services
P.O. Box 320, Stellenbosch, 7599
Tel: 031 242 2318
Email: rabed@csir.co.za

On behalf of:

Veroniva (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: 12 October 2020
Draft for comment: 16 October 2020
Final report: 17 November 2020

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

Basic Assessments for the Proposed Development of four 175 MW Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure (i.e. Hoek Doornen 1; Hoek Doornen 2; Hoek Doornen 3; and Hoek Doornen 4), near Touws River, Western 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:	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:

11-10-2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

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

11-10-2020

Date

7234705-6

N BACA CST

Signature of the Commissioner of Oaths

2020-10-11

Date

SOUTH AFRICAN POLICE SERVICE
KIRSTENHOF SAPS
2020 -10- 11
CSC
SUID AFRIKAANSE POLISIEDIENS

Details of Specialist, Declaration and Undertaking Under Oath

EXECUTIVE SUMMARY

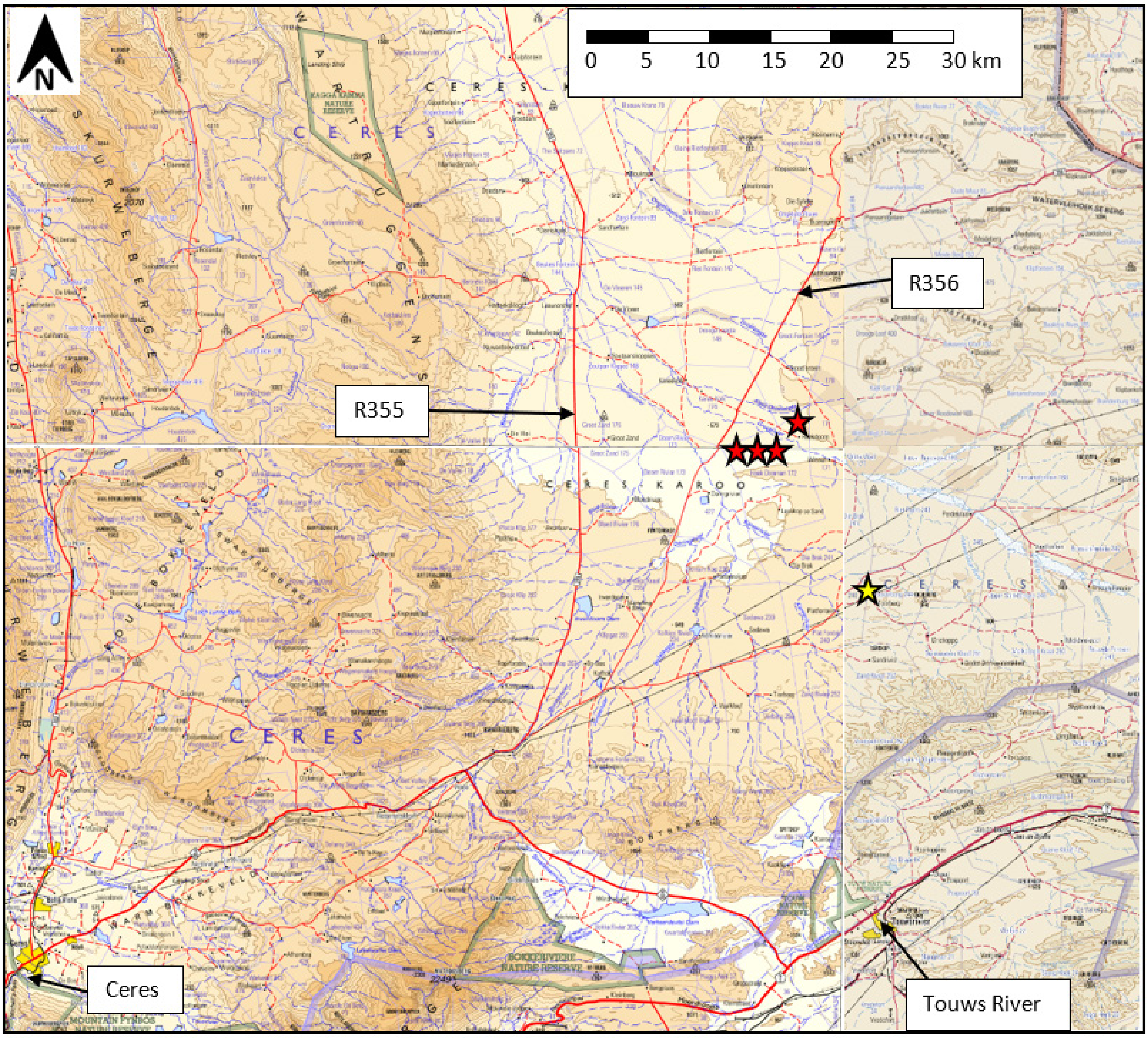
1. **Site Name**

Hoek Doornen

2. **Location**

Address: Off R356
Farms: Four photovoltaic (PV) facilities to be on Hoek Doornen 172/1 and four powerlines (within an assessed corridor) over farms Witte Wall 171, Die Brak 241 and Platfontein 240.
Centre of PV study area: S33° 00' 00" E19° 55' 50"
Southern end of powerline corridor: S33° 06' 36" E20° 00' 45"

3. **Locality Plan**



PV facilities at red stars, southern end of power line corridor at yellow star.

4. Description of Proposed Development

The proposed project includes four solar fields of 250 ha each and up to 10 m high, operation and maintenance buildings, three power lines and substations (i.e. electricity grid infrastructure (EGI)), access roads, battery energy storage facilities, fencing, and other associated and supporting infrastructure.

5. Heritage Resources Identified

Palaeontological resources were found to be very sparsely distributed across the landscape and the impacts to fossils are considered to be of generally low significance. Archaeological resources were widespread but very strongly dominated by background scatter. Dense areas of artefacts were rare with the main exception being a very dense artefact manufacturing locality on the Matjiesfontein Chert ridge along the southern boundary of the study area and which is excluded from the development footprint area. An area of sand dunes with a number of ephemeral traces of Later Stone Age (LSA) occupation was an interesting feature in the south-eastern part of the study area and one possible grave was also seen there. This area is entirely excluded from development. Historical cottage, likely originally a *brakdak*, likes on the north bank of the Groot River but has been heavily modified over the years. The cultural landscape (largely a natural landscape with aesthetic significance) was also identified as a heritage resource, but the location of the site within a Renewable Energy Development Zone (REDZ) was noted. The site is very close to the R356 but this road is not frequently used and is not considered a scenic route.

6. Anticipated Impacts on Heritage Resources

Fossils are sparse and difficult to locate. Impacts cannot be readily predicted but the chance of impacting significant fossils is low. The layout has been designed to avoid sensitive archaeological sites. Nevertheless, large numbers of background scatter artefacts would likely be lost during development. The layout has avoided the steeper slopes on site which will reduce the visibility of the PV facilities. Given (1) the findings of the Visual Impact Assessment (VIA), (2) the location of the facilities within a REDZ and (3) the existence of a wind energy facility, large substation and power lines nearby, significant new impacts to the landscape are not expected.

7. Recommendations

Hoek Doornen PV 1

It is recommended that the proposed Hoek Doornen PV 1 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- The stone boundary beacon at waypoint 132 must be protected from harm. Any road widening needed here must be undertaken towards the north; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

Hoek Doornen PV 2

It is recommended that the proposed Hoek Doornen PV 2 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- The stone boundary beacon at waypoint 132 must be protected from harm. Any road widening needed here must be undertaken towards the north; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

Hoek Doornen PV 3

It is recommended that the proposed Hoek Doornen PV 3 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- The stone boundary beacon at waypoint 132 must be protected from harm. Any road widening needed here must be undertaken towards the north; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

Hoek Doornen PV 4

It is recommended that the proposed Hoek Doornen PV 4 development and rerouted private road be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- The stone boundary beacon at waypoint 132 must be protected from harm. Any road widening needed here must be undertaken towards the north; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

EGI

It is recommended that the proposed EGI development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) whether any areas of background scatter artefacts should be sampled;

- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

8. Author/s and Date

Heritage Impact Assessment: Jayson Orton, ASHA Consulting (Pty) Ltd, 17 November 2020
Archaeological specialist study: Jayson Orton, ASHA Consulting (Pty) Ltd, 09 October 2020
Palaeontological specialist study: John Almond, Natura Viva cc, October 2020
Visual Impact Assessment: Quinton Lawson and Bernard Oberholzer, QARC and BOLA, 16 October 2020

Glossary

Background scatter: Artefacts whose spatial position is conditioned more by natural forces than by human agency

Brakdak: A roof building technique in which large beams are covered by smaller poles, bamboo or reeds and finally a layer of mud.

Early Stone Age: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.

Handaxe: A bifacially flaked, pointed stone tool type typical of the Early Stone Age.

Holocene: The geological period spanning the last approximately 10-12 000 years.

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.

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

DMR: Department of Mineral Resources

ECO: Environmental Control Officer

EGI: Electricity Grid Infrastructure

EIA: Environmental Impact Assessment

EMPR: Environmental Management Programme

ESA: Early Stone Age

GPS: Global Positioning System

GP: General Protection

HIA: Heritage Impact Assessment

HWC: Heritage Western Cape

LSA: Later Stone Age

MSA: Middle Stone Age

NCW: Not Conservation Worthy

NEMA: National Environmental Management Act (No. 107 of 1998)

NHRA: National Heritage Resources Act (No. 25) of 1999

NID: Notification of Intent to Develop

PHS: Provincial Heritage Site

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 3.1
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 7.4, 7.1.4, 7.5
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;	Section 1.1.3, Section 5, Appendix 3
g) an identification of any areas to be avoided, including buffers;	Section 13
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 13
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.5
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 10
l) any conditions for inclusion in the environmental authorisation;	Section 14
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;	Section 13.1
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 12
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 12
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.

Contents

1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by Veroniva (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed development of four 175 MW photovoltaic (PV) solar energy facilities on the farm Hoek Doornen 172/rem and four power lines (within an assessed corridor) stretching over farms Witte Wall 171, Die Brak 241 and Platfontein 240 to end at the existing Eskom Kappa Substation located on the latter farm. The centre of the PV study area is at S33° 00' 00" E19° 55' 50", while the Kappa Substation at the southern end of the powerline corridor is at S33° 06' 36" E20° 00' 45". The study area lies off the R356 in the Ceres Karoo with the proposed PV area being some 37 km north of Touws River and 30 km northeast of Karoo Poort (Figures 1 & 2).

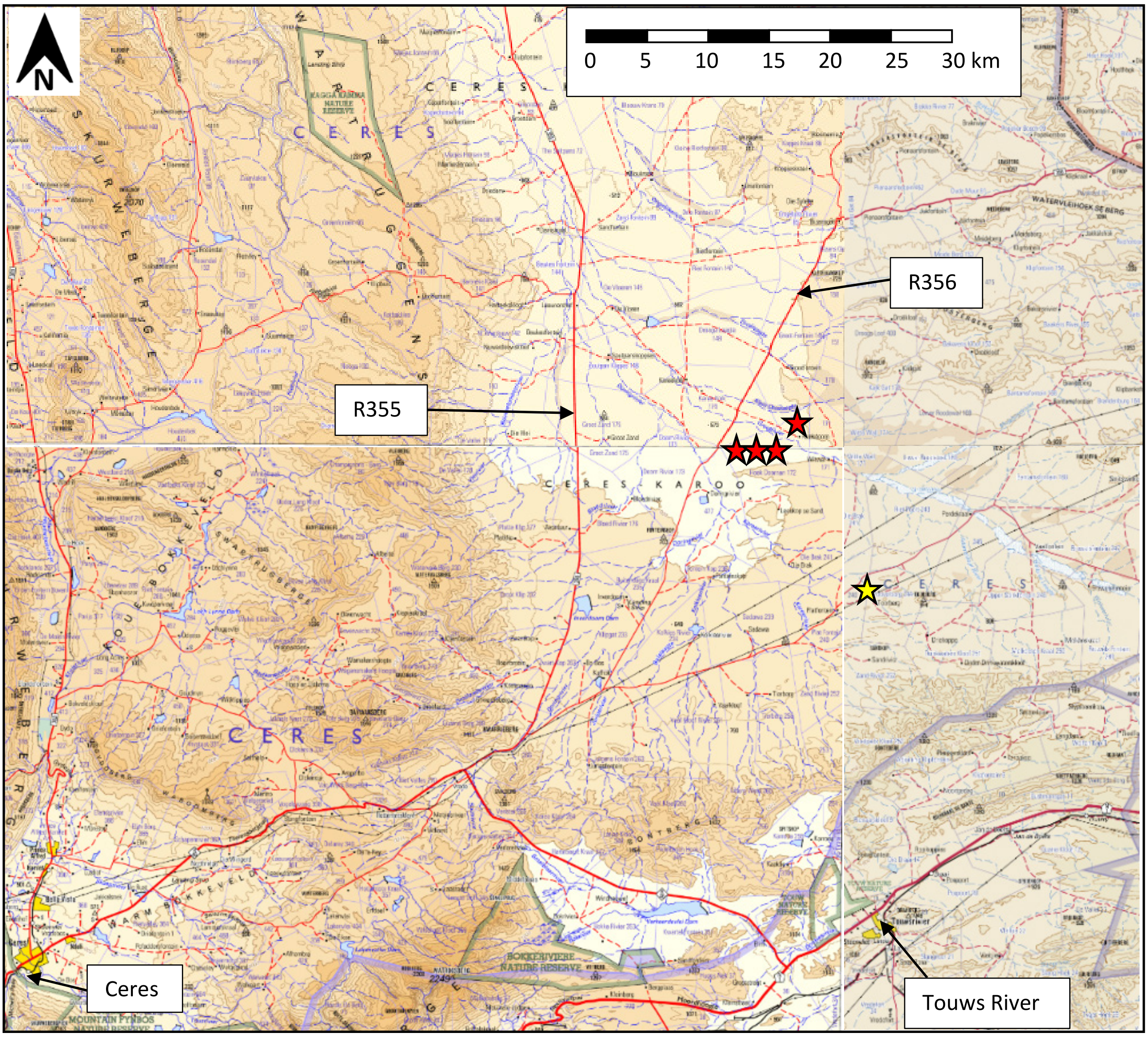


Figure 1: *Composite of the 3218, 3220, 3319, and 3320 1:250 000 topographic maps showing the approximate location of the PV sites (red stars) and the existing Eskom Kappa Substation (yellow star). Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.*

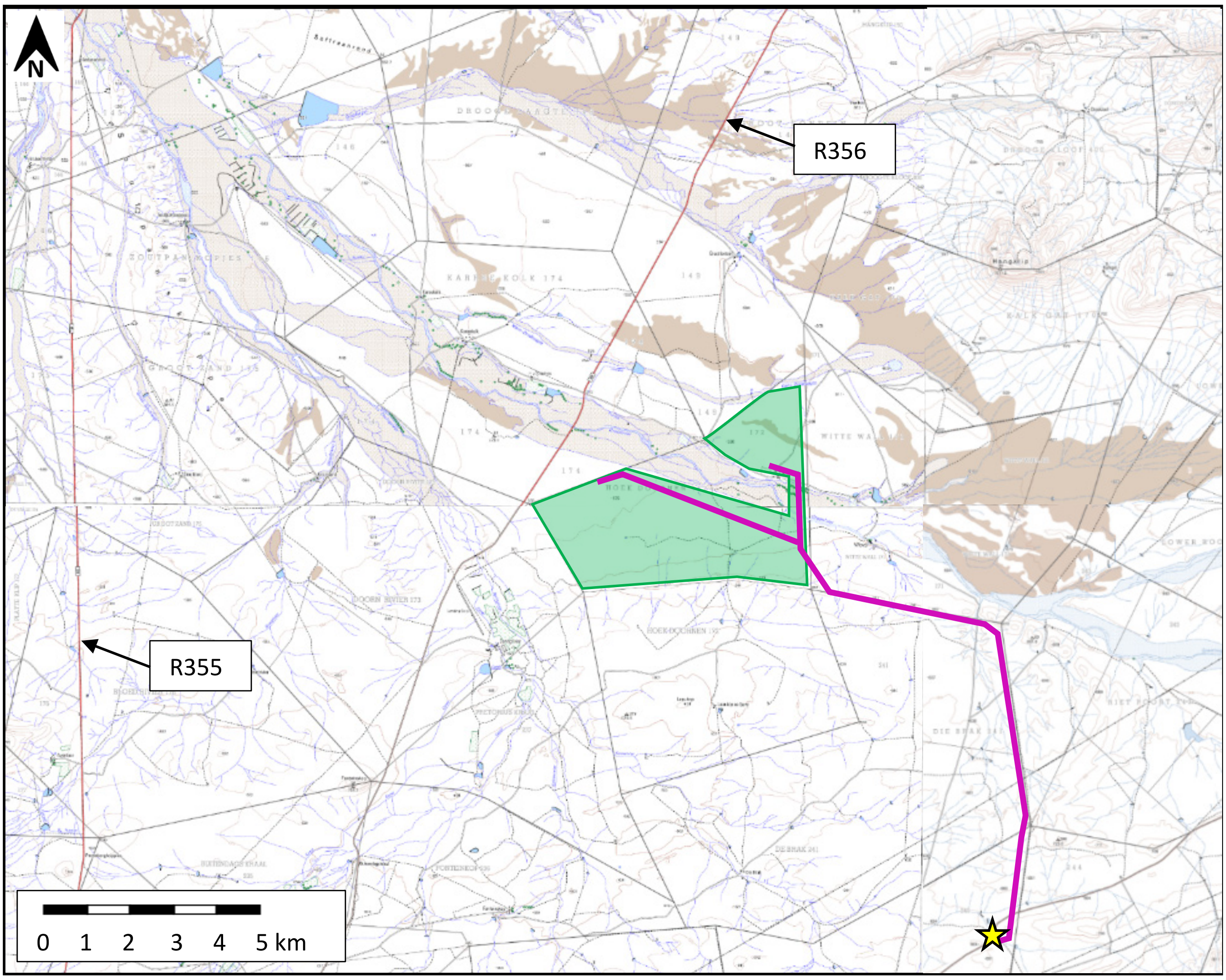


Figure 2: *Extract from 1:50 000 mapsheets 3219DD, 3319BB, 3220CC & 3220AA showing the approximate location of the PV study area (green shaded polygon), power line corridor (purple line) and Eskom Kappa Substation (yellow star).*

The Applicant is proposing to develop nine solar PV facilities and nine power lines and associated infrastructure to link the PV facilities to the Eskom Kappa Substation. Two PV facilities are being proposed on the farm Witte Wall 171; three PV Facilities are being proposed on the farm Grootfontein 149; and four PV Facilities will be constructed on the Farm Hoek Doornen 172. This Heritage Impact Assessment (HIA) deals with the Hoek Doornen projects to be known as Hoek Doornen PV 1, Hoek Doornen PV 2; Hoek Doornen PV 3 and Hoek Doornen PV 4.

1.1. The proposed project

1.1.1. Project description

Each PV project would comprise of the following components (Figure 3 shows the PV layout area and powerline corridor):

- Solar Field, comprising Solar Arrays with a maximum height of 10 m and maximum footprint of 250 hectares per project, including the following:
    - PV Modules;

- Single Axis Tracking structures (aligned north-south), Fixed Axis Tracking (aligned east-west), Dual Axis Tracking (aligned east-west and north-south), Fixed Tilt Mounting Structure or Bifacial Solar Modules;
  - Solar module mounting structures comprised of galvanised steel and aluminium; and
  - Foundations which will likely be drilled and concreted into the ground.
- Building Infrastructure
  - Offices (maximum height 7 m and footprint of 1000 m^2);
  - Operational and maintenance control centre (maximum height 7 m and footprint 500 m^2);
  - Warehouse/workshop (maximum height 7 m and footprint 500 m^2);
  - Ablution facilities (maximum height 7 m and footprint 50 m^2);
  - Converter/inverter stations (height from 2.5 m to 7 m (maximum) and footprint 2500 m^2);
  - On-site substation and/or a switching substation (footprint 20 000 m^2); and
  - Guard Houses (height 3 m, footprint 40 m^2).
- Associated Infrastructure
  - 132 kV overhead power line to connect to the existing Eskom Kappa Substation to be located within a corridor of approximately 300 m wide that has been assessed as part the Basic Assessment (BA) Process. The specific power line will have the following specifications:
    - Height = 22.5 m to 30 m.
    - The servitude for the 132 kV power line will be 33 m wide.
    - Length from the PV site to the Eskom Substation:
      - Hoek Doornen PV 1 Power Line: Approximately 18 km
      - Hoek Doornen PV 2 Power Line: Approximately 20 km
      - Hoek Doornen PV 3 Power Line: Approximately 21 km
      - Hoek Doornen PV 4 Power Line: Approximately 18 km
  - Associated electrical infrastructure at the Eskom Kappa Substation (including but not limited to feeders, Busbars, new transformer bay (up to 500 MVA) and extension to the platform at the Eskom Kappa Substation);
  - On-site substation and/or a switching substation;
  - Internal 33 kV power lines/underground cables (either underground to maximum depth of 1.6 m or above ground with height of 9 m);
  - A Lithium Ion battery storage facility for each Solar PV project, which may cover an area of up to 8 hectares and a height of up to 5 – 10 m (to be constructed within the proposed laydown area);
  - Underground low voltage cables or cable trays (underground to maximum depth of 1.4 m);
  - Access roads:
    - Width ranging between 4 - 8 m.
    - Total Length: Approximately 1 km for the Hoek Doornen PV1 to PV3 Projects and 6 km for Hoek Doornen PV4.

        - Internal gravel roads and service road below the power line (width of 4 m);
        - A section of private road through the Hoek Doornen PV 4 site will need to be rerouted to the southern and eastern boundary of the site;
    - Fencing (between 2 – 3 m high) around the PV Facilities - Access points will be managed and monitored by an appointed security service provider. The type of fencing will either be of palisade, mesh type or a fully electrified option;
    - Fencing for the power corridors: game fences will be constructed along the power line route to fence off the servitudes across the farms Witte Wall and Die Brak. No fencing will be constructed along the power line where it traverses the Platfontein Farm;
    - Panel maintenance and cleaning area;
    - Stormwater channels;
    - Construction work area (i.e. laydown area of maximum 13 ha);

It is proposed that panel cleaning will take place quarterly; however, this may be revised should the site conditions warrant more frequent cleaning. It is estimated that the panel washing process will require approximately 5 million to 8 million litres of water per year during operations; this is to be sourced from the Municipality. At this stage, no water is planned to be abstracted from or discharged to any surface water systems.

The construction phase for each proposed project is expected to extend 12 to 14 months.

The total maximum project footprint of each PV facility will be approximately 250 hectares including the PV facility and infrastructure such as internal roads for each PV facility. Some of the main access roads will fall outside of the 250 hectares. Therefore, overall the PV facility and associated infrastructure including access roads will cover an estimated area of 260 hectares.

1.1.2. Identification of alternatives

No site alternatives are being considered. However, the layout was designed after provision of sensitivity data by the specialists to ensure that it would have the least possible overall impact. One EGI corridor has been proposed but this is wide enough to allow some micrositing of the alignment to reduce impacts.

1.1.3. Aspects of the project 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.

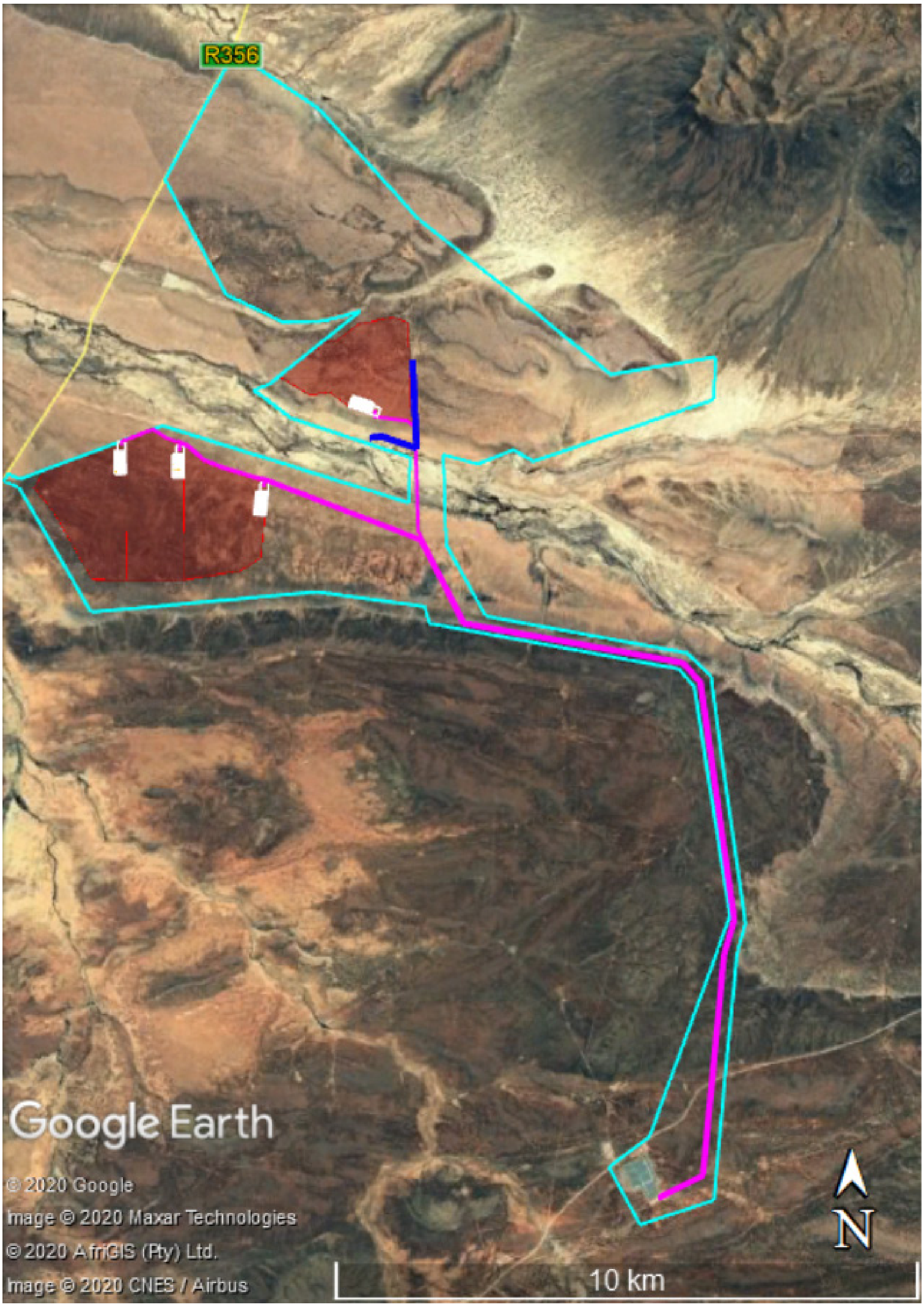


Figure 3: *Aerial view of the greater project area for all nine PV facilities and the associated Electrical Grid Infrastructure (EGI) corridor (turquoise) showing the location of the proposed Hoek Doornen PV 1, PV 2, PV 3 & PV 4 facilities (red shading) and their associated powerlines (pink lines). The dark blue line is the section of private road to be rerouted.*

1.2. Terms of reference

ASHA Consulting was asked to compile a Heritage Impact Assessment (HIA) that would meet the requirements of Heritage Western Cape (HWC) and that included assessments for each of the three proposed PV facilities, power lines and their associated infrastructure. The study also needed to include the following aspects:

- Comply with the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, Government Notice (GN) 320. This specifically includes Part A, which provides the Site Sensitivity Verification Requirements where a Specialist Assessment is required but no Specific Assessment Protocol has been prescribed.
- 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.
- Comply with Appendix 6 of the 2014 National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) EIA Regulations (as amended), as well as any additional relevant legislation and guidelines that may be deemed necessary.
- The specialist must undertake a site visit in order to identify the level of sensitivity assigned to the project area on the National Web-Based Environmental Screening Tool (Screening Tool), and to verify and confirm this sensitivity and land-use.
- 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.
- Provide sensitivities in KMZ or similar GIS format.
- Provide review input on the preferred infrastructure layout following the sensitivity analysis and layout identification.
- Describe and map the heritage and features of the site and surrounding area based on desktop reviews, fieldwork, available databases, findings of the Renewable Energy Development Zones (REDZs) Phase 1 Strategic Environmental Assessment (SEA) (DEA 2015), and findings from other heritage studies in the area, where relevant. Include reference to the grade of heritage feature and any heritage status the feature may have been awarded. The assessment must also consider the maps generated by the Screening Tool.
- Map heritage sensitivity for the site. Clearly show any “no-go” areas in terms of heritage and provide recommended buffers or set-back distances. Indicate which very high sensitivity areas are regarded as complete no-go areas.
- Identify and assess the potential direct, indirect and cumulative impacts of the proposed development on the full scope of heritage features, including archaeology, palaeontology and the cultural-historical landscape, as required by heritage legislation. Impact significance must be rated both without and with mitigation, and must cover the construction, operational and decommissioning phases of the project.
- Liaise with the relevant authorities (i.e. HWC) in order to obtain a letter of approval, comments or a Permit in terms of National Heritage Resources Act, 1999 (Act No. 25 of 1999), including Regulations issued thereunder, as necessary. This also includes submitting a Notice of Intent to Develop to HWC and meeting the requirements of HWC.

- 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 Environmental Management Programme (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).
- Review the Generic EMPr for 1) Power Lines and 2) 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 are not included in the pre-approved generic EMPr (Part B – Section 1). If so, provide a list of these specific impact management outcomes and actions.

As part of the process a Notification of Intent to Develop (NID) form was submitted to HWC. Please note that at the time three PV facilities were proposed on Hoek Doornen but due to constraints on the Witte Wall site which led to a reduction in number there, a fourth facility has been added to Hoek Doornen to keep the overall number of facilities at nine. HWC responded on 14th September 2020 with the following requirements for the HIA:

> Heritage Western Cape is in receipt of your application for the above matter received. This matter was discussed at the Heritage Officers meeting held on 7 September 2020.
>
> You are hereby notified that, since there is reason to believe that the proposed three 115 MW Solar Photovoltaic (PV) power generation facilities to be constructed on Witte Wall 171, farm Die Brak 241, farm Platfontein 240. Witzenbergwill impact on heritage resources, HWC requires that a Heritage Impact Assessment (HIA) that satisfies the provisions of section 38(3) of the NHRA be submitted. This HIA must have specific reference to the following:
>
> - A Visual Impact Assessment;
> - An Archaeological Impact Assessment; and
> - A Palaeontological Impact Assessment.
>
> The required HIA must have an integrated set of recommendations.
> Please note, should you require the HIA to be submitted as a Phased HIA, a written request must be submitted to HWC prior to submission. HWC reserves the right to determine whether a phased HIA is acceptable on a case by case Basis.
>
> The comments of relevant registered Conservation Bodies; all Interested and Affected parties; and the relevant Municipality must be requested and included in the HIA where provided. Proof of these requests must be supplied.

It should also be noted, however, that following S.38(3) of the National Heritage Resources Act (No. 25 of 1999), even though certain specialist studies may be specifically requested, <u>all</u> heritage resources should be identified and assessed.

1.3. Scope, purpose and objectives of the report

An HIA is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued by them for consideration by the Department of Environment, Forestry and Fisheries (DEFF) who will review the BA and grant or refuse authorisation. The HIA report outlines 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

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting HIAs and archaeological specialist studies in 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) Cultural Resources Management (CRM) section (Member #233) as follows:

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

2. HERITAGE LEGISLATION

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

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old 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.

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 NEMA (No. 107 of 1998), as amended, the project is subject to a BA. The present report provides the heritage component. HWC is required to provide comment on the proposed project in order to facilitate decision making by the DEFF.

3. APPROACH AND METHODOLOGY

3.1. Literature survey and information sources

Table 1 lists the sources of information used in this report.

***Table 1:** Sources of information.*

Data / Information	Source	Date	Type	Description
1:50 000 map 3219DD	Chief Directorate: National Geo-Spatial Information	1960, 1987, 2003	Topographic maps	1:50 000 maps
1:50 000 map 3319BB	Chief Directorate: National Geo-Spatial Information	1969, 1987, 1997	Topographic maps	1:50 000 maps
3220CC	Chief Directorate: National Geo-Spatial Information	1968, 1986, 2005	Topographic maps	1:50 000 maps
3220AA	Chief Directorate: National Geo-Spatial Information	1967, 1986, 2005	Topographic maps	1:50 000 maps
1:250 000 map 3218	Chief Directorate: National Geo-Spatial Information	2003	Topographic map	1:250 000 maps
1:250 000 map 3220	Chief Directorate: National Geo-Spatial Information	2005	Topographic map	1:250 000 maps
1:250 000 map 3319	Chief Directorate: National Geo-Spatial Information	1997	Topographic map	1:250 000 maps
1:250 000 map 3320	Chief Directorate: National Geo-Spatial Information	2006	Topographic map	1:250 000 maps
Cadastral details	CapeFarmMapper	current	Cadastral map	Cadastral map
Descriptions of heritage resources	South African Heritage Resources Information System	Various	Unpublished reports	Commercial impact assessment reports listing heritage resources recorded during their compilation
Descriptions of heritage resources	Books	Various	Published books	Books on various aspects of local history

3.2. Field survey

The PV site was subjected to a foot survey on 7^{th}, 9^{th} and 11^{th} September 2020. Sections of the EGI corridor in the north were surveyed on 8^{th} and 9^{th} September 2020, while other parts further to the south were also visited briefly on 28 January 2020 (Figure 4). These surveys were in spring and summer but, in this very dry area, the season makes no meaningful difference to vegetation covering and hence the ground visibility for the archaeological survey. Other heritage resources are not affected by seasonality. During the survey the positions of finds and survey tracks were recorded on a hand-held Global Positioning System (GPS) receiver set to the WGS84 datum.

Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

It should be noted that amount of time between the dates of the field inspection and final report do not materially affect the outcome of the report.

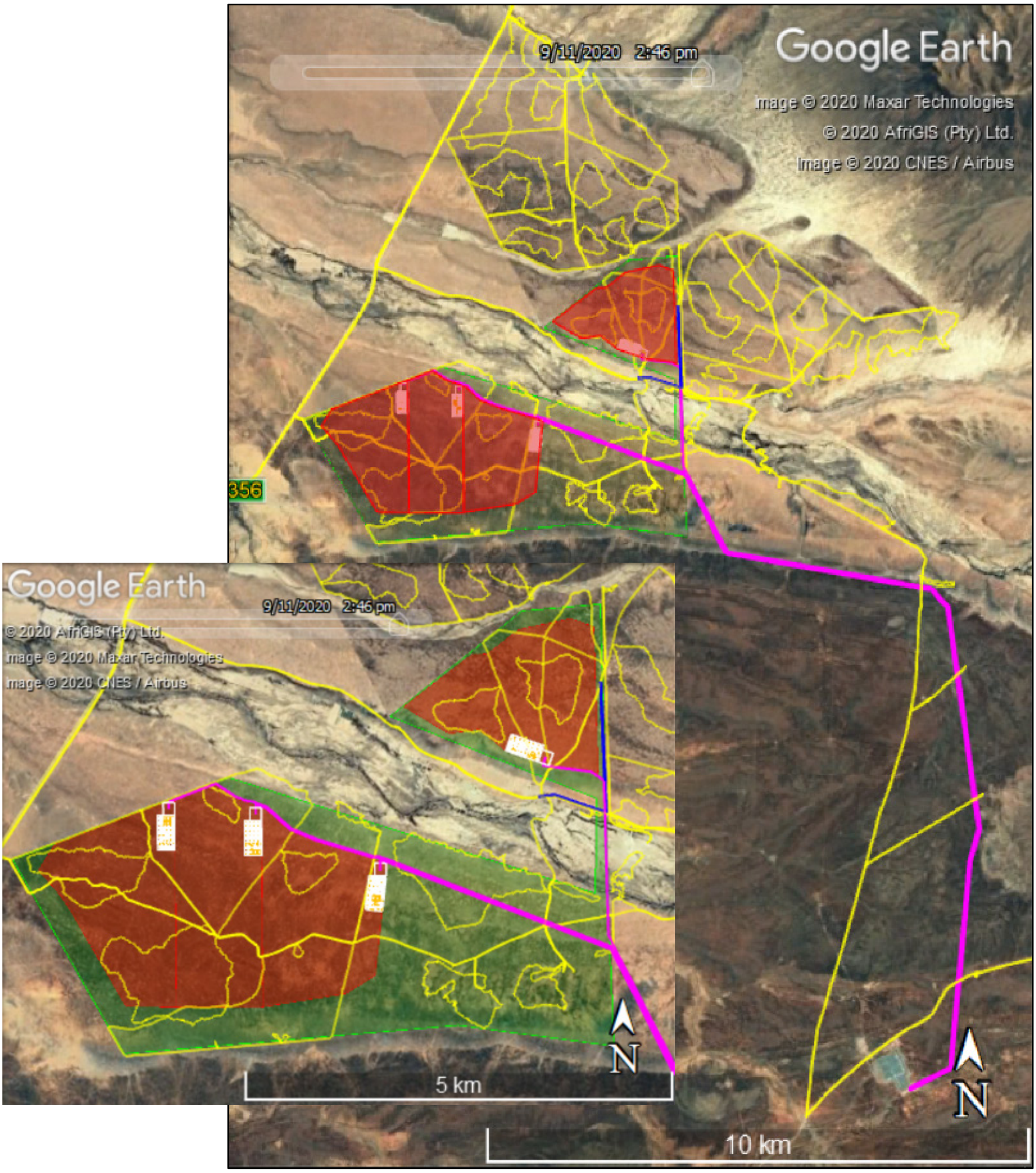


Figure 4: *Aerial view showing the survey tracks (yellow lines). The red shading shows the PV footprints and the green shading the broader study area considered for development. The approximate alignment of the power lines is shown in purple.*

3.3. Impact assessment

For consistency among specialist studies, the impact assessment was conducted through application of a scale supplied by the CSIR. The methodology is presented in full in the BA report.

3.4. Grading

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

It is intended that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. Heritage Western Cape (2016), however, uses a system in which resources of local significance are divided into Grade 3A, 3B and 3C. These approximately equate to high, medium and low local significance respectively, while sites of very low or no significance (and generally not requiring mitigation or other interventions) are referred to as Not Conservation Worthy (NCW).

3.5. 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. Due to the size of the site it was not possible to examine every part of it in detail. The focus was on understanding the distribution and types of heritage resources present and it was assumed that this distribution would be broadly true throughout the study area.

Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 30 km radius. The existing and proposed developments that were taken into consideration for cumulative impacts are shown in Figure 5[1]. Note that the cumulative impact assessment also takes into consideration the proposed Ceres PV development, i.e. nine solar PV and nine power lines.

[1] Please note that the map shows affected farms Witte Wall and Karrekolk, however it must be noted that there are no approved Renewable Energy projects on these farm portions. An updated map will be included in the BA Report.

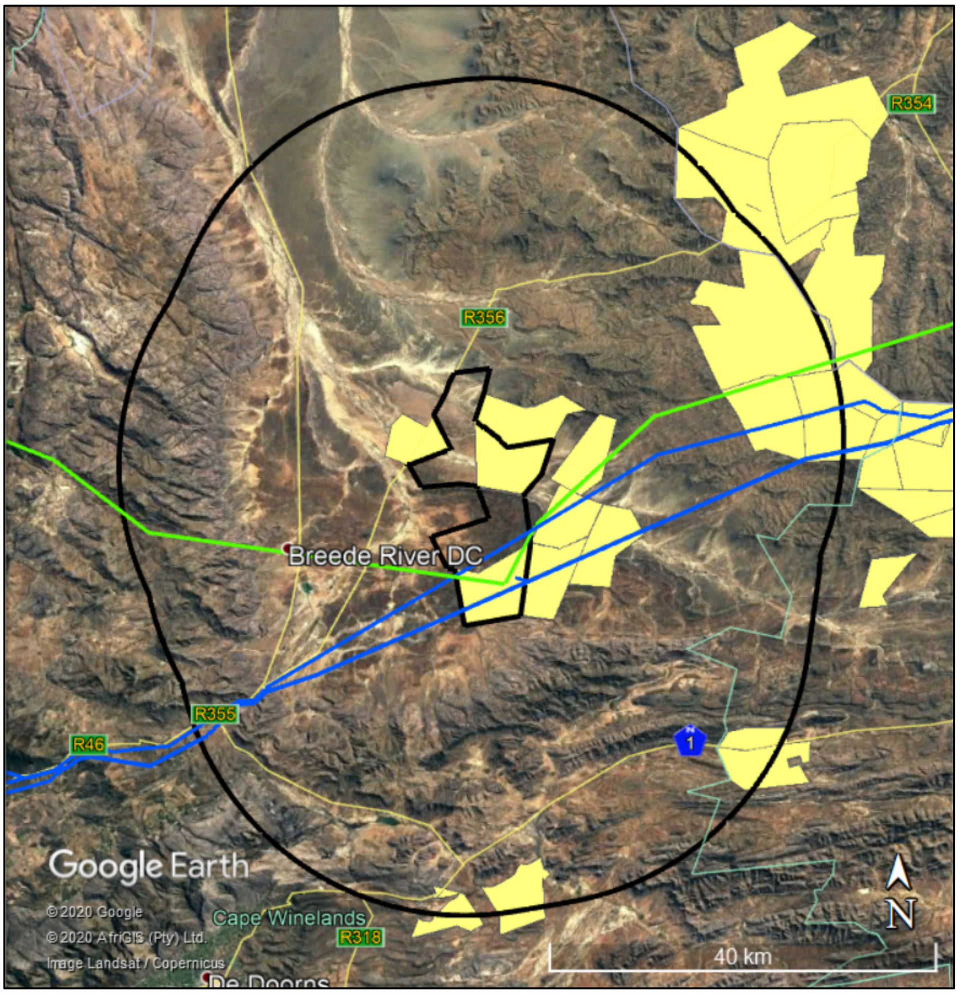


Figure 5: *Aerial view of the broader study area (black polygon) showing other existing and proposed renewable energy and electrical developments within a 30 km radius (black oval). Yellow shading denotes renewable energy facilities (but please see footnote 1), while the green and blue lines are large power lines (either existing or proposed).*

3.6. Consultation processes undertaken

The draft HIA was submitted to relevant interested and affected parties as required by HWC in their response to the NID application (Section 1.2). The report was also included in the main public participation process (PPP) required under NEMA as part of the EIA.

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The site is in a remote location in the Ceres Karoo. It lies off the R356 gravel road. Although the area is currently only used for the grazing of livestock and game, it does lie within the Komsberg REDZ and one wind energy facility has already been developed between 10 km and 18 km to the southeast. The large Eskom Kappa Substation and several power lines occur in the south. Other infrastructure, aside from farm buildings and wind pumps, is largely absent from the local landscape.

4.2. Site description

The broader study area is a wide, flat plain bisected by the Groot River and its tributaries. The Hoek Doornen PV 4 study area lies north of the Groot River, while the other three sites are to the south. The majority of the study area is flat and coated in sand and gravel with only very low vegetation, but denser low bushes do occur in places (Figures 6 to 8). The exception is close to the rivers where trees occur. The southern margin of the site is formed by the Matjiesfontein Chert ridge (Figure 9) and in the southeast sand that has blown over this ridge has formed a small dune field which differs in character from the rest of the study area due to its sandy substrate. It tends to have lower density but far larger bushes (Figure 10).

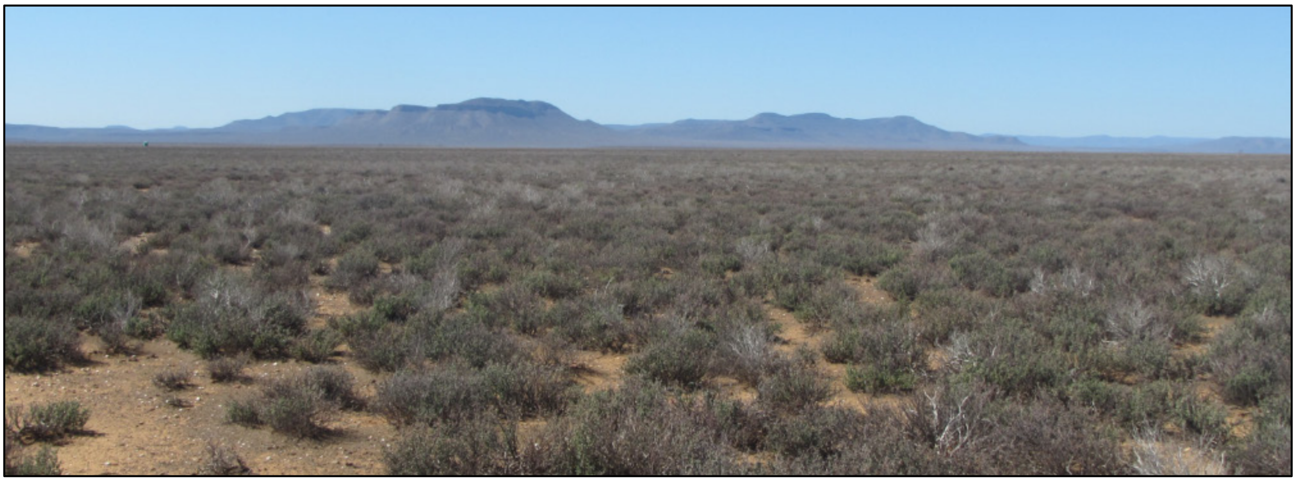


Figure 6: *View towards the northeast across the Hoek Doornen PV 3 & PV 2 sites showing the low vegetation.*

Figure 7: *View towards the southwest within the Hoek Doornen PV 3 site showing sparse vegetation.*

Figure 8: *View towards the northeast across the Hoek Doornen PV 4 site showing sparse vegetation.*

Figure 9: *View towards the west along the southern margin of the broader Hoek Doornen study area (fence line at left) from the Matjiesfontein Chert ridge. The high point in mid-view is also part of the ridge.*

Figure 10: *View towards the north from the high-lying sand dunes in the south-eastern part of the larger Hoek Doornen study area. The different vegetation when compared to the low-lying flat land is obvious.*

The powerline corridor was mostly visited in the north where it passed through the various PV study areas. However, during an earlier survey, parts of the corridor were visited and can be briefly described. Figure 11 shows a view towards the west along the west-east section of the power line corridor. It shows the ridge containing the Matjiesfontein Chert band. And the plains to its south. Figure 12 shows an example of one of the patches of fractured chert debris that occur along the ridge in places. The southernmost part of the corridor is very flat and ends at the large Eskom Kappa Substation (Figure 13).

Figure 11: *View towards the west from the eastern end of the west-east section of the power line corridor. The dashed line shows the approximate centre of the corridor until it passes over the ridge in the distance. The yellow arrow marks the location of Figure 12. Photographed 28 January 2020.*

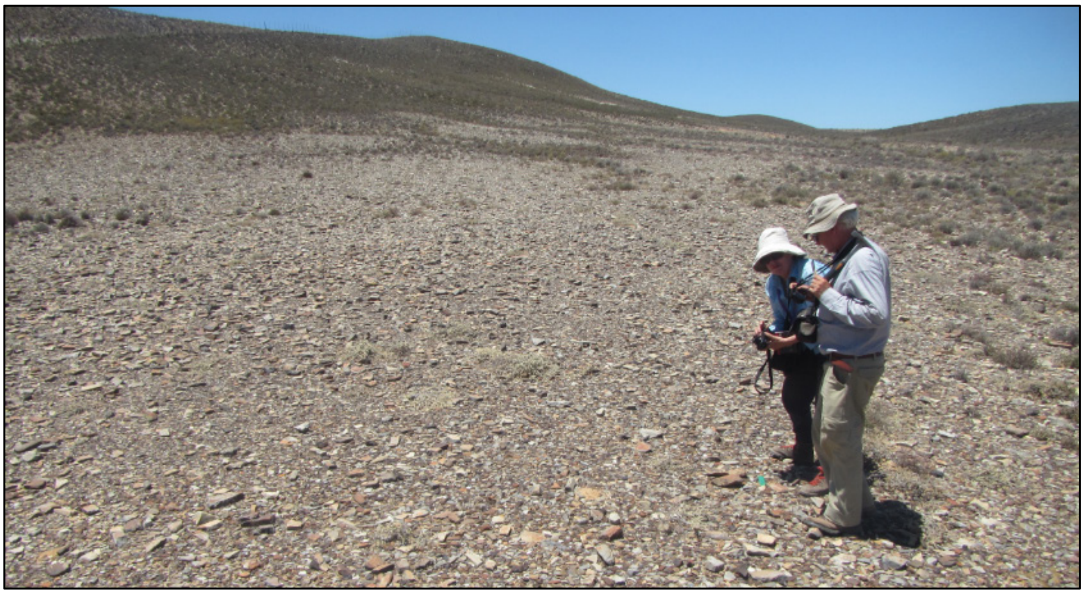


Figure 12: *View of the southern base of the Matjiesfontein Chert ridge showing the fractured debris that has accumulated from weathering of the ridge. Figure 11 was photographed from the skyline in mid-picture. Photographed 28 January 2020.*

Figure 13: *View towards the south of the Kappa Substation from within the southern end of the power line corridor. Photographed 28 January 2020.*

5. FINDINGS OF THE HERITAGE STUDY

This section describes the heritage resources recorded in the study area during the course of the project. Note that mapping has been included in Appendix 3.

5.1. Palaeontology

The South African Heritage Resources Information System (SAHRIS) Palaeosensitivity map shows the study area to be of medium to high sensitivity with a very narrow band of very high sensitivity along the west-east section of the power line corridor.

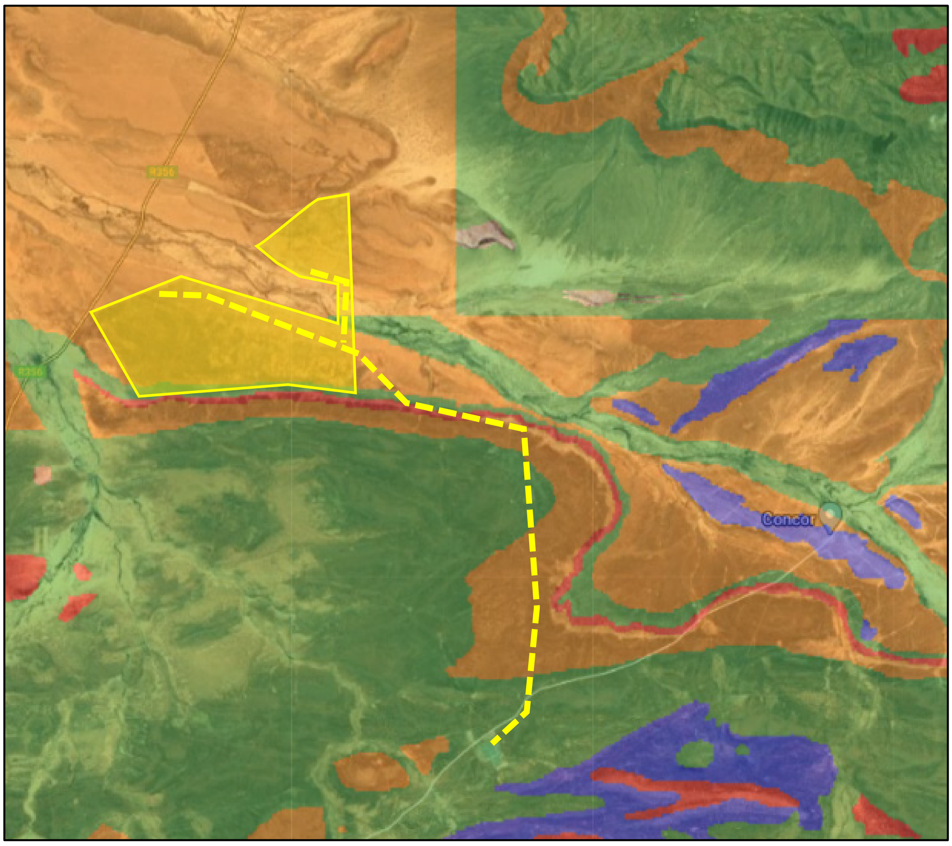


Figure 14: *Extract from the SAHRIS Palaeosensitivity map showing the study area to be of largely medium and high palaeontological sensitivity (green and orange shading respectively). A strip along the power line route is of very high sensitivity (red).*

Almond (2020) notes that the project area is situated on a pediment surface of Neogene to Pleistocene age that has been planed off by river erosion. Beneath a thin capping of alluvial gravels, calcrete hardpans, sandy soils and downwasted surface gravels are Tierberg Formation (Ecca Group) sediments of Middle Permian age. They are weathered, folded and often tectonically-cleaved. Almond (2020:1) comments that “the only fossil remains recorded from such pediment settings in the Ceres Karoo comprise (1) sparse, generally small blocks of reworked silicified fossil wood within alluvial and surface gravels of uncertain provenance (probably Ecca Group) and (2) occasional calcretised fossil termite nests of probable Pleistocene age that are found embedded within calcretised superficial sediments as well as weathered, calcrete-veined bedrocks. … These fossils are of widespread occurrence within the Ceres Karoo region and are not of high scientific interest or conservation value.” He notes that most fossil occurrences found in the field were outside of the PV footprint areas.

The power line corridor overlies rocks of the Permo-Carboniferous, glacial-related Dwyka Group and the lower Ecca Group (Prince Albert, Whitehill and Collingham Formations). The potentially-fossiliferous Prince Albert, Whitehill and Collingham Formations were found to be highly weathered and cleaved in the study area and no sensitive fossil sites have been found along the corridor (Almond 2020).

The full palaeontological specialist study is included in Appendix 4.

5.2. Archaeology

5.2.1. Desktop study

Some other studies have been done in the area but few are available on SAHRIS. Halkett and Webley (2011) located many light scatters of artefacts in an area to the southeast of the present study area and focused along the margins of streams. The vast majority were considered to be Middle Stone Age (MSA) with far fewer relating to either the Early (ESA) or Late (LSA) Stone Ages. A few bifacial pieces seemed likely to be ESA handaxes though. Orton (2008) worked at the southern end of the present power line corridor and located a number of light scatters of artefacts. Most were MSA artefacts (e.g. Figure 15) but one small scatter was strongly dominated by LSA artefacts (Figure 16). A single willow pattern ceramic (plate) fragment was also found.

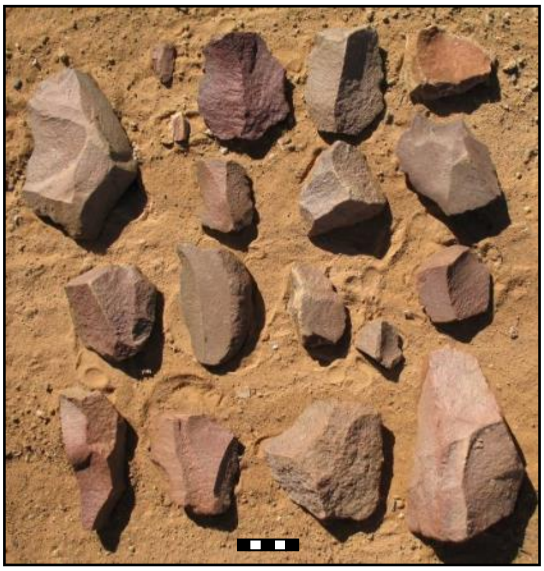


Figure 15: *Artefacts from PFN2008/007. Scale in cm. Source: Orton 2008: fig. 63.*

Figure 16: *A selection of artefacts from PFN2008/004. Note the inclusion of quartz and absence of quartzite. The dark rock is unweathered hornfels. Scale in cm. Source: Orton 2008: fig. 65.*

Towards the east and into the foothills of the escarpment, Smuts (2018) found stone artefacts to be far rarer than out on the plains but also noted that what was present was focused along rivers. Smuts (2018) also recorded a rock shelter with finger paintings and a single pot sherd. A subsequent visit to this site by the present author showed it to contain a good deposit with many stone artefacts, some grindstones, a grooved stone, many finger-painted images on the rear wall and a string of five *Nassarius kraussianus* shell beads. These are estuarine shells that had to have been brought to the site from the coast. Two other rock art sites – one a fine line painting and another a set of geometric paintings – have been seen by the present author some 19 km north of the PV study area.

5.2.2. Site visit

Table 1 provides a list and description of all heritage resources recorded during the ground survey. Not recorded are the very large number of isolated Stone Age artefacts seen throughout the study area (except for ESA bifaces and LSA lower grindstones which were recorded). These isolated artefacts are what are commonly referred to as background scatter, their distribution having been conditioned more by natural forces than anthropogenic ones (Orton 2016). They are dominated by

MSA artefacts but ESA and LSA artefacts were also frequently seen. Figure 17 shows a selection of such isolated finds from the Hoek Doornen farm, while Figure 18 shows the three ESA bifacial artefacts (handaxes) seen. Figures 19 and 20 show artefacts from two patches of denser background scatter in the western part of the study area. These were close to a small scraped dam in a very flat area and it is possible that the dam was once a natural pan. Figure 21 shows artefacts from a small scatter of silcrete artefacts in the Hoek Doornen PV 4 study area, just north of the Groot River. This scatter, while still part of the background scatter because of the small number of artefacts, must relate to activity that happened on that spot. Background scatter artefacts were seen in all of the few locations visited along the power line corridor, while some denser scatters of artefacts were recorded by Orton (2008) in the very southern end of the corridor alongside the Kappa Substation. The artefacts along the power line corridor seem to be largely MSA, as occurs elsewhere, but a number of ESA items have been seen by both the archaeologist and palaeontologist in close proximity to the Matjiesfontein Chert ridge.

Table 1: *List of heritage resources recorded during the survey.*

Waypoint	Location	Description	Significance	Grade
132	S32 59.962 E19 53.616	Large stone beacon at the intersection point of three farms.	Medium	IIIB
133	S33 00.076 E19 53.977	A scraped area revealing MSA background scatter (BGS). Plenty of retouched artefacts, some points present. Materials include hornfels, cryptocrystalline silica (CCS) and 'other'.	Very low	NCW
134	S33 00.057 E19 53.919	An area with elevated density BGS. Some retouched pieces present. The material is MSA in age. Materials include quartzite hornfels, CCS, silcrete and 'other'. Potential sample location.	Very low	NCW
135	S33 00.034 E19 53.802	An area of BGS with a semi-*in situ* scatter of light grey artifacts that were obviously flaked at this spot. The artefacts are of Matjiesfontein Chert. Potential sample location.	Low	IIIC
136	S32 59.902 E19 54.333	An area of elevated density BGS.	Very low	NCW
137	S33 00.961 E19 54.646	An area of elevated density BGS but seemingly with a low density, possibly in situ scatter of grey Matjiesfontein Chert artefacts.	Very low	NCW
138	S33 01.193 E19 54.487	A large and extremely dense CCS (Matjiesfontein Chert, but darker grey than usual) factory site located on the crest of a hill. It extends at least 200m towards the east from this waypoint. The hill is part of the ridge in which the Matjiesfontein Chert lies.	Medium	IIIB
139	S33 01.102 E19 55.157	An area of dense BGS in a sandy area further along the same ridge.	Very low	NCW
140	S33 01.089 E19 55.637	A small scatter of LSA artefacts on a sand dune area on the northwest side of the Matjiesfontein Chert ridge. There are maybe fifteen artefacts visible and several pieces of ochre. There may be more buried in the sand. Included in the flaked assemblage is half a segment on Matjiesfontein Chert. There is also hornfels and one quartz flake.	Low	IIIC
141	S33 01.075 E19 55.669	A small scatter of LSA artefacts on a sand dune area on the northwest side of the Matjiesfontein Chert ridge. There are maybe fifteen artefacts visible. Materials include hornfels and CCS (Matjiesfontein Chert).	Low	IIIC

Waypoint	Location	Description	Significance	Grade
171	S32 59.560 E19 57.640	A cottage that has been renovated and added to in an organic manner over the years. The original was undoubtedly a brakdak structure.	Low	IIIC
172	S32 59.209 E19 57.310	An undiagnostic scatter of silcrete flakes and a single core, about 20 artefacts. Occurs amongst the general background scatter.	Very low	NCW
221	S33 00.867 E19 56.948	A stone cluster/feature on a sand dune. One ostrich eggshell fragment nearby. Possible grave.	High	IIIA
222	S33 00.863 E19 56.945	A very loose cluster of rocks on a sand dune (seems unlikely to be a grave) with 1 quartz, 1 CCS and about 10 chert artefacts associated. Also 1 ostrich eggshell fragment, a lower grindstone and an upper grindstone/hammerstone.	Very low	IIIC
223	S33 00.816 E19 56.875	A scatter of ostrich eggshell fragments and 4 rocks on a sand dune.	Very low	NCW
224	S33 00.764 E19 56.854	A cluster of rocks on a sand dune. Seems unlikely to be a grave.	Very low	NCW
225	S33 00.804 E19 56.752	A deflation hollow with an ephemeral scatter of quartz, chert and CCS flaked artefacts. There is a cluster of rocks in the southern end of the hollow and another in the west. The latter includes an anvil stone. There are also 2 lumps of yellow ochre in the southern part of the hollow.	Low	IIIC
226	S33 00.891 E19 57.772	A scatter of rocks on a sand dune with three cores, a few flakes and a hammerstone. There is recent sand deposition so undoubtedly there are more buried flaked artefacts. There is also a light scatter of flakes and ostrich eggshell fragments about 8 m to the south of the rock cluster.	Low	IIIC
227	S33 00.048 E19 57.585	Two stone features along the edge of the raised terrace overlooking the river floodplain. Very unlikely to be graves because of hard, rocky substrate.	Very low	NCW
228	S33 00.012 E19 57.485	A large mound of stones at the edge of the raised terrace overlooking the river floodplain. Seems very unlikely to be a grave.	Very low	NCW
229	S33 00.026 E19 57.438	A mound of stones at the edge of the raised terrace overlooking the river floodplain. Not a grave because bedrock is visible adjacent to the lowest stones.	Very low	NCW
230	S32 59.964 E19 57.322	An ephemeral scatter of hornfels and chert flaked artefacts, ostrich eggshell fragments and rocks as well as a lower grindstone and an upper grindstone/hammerstone.	Low	IIIC
231	S32 59.942 E19 57.257	A small cluster of rocks including one possible lower grindstone eroding off the edge of a silt stack on the river floodplain. Seems very unlikely to be a grave (silt does not look disturbed).	Very low	NCW
232	S33 00.156 E19 57.474	A handaxe of 110 (broken) x 68 x 38 mm. The tip break is fresh.	Very low	NCW
670	S33 05.494 E20 01.541	Low density background scatter on Dwyka Tillite gravel.	Very low	NCW
671	S33 02.423 E20 01.424	Low density background scatter on Dwyka Tillite gravel.	Very low	NCW
672	S33 01.542 E20 00.936	Background scatter along the edge of the Collingwood Formation which has several chert bands, including the well-known Matjiesfontein Chert. The scatter was low density but it was interesting to note the variety of	Low	IIIC

Waypoint	Location	Description	Significance	Grade
		items present. These includes material likely to be of all three Stone Ages. Notably, many artefacts were simply natural pieces of stone, often diamond-shaped in cross-section), that had been modified slightly for further use. This included many small slabs of rock with abundant edge-damage as well as well-weathered handaxes that were made with around 3 to 5 removals. Although outside the powerline route, it likely serves as a representative sample of what would be present in those places where the route crosses this geology elsewhere.		
003	33° 06 41.9 S 20° 00 59.6 E	Deflated area with LSA and MSA artefacts on hornfels and quartzite. Recorded by Orton (2008).	Very low	NCW
004	33° 06 43.4 S 20° 00 50.7 E	Good scatter of LSA artefacts over an area about 5 m across, no evidence of organics, just two MSA. Recorded by Orton (2008).	Low	IIIC **Sample**
005	33° 06 37.4 S 20° 00 59.0 E	MSA background scatter artefacts in quartzite and hornfels. Recorded by Orton (2008).	Very low	NCW
006	33° 06 38.2 S 20° 01 03.1 E	MSA background scatter artefacts in quartzite and hornfels. Recorded by Orton (2008).	Very low	NCW
007	33° 06 35.6 S 20° 00 53.8 E	Widespread MSA background scatter artefacts in quartzite and hornfels. One LSA artefact. Recorded by Orton (2008).	Very low	NCW
kraal 1	33° 06 51.5 S 20° 01 27.6 E	Historical stone-built kraal built on a north-facing hill slope. Also many LSA stone artefacts noted in the vicinity. Recorded by Orton (2008).	Medium	IIIB
kraal 2	33° 06 54.0 S 20° 01 31.0 E	Historical stone-built kraal built on a south-facing hill slope (same hill as kraal 1). Visible on aerial photography.	Medium	IIIB

Figure 17: *Selection of background scatter artefacts from the Hoek Doornen farm. They include mostly ESA and MSA artefacts with only rare LSA materials. Notable inclusions are a natural slab with a worked edge (bottom centre, edge and plan view shown) and an MSA point with notched margins (bottom right, ventral and dorsal surfaces shown).*

Figure 18: *ESA bifaces (handaxes) from Hoek Doornen. Middle artefact is from waypoint 232.*

.

Figure 19: *Background scatter artefacts from waypoint 134.*

Figure 20: *Background scatter artefacts from waypoint 135.*

Figure 21: *A selection of silcrete artefacts from waypoint 172.*

The south-western corner of the wider study area (and indeed its southern boundary) lies along the ridge that hosts the Matjiesfontein Chert band. At the corner there is a prominent hill (Figure 9) which hosts a massive number of stone artefacts. It is quite clear that this prominent landmark location has been extensively quarried for chert to manufacture stone artefacts amongst the chert gravel (Figure 22 & 23).

Figure 22: *View east from the hilltop site at waypoint 138.*

Figure 23: *Stone artefacts in Matjiesfontein Chert at waypoint 138.*

The south-eastern part of the Hoek Doornen study area is quite different from the rest thanks to the red sand dunes it hosts. This dune area was frequented by LSA people who left many ephemeral sites. The sites have flaked and ground stone artefacts, clusters of rocks and some ostrich eggshell fragments. Figure 24 shows artefacts from waypoint 140. Aside from a fragment of ochre, a notable inclusion is a segment (Figure 25). This is an artefact type usually – but not exclusively – made during the mid-Holocene, 6000 to 3000 years ago. Figures 26 and 27 show another example of one of these LSA sites, while Figure 28 and 29 show a third. The latter includes a lower grindstone. An ephemeral LSA artefact scatter was also seen along the southern bank of the Groot River.

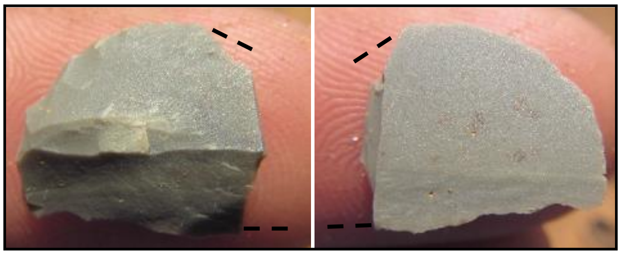


Figure 24: *Chert artefacts and an ochre fragment from waypoint 140. Upper right artefact is a broken segment.*

Figure 25: *Dorsal and ventral views of a chert segment from waypoint 140. The dashed lines indicate the break.*

***Figure 26:** View across a site on the dunes at waypoint 187.*

***Figure 27:** Chert artefacts from waypoint 187.*

***Figure 28:** A stone cluster on the sand dunes at waypoint 222.* It seems unlikely to be a grave.

***Figure 29:** A lower grindstone at waypoint 222.*

Historical archaeological materials were surprisingly not seen in the Hoek Doornen study area.

5.3. Graves

A number of piles of stones were seen in one area close to the southern bank of the Groot River (e.g. Figures 30 & 31). These were largely on the rocky terrace and none looked like graves. Their function is unknown. Figures 30 and 31 show examples.

Figure 30: *Two stone piles at waypoint 227.*

Figure 31: *A stone pile at waypoint 229.*

5.4. Historical aspects and the Built environment

5.4.1. Desktop study

In addition to standing structures, Halkett and Webley (2011) found many small stone ruins. They were from a variety of features including houses, kraals, ovens, a possible threshing floor and a well. Smuts (2018) also noted many stone structures and ruins. To the south of the Kappa Substation and some 450 m outside the proposed power line corridor, a large stone-built kraal was recorded on a north-facing slope by Orton (2008; Figures 32 & 33). A second one lies over the hill about 100 m further to the southeast.

Figure 32: *View across the Platfontein site towards the kraal. The study area extends approximately as far as the power lines visible in the photograph and the kraal is some 350 m beyond its edge. Source: Orton (2008: fig. 66).*

Figure 33: *Close up view of the kraal looking southwards. Source: Orton (2008: fig. 67).*

Karoo Poort is an important historical passage that hosts a Provincial Heritage Site (PHS), the Karoopoort Outspan. The poort is located some 35 km southwest of the PV study area. The PHS buildings and grounds are sadly run down and the “mile-long row of ancient fig trees” mentioned by Mossop (1927:182) is now largely dead. The old road, or ‘Forgotten Highway’, to the diamond fields used to pass through Karoo Poort (also once known as Bokkeveld’s Poort) on its way to Sutherland. Figure 34 shows Mossop’s (1927: facing page 168) map of the area. The historical road approximately equates to the R356 of today with the latter simply being a straightened and modernised version. After passing the study area, the road makes its way below a prominent landmark hill known as Hanglip, for the slightly overhanging cliff visible in profile from the southwest and northeast. The original road lay closer to the foot of Hanglip (as shown by a photograph in Mossop (1927)). There was also an outspan at the foot of the hill.

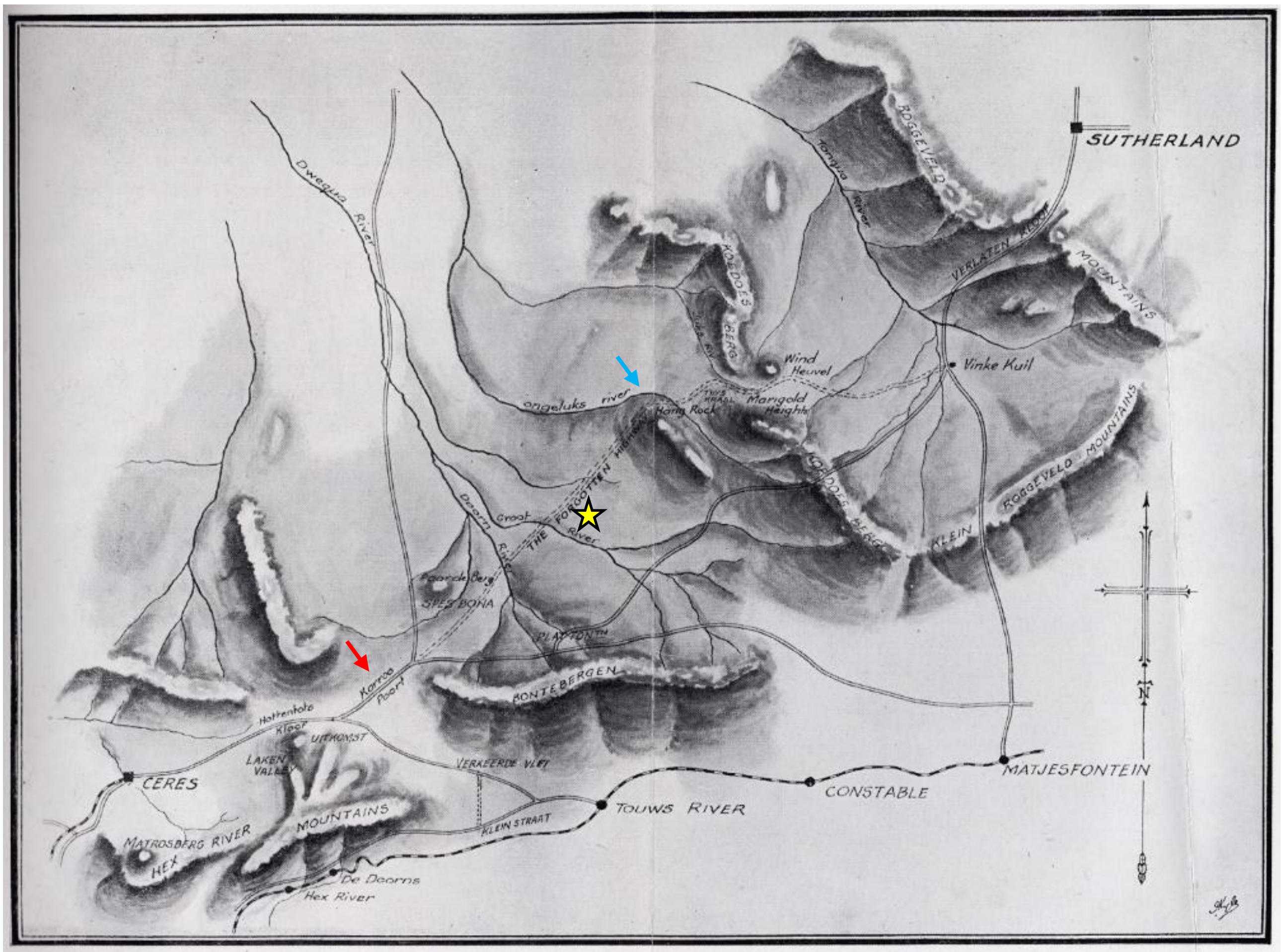


Figure 34: *Map of the Ceres Karoo showing the 'Forgotten Highway' leading past the study area (yellow star). The important landmarks of Karoo Poort (red arrow) and Hanglip (blue arrow) are indicated.*

5.4.2. Site visit

Two historical features were noted on site. One was a large stone boundary beacon (Figure 35) and the other was a cottage that had clearly been altered, added to and maintained many times over the years. It very likely started out as a brakdak house but now has a flat corrugated iron roof.

Figure 35: *The stone cairn at the western corner of Hoek Doornen at waypoint 132. This point is the intersection of three farms.*

Figure 36: *The cottage at waypoint 171 on the north bank of the Groot River.*

5.5. Cultural landscapes and scenic routes

The landscape is very strongly a natural one which has a distinctive aesthetic appeal to lovers of South Africa's dry landscapes. Figures 6 to 12 provide an impression of the landscape, showing its expansiveness and, within the Ceres Karoo basin, lack of steep topography. The triangular basin is ringed by mountains: the Swatruggens lie in the west, the Bontberg and other small unnamed mountains form the southern edge, and the Roggeveld Mountains lead up to the escarpment in the northeast. Although the area is very remote and has no paved roads, it has been included in the Komsberg REDZ which means that wind and solar farms can be expected to be developed in the area (Figure 37). The REDZ already hosts several wind farms, including one located to the southeast of the present study area. The Kappa Substation occurs at the southern end of the proposed power line corridor and several large power lines already traverse the Ceres Karoo going in and out of the substation (Figures 5 & 13).

Although Winter and Oberholzer (2013) list Karoo Poort as a Grade II scenic resource for its historical and architectural value and the uplands (Koedoesberge) to the north of the project area as a Grade III scenic resource rising from the flat plain, they ascribe no scenic value to the plain itself and the R356 that traverses it. The road is nevertheless considered by the present specialist to have at least some value as a local scenic route, especially given its historical role.

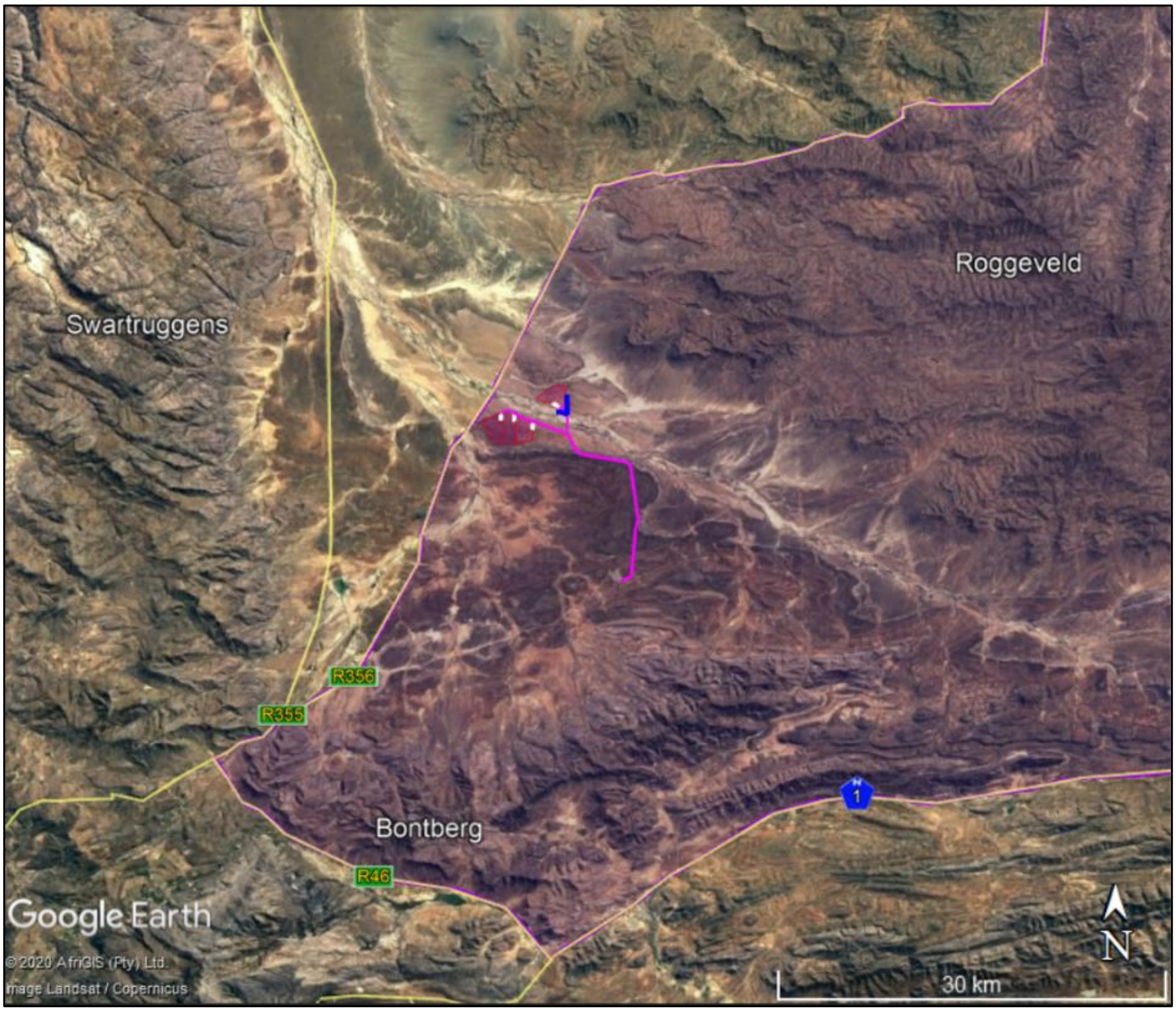


Figure 37: *Aerial view of the Ceres Karoo showing project site (PV Areas for Hoek Doornen PV 1 to PV 4 and power lines to the Eskom Kappa Substation) relative to the western part of the Komsberg REDZ (purple shading) and surrounding mountains (labelled).*

As already noted in Section 5.4.1, the Ceres Karoo hosted an important historical travel route. The small mountain known as Hanglip was a crucial landmark in the landscape as it signalled the end of the Ceres Karoo crossing and also arrival at an outspan. Hanglip is very prominent and forms a key component of the cultural landscape (Figure 38). For the rest, the natural landscape is marked only by rare houses, often accompanied by gum or other trees, farm fences and tracks and water infrastructure (earthen dams, round cement reservoirs and wind pumps). The anthropogenic imprint on the landscape is thus very light. Karoo Poort is also an important component of the wider cultural landscape but, owing to its distance from the project area, is not of concern here.

Figure 38: *View along the R356 northwards towards Hanglip, the small peak at the left end of the middle ground mountain.*

5.6. Visual impact assessment

A specialist visual assessment has been carried out by Oberholzer and Lawson (2020; see Appendix 5). They note that the viewshed extends up to 5 km but that the visual exposure is medium because some areas fall within a view shadow. They note that scenic resources are absent from the immediate area with only farmsteads serving as visual receptors. The landscape integrity is considered to be low with powerlines and the Perdekraal wind energy facility having disturbed the landscape. Figures 39 shows that the R356 could be significantly affected by the PV projects, while Figure 40 shows that the EGI would not visually impact this road. Figure 41 shows that, despite a 500 m buffer, the PV panels would be moderately visible from the R356. The power lines would be visible from the road passing the Kappa Substation but much other electrical infrastructure already occurs in that area.

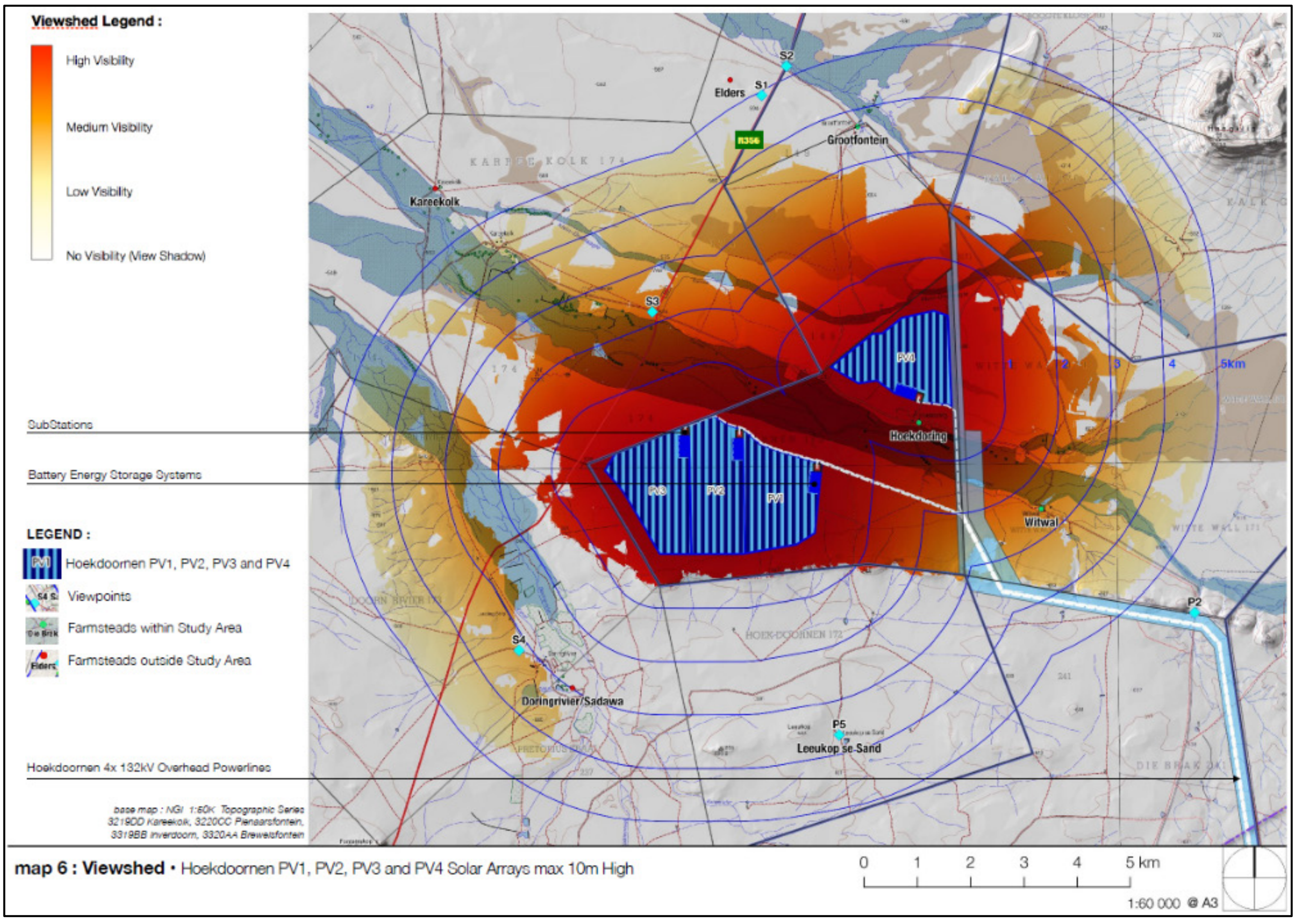


Figure 39: *Viewshed map for the four Hoek Doornen PV projects.*

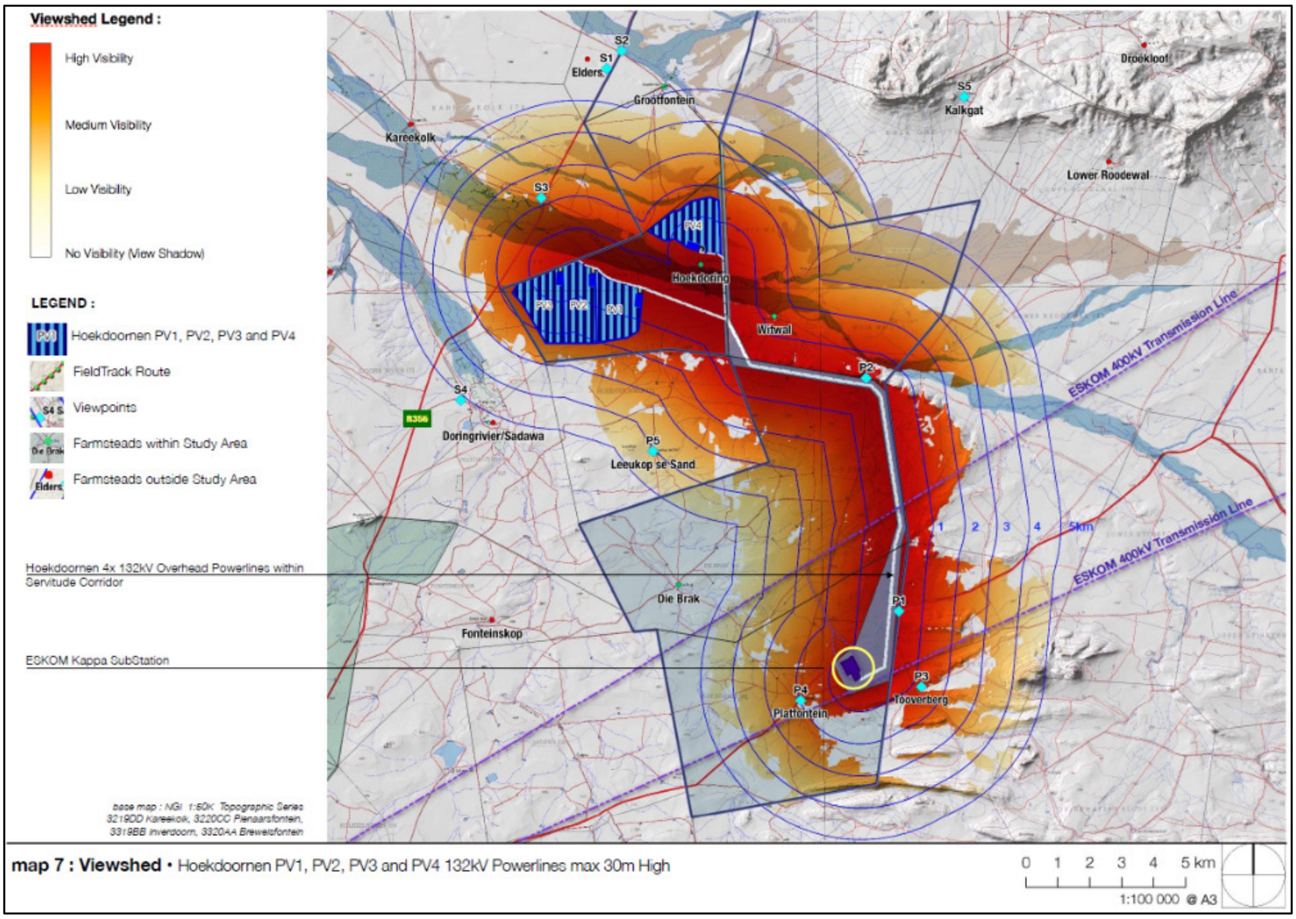


Figure 40: *Viewshed map for the Hoek Doornen EGI.*

Figure 41: *Photomontages looking eastwards and south-eastwards from the R356 (immediately north of the Groot River). Source: Lawson & Oberholzer 2020: fig. P1).*

5.7. 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 palaeontological resources are deemed to have low cultural significance for their scientific value. Any fossils found are likely to be in the Grade IIIB to NCW range.

The archaeological resources within the Hoek Doornen PV 1 to PV 4 and power line study areas are deemed to have generally low cultural significance for their scientific value. They are rated as NCW. Other sites of greater significance have been excluded from the development footprints and are graded up to IIIA (Figure 42). There are no historical archaeological resources within the study area. The two stone kraals just outside the power line corridor are also given Grade IIIB.

Graves are deemed to have high cultural significance for their social value and are considered Grade IIIA resources. None are known within the development areas.

There are no buildings within the PV sites. Elsewhere on the farm, the single built heritage structure to the north of the Groot River and the stone boundary beacon to the south are considered low and medium cultural significance respectively for their architectural and social values and are graded IIIC and IIIB.

The cultural landscape, despite already hosting significant electrical infrastructure, is considered to be of at least medium significance worthy of a IIIB grading. Certain iconic views, for example within Karoo Poort or of Hanglip can be considered as of high significance and worthy of grade IIIA.

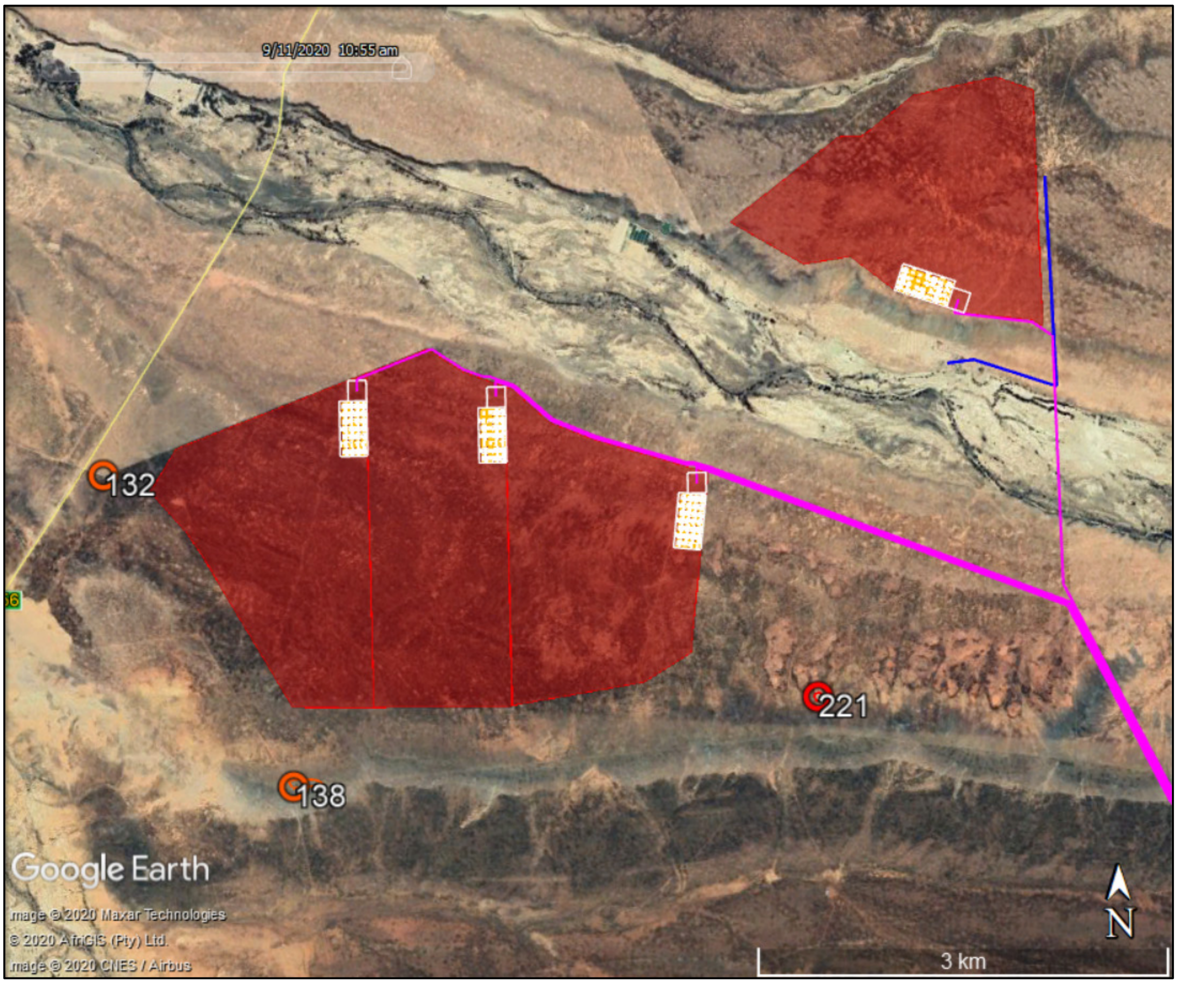


Figure 42: *Aerial view of the PV study area (red shading) and northern part of the power line corridor (pink lines) showing heritage resources of Grade IIIA (red circles – waypoint 221) and IIIB (orange circles – waypoints 132 and 138).*

5.8. Summary of heritage indicators

Fossils can be present in the landscape and are easily damaged or destroyed during development.

- <u>Indicator</u>: Significant fossils should not be damaged or destroyed.

Archaeological resources and graves are generally very fragile and vulnerable to damage or disturbance.

- <u>Indicator</u>: Significant archaeological resources and graves should not be damaged or destroyed.

The cultural landscape can be very easily spoiled by insensitive developments that dominate from many viewpoints.

- <u>Indicator</u>: The cultural landscape should not be visually dominated by the proposed development.
- <u>Indicator:</u> Steep slopes should be avoided for the PV layouts and BESS.
- <u>Indicators:</u> The southern ridge and sand dune area should be avoided as much as possible for the PV layouts (Figure 43).

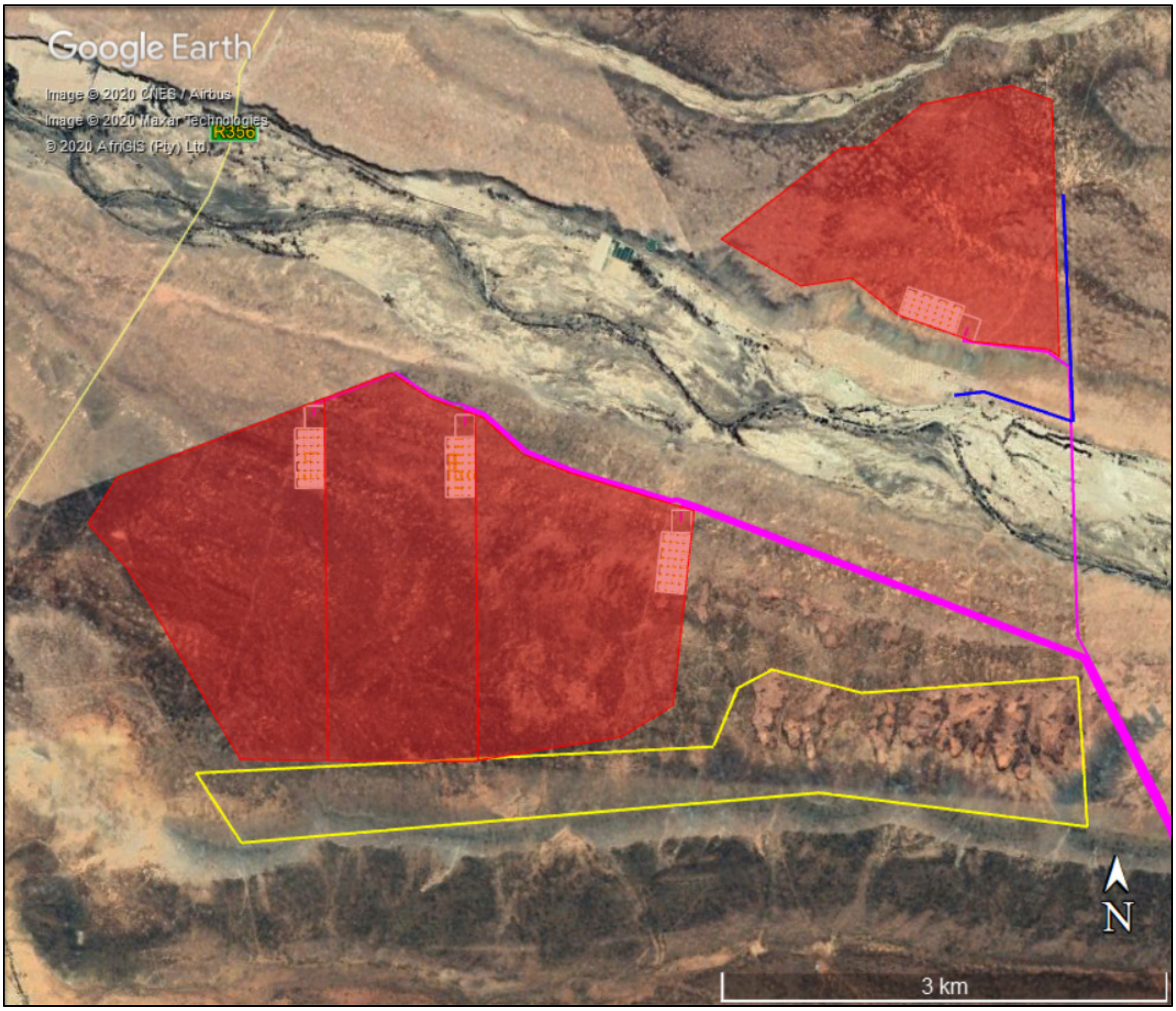


Figure 43: *Aerial view of the Hoek Doornen PV sites showing the area (outlined in yellow) to be avoided for visual and cultural landscape reasons.*

6. ISSUES, RISKS AND IMPACTS

6.1. Issues, risks and impacts

The potential impacts identified during the assessment are the **same** for **the Hoek Doornen PV 1 to PV 4 projects (i.e. including the PV Facilities, Power Lines and Associated Infrastructure)**. They are:

Construction Phase

- Potential impacts to palaeontological resources
- Potential impacts to archaeological resources and graves
- Potential visual impacts to the cultural landscape

Operational Phase

- Potential visual impacts to the cultural landscape

Decommissioning Phase

- Potential visual impacts to the cultural landscape

Cumulative impacts

- Potential impacts to palaeontological resources
- Potential impacts to archaeological resources
- Potential impacts to the cultural landscape

7. IMPACT ASSESSMENT: HOEK DOORNEN PV 1 TO PV 4

The impact assessments for all four projects are expected to be the same. Please note that the assessments for palaeontology have been provided in the attached palaeontological specialist study (Appendix 4) and are not repeated here, save to note that the impacts would occur during the construction phase and their significance would be **very low negative** both before and after mitigation.

The impacts below apply to the **PV Facilities, Power Lines and Associated Infrastructure**.

7.1. Direct Impacts

7.1.1. Construction Phase

Potential Impacts to archaeology and graves

Impacts to archaeology and graves would be direct impacts that might occur during construction when these resources are damaged or destroyed during excavation work. Although the impacts would be permanent and are very likely to happen, the moderate consequence means that significance before mitigation is **low negative** (Table 2). A detailed pre-construction survey of the final layouts (PVs and power lines) should be undertaken in order to determine appropriate sample areas from which to collect artefacts. There is a small possibility that more significant sites or even graves may be found. While background scatter artefacts occur widely and in variable densities across the landscape, it is suggested that one area per PV project footprint could be collected from in order to record some of the variability across the wider project area. Collection along the power line route can also be contemplated if necessary but, because of the limited footprint associated with the power lines, this is likely to not be needed, especially since micrositing of pylons and the service track should be fairly straightforward. The ECO should also ensure that all staff are alerted to the possibility of finding archaeological resources and instructed to report any unusual finds. With mitigation the impact significance is expected to be **very low negative**, although it is noted that new data from an otherwise poorly understood area could contribute some scientific benefit.

Table 2: *Impacts to archaeology & graves – construction phase.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Impacts to archaeology & graves	Status	*Negative*	*Low (4)*	*Pre-construction survey.* *Sample artefacts.* *Educate staff on possible finds.*	*Very low (5)*	*High*
	Spatial Extent	*Site specific*				
	Duration	*Permanent*				
	Consequence	*Moderate*				
	Probability	*Very likely*				
	Reversibility	*Non-reversible*				
	Irreplaceability	*High*				

Potential Impacts to the cultural landscape

Impacts to the cultural landscape would be direct impacts that might occur during construction when much machinery and equipment is on site and there is plenty of activity in what is an otherwise very quiet and tranquil landscape with minimal traffic. The impacts would be medium term (as long as construction takes) and are very likely to happen. The substantial consequence means that the significance before mitigation is **moderate negative** (Table 3). Mitigation would entail minimising the disturbance footprint, utilising dust suppression measures, ensuring effective rehabilitation of areas not needed during operation, locating the laydown area and batching plant (if needed) as far from public roads as possible and using natural colours and finishes on buildings. With mitigation the impact significance is expected to be **low negative**. It is noted that Lawson and Oberholzer (2020) have rated the significance of visual impacts as **low negative** both before and after mitigation.

Table 3: *Impacts to the cultural landscape – construction phase.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Impacts to cultural landscape	Status	*Negative*	*Moderate (3)*	*Minimise disturbance footprint.* *Employ dust suppression measures.* *Ensure effective rehabilitation.* *Locate laydown, batching plant and buildings far from public road.* *Natural colours and finishes on buildings.*	*Low (4)*	*High*
	Spatial Extent	*Local*				
	Duration	*Medium term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Non-reversible*				
	Irreplaceability	*High*				

7.1.2. Operation Phase

Potential Impacts to the cultural landscape

Impacts to the cultural landscape would be direct impacts that might occur during operation through the visual intrusion of an industrial-type facility on the otherwise rural cultural landscape. Because the facility layout has responded to the landscape character and will sit quite low in the landscape, the extent of impacts is expected to be local. The impacts would be long term and are very likely to happen. The moderate consequence means that significance before mitigation is **low negative** (Table 4). Once construction is over, there are only minor mitigation measures that can be applied. Security lighting should be directed to minimise light pollution and signage should be as small and unobtrusive as possible. These will not change the overall visual intrusion much and the post-mitigation significance thus remains **low negative**. It is noted that Lawson and Oberholzer (2020) have rated the significance of visual impacts as **low negative** both before and after mitigation.

Table 4: *Impacts to the cultural landscape – operation phase.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
OPERATION PHASE						
Impacts to cultural landscape	Status	*Negative*	*Low (4)*	*Minimise light pollution.* *Signage to be small and unobtrusive.*	*Low (4)*	*High*
	Spatial Extent	*Local*				
	Duration	*Long term*				
	Consequence	*Moderate*				
	Probability	*Very likely*				
	Reversibility	*Non-reversible*				
	Irreplaceability	*High*				

7.1.3. Decommissioning Phase

Potential Impacts to the cultural landscape

Impacts to the cultural landscape would be direct impacts that might occur during decommissioning when much machinery and equipment is on site and there is plenty of activity. The impacts would be long term because rehabilitation is likely to take decades to be completed. Impacts are very likely to happen. The substantial consequence means that significance before mitigation is **moderate** (Table 5). Mitigation would largely entail employing best practice i.e. minimising the disturbance footprint, utilising dust suppression measures, and ensuring effective rehabilitation of all areas. With mitigation the impact significance is expected to be **low**. It is noted that Lawson and Oberholzer (2020) have rated the significance of visual impacts before mitigation as **low negative** and after mitigation as **very low negative**.

Table 5: *Impacts to the cultural landscape – decommissioning phase.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
DECOMMISSIONING PHASE						
Impacts to archaeology & graves	Status	*Negative*	*Moderate (3)*	*Minimise disturbance footprint.* *Employ dust suppression measures.* *Ensure effective rehabilitation.*	*Low (4)*	*High*
	Spatial Extent	*Local*				
	Duration	*Long term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Non-reversible*				
	Irreplaceability	*High*				

7.1.4. Cumulative Impacts

Cumulative impacts relate to the loss of archaeological resources over wide areas and the presence of multiple electrical facilities in the landscape. Because significant archaeological sites are generally located and protected from development – and so few significant sites exist in developable areas – the cumulative impacts are driven mainly by the visual impacts to the cultural landscape. In this regard, wind turbines have the greatest impact, followed perhaps by power lines, although the latter reduce in visibility more quickly than turbines do. It is expected that the cumulative impacts to heritage will be **moderate negative**. Mitigation measures would be the same as proposed for the present projects but, because visual mitigation measures can never screen these large developments, the post-mitigation impacts are expected to remain **moderate negative**. Note that because the various facilities in the landscape will be built, operated and decommissioned at different times, there is no distinction made between the project phases for cumulative impacts.

Table 6: *Cumulative impacts to heritage resources.*

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
ALL PHASES						
Impacts to all heritage resources	Status	*Negative*	*Moderate (3)*	*Pre-construction archaeological surveys with sampling as needed. Minimise areas disturbed. Minimise light pollution and signage. Effective rehabilitation.*	*Moderate (3)*	*High*
	Spatial Extent	*Regional*				
	Duration	*Long term*				
	Consequence	*Substantial*				
	Probability	*Very likely*				
	Reversibility	*Reversible*				
	Irreplaceability	*High*				

7.2. Indirect Impacts

No indirect impacts are anticipated.

7.3. The No-Go alternative

The No-Go alternative would entail not developing the projects and the landscape would remain in its present undeveloped state. Not developing the projects would not result in any new impacts to heritage resources. Existing natural erosion and weathering of artefacts, ruins and buildings would continue but at a very slow rate. Impact significance from the No-Go alternative is thus expected to be **very low negative** for all aspects of heritage.

7.4. 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 will affect archaeological materials, ruins and structures. Trampling from grazing animals and/or farm/other vehicles may also affect artefacts.

7.5. 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 vantage points is undesirable.

8. IMPACT ASSESSMENT SUMMARY

Table 7 provides a summary of the expected impacts after mitigation.

Table 7: *Overall Impact Significance (Post Mitigation)*

Phase	**Overall Impact Significance**
Construction	Low
Operational	Low
Decommissioning	Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Moderate
Cumulative - Operational	Moderate
Cumulative - Decommissioning	Moderate

9. LEGISLATIVE AND PERMIT REQUIREMENTS

This report and the proposed recommendations will need to be approved by HWC. There are no further legislative requirements for the approval process but if archaeological mitigation is needed then the appointed archaeologist will need to submit a Workplan to HWC to do the work. This must be carried out well in advance of construction to ensure that there is enough time for HWC to approve the mitigation work before construction commences.

10. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

EMPr inputs for palaeontology and visual concerns are provided in the separate palaeontological and visual specialist reports. This section deals only with archaeology as this was the specialist aspect conducted by the present author.

There are three main recommendations to be included in the EMPrs for all project components. The first is to commission a pre-construction survey of the approved PV layouts and power line routes. Further recommendations will stem from the results of that survey. The survey should be done well in advance of construction (preferably at least 6 months) in order to allow time for:

- The field survey;
- Reporting to HWC and application for Workplan approval;
- Conducting the mitigation fieldwork;
- Analysis and reporting; and

- Final approval by HWC

The project developer should ensure that this appointment is made or, if an Environmental Control Officer (ECO) is already appointed, they can see that the requirements are met.

The second measure is for the ECO to ensure that all project staff are aware of the possibility of finding buried heritage materials and that they know the procedure to protect and report such finds. Workers must keep a watch for such items during work.

The third is that the ECO must conduct formal monitoring site visits to (1) verify that all work is remaining within the authorised area and (2) check for any fossils or artefact concentrations that might be revealed.

One specific measure that is required is to ensure the protection of the stone cairn at waypoint 132 if this access point is used. If road widening is required, then this must happen towards the north (i.e. away from the beacon).

The generic EMPrs for substations and power lines (GN 435) make provision for general monitoring by project staff and protection and reporting of any chance finds.

11. 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 projects will result in an improved electricity supply for South Africa which can have extensive benefits in terms of improving the economic outlook and investment potential in the country. At the local scale, it is likely that between about 90 and 150 skilled and between 400 and 460 unskilled employment opportunities will be created during the construction phase per project, while approximately 20 skilled and 40 unskilled employment opportunities would be created over the 20-year operational lifespan of the proposed facility. These unskilled jobs will be linked to services such as panel cleaning, maintenance and security. The heritage resources are not of such a significance that they outweigh the socio-economic benefits of the proposed developments.

12. CONSULTATION WITH HERITAGE CONSERVATION BODIES

This report[2] was submitted to the Witzenberg Municipality for comment as required by the HWC NID response. In addition, and because there are no conservation bodies registered in the area, the report was also sent to Hex Valley Tourism Association and the Touws River Heritage and Conservation Society as the next closest registered organisations. This was on 16 October 2020. By the time of finalising this report on 17 November 2020, only the Hex Valley Tourism Association had responded as shown below. They were in support of the project, the assessment and the

[2] Please note that since submission to the I&APs, the laydown areas for each project have been increased from 5 ha to 13 ha.

recommendations of the HIA. The BA with all specialist studies is due to undergo full public participation shortly.

Re: Re[6]: Ceres Karoo heritage consultation

GA

From Graham Abrahams
to Jayson and copy to Hex Valley Tourism, christiaan@netandmail.com, david@witzenberg.gov.za, RAbed@csir.co.za

Mon 2020/11/16 12:20

⚠ Download pictures or always download pictures from this sender. To preserve privacy, external content was not downloaded.

Hi Jayson

I trust that you, your family and colleagues are all well?

Thank you for making the effort to connect with our society through your email, and for meeting with me. Thank you for sharing your work and findings and the supporting documents, in terms HWC Case No: 20081910SB0825E, in regard to the three heritage impact assessments for solar projects in the Tankwa Karoo region, that I received from you and which I have now read through.

I have definitely benefited (and am enlightened) from reading through your Impact Assessment papers. They certainly provided me with a fresh perspective on the content and quality of the detail that goes into a report such as this. Well done on providing such detailed and comprehensive content.
I respect your professional opinion in this regard in relation to all of the planned PV and associated EGI projects, and therefore support your findings and recommendations, since I am satisfied that they cover all of the issues that are contained in Appendix 6.

I have made copies of the general compliance requirements (Appendix 6) to distribute among my own committee members so that they too can have a better understanding of everything that is considered, such as the "Chance Find Procedure" you mention, and appropriate steps to take in terms of Impact Assessments from the Conservation standpoint.

Then, I have also spoken to my colleague, Melanie Esterhuyse (CEO of Hex River Valley Tourism), regarding your and my discussions on inviting you to address local Stakeholders and Media on Conservation issues in our valley. I think they will find this very interesting. Melanie suggested that one of the evenings of the Media Educational Tour, which at this stage is scheduled for the week 15th to 19th Feb 2021, would be most suitable. She is busy with logistics arrangements (due to limited accommodation in the valley) so I await to hear from her as to which date would be best, and I will let you know asap.

Once again thank you for making contact with us, and we look forward to seeing you next year!

Kind regards,

Graham
G.N.Abrahams: Chairman - Hex River Valley Heritage & Conservation Society
Cell: +27(0)61-583-4269

13. CONCLUSIONS

Table 8 lists the heritage indicators identified for these projects and shows the responses. Some are design responses but others will only be met later through the application of mitigation measures. There are no remaining concerns and it is considered that the proposed developments will not result in significant impacts to heritage resources. There are currently no areas within the PV layouts or power line corridors that require avoidance, but it should be noted that a stone boundary beacon occurs alongside the current access to the southern part of the farm at waypoint 132. It is acceptable that this road may be used by the project so long as any widening happens northwards, away from the beacon.

Table 8: *Heritage indicators and design responses.*

Indicator	Project Response
Significant fossils should not be damaged or destroyed.	No design response possible but a Chance Finds Procedure will be implemented under the EMPr to ensure that any chance finds are recorded and/or collected as required.
Significant archaeological resources and graves should not be damaged or destroyed.	Known significant sites have been avoided by the PV layout and a pre-construction survey is recommended to (1) ascertain whether any further sites are present within the footprint and (2) choose the densest areas of background scatter for formal sampling.
The cultural landscape should not be visually dominated by the proposed development.	Because the PV developments are relatively low to the ground and the power lines lack significant mass, they should only be visible from relatively close to the sites.
Steep slopes should be avoided for the PV layouts and BESS.	The PV project has avoided the visually significant ridge along the southern margin of the study area as well as the area of sand dunes in the southeast. The R356 has been given a 500 m buffer which will reduce the visibility of the project to road users.

13.1. Statement and reasoned opinion of the specialist

Because no significant impacts to culturally significant heritage resources are anticipated and impacts of low significance can be easily managed or mitigated, all four of the proposed Hoek Doornen PV developments and their associated electrical grid infrastructure (EGI) should be authorised in full. This includes the rerouting of the public road at Hoek Doornen PV 4.

14. RECOMMENDATIONS

14.1. Hoek Doornen PV 1

It is recommended that the proposed Hoek Doornen PV 1 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- The stone boundary beacon at waypoint 132 must be protected from harm. Any road widening needed here must be undertaken towards the north; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

14.2. Hoek Doornen PV 2

It is recommended that the proposed Hoek Doornen PV 2 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- The stone boundary beacon at waypoint 132 must be protected from harm. Any road widening needed here must be undertaken towards the north; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

14.3. Hoek Doornen PV 3

It is recommended that the proposed Hoek Doornen PV 3 development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- The stone boundary beacon at waypoint 132 must be protected from harm. Any road widening needed here must be undertaken towards the north; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

14.4. Hoek Doornen PV 4

It is recommended that the proposed Hoek Doornen PV 4 development and rerouted public road be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) the best area for sampling of background scatter artefacts;
- The stone boundary beacon at waypoint 132 must be protected from harm. Any road widening needed here must be undertaken towards the north; and
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

14.5. EGI

It is recommended that the proposed EGI development be authorised but subject to the following recommendations:

- A pre-construction archaeological survey must be carried out to determine (1) whether any further sites are present and (2) whether any areas of background scatter artefacts should be sampled;
- If any fossils, archaeological material or human burials are uncovered during the course of the 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.

15. REFERENCES

Almond, J.E. 2020. Palaeontological input to Heritage Impact Assessment: proposed development of nine 175 Mw Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure near Touwsriver, Witzenberg Local Municipality, Western Cape. Unpublished report prepared for Veroniva (Pty) Ltd, Cape Town: Natura Viva.

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.

Halkett, D. & Webley, L. 2011. Heritage Impact Assessment: proposed Perdekraal Wind and Solar Energy Facility, Western Cape Province. Unpublished report prepared for ERM Southern Africa. St James: ACO Associates cc.

Heritage Western Cape. 2016. Grading: purpose and management implications. Document produced by Heritage Western Cape, 16 March 2016.

Mossop, E.E. 1927. *Old Cape Highways*. Cape Town: Maskew Miller Limited.

Orton, J. 2008. Heritage impact assessment of three sites for the proposed Kappa Substation, Ceres Magisterial District, Western Cape. Unpublished report prepared for Zitholele Consulting. Archaeology Contracts Office, University of Cape Town.

Orton, J. 2016. Prehistoric cultural landscapes in South Africa: a typology and discussion. *South African Archaeological Bulletin* 71: 119-129.

Smuts, K. 2018. Archaeological Impact Assessment Basic Assessment for the Proposed Development of the 325MW Kudusberg Wind Energy Facility and associated infrastructure, between Matjiesfontein and Sutherland in the Western and Northern Cape Provinces: BA report. Unpublished report prepared for CSIR – Environmental Management Services. Stanford: Katie Smuts.

Winter, S. & Oberholzer, B. 2013. Heritage and Scenic Resources: Inventory and Policy Framework for the Western Cape. Report prepared for the Provincial Government of the Western Cape Department of Environmental Affairs and Development Planning. Sarah Winter Heritage Planner, and Bernard Oberholzer Landscape Architect / Environmental Planner, in association with Setplan.

APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

Address: 40 Brassie Street, Lakeside, 7945
Telephone: (021) 789 0327
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. The details of the site sensitivity verification are noted below:

Date of Site Visit	7, 9 and 11 September 2020
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

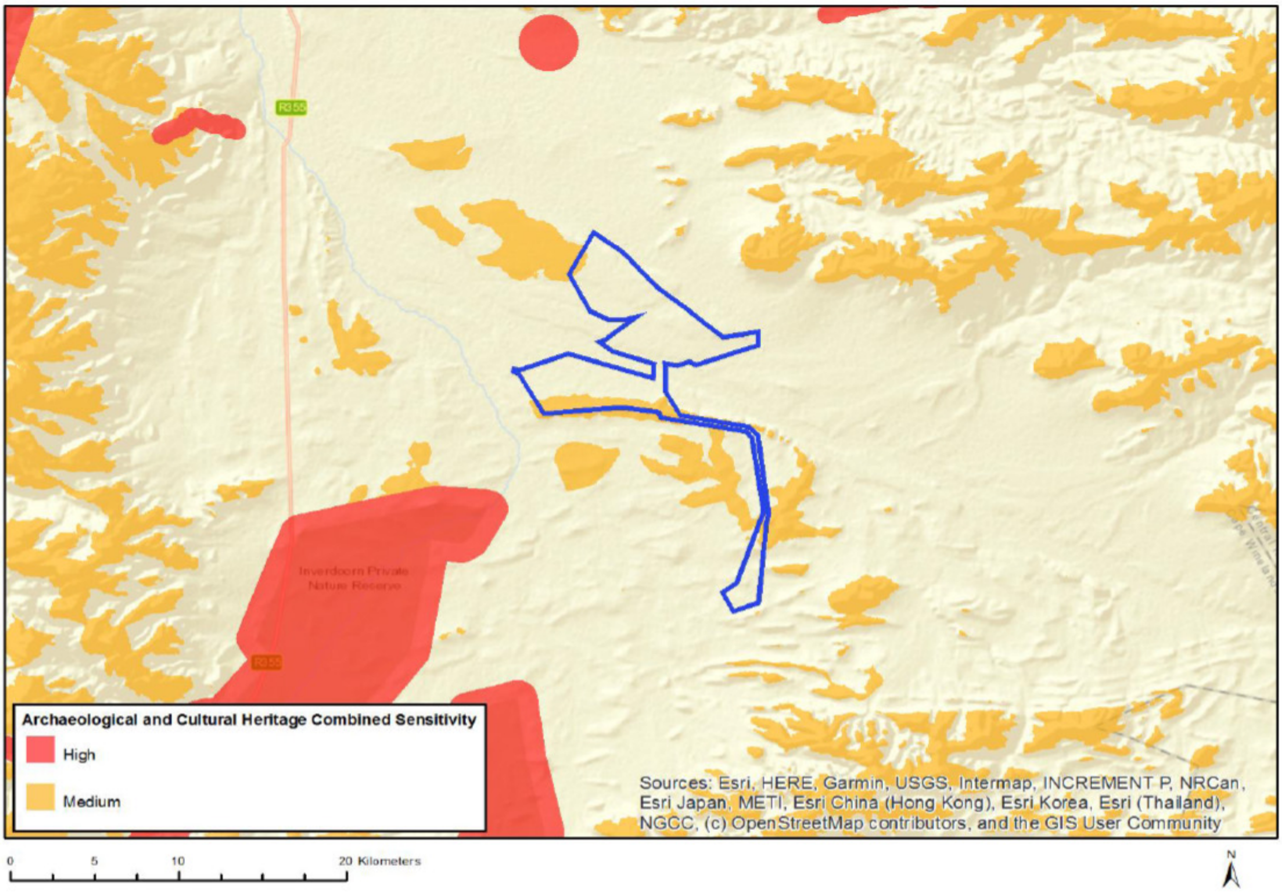
- Provide a description on how the site sensitivity verification was undertaken using the following means:
(a) desk top analysis, using satellite imagery;
(b) preliminary on -site inspection; and
(c) any other available and relevant information.

Initial work was carried out using satellite aerial photography in combination with the author's accumulated knowledge of the broader landscape. This was used to determine areas that should be targeted for fieldwork. Subsequent fieldwork then 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 all presented in the report (Section 5).

Outcome

- Provide a description of the outcome of the site sensitivity verification in order to:
(a) confirm or dispute 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.; and
(b) include a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity.

The map below is extracted from the screening tool report and shows the archaeological and heritage sensitivity to be low throughout most the Hoek Doornen PV 1 to PV 4 study areas but with a strip of medium sensitivity along the southern margin. The site visit confirms the sensitivity ratings, although in practice the medium sensitivity area is not continuous but limited to small areas where archaeological sites occur. Figure 42 in the report shows the areas considered to be archaeologically sensitive. They have medium to high heritage significance. A photographic record and description of the relevant heritage resources is contained within the impact assessment report with further photographs on record with the specialist. The screening tool map shows parts of the power line corridor to be of medium sensitivity. This is disputed, however, since only sites of low cultural significance were found in the areas examined and there is little reason to believe that this would change with further survey. The nature of the archaeological resources along the area shown in the screening tool map as of medium sensitivity is such that it is an extensive resource with low cultural significance.



The screening tool map for palaeontology has been included and discussed in the palaeontological specialist report (Appendix 4 of the present HIA).

APPENDIX 3 – Mapping

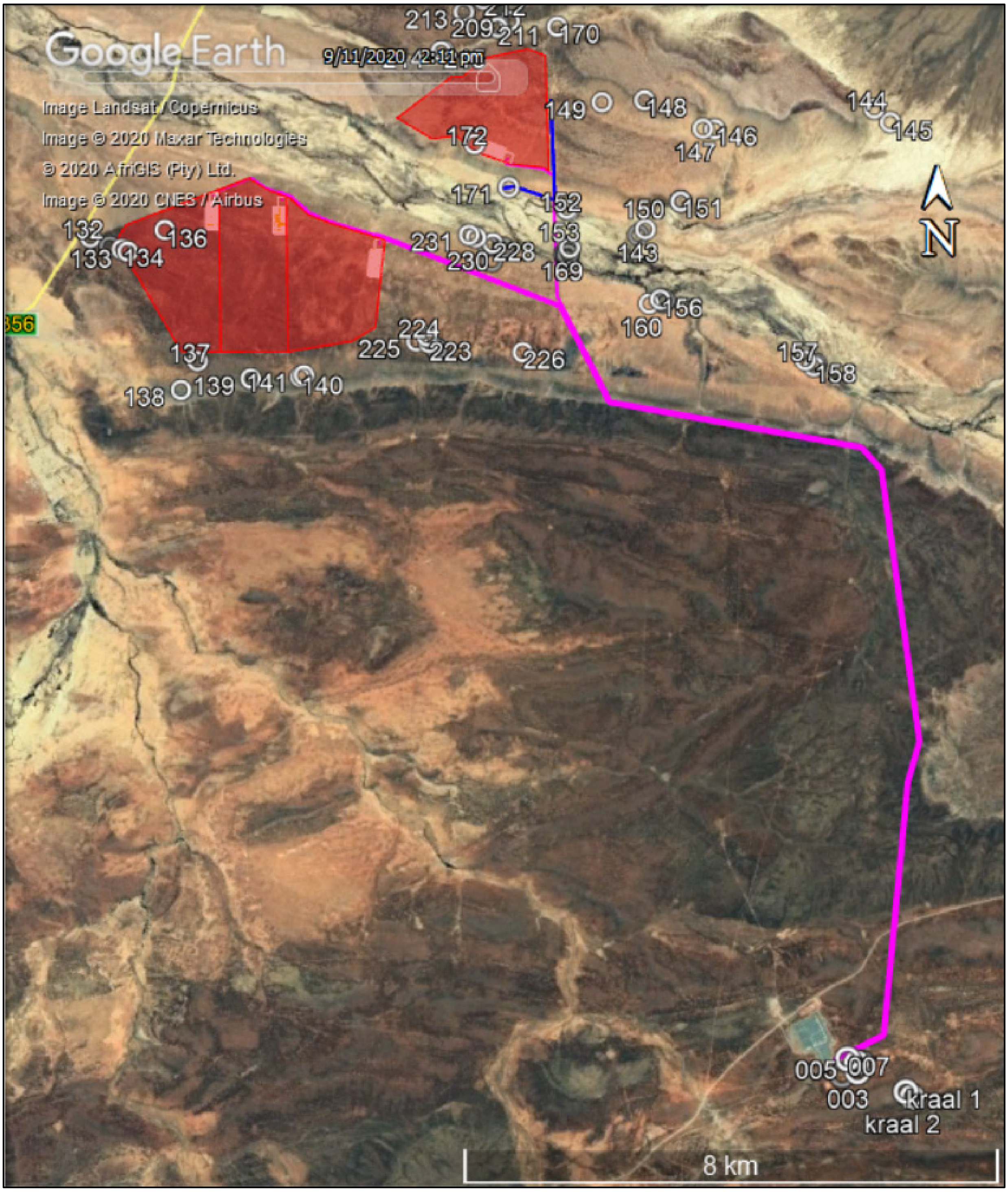


__Figure A3.1:__ Aerial view of entire study area showing all heritage resources recorded.

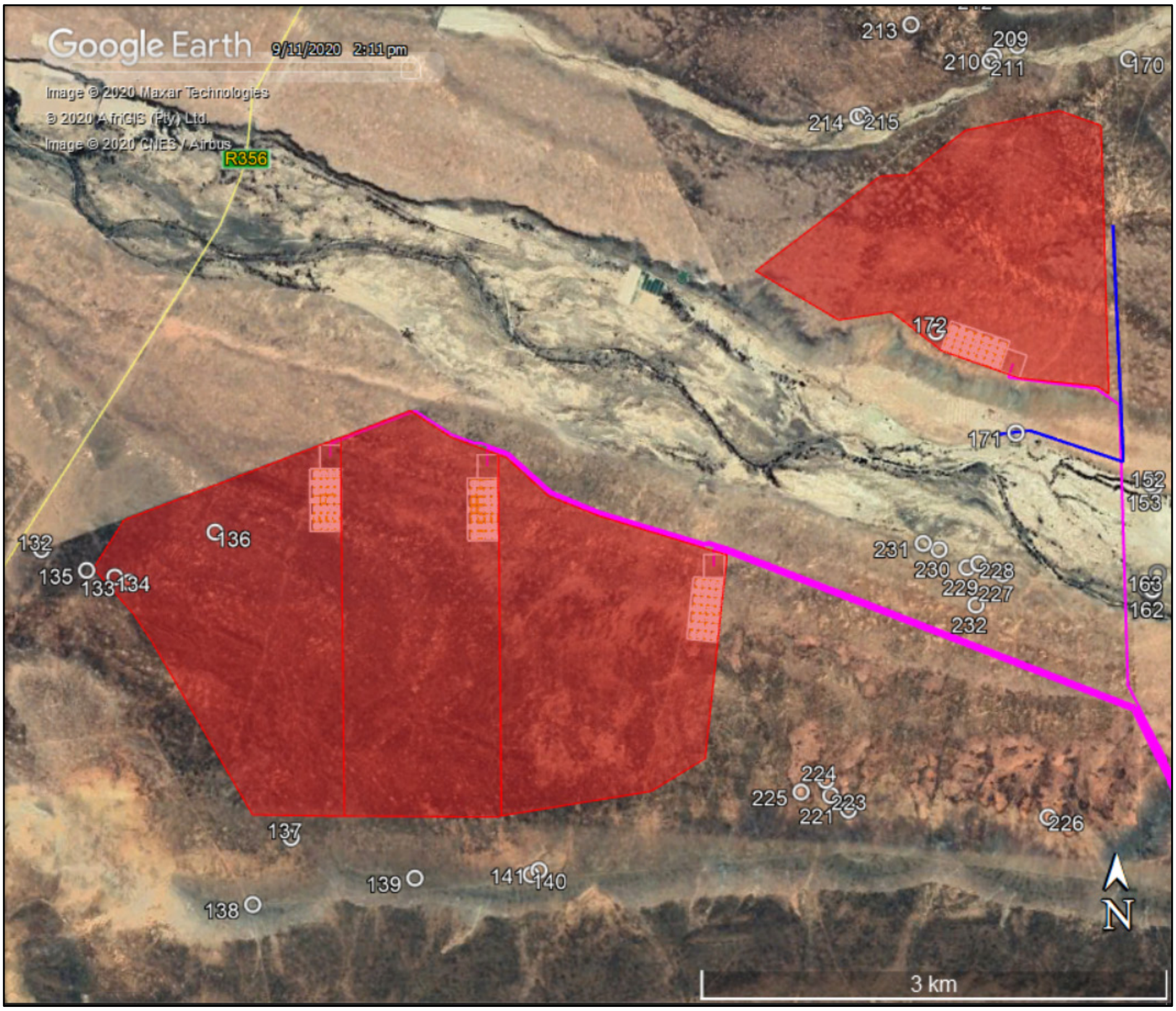


Figure A3.2: *Aerial view of the PV sites (red shading) showing all heritage resources recorded.*

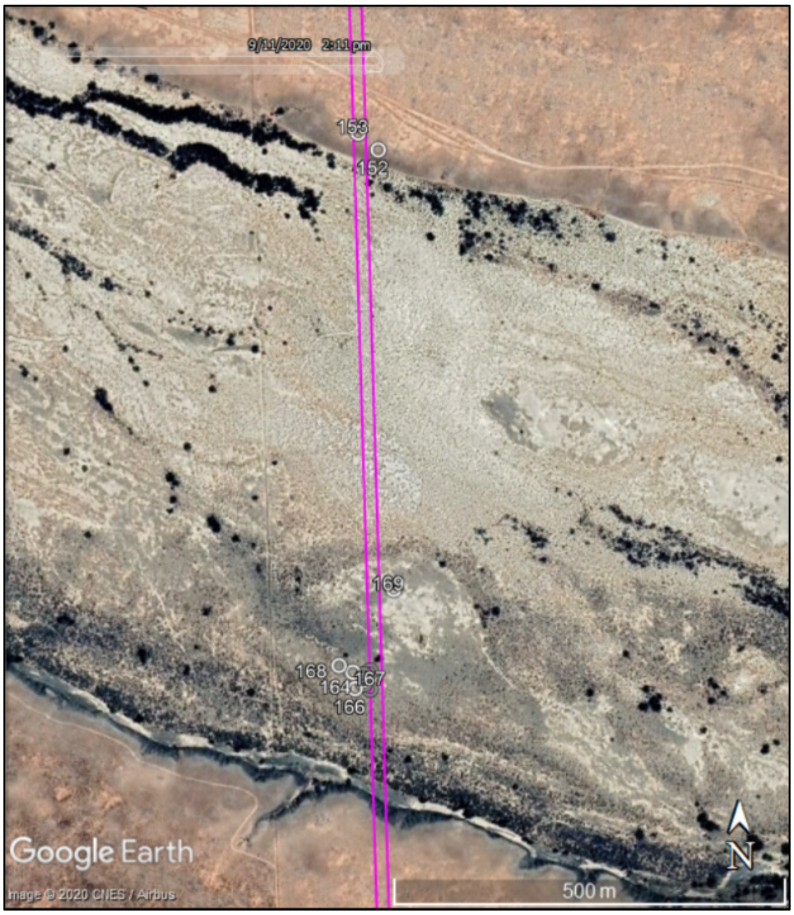


Figure A3.3: *Aerial view of the area where the power lines cross the river showing all heritage resources recorded.*

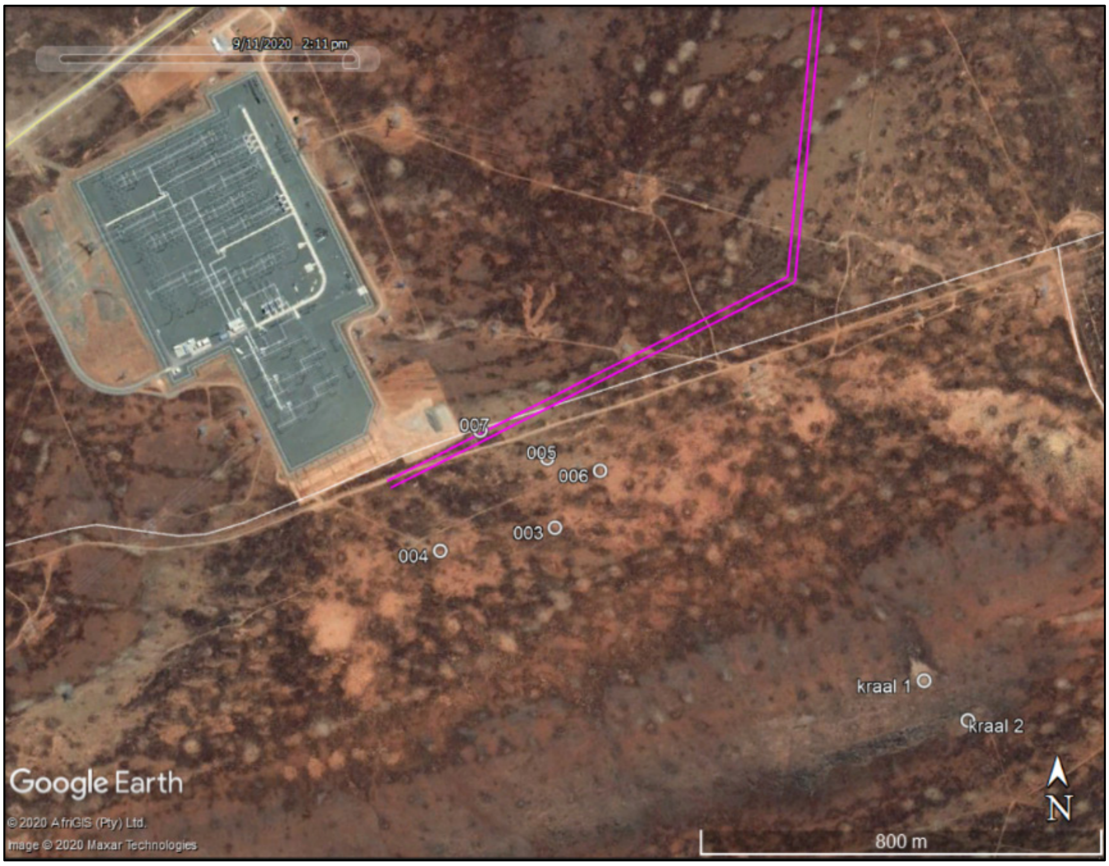


Figure A3.4: *Aerial view of the southern end of the power line corridor showing all heritage resources recorded.*

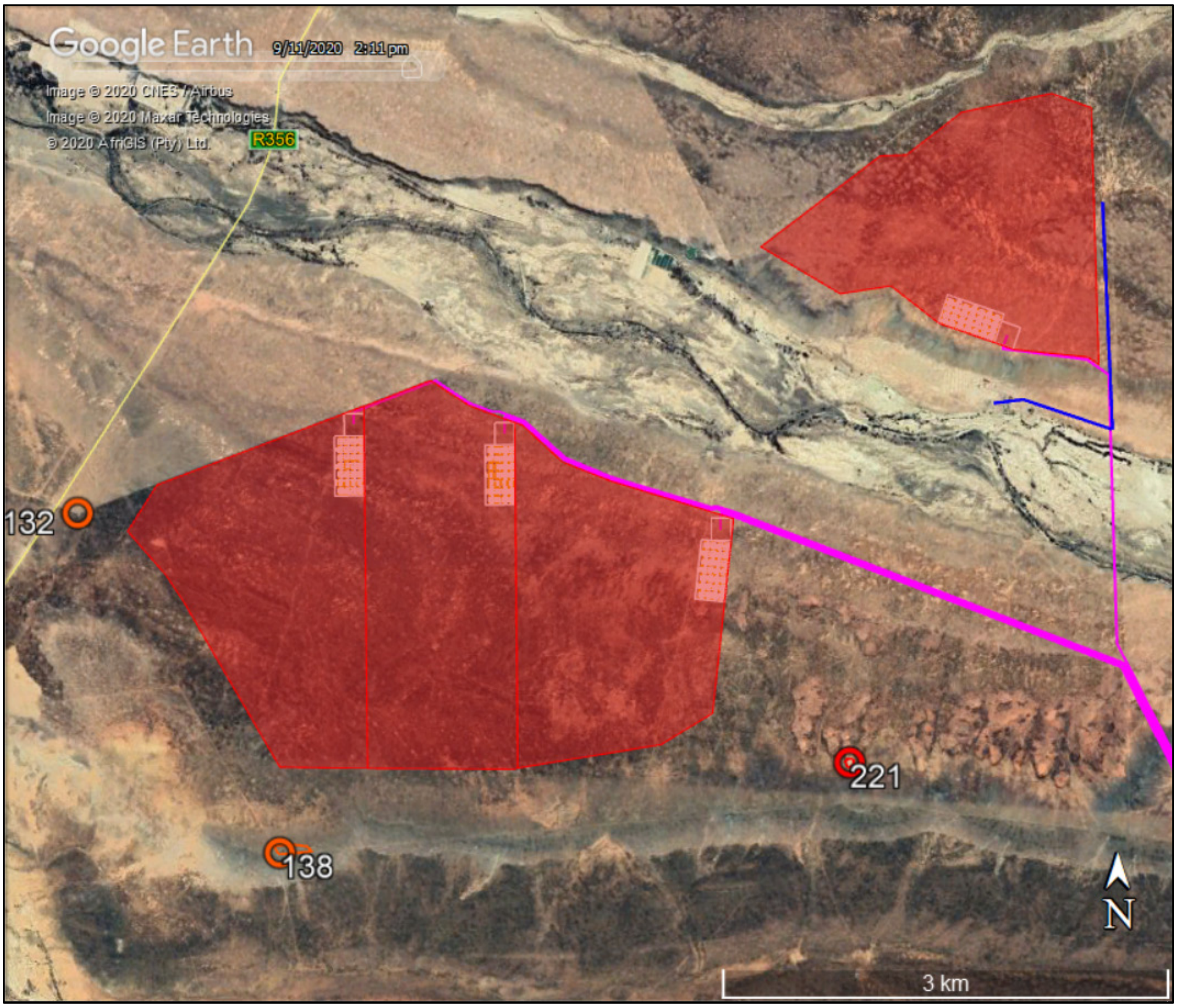


Figure A3.5: *Aerial view of the PV site and surrounds showing the one Grade IIIA (waypoint 221) and two Grade IIIB heritage resources (waypoints 132 & 138).*

Figure A3.6: *Aerial view of the southern end of the power line corridor showing the Grade IIIC heritage resource requiring mitigation.*

APPENDIX 4 – Palaeontological study

Refer to separately attached document.

APPENDIX 4 OF THE HERITAGE IMPACT ASSESSMENT: PALAEONTOLOGICAL INPUT TO HERITAGE IMPACT ASSESSMENT

PROPOSED DEVELOPMENT OF NINE 175 MW SOLAR PHOTOVOLTAIC FACILITIES AND ASSOCIATED ELECTRICAL GRID INFRASTRUCTURE NEAR TOUWSRIVER, WITZENBERG LOCAL MUNICIPALITY, WESTERN CAPE

Dr John E. Almond
***Natura Viva* cc**
PO Box 12410 Mill Street
CAPE TOWN 8010, RSA

October 2020

EXECUTIVE SUMMARY

The Project Applicant is proposing to develop nine 175 MW Solar Photovoltaic (PV) power generation facilities in the Ceres Karoo region near Touwsrivier, situated in the Witzenberg Local Municipality of the Western Cape Province. Each solar PV facility will have a range of associated infrastructure, including an on-site substation with Battery Energy Storage System (BESS), and will connect to the existing Eskom Kappa Substation *via* a dedicated 132 kV power line. The proposed PV facilities will be constructed on the following farm portions: Remainder of Grootfontein Farm 149; Portion 5 of Grootfontein Farm 149; Remainder of Witte Wall Farm 171; and Portion 1 of Hoek Doornen Farm 172. The power lines will traverse these farm portions, as well as the farms Die Brak 241 and Platfontein 240. Given the very similar geological and palaeontological context and scale of each of the nine proposed solar PV facilities and its associated power lines, the impact assessments and mitigation recommendations for each project are identical and can be summarized as follows:

The solar PV facility project area is situated on a flat to gently-sloping pediment surface of Late Caenozoic (Neogene – Pleistocene) age on the flanks of the Grootrivier Valley which drains this sector of the Ceres Karoo. The pediment surface has been planed-off by river erosion into underlying fine-grained, non-marine, basinal to distal submarine fan sediments of the Tierberg Formation (Ecca Group) that are Middle Permian in age. Field surveys show that the Tierberg bedrocks beneath the thin (few dm to few meters maximum) capping of alluvial gravels, calcrete hardpans, sandy soils and downwasted surface gravels capping the pediment surface are weathered, folded and often tectonically-cleaved. The only fossil remains recorded from such pediment settings in the Ceres Karoo comprise (1) sparse, generally small blocks of reworked silicified fossil wood within alluvial and surface gravels of uncertain provenance (probably Ecca Group) and (2) occasional calcretised fossil termite nests of probable Pleistocene age that are found embedded within calcretised superficial sediments as well as weathered, calcrete-veined bedrocks. The majority of fossil sites recorded fall within designated No-Go areas lying *outside* the project footprint. These fossils are of widespread occurrence within the Ceres Karoo region and are not of high scientific interest or conservation value. No fossil sites of high sensitivity or No-Go areas were identified within the solar PV project areas during the palaeontological field survey and the palaeontological sensitivity of the project area is assessed as generally LOW.

The power line corridor between the solar PV sites and the existing Kappa Substation on Platfontein 240 traverses the outcrop areas of the Permo-Carboniferous, glacial-related Dwyka Group as well as the lower Ecca Group (Prince Albert, Whitehill and Collingham Formations). The potentially-fossiliferous Prince Albert, Whitehill and Collingham Formations are highly weathered and cleaved in this region. No sensitive fossil sites have been recorded within or close to the proposed corridor on Die Brak 241 and Platfontein 240 during the present field survey or several previous field studies in the vicinity by Almond (2010a-c, 2016a) and the palaeontological sensitivity of the corridor is assessed as LOW.

As a consequence of (1) the paucity of irreplaceable, unique or rare fossil remains within the development footprint, as well as (2) the extensive superficial sediment cover overlying most potentially-fossiliferous bedrocks within the solar PV facility and power line project area, the overall impact significance of the construction phase of the proposed solar PV facility regarding legally-protected palaeontological heritage resources is assessed as *VERY LOW* (*negative status*), with and without mitigation. This assessment applies to all the associated solar PV facility and power line infrastructure within the project area. No significant further impacts on fossil heritage are anticipated during the operational and decommissioning phases of the solar PV energy facility and associated infrastructure. The No-Go alternative (*i.e.* no solar PV facility and power line development) will probably have a neutral impact on palaeontological heritage. Confidence levels for this assessment are MEDIUM, given the generally low exposure levels of potentially-fossiliferous bedrocks.

Anticipated cumulative impacts in the context of other renewable energy projects in the Ceres Karoo region – *including* the nine solar PV facilities - are assessed as *LOW (negative)* without mitigation but *VERY LOW (negative)* with mitigation. It is concluded that as far as fossil heritage resources are concerned, the proposed solar facility and power line projects, whether considered individually or together, will *not* result in an unacceptable loss or unacceptable additional impacts, considering all the renewable energy projects proposed in the area. This analysis only applies *provided that* all the proposed monitoring and mitigation recommendations made for all these various projects are consistently and fully implemented.

No specialist palaeontological monitoring or mitigation is recommended for this development, pending the potential discovery of significant new fossil material here during the construction phase. The ECO should be made aware of the possibility of important fossil remains (bones, teeth, petrified wood, plant-rich horizons, fossil termitaria *etc.*) being found or unearthed during the construction phase of the development. Monitoring for fossil material of all major surface clearance and deeper (>1m) excavations by the Environmental Control Officer on an on-going basis during the construction phase is therefore recommended. Significant fossil finds should be safeguarded and reported at the earliest opportunity to Heritage Western Cape for recording and sampling by a professional palaeontologist. The palaeontologist concerned will need a Fossil Collection Permit from Heritage Western Cape and all fossil material collected must be properly curated in an approved repository (museum / university collection). These recommendations must be included within the Environmental Management Programme (EMPr) for the solar PV facility and power line developments. A protocol for Chance Fossil Finds is appended to this report (Appendix C).

There are no identified fatal flaws and no objections on palaeontological heritage grounds to authorisation of the proposed solar PV facilities with its associated power line connections to the Kappa Substation.

1. INTRODUCTION & BRIEF

1.1. Project outline

The Project Applicant is proposing to design, construct and operate nine 175 MW solar photovoltaic (PV) power generation facilities in the Ceres Karoo region near Touwsrivier, situated in the Witzenberg Local Municipality of the Western Cape Province. Each solar PV facility will have a range of associated infrastructure, including an on-site substation with a Battery Energy Storage System (BESS), and will connect to the Eskom Kappa Substation *via* a dedicated 132 kV power line. The proposed PV facilities will be constructed on the following farm portions (Fig. 1):

- Remainder of Grootfontein Farm 149;
- Portion 5 of Grootfontein Farm 149;
- Remainder of Witte Wall Farm 171; and
- Portion 1 of Hoek Doornen Farm 172.

The power lines will traverse these farm portions, as well as the farms Die Brak 241 and Platfontein 240 (Fig. 1).

A total of four separate Basic Assessment processes are being conducted for the following projects (Fig. 1):

- Witte Wall Farm 171: 2 PV Facilities (*i.e.* **Witte Wall PV 1 and PV 2**) and Associated Infrastructure;

- Grootfontein Farm 149: 3 PV Facilities (*i.e.* **Grootfontein PV 1, PV 2 and PV 3**) and Associated Infrastructure;

- Hoek Doornen Farm 172: 4 PV Facilities (*i.e.* **Hoek Doornen PV 1, PV 2, PV 3 and PV 4**) and Associated Infrastructure; and

- Electrical Grid Infrastructure for each PV Plant (*i.e.* 9 Power Lines and 9 onsite substations) and Associated Infrastructure.

A detailed description of each PV project is supplied in the Heritage Impact Assessment reports.

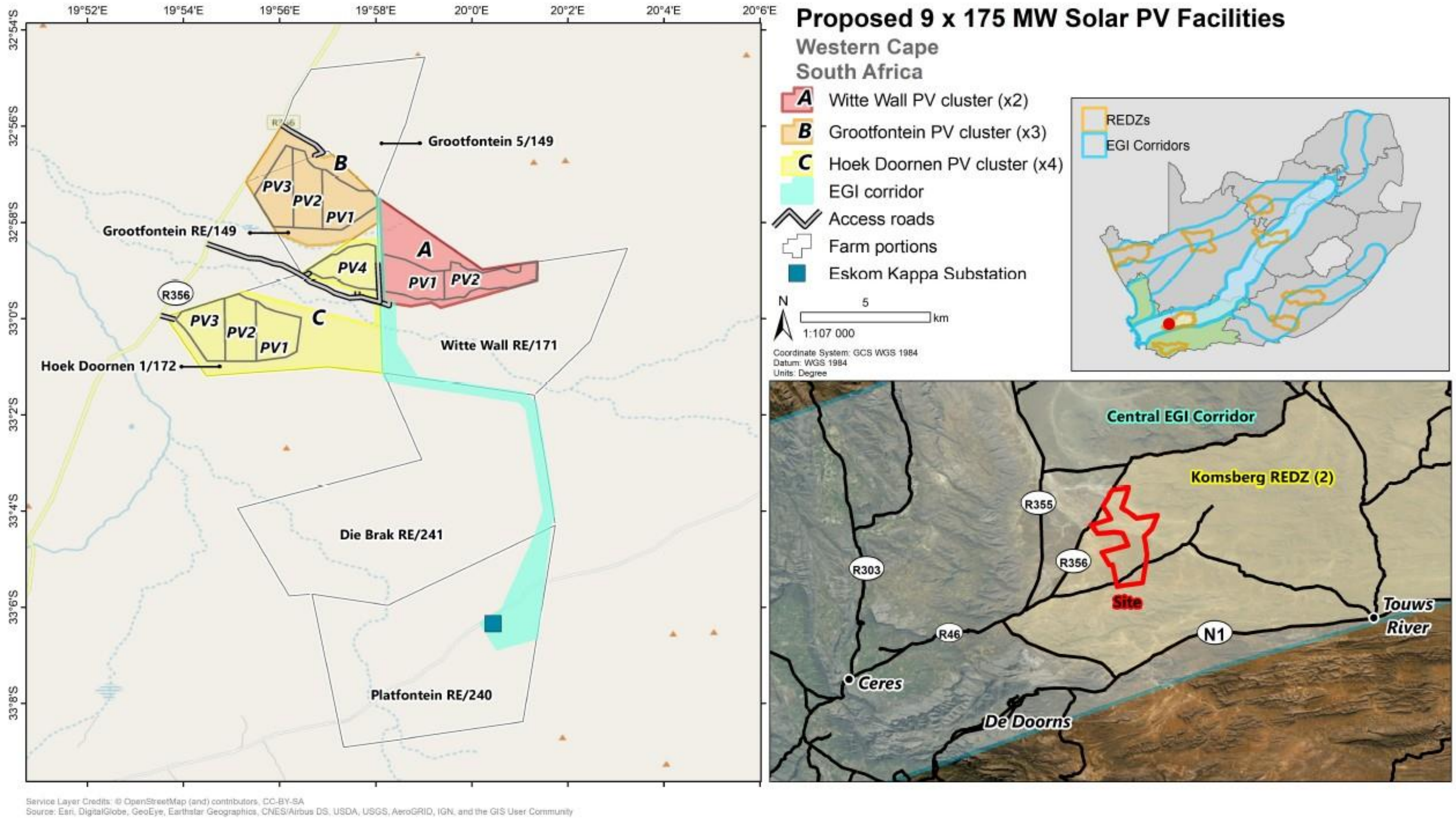


Figure 1: Maps showing the location of the solar PV facility project area in the Ceres Karoo region, *c*. 40 km north of Touwsrivier, Witzenberg Local Municipality, Western Cape Province (Image supplied by CSIR - Environmental Management Services). The project area lies within the Komsberg Renewable Energy Development Zone 2 (REDZ 2).

1.2. Purpose of report

The project area for the proposed solar PV facilities and associated power lines is underlain by potentially-fossiliferous sedimentary bedrocks of the Karoo Supergroup (Dwyka and Ecca Groups) as well as Late Caenozoic superficial deposits (Sections 4 & 5). The construction phase of the developments may entail the disturbance, damage, destruction or sealing-in of scientifically valuable and legally protected palaeontological heritage resources preserved at or beneath the ground surface within the project footprint. No further significant impacts on palaeontological heritage are anticipated during the operational and decommissioning phases of the developments.

Because the project areas lie within the gazetted Komsberg Renewable Energy Development Zone (REDZ 2) gazetted by the Minister of Environmental Affairs in Government Gazette 41445, Government Notice (GN) 114 on 16 February 2018 (*cf* Fourie *et al.* 2015), the proposed renewable energy projects will be subject to a Basic Assessment (BA) Process. The present combined Palaeontological Heritage Assessment Report will contribute to the three separate consolidated Basic Heritage Impact Assessments (HIAs) for the proposed solar PV facilities and their associated power lines, as listed above, in accordance with the latest requirements of the 2014 National Environmental Management Act (Act 107 of 1998, as amended in 2017) (NEMA) Environmental Impact Assessment (EIA) Regulations. The consolidated HIAs are being compiled by Dr Jayson Orton of ASHA Consulting (Pty) Ltd (Contact details: 40 Brassie Street, Lakeside, 7945, South Africa. Telephone: 021 783 0557. E-mail: jayson@asha-consulting.co.za).

Four separate BA Processes as listed in Section 1.1 are being conducted for the solar PV facility and power line developments on behalf of the proponent by the CSIR - Environmental Management Services, Durban (Contact details: Ms Rohaida Abed. CSIR - Environmental Management Services. P.O. Box 59081, Umbilo, Durban, 4075. Tel: 031 242 2318. Fax: 031 261 8172. E-mail: rabed@csir.co.za).

1.3. Terms of reference

The Terms of Reference for this palaeontological study, as specified by the CSIR, are as follows:

- Comply with the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, GN 320. This specifically includes Part A, which provides the Site Sensitivity Verification Requirements where a Specialist Assessment is required but no Specific Assessment Protocol has been prescribed.
- 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.
- Compile a Palaeontological Impact Assessment (PIA) in compliance with Appendix 6 of the 2014 NEMA EIA Regulations (as amended) and any additional relevant legislation and guidelines that may be deemed necessary.
- 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.
- 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.

- Provide review input on the preferred infrastructure layout following the sensitivity analysis and layout identification.
- Prepare and undertake a study on the palaeontology and fossil heritage within the proposed project area, based on:
    - Site visit (as required);
    - a review of all relevant palaeontological and geological literature, including
        - geological maps and previous reports,
        - location and examination of fossil collections from the study area (e.g. museums), and
        - data on the proposed development (e.g. location of footprint, depth and volume of bedrock excavation envisaged).
- Describe the type and location of known palaeontology and fossil heritage sites in the study area, and characterize all items that may be affected by the proposed project.
- Note fossils and associated sedimentological features of palaeontological relevance (photos, maps, aerial or satellite images, and stratigraphic columns).
- Evaluate the potential for occurrence of palaeontology and fossil heritage features within the study area.
- Identify and rate potential direct, indirect and cumulative impacts of the proposed project on the palaeontology and fossil heritage during the construction, operational and decommissioning phases of the project. Study the cumulative impacts of the project by considering the impacts of existing renewable energy plants within the area (as well as those proposed), together with the impact of the proposed project.
- Identify any protocols, legal and permit requirements that relevant to this project and the implications thereof.
- Provide recommendations and suggestions regarding fossil heritage management on site, including conservation measures, as well as promotion of local fossil heritage to ensure that the impacts are limited.
- 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.
- Incorporate and address all review comments made by the Project Team (CSIR and Project Applicant) during the various revisions of the specialist report.
- Incorporate and address relevant issues and concerns raised by Stakeholders (i.e. Heritage Western Cape and South African Heritage Resources Agency (SAHRA)), Competent Authority, Interested and Affected Parties (I&APs) and the public during the Public Participation Process (where relevant and applicable).
- Review the Generic Environmental Management Programme (EMPr) for 1) Power Lines and 2) Substations (GN 435).

2. STUDY APPROACH

The approach to this palaeontological heritage study can be briefly summarized as follows. Fossil bearing rock units occurring within the broader study area (including all relevant land parcels) are determined from geological maps and relevant geological sheet explanations as well as satellite images. Known fossil heritage associated with each rock unit is inventoried from published and unpublished scientific literature, previous PIAs of the broader study region, and the author's field

experience and palaeontological database (*cf* Almond & Pether 2008). Based on this data as well as field examination of representative exposures of all major sedimentary rock units present, both within and in the vicinity of the project footprint, the impact significance, including cumulative impacts, of the proposed developments is assessed using the methodology specified by the CSIR. Recommendations for any further studies or mitigation are outlined for inclusion within the EMPr for the development.

In the case of the present solar PV facility assessments, several transects across the stratigraphy underlying the three affected land parcels were made over the course of four days in order to gauge the levels of exposure, weathering, tectonic deformation and palaeontological sensitivity of each of the sedimentary rock units represented here. The power line corridors between the PV facility project areas and the Kappa Substation were mainly assessed on the basis of data from several relevant PIA reports by the author (notably Almond 2010a-c, 2016b) as well as additional field observations made for an adjoining renewable energy development in 2020.

Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have been published by SAHRA (2013) and by Heritage Western Cape (2016).

2.1. Information sources

The present combined desktop and field-based palaeontological heritage assessment for the solar PV facilities and associated power lines is based on:

- A brief project outline, kmz files and maps provided by CSIR - Environmental Management Services;
- A desktop review of (a) the relevant 1: 50 000 and 1: 250 000 scale topographic maps, (b) Google Earth© satellite imagery, (c) published geological and palaeontological literature, including 1: 250 000 geological maps and accompanying sheet explanations (Theron 1983, Theron et al. 1991, Gresse & Theron 1992, Almond 2008b) as well as (d) several previous and on-going fossil heritage assessments in the Ceres Karoo region by the author and colleagues (e.g. Almond 2010a, 2010b, 2010c, 2010d, 2015a, 2016a, 2016b, 2018, 2020, Almond in prep. and Butler 2018);
- The author's field experience with the formations concerned and their palaeontological heritage (cf Almond & Pether 2008, Almond 2008b and PIA reports listed in the References); and
- A four-day field assessment of the study area, including all land parcels involved, by the author and an experienced field assistant, Madelon Tusenius, during the period 7 to 10 September, 2020. The season in which the site visit took place has no bearing on the study.

2.2. Assumptions and limitations

The accuracy and reliability of palaeontological specialist studies as components of HIAs are generally limited by the following constraints:

- Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

- Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant ("mappable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil etc.), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.
- Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information;
- The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (e.g. of commercial mining companies) - that is not readily available for desktop studies;
- Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

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

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

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

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails inferring the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a PIA may be significantly enhanced through field assessment by a professional palaeontologist. In the present case, site visits to the study areas in some cases considerably modified our understanding of the rock units (and hence potential fossil heritage) represented there.

In the case of the present study area in the Ceres Karoo region near Touwsrivier (Western Cape) exposure of potentially fossiliferous bedrocks is very limited, due to extensive cover by superficial sediments and karroid *bossieveld* vegetation. However, sufficient exposures were examined to allow a realistic assessment of the palaeontological sensitivity of the key rock units (See Section 4), while a substantial amount of relevant geological and palaeontological data is available from previous PIAs in the region (See, for example, References under Almond). Confidence levels for this assessment are accordingly rated as Medium. Comparatively few academic palaeontological studies have been carried out in the region, so any new data from impact studies here are of scientific interest.

3. LEGISLATIVE CONTEXT AND PERMIT REQUIREMENTS

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

Where palaeontological mitigation of a development project in the Western Cape is required, the palaeontologist concerned with mitigation work would need a valid fossil collection permit from Heritage Western Cape (HWC). Any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for palaeontological studies developed by SAHRA (2013) and Heritage Western Cape (2016).

The present palaeontological heritage assessment falls under Sections 35 and 38 (Heritage Resources Management) of the South African Heritage Resources Act (Act No. 25 of 1999), and it will also inform the EMPr for this project. The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

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

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

(1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
(2) All archaeological objects, palaeontological material and meteorites are the property of the State.
(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.
(4) No person may, without a permit issued by the responsible heritage resources authority—
(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) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological

site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—
(a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
(b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;
(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
(d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

- **Legislative and Permit Requirements for potential specialist mitigation**

(1) Should professional palaeontological mitigation be necessary during the construction phase, the palaeontologist concerned will need to apply for a Fossil Collection Permit from Heritage Western Cape. (2) Palaeontological collection should comply with international best practice. (3) All fossil material collected must be deposited, together with key collection data, in an approved depository (museum / university). (4) Palaeontological mitigation work including the ensuing Fossil Collection reports should comply with the minimum standards specified by Heritage Western Cape (2016) and SAHRA (2013).

4. GEOLOGICAL SETTING

The combined proposed PV facility and power line project area is located in a low-lying, semi-arid extension of the Great Karoo region known as the Ceres Karoo or southern Tanqua Karoo. It is situated between the rugged Bontberg mountain range to the south – a west-east trending subunit of the Cape Fold Mountains - and the foothills of the Klein-Roggeveld Escarpment to the north. Topographic relief here is generally low (Figs. 5 to 7), with elevations between 600 and 700 m amsl (above mean sea level), since the area is largely underlain by readily-weathered, clay-rich sedimentary rocks and has experienced extensive, protracted weathering and denudation by post-Gondwana river systems during the Caenozoic Era. The area is drained by the non-perennial Grootrivier and its various tributaries (notably the Klein-Droëlaagte); the Grootrivier is itself a tributary of the extensive Doringrivier – Tanquarivier drainage system of the Ceres – Tanqua Karoo. Levels of bedrock exposure in the flatter-lying portions of the Ceres Karoo region are generally poor, except along larger water courses (Figs. 4, 14), because in most areas there is extensive cover by alluvial and colluvial deposits (*e.g.* river conglomerates, grits and sands as well as surface gravels, soils) and by karroid vegetation - Tanqua Karoo and Koedoesberg-Moordenaarskaroo bossieveld *plus* Tanqua Wash Riviere along drainage channels.

In geological terms the PV facility and transmission line project area lies along the south-western margin of the Main Karoo Basin of South Africa (Johnson *et al.* 2006). The bedrocks have been deformed during the Permo-Triassic Cape Orogeny (mountain building event) and thus lie within, and towards the northern margin of, the Cape Fold Belt (CFB), within or just to the east of the Cape syntaxis (*i.e.* junction of the N-S and E-W branches of the CFB). The geology of the study area is outlined on the four adjoining 1: 250 000 geology sheets Clanwilliam 3218, Sutherland 3220, Worcester 3319 and Ladismith 3320 (Council for Geoscience, Pretoria) (Fig. 2). A total of

seven mappable sedimentary rock units (formations) are represented within the study area, most of which are assigned to the **Karoo Supergroup** and are of Gondwanan (Permo-Carboniferous) age (See stratigraphic column in Fig. 3). Within the PV facility project area, the Karoo bedrock succession generally youngs to the north and northeast towards the Klein-Roggeveld Escarpment. The power line connection southwards to Kappa Substation traverses a broad anticline-syncline pair of Dwyka and Ecca Group bedrocks with WSW-ESE fold axes which is clearly picked out by the sinuous ridge of the more resistant-weathering Collingham Formation (marked by a pale band on satellite images) as well as cyclical banding within the dark Dwyka outcrop area. Nevertheless, given the gentle nature of the broad-scale folding, levels of tectonic deformation are generally low, with gentle bedding dips of 5º to 20° (occasionally higher dips are seen along the banks of the Grootrivier; Figs. 4, 14). A tectonic cleavage may be well-developed within finer-grained mudrocks, especially towards the Bontberg range in the south, while soe brittle rock units such as the cherty beds within the Collingham Formation show pronounced, closely spaced jointing (Fig. 13). Only very minor intrusions of the Karoo Dolerite suite - a single narrow but regionally persistent dolerite dyke (Fig. 19) - are mapped within the study area.

The geology and sedimentology of the various sedimentary rock units represented in the solar facility and power line project area has been covered in some detail, with extensive references, in previous PIAs for the Ceres Karoo region and southern margins of the Great Karoo by the author (*e.g.* Almond 2016a-b, 2018, 2020) and will not be repeated here.

4.1. Dwyka Group

Portions of the power line route on Die Brak 241 as well as in the vicinity of Kappa Substation on Platfontein 240 are underlain by Late Carboniferous to Early Permian glacial sediments of the **Dwyka Group** (**C-Pd**), namely the **Elandsvlei Formation** (Fig. 8). The Dwyka rocks here, with a brownish hue on satellite images, build the cores of WSW-ENE trending CFB mega-anticlines. They are generally poorly exposed, with the exception of several good sections of grey, clast-rich Dwyka tillite seen along larger water courses such as the Kareerivier to the east and north of Die Brak homestead (Almond 2016a). The tillites display well-developed tombstone weathering which clearly developed before deposition of the overlying pervasive mantle of gravelly to sandy alluvial sediments. Low hills and ridges of Dwyka rocks within the region probably represent the coarser basal portion of several deglaciation cycles which impart a colour-banded pattern to the Dwyka outcrop area. A series of several low, rocky outcrops of greyish, gritty to pebbly, locally cross-bedded or deformed quartzites and sandstones in the central portion of Die Brak probably represent glacial outwash fans or eskers within the Elandsvlei Formation. The quartzose bodies are only a few meters across and irregular in geometry (Almond 2016a).

4.2. Ecca Group

The remainder of the power line corridor as well as all the proposed PV project areas are underlain at depth by basinal "marine" to submarine fan sediments of the **Ecca Group** that were deposited within an extensive brackish to freshwater inland lake or Ecca Sea in Early to Middle Permian times (Cole & Basson 1991, Cole 2005, Viljoen 2005). Several lower Ecca Group formations, predominantly recessive-weathering mudrocks with subordinate fine-grained wackes (impure sandstones), crop out here around the flanks of the WSW-ENE trending mega-anticline. In order of decreasing age these are: the Prince Albert Formation (Pp/ Ppr), the Whitehill Formation (Pw), the Collingham Formation (Pc) and the Tierberg Formation (Pt / K2S1).

The **Prince Albert Formation** forms low-lying terrain of little relief that is largely blanketed in alluvial soils and fine surface gravels downwasted from the nearby Collingham outcrop area. Limited exposures on the northern edge of Die Brak 241 (Fig. 9) favour zones of thin, resistant-weathering but highly-jointed, grey-green to yellowish-weathering cherty bands or lenticles. Some of these beds are strongly mineralised with rusty iron and metallic-grey manganese ores associated with snuffbox weathering.

The **Whitehill Formation** is exposed in numerous small erosion gullies on the south- and west-facing flanks of the low range of hills that defines the border between Die Brak 241 and Witte Wall 171, curving southwards through Rietpoort RE/243 just to the east of the power line corridor. The originally thinly-laminated, dark, carbonaceous Whitehill mudrocks here are invariably highly altered through near-surface weathering to friable, white or cream saprolitic material traversed by veins of multi-hued secondary minerals. Large, boulder-sized, sphaeroidal concretions of greyish dolomite weather out in the lower part of the succession (Fig. 11).

The overlying **Collingham Formation** builds the crests and dip slopes of the sinuous range of low hills described earlier which runs to the south of the PV project areas but is followed or traversed by the power line corridor at several points (*e.g.* southern margins of Hoek Doornen 172 – Witte Wall 171 project areas; see satellite image Fig. 53). The Collingham exposures are dominated by several prominent-weathering, highly-jointed, tabular cherty beds between 20 and 50 cm in thickness that show local thrusting and small-scale folding (Figs. 12 & 13). These cherty layers are broadly equivalent to the **Matjiesfontein Member** identified within the Collingham Formation elsewhere along the southern Karoo margin; the presence of several chert bands is a special feature of the Collingham Formation in the Ceres Karoo region (*cf* Almond 2015a). Where they are not too intensely jointed, the Collingham cherts have been extensively exploited by Stone Age peoples as raw material for stone artefacts. These last often abound in the vicinity of the chert bands. For example, an unusually dark grey, hornfels-like chert bed along the Hoek Doornen fence line is associated with a carpet of anthropogenically flaked rubble while the *in situ* chert itself as well as large float blocks in the area show abundant evidence of flaking. The intervening grey hackly-weathering siltstone horizons are occasionally exposed in erosion gullies (*e.g.* on Witte Wall 171). The majority of the narrow Collingham outcrop area is typically mantled by angular, blocky colluvial gravels of grey, silicified mudrock that show up clearly as a pale brownish zone on satellite images. The cherty Collingham gravels also cover most of the lower-lying Whitehill Formation outcrop and the lower beds of the adjoining Tierberg Formation (Fig. 37).

The **Tierberg Formation** that underlies all the PV facility project areas on Witte Wall 171, Hoek Doornen 172 and Grootfontein 149 where it is almost entirely covered by a blanket of alluvial sediments and soils (Figs. 4, 14-18). There are occasional good exposures along the steep southern banks of the Grootrivier and much more limited ones in the beds of its shallow tributaries. Near-surface, as well seen along the northern bank of the Grootrivier on Karee Kolk 174 as well as in low pediment escarpment exposures north of the Grootrivier, the Tierberg mudrocks are usually weathered and crumbly with no bedding plane exposure and are in addition extensively veined by Late Caenozoic calcrete (Fig. 5). The Tierberg succession is dominated by laminated to thin-bedded, highly-tabular, dark grey to khaki mudrocks with zones of large, oblate sphaeroidal to flattened lenticular concretions and lenticular beds of rusty-brown, ferruginous carbonate or mudrock. The concretions are late diagenetic and often display superficially fossil-like cone-in-cone structures (Fig. 41). Pale, grey-green bands of friable, fine-grained clay-like material may be altered tuff bands (volcanic ashes).

4.3. Karoo Dolerite Suite

A straight SE-NW trending dyke of the Early Jurassic **Karoo dolerite suite** traversing the NE part of Die Brak 241 from Riet Poort 243 is mapped on 1: 250 000 sheet 3320 (Fig. 2). The same intrusion probably extends further to the NW into the PV project area since it re-appears along strike close to the intersection of farms Grootfontein 149, Hoekdoornen 172 and Karee Kolk 174. This subvertical dyke of rusty-brown dolerite reaches a thickness of 2.5 m to 6 m (but is often thinner) with narrower veins or apophyses extending into the Tierberg country rocks. It features impressive radiating fans of pale bladed sparry calcite (Fig. 19).

4.4. Late Caenozoic superficial deposits

As is apparent in satellite images, and especially in the field, the Palaeozoic sedimentary bedrocks in the Ceres Karoo region are extensively blanketed by a range of – mostly unconsolidated - superficial deposits. These include pedocretes (*e.g.* calcrete), colluvium (slope deposits such as scree and hillwash), sheetwash and alluvial (river) sediments, surface gravels as well as silty, sandy and gravelly / rocky soils of mainly Quaternary to Recent age. Of these younger sedimentary units, most are too thin to be mapped separately at 1: 250 000 scale.

A wide range of **Late Caenozoic alluvial deposits** are represented within PV facility and power line project area, especially along the Grootrivier and other larger drainage systems, as well as in the *vlaktes* to the north and south of the Grootrivier on Witte Wall 171, Hoek Doornen 172 and Grootfontein 149 (Figs. 20 to 37). The dominant geomorphological feature here, clearly seen on satellite images, are series of dissected, flat to very gently sloping **pediment surfaces** planed across the Tierberg Formation bedrocks by earlier phases of the Grootrivier (Fig. 53). There is a flight of at least three or more pediment surfaces which increase in elevation and age with distance from the modern rivier. Based on (*N.B.* very inaccurate) Google Earth spot heights, these surfaces lie at approximately 580 m amsl., 600 m amsl and 620-640 m amsl (the last outside and NE of the project area). The surfaces slope gently down in a downstream direction and even the lowest lies some 10-15 m or more above present day river level. The ages of these surfaces is uncertain but is likely to span at least the Late Neogene Period and Pleistocene Epoch. The key infrastructure for all the PV facilities will be situated on these almost level to stepped pediment surfaces (Fig. 53).

In contrast to their marginal scarps, where weathered and calcretised Tierberg Formation bedrocks are locally exposed, the pediment surfaces are widely mantled by alluvial gravels) of guesstimated Late Neogene to Pleistocene age (Figs. 6 & 29). The relict gravelly patches are mapped along the banks of the Grootrivier as so-called **High Level Gravels** and are provisionally assigned to the **Grahamstown Formation** (Tg), doubtless a misnomer since no *in situ* evidence of the extensive silcretisation typical of this latter rock unit is observed. The coarse, poorly-sorted alluvial to downwasted pediment gravels are generally dominated by angular to subrounded reddish-brown weathering Ecca wackes with subordinate ferruginised mudrock (often desert-varnished), pale grey Matjiesfontein Member chert, white Witteberg quartzite, rare pale yellowish-green, orange-patinated tuff or tuffite, vein quartz, polymict Dwyka erratics (*e.g.* Precambrian vesicular lavas, silicified breccias), occasional dolerite and small clasts of petrified wood. Larger, boulder-sized clasts may retain surface impact crescents. An interesting, locally abundant component to the pediment gravels are pale grey to buff or yellowish-green sandy to gritty silcretes whose provenance is currently unclear; they may have been derived from Neogene silcrete outcrops (the "real" Grahamstown Formation) further to the east within the Grootrivier catchement area that have since been completely denuded. A high proportion of the silcrete clasts are anthropogenically

flaked (Fig. 30). On satellite images the pediment surfaces are densely pock-marked by small round *heuweltjies* of possible termite and / or bush-clump origin. Away from the edges of the pediments, flat areas are often mantled with pale orange sandy to silty soils (possibly with aeolian reworking in places) with sparse gravels or unvegetated patches with fine sheetwash gravels (Figs. 31 to 33).

A well-developed, solid to rubbly or nodular **calcrete hardpan** up to a few meters thick typically crops out along the crests of the marginal scarp defining the relict pediment surfaces patches (Figs. 4, 5 & 20 to 22). This is well seen, for example, on Karee Kolk 174 on the northern bank of the Groootrivier. The underlying Tierberg mudrocks are weathered and calcrete veined. Excellent exposures of calcretised fluvial conglomerates up to several (3-10) meters-thick are seen along the south bank of the Grootrivier on Witte Wall 171 where they show a sharp basal angular unconformity overlying inclined Tierberg Formation bedrocks that may be elevated up to 10 m or more above the present river bed. The conglomerates are oligomict (dominated by Ecca wackes), poorly-sorted with local development of current-generated clast imbrication as well as interbedded lenticular to tabular packages of pale brownish to greyish, gritty, horizontally-bedded to cross-bedded, calcretised sands. These last sometimes cap or pass horizontally into coarse channel lag conglomerates incised into the bedrock representing perched tributaries of the ancient Grootrivier. The ruditic High Level Gravel alluvial deposits are in turn overlain by unconsolidated younger alluvial silts and sands as well as aeolian reworked sands. Dispersed angular clasts of pale greyish Matjiesfontein chert within the High Level Gravels are often marginal flaked but this might be natural damage rather than anthropogenic (Fig. 20).

Blocky **colluvial gravels** are well seen on the steep to gentle slopes of low hills capped by the Collingham Formation, as described earlier (Fig. 37). Extensive flat-lying portions of the study area, including parts of the pediment surfaces, feature sheetwashed **surface gravels** of various sorts that are best seen in unvegetated patches. The sheetwash gravels are fine, angular to subrounded and dominated by reistent-weathering lithologies such as cherts, silicified and ferruginised mudrocks with occasional small blocks of petrified wood (Figs. 31 & 32).

Coarse cobbly to bouldery modern gravels strongly dominated by Ecca wackes as well as finer alluvial sands occur along the present course of the Grootrivier. Distinctive coarse, multi-hued, oligomict gravels rich in silcrete clasts are seen along bed of Klein-Droëlaagte where they are exposed as low gravel bars and in stream banks beneath sandy alluvium (Figs. 24 to 26). As well as lots of silcrete, these gravels include clasts of Matjiesfontein cherts, highly patinated wacke, occasional quartzite, Dwyka erratics (vesicular lavas, silicified breccias) and weathered-out Tierberg ferruginous carbonate concretions (Fig. 41). The clasts are variously angular to well-rounded. They are of interest in that they are often (but not invariably) associated with abundant Early Stone Age (ESA) bifaces (Pleistocene) as well as occasional small blocks of petrified wood and rare small fossil logs (Section 5 and Fig. 44). The contrast between these polymict gravels and the local modern river gravels in terms of clast lithology, archaeology and palaeontology suggests that they may have a different provenance, perhaps reflecting different drainage patterns in Plio-Pleistocene times. They are largely buried beneath younger superficial sediments and only exposed where the modern and fossil drainage networks intersect.

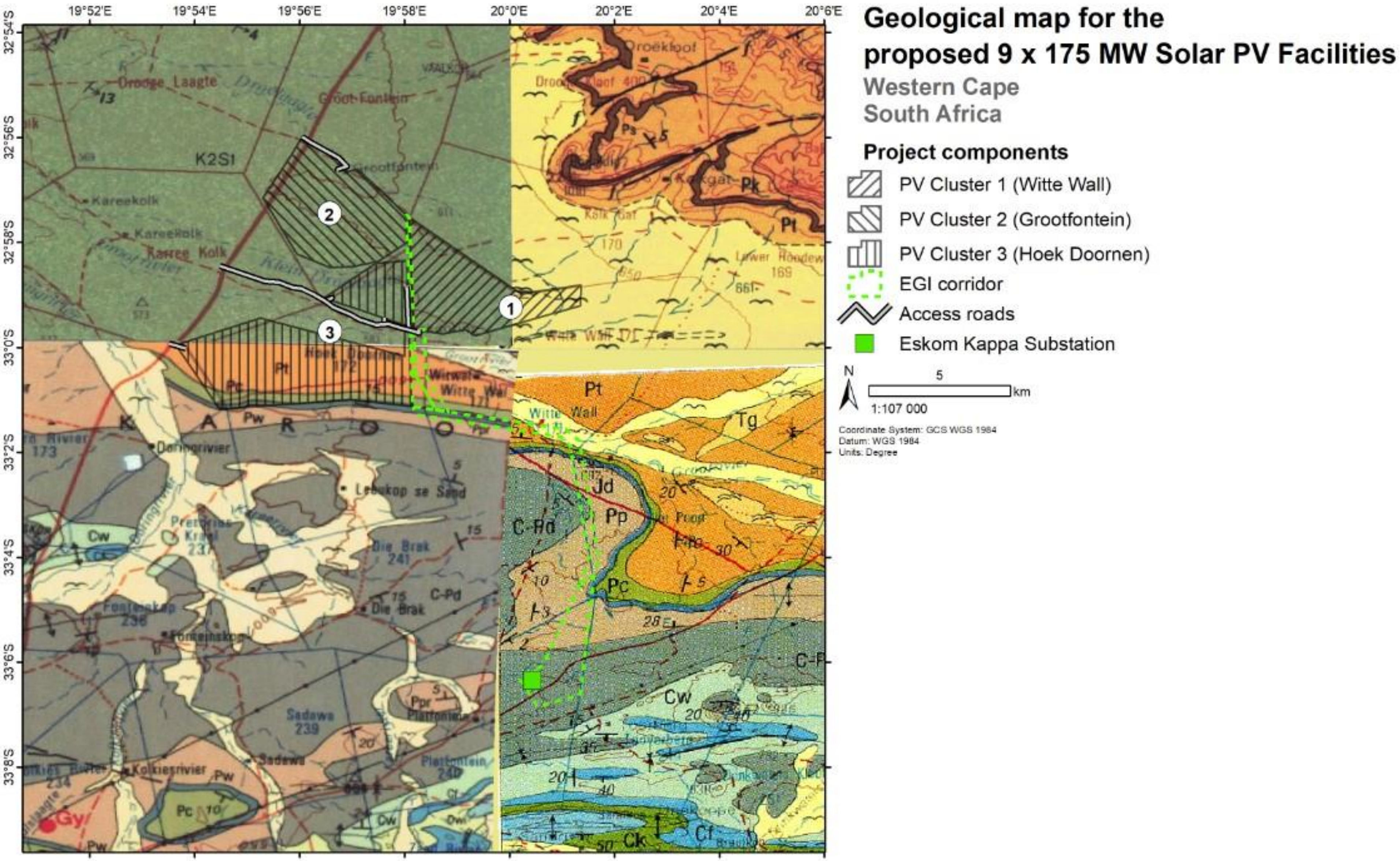
Thick deposits of alluvial sands along the course of the Grootrivier locally contain nodular calcrete hardpans. Locally they have been reworked into small **aeolian dunefields** characterised by well-sorted, orange-brown unconsolidated fine sands, locally displaying large scale dune cross-sets

(Fig. 35). Deflation of fine river sands up onto adjacent hillslopes is well seen in the southern portion of Hoek Doornen 172 where the dunes support a distinctive shrubby vegetation (Fig. 34).

Surface gravels overlying the Dwyka Group are typically highly polymict, *i.e.* composed of a wide range of rock types (cherts, carbonates, quartzites, lavas, granites *etc*), reflecting the range of glacial erratics enclosed by the underlying tillites. Fine pebbly gravels overlying the Prince Albert Formation are dominated by angular to subrounded cherty and siliceous mudrock clasts, many of which are ferruginised or with a well-developed patina of desert varnish (Fig. 10). **Calcrete hardpans** have developed within older sandy to silty alluvial deposits and soils, especially overlying the Dwyka Group, and are well exposed along the banks of drainage courses (*e.g.* near Die Brak homestead and along the banks of the Grootrivier) (Almond 2016a).

Figure 2 (following page): Extracts from four adjoining 1: 250 000 scale geology sheets Clanwilliam 3218, Sutherland 3220, Worcester 3319 and Ladismith 3320 (Council for Geoscience, Pretoria) showing the main stratigraphic units represented within the proposed solar PV facility and power line project area located *c*. 30 km north of Touwsrivier, Western Cape (black polygon). The dashed green polygon indicates the corridor for the power line connections to the existing Eskom Kappa Main Transmission Substation. The main geological units mapped within the study area include:

- **DWYKA GROUP: C-Pd (grey) = Elandsvlei Formation**
- **ECCA GROUP: Ppr, Pp (pale brown or buff) = Prince Albert Formation; Pw (dark blue) = Whitehill Formation; Pc (green, grey-green) = Collingham Formation; Pt, K2S1 (dark yellow, pale orange or grey) = Tierberg Formation**
- **KAROO DOLERITE SUITE: Jd (red line)**
- **SUPERFICIAL DEPOSITS: medium yellow (Tg with double flying bird symbol) = Tertiary or Quaternary High Level Gravels; pale yellow or white with single flying bird symbol = Quaternary to Recent alluvium**


Geological map for the
proposed 9 x 175 MW Solar PV Facilities
Western Cape
South Africa
Project components
PV Cluster 1 (Witte Wall)
PV Cluster 2 (Grootfontein)
PV Cluster 3 (Hoek Doornen)
EGI corridor
Access roads
Eskom Kappa Substation
N
5
km
1:107 000
Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree
19°52'E
19°54'E
19°56'E
19°58'E
20°0'E
20°2'E
20°4'E
20°6'E
32°54'S
32°56'S
32°58'S
33°0'S
33°2'S
33°4'S
33°6'S
33°8'S
K2S1
Pt
Pk
Ps
Tg
Jd
Pp
Pc
C-Pd
Cw
Ck
Cf
Pw
Ppr
Dw
Gy

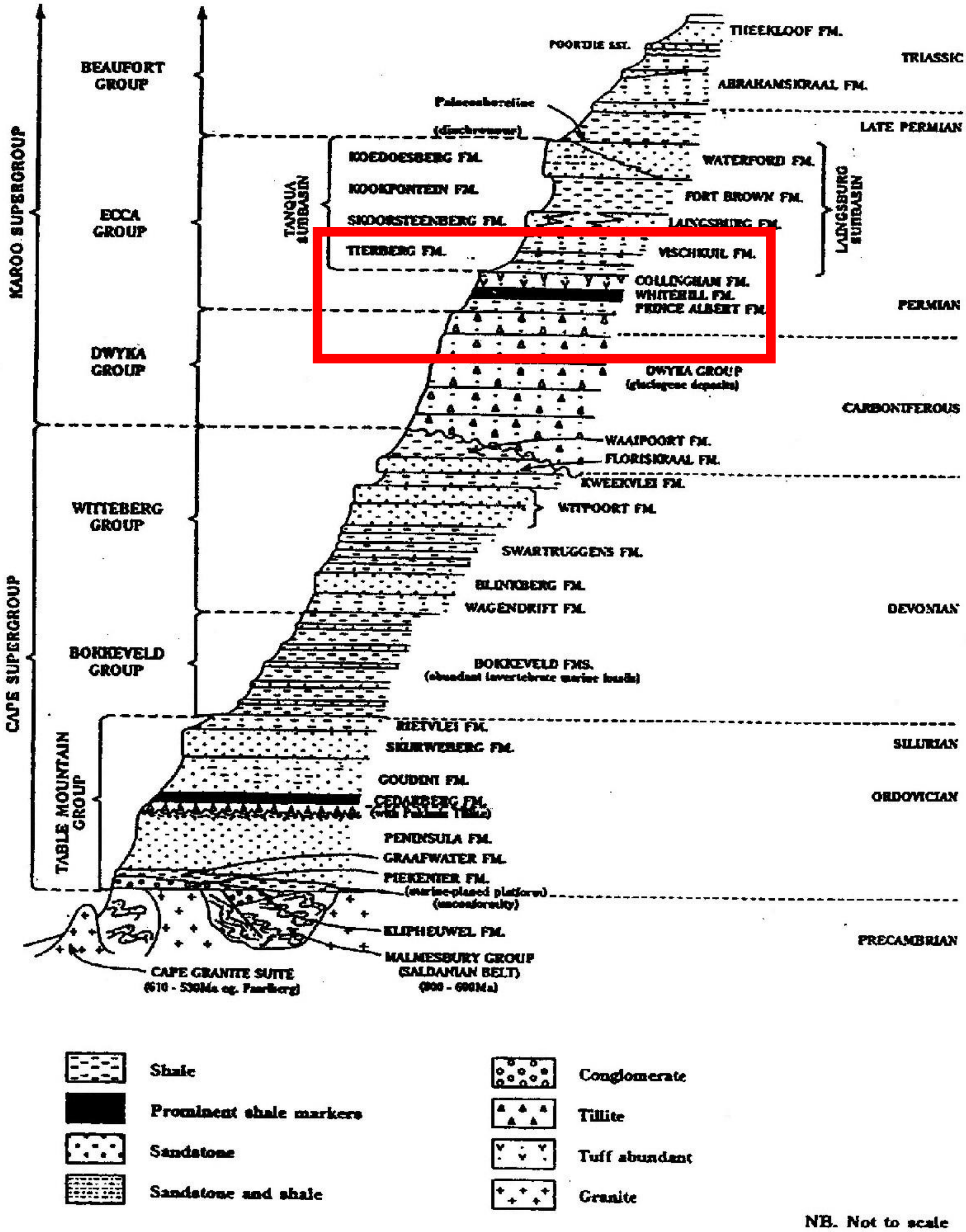


Figure 3: Schematic stratigraphic column for the Western Cape, the red box outlining the Late Palaeozoic formations of Karoo Supergroup sedimentary rocks that crop out in the solar PV facility and power line project area (Modified from original figure by H. de V. Wickens).

Figure 4: Riverine cliff exposure of eastward-dipping Tierberg Formation mudrocks unconformably capped by calcretised High Level Gravels with aeolian dune sands banked up against the cliff base, southern bank of the Grootrivier, Wittewall 171.

Figure 5: View eastwards along the low scarp marking the riverine edge of the lowest pediment surface on the northern side of the Grootrivier, Karee Kolk 174. The extensive flat-topped pediment is incised into weathered, khaki-hued Tierberg Formation mudrocks and its edge is heavily calcretised.

Figure 6: View southwards across the flat to gently sloping pediment surface on Grootfontein 149 with the Bontberg range in the background. The pediment surface here is mantled by poorly-sorted, downwasted alluvial gravels.

Figure 7: View of the low ridge of Ecca Group rocks running along the southern boundary of Witte Wall 171. The power line corridor runs along the ridge crest. Note thick sandy alluvial soils and dense *bossieveld* vegetation clothing the north-eastern sector of De Brak 241 in the foreground.

Figure 8: Typical appearance of the Elandsfontein Formation (Dwyka Group) outcrop area showing tombstone weathering of massive, grey-green tillites and polymict downwasted surface gravels derived from weathered-out glacial erratics, Die Brak 241 (From Almond 2016a).

Figure 9: Tabular-bedded, grey-green basinal mudrocks and fine-grained wackes of the Prince Albert Formation near the boundary between Die Brak 241 and Witte Wall 171 (From Almond 2016a). Good bedding plane exposures of this unit are rare.

Figure 10: Surface gravels overlying the Prince Albert Formation outcrop area, typically dominated by silicified mudrocks, cherts, vein quartz and other resistant-weathering rock types, with rare clasts of petrified wood of uncertain provenance, Die Brak 241 (Hammer = 30 cm).

Figure 11: Gullied exposure of highly-weathered, friable and mineralised mudrocks of the Whitehill Formation with boulder-sized dolomite concretions in the foreground, low hills along boundary between Witte Wall 171 and Die Brak 241 (From Almond 2016a).

Figure 12: Multiple tabular beds of prominent-weathering chert or silicified mudrocks assigned to the Matjiesfontein Member within the Collingham Formation, Witte Wall 171 (Hammer = 30 cm) (From Almond 2016a). The intervening mudrocks are mantled by downwasted cherty rubble.

Figure 13: Closely-spaced fracture set transecting brittle, silicified mudrock beds of the Collingham Formation, Witte Wall 171 (Hammer = 30 cm).

Figure 14: Eastward-dipping, laminated to thin-bedded, dark grey to khaki-weathering mudrocks with thin lenses and concretions of ferruginous carbonate as well as packages of brownish fine-grained wackes of the Tierberg Formation exposed along the southern banks of the Grootrivier, Witte Wall 171.

Figure 15: Stream gulley exposure of crumbly, weathered Tierberg Formation mudrocks with zone of prominent-weathering, rusty-brown, sphaeroidal diagenetic concretions of ferruginous carbonate, Witte Wall 171 (Hammer = 30 cm).

Figure 16: Stream bed exposure of gently-dipping, dark grey-green Tierberg Formation mudrocks along the Klein-Droëlaagte drainage line, northern margins of Hoek Doornen 172. The Ecca bedrocks here are mantled by oligomict alluvial gravels and younger sandy alluvium.

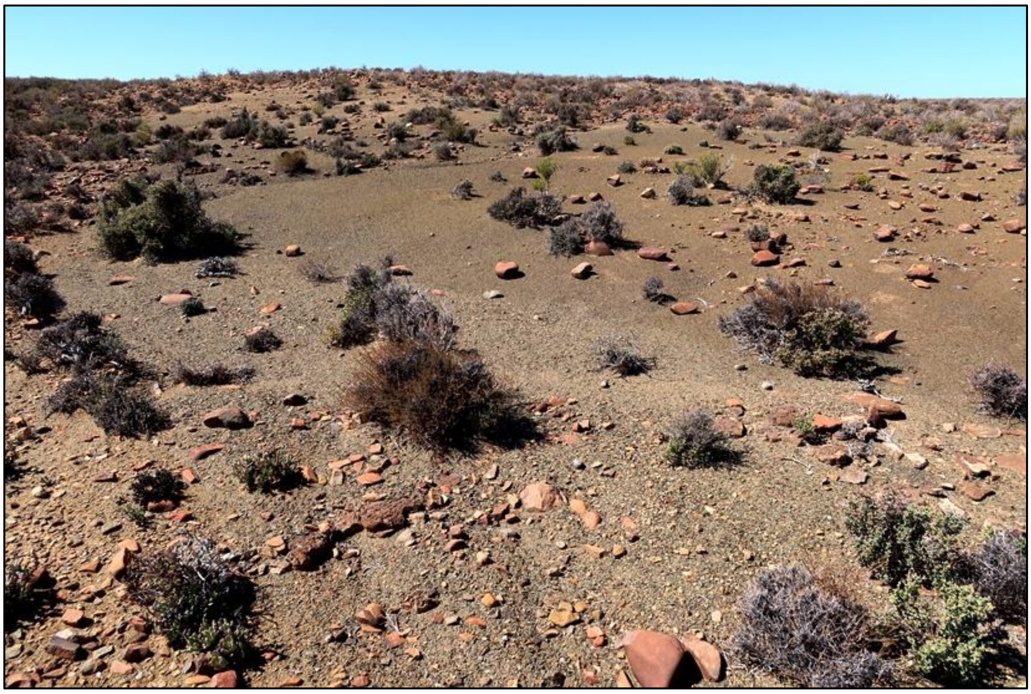


Figure 17: Friable weathered mudrocks with thin ferruginous carbonate lenses of the Tierberg Formation intermittently exposed along a low scarp between adjoining pediment surfaces, Hoek Doornen 172.

Figure 18: Limited exposure of weathered Tierberg Formation bedrocks along an erosion gulley through alluvial gravels and overlying sandy soils, southern margins of pediment surface on Hoek Doornen 172.

Figure 19: Narrow, rusty-brown, weathered dolerite dyke with pale veins of bladed sparry calcite extending across the boundary between Witte Wall 171 and Karee Kolk 174 (Hammer = 30 cm).

Figure 20: Thick, heavily-calcretised fluvial gravels with subordinate lenticular beds of gritty sandstone exposed along the southern bank of the Grootrivier on Witte Wall 171 (Hammer = 30 cm). The gravels contain sparse clasts of pale grey Matjiesfontein chert, some of which might be flaked artefacts, but this is equivocal.

Figure 21: Calcretised rubbly alluvial gravels along the edge of the lowermost pediment surface north of the Grootrivier on Karee Kolk 174 (Hammer = 30 cm). Many of the cobble-sized wacke clasts are moderately well-rounded.

Figure 22: Block-weathering, sparely-gravelly, pale brown calcretised alluvial sands locally capping the southern bank of the Grootrivier on Witte Wall 171 (Hammer = 30 cm). These sandy deposits pass downwards and laterally into coarse alluvial High Level Gravels.

Figure 23: Rubbly to nodular calcrete hardpan exposed along the crest of a low scarp between successive flat-topped pediment surfaces on Witte Wall 171.

Figure 24: Distinctive oligomict, coarse, unconsolidated gravels rich in chert clasts as well as ESA bifaces and occasional petrified wood blocks, Klein-Droëlaagte on Grootfontein 149. The gravels directly overlie Tierberg mudrocks and are mantled by unconsolidated sandy alluvium.

Figure 25: Close-up of oligomict gravels exposed along the Klein-Droëlaagte similar to those seen in previous figure (but here on Hoek Doornen 172) showing abundance of flaked ESA artefacts of brownish silcrete and grey Matjiesfontein chert (Scale is *c.* 15 cm long).

Figure 26: Calcretised, possibly cross-bedded lens of fine gravelly to gritty alluvium overlying Tierberg Formation bedrocks on the banks of the Klein-Droëlaagte, Grootfontein 149 (Hammer = 30 cm). These beds may be similar in age to the unconsolidated coarse oligomict gravels found along the same drainage line (*cf* Figure 24).

Figure 27: Pale, gullied, unconsolidated Recent sandy alluvium along the southern banks of the Klein-Droëlaagte on Hoek Doornen 172.

Figure 28: Section through the younger sandy alluvium with sparse dispersed gravel clasts overlying Tierberg Formation bedrocks, banks of the Klein-Droëlaagte on Hoek Doornen 172 (Hammer = 30 cm).

Figure 29: Poorly-sorted, oligomict downwasted surface gravels dominated by brownish-patinated Ecca wacke clasts and pale sandy soils that typically blanket the flat to gently-sloping pediment surfaces long the Grootrivier, seen here on Hoek Doornen 172.

Figure 30: Close-up of pediment gravels on Witte Wall 171 in an area showing a preponderance of pale grey to brownish silcrete clasts, many of which are anthropogenically flaked (Scale in cm). Small water-worn blocks or pebbles of silicified wood may occur in such areas (*cf* Figure 48).

Figure 31: Open, unvegetated area of pediment surface on Witte Wall 171 showing mantle of sandy alluvial soils and thin veneer of fine sheetwash gravels.

Figure 32: Close-up of angular to subrounded sheetwash gravels seen in the previous figure (Scale in cm and mm), Witte Wall 171. The clasts are largely of resistant-weathering lithologies including silicified mudrocks, cherts, occasional Dwyka erratics with sparse small blocks of petrified wood.

Figure 33: Patch of pale sandy soils on a pediment surface on Witte Wall 172 showing development of nodular calcrete and animal burrowing typical of these *heuweltjie* areas – possibly associated with ancient termite activity and / or bush clumps.

Figure 34: Patches of thick, fine sandy soils with distinctive shrubby vegetation and no gravels, such as seen here mantling gentle north-facing pediment slopes on Hoek Doornen 172, represent alluvial sands deflated from the bed of the Grootrivier by winds.

Figure 35: Large-scale sand dunes with typical low-angle aeolian cross-bedding exposed on the bed of the Grootrivier on Witte Wall 171.

Figure 36: Younger alluvial deposits exposed along the northern bank of the Grootrivier on Hoek Doornen 172, including well-rounded, cobbly to pebbly basal gravels and well-bedded overlying sandy deposits (Hammer = 30 cm).

Figure 37: Thin carpet of angular cherty colluvial gravels downwasted from the Collingham Formation and mantling a gently-sloping pediment surface on the southern sector of Hoek Doornen 172. The gravels include a sparse background scatter of flaked stone artefacts.

5. PALAEONTOLOGICAL HERITAGE

Fossil assemblages that have been recorded elsewhere from the various Karoo Supergroup and Late Caenozoic rock units represented within the proposed solar PV facility and power line project areas are outlined in Table 1 below. They have been treated, with extensive references, in several previous combined desktop and field-based palaeontological assessment studies for the Ceres Karoo region by the present author dealing with electrical infrastructure projects (*e.g.* Kappa Substation, Gamma – Omega transmission line) as well as renewable energy projects in the Ceres Karoo such as the Perdekraal Wind Energy Facility (WEF), Rietkloof WEF, Kolkies WEF and Karee WEF projects (See References under Almond). New fossil sites recorded during the recent palaeontological field survey of the proposed solar PV and power line facility project areas are listed together with GPS data and comments as well as proposed field ratings in Appendix A while numbered fossil localities are shown on the satellite maps in Figures 53 and 54. For sectors of the associated power line corridor between Witte Wall 171 and the Kappa Substation, field observations from several previous PIA studies by Almond (2010a-d, 2016a) have been taken into consideration as well as a recent site visit to Die Brak 241 for another renewable energy project (Almond in prep., 2020).

All of the sedimentary formations enumerated in Table 1 are potentially fossiliferous, although only three are considered to be generally or potentially of moderate to high palaeontological sensitivity (Theron *et al.,* 1991, Almond 2008a, 2008b, Almond & Pether 2008). Fossils within the glacially-influenced **Dwyka Group** succession are rare and mainly confined to thin interglacial or post-glacial facies, with the notable exception of occasional ice-rafted limestone or dolomite erratics, examples of which containing Cambrian archaeocyathids (fossil sponges) and trilobites have been recorded from the southern margins of the Great Karoo and Namibia. A small boulder of stromatolitic limestone or dolomite of probable Precambrian or Cambrian age from the Dwyka tillite is recorded from Sadawa 238, adjoining Platfontein 240 on the west, by Almond (2016a). No further fossiliferous carbonate erratics were encountered during recent fieldwork.

An important fossiliferous interval occurs within the lowermost **Prince Albert Formation**; fossil fish, molluscs and petrified wood have been recorded here in the Tanqua Karoo and the Northern Cape. A few small blocks of silicified wood displaying fine seasonal growth rings were recorded from surface gravels overlying the Prince Albert Formation in the Kolkies WEF study area by Almond (2016a) but their stratigraphic provenance is ambiguous; they have probably been reworked from younger Ecca Group formations. A fragment of a sizeable petrified trunk with fine growth rings from the SW Tanqua Karoo is displayed at the Doringrivier homestead (Pretorius Kraal 237) to the NW of Die Brak 241. The provenance is uncertain, but it probably also comes from the lower Ecca Group.

The **Whitehill Formation** is famous for its well-preserved skeletons of intact mesosaurid reptiles and palaeoniscoid bony fish, as well as prolific small crustaceans. However, these carbonaceous mudrocks are highly weathered and secondarily mineralised near-surface within the study area (Fig. 11), with little exposure of fresh bedding planes. No fossils were recorded from the Whitehill bedrocks, including the prominent-weathering, large dolomitic concretions and lenses, during the present field survey.

The overlying **Collingham Formation** along the southern Great Karoo margins is well-known for rare well-preserved petrified logs and trackways of giant eurypterids (water scorpions). Occasional small blocks of petrified wood occur among downwasted cherty Collingham gravels on Hoek

Doornen 172 (Fig. 47), close to exposures of the Matjiesfontein chert, although the Collingham Formation is not mapped here. Small cylindrical burrows infilled with pale ash that contrasts with the dark mudrock matrix are found along the contacts of thin tuff horizons on Witte Wall 171 (Fig. 43). The only other fossils seen this formation within the Ceres Karoo are dense but low-diversity assemblages of horizontal burrows that are widely recorded elsewhere along the southern Karoo margins (Fig. 42) (Almond 2016a).

The basinal and distal submarine fan mudrocks of the **Tierberg Formation** are characterised by a range of interesting trace fossils and drifted plant material of the *Glossopteris* Flora (*e.g.* stems, leaves and segmented roots of *Glossopteris* trees); animal body fossils (*e.g.* palaeoniscoid fish) are very rare, however. Apart from occasional fragmentary rusty-brown compressions of wood remains within siltstone exposed close to the Grootrivier (J. Orton., pers. comm. 2020), fossil plant material was not observed *in situ* in the PV facility project area. Low diversity assemblages of simple horizontal burrows can be seen within dark Tierberg mudrocks along the banks of the Grootrivier on Witte Wall 171 (Fig. 39) as well as along the Klein-Droëlaagte on Hoek Doornen 172 (Fig. 40). These trace fossils are widely-occurring forms of no special conservation significance, however. Complex cone-in-cone structures developed within diagenetic concretions of ferruginous carbonate in the Tierberg Formation have frequently been mistaken for fossil stromatolites but are actually pseudofossils (Fig. 41). The same applies to dendrites - moss- or fern-like growths of the manganese psilomelane commonly seen on bedding planes and fracture surfaces of Tierberg wackes.

Older **alluvial gravels,** such as the calcretised, downwasted and sheet-washed pediment gravels along the margins of the Grootrivier, contain a sparse background scatter of small blocks of resistant-weathering silicified wood reworked from the Ecca Group bedrocks (Figs. 46 & 48). The blocks are various angular to water-worn and are generally only a few cm in maximum diameter. The wood shows well-developed seasonal growth lines, as typically seen in the high-palaeolatitude Karoo Basin. Some, and perhaps the majority, of the silicified wood specimens encountered within surface gravels within the project area come from the Tierberg Formation. Given the extensive catchment area of the Grootrivier and its tributaries, it is possible that some of the petrified wood comes from the Mid-Permian Waterford Formation (Ecca Group) which is known to contain well-preserved fossil logs in the Klein-Roggeveldberge region (*cf* Almond 2018) or from the Collingham Formation as previously discussed. It is noted that a high proportion of the fossil wood blocks recorded during the recent field survey – including one small log - come from the distinctive coarse, oligomict alluvial gravels found along the Klein-Droëlaagle drainage line where they are associated with abundant silcrete clasts (including common ESA bifaces) (Figs. 44 & 45). Where concentrations of silcrete clasts are found on the pediment surfaces away from modern water courses, float blocks of petrified wood (and stone artefacts) often occur here as well, suggesting the possible presence of buried ancient channel conglomerates at these sites. Given its uncertain provenance and widespread occurrence within surface gravels in the region, the scientific and conservation value of the petrified wood material encountered is rated as low and no special mitigation measures are proposed for the known fossil sites. The sites along the Klein-Droëlaagle drainage line will be protected within the riverine buffer zone (Fig. 54).

Large (several dm diameter), sphaeroidal, calcretised subterranean termitaria (termite nests) with finely-spaced ribbing on the inner surface (marginal supports for the delicate fungus-garden combs) and porous outer walls have been reported from a number of localities in the semi-arid Western and Northern Cape where they may be embedded within saprolite (weathered bedrock) of

a wide range of ages. The complex wavy-laminated internal structure of the thick nest wall is well seen on fractured surfaces. Several partial specimens and broken fragments of fossil nests were recorded within or near the proposed project area in the Ceres Karoo where they are found weathering-out from weathered, calcrete-veined Tierberg Formation mudrocks and overlying calcretised pediment sediments close to the scarp edges (Figs. 49 to 52). Some of these nests may have originally been built several meters below the ground surface while the ill-defined calcrete "veins" in the vicinity might in part be fossilised termite tunnels. The age of the fossil nests is unclear; they may well reflect termite activity during cool, dry episodes within the Pleistocene Epoch which may have supported a more grassy vegetation than found locally today. The dense pattern of *heuweltjies* seen in satellite images of the Ceres Karoo pediment surfaces may be related to the activities the same termites. The preferential development of calcretised soils within the *heuweltjies* could be an indirect consequence of their biological activity.

Finer-grained **alluvium** may host Pleistocene to recent mammal bones, teeth and horn cores as well as distinctive calcretised fossil termite nests and other burrows. Fossils previously recorded within the superficial deposits in the Ceres Karoo region comprise (1) isolated small blocks of reworked petrified wood within surface gravels (see above), and (2) bioturbated horizons within calcretised sandy alluvium along the banks of the Grootrivier (Almond 2016a). The trace fossils concerned in the second case might be rhizoliths (calcretised root casts) and / or invertebrates; they are probably of Pleistocene age.

Given (1) the scarcity of unique or scientifically-valuable fossils recorded during the field-based scoping assessment of the proposed solar PV facility and power line project areas, as well as (2) the paucity of fossil remains recorded during previous PIA studies in the Ceres Karoo region (See References under Almond) it is concluded that these areas are of low palaeontological sensitivity. The fossil material recorded – principally (1) low-diversity trace fossil assemblages within the Ecca Group, (2) sparse, widely-dispersed and mostly small, reworked blocks of petrified wood of uncertain stratigraphic provenance within surface and alluvial gravels, and (3) calcretised termite nests of probable Pleistocene age – is of widespread occurrence along the SW Karoo margins and not of any special scientific or conservation value. No fossil sites of high palaeosensitivity of No-Go areas were identified during the field survey. No special mitigation measures are recommended for the recorded fossil sites, all of which are assigned a low provisional field rating (See table in Appendix A).

- **Palaeontological heritage site sensitivity verification**

The palaeosensitivity map generated by the Department of Environment, Forestry and Fisheries (DEFF) screening tool for the combined proposed solar PV facility and associated power line project area is provided in Figure 38. According to this map, the project area includes regions of (1) medium sensitivity towards the north, corresponding largely to the Tierberg Formation outcrop area, (2) high sensitivity towards the south, corresponding to the Dwyka Group outcrop area, and (3) a central band with unspecified sensitivity which corresponds to the folded Lower Ecca Group outcrop area.

On the basis of (1) the recent palaeontological field survey for the proposed solar and power line projects as well as (2) several desktop- and field-based previous PIA studies in the Ceres Karoo (notably Almond 2010a-c, 2016a, 2018, 2020), the screening tool map is disputed and *rejected* here as an accurate reflection of palaeosensitivity within the present study area. The main reasons for this are:

- The inaccurate overlay of the project area on the palaeosensitivity map (which is based primarily on the relevant 1: 250 000 geological maps);
- The Dwyka Group (indicated in red) is generally regarded as of LOW palaeosensitivity whereas the Tierberg Formation is of MEDIUM sensitivity, at most. Field data for the proposed project suggest a LOW palaeosensitivity for the Tierberg Formation outcrop area here due to weathering and extensive cover by low-sensitivity calcrete, gravels and soils.
- Potentially-sensitive rock units such as the basal Prince Albert Formation and Whitehill Formation are not rated on the map (Field data suggests these are generally of LOW palaeonsensivity in this region, mainly due to weathering and cleavage development).
- The map does not address the Late Caenozoic sediments that mantle the bedrocks in the project area, and in particular the pediment gravels (ancient alluvium) underlying almost the entire solar PV study areas as well as younger alluvium along the Grootrivier and its tributaries. Almost all the new fossil occurrences noted during the recent field survey were found in such settings. However, these fossils are generally of low conservation value and the palaeosensitivity of the Late Caenozoic sediments is according rated as LOW.

It is concluded that the entire combined project area for the proposed solar PV facilities and associated power line to Kappa Substation is in practice of LOW palaeosensivity. Potentially fossiliferous rock units such as the Prince Albert and Whitehill Formations are too weathered and tectonically deformed (cleaved) to contain scientifically valuable fossils in the project area. No significant, conservation-worthy fossil sites or palaeontological No-Go areas were recorded during the field survey.

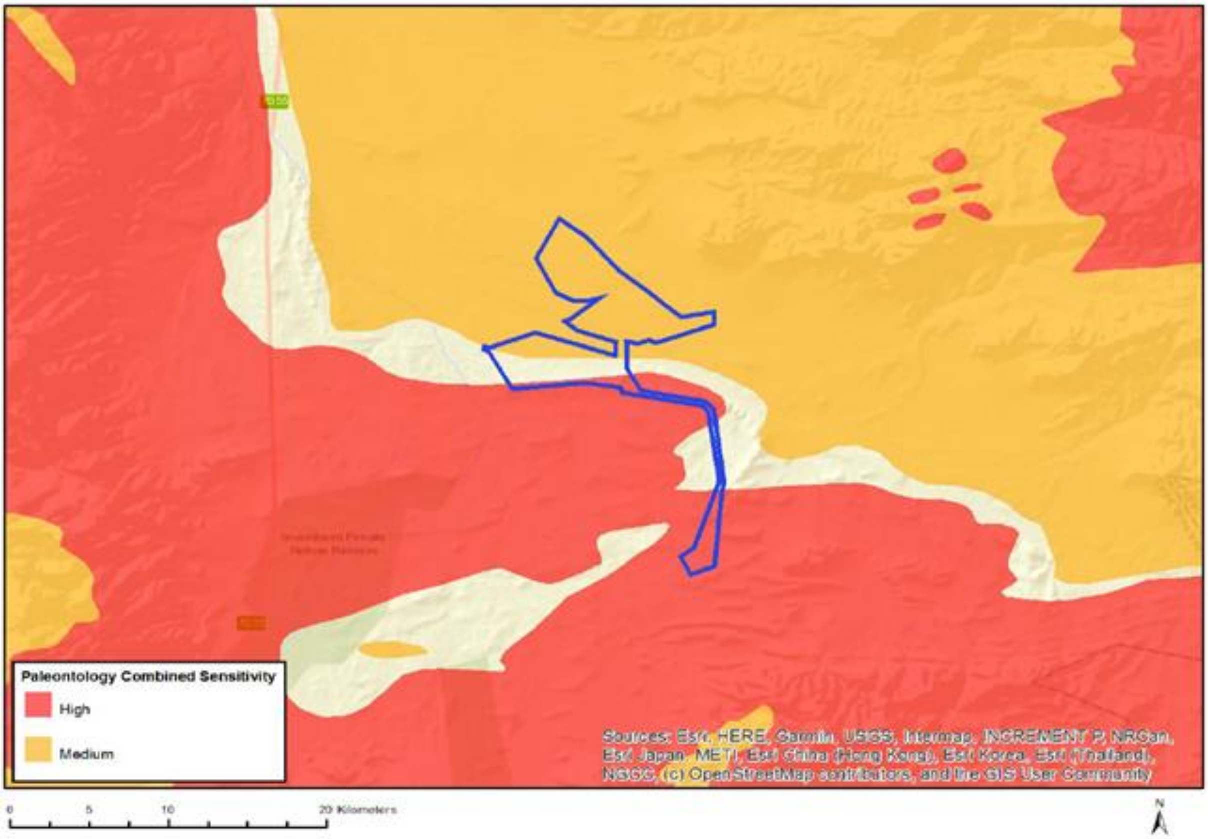


Figure 38: Palaeosensitivity map for the combined solar PV facility and associated power line project area (blue polygon) produced from the DEFF screening tool. Data from several recent field surveys as well as desktop studies indicate that in practice the project area is of LOW palaeosensitivity.

Figure 39: Low diversity assemblages of simple, straight to sinuous horizontal endichnial burrows (*c*. 4 mm wide) on rare bedding plane exposures of the Tierberg Formation, south bank of the Grootrivier, Witte Wall 171 (Loc. 149).

Figure 40: Cylindrical to flattened horizontal, straight to gently-curved burrows (1-2 cm wide, arrowed) with distinctive longitudinal surface ridges or wrinkles (*cf Palaeophycus*), Tierberg Formation exposures in bed of Klein-Droëlaagte, Hoek Doornen 172 (Loc. 122).

Figure 41: Weathered-out, oblate diagenetic concretions of ferruginous carbonate from the Tierberg Formation showing stromatolite-like cone-in-cone structures (pseudofossils), bed of the Klein-Droëlaagte on Hoek Doornen 172 (Scale *c*. 15 mm long).

Figure 42: Typical dense, low-diversity assemblage of horizontal burrows (*c*. 2-3 mm across) preserved within silicified mudrocks of the Collingham Formation (Witte Wall 171) (From Almond 2016a).

Figure 43: Small (1-2 mm diameter) ash-infilled invertebrate burrows (arrowed) close to the interface with a pale cream tuff horizon, Collingham Formation (Witte Wall 171) (From Almond 2016a).

Figure 44: Coarse silcrete gravels and associated reworked petrified wood block from the bed of the Klein-Droëlaagte on Grootfontein 149 (Loc. 165) (Scale in cm).

Figure 45: Portion of a small petrified log showing well-developed seasonal growth lines recorded among oligomict, silcrete gravels in the bed of the Klein-Droëlaagte on Grootfontein 149 (Loc. 169) (Scale in cm).

Figure 46: Collection of small angular to slightly rounded blocks of petrified wood from sheetwash surface gravels on Hoek Doornen 172 (Loc. 128) (Scale in cm and mm).

Figure 47: Small block of petrified wood showing prominent seasonal growth rings recorded close to an exposure of Matjiesfontein chert and so possibly from the Collingham Formation (not mapped here), Hoek Doornen 172 (Loc. 150) (Scale in cm and mm).

Figure 48: Small, well-rounded (water-worn) clasts of silicified wood from pediment surface gravels on Witte Wall 171 (Loc. 132) where they occur in possible association with silcrete-rich older alluvial gravels (Scale in cm and mm).

Figure 49: *In situ* large sphaeroidal calcretised termitarium (yellow dashed area) still largely buried within calcretised pediment gravels with detached blocks extending downslope in float, Grootfontein 149 (Loc. 158) (Scale is *c*. 15 cm long).

Figure 50: Close-up of fragment of calcretised termitarium wall showing the distinctive wavy or zigzag pattern of the fine internal lamination. Block is c. 10 cm across. Same locality as previous figure.

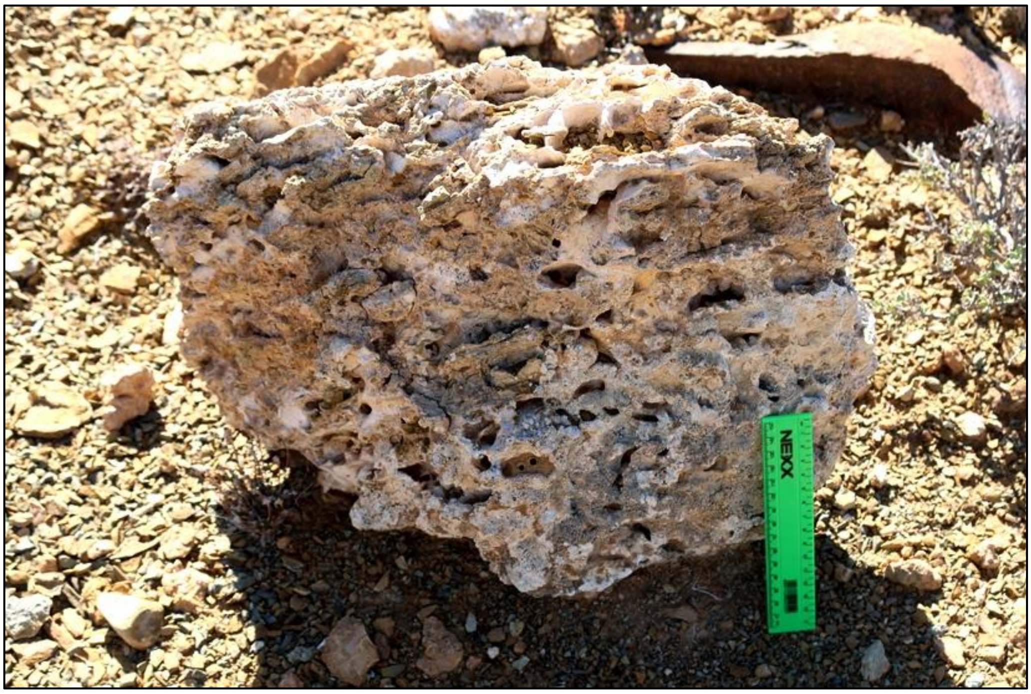


Figure 51: Porous outer surface of a partially weathered-out sphaeroidal termitarium originally embedded within weathered Tierberg Fromation mudrocks on the northern banks of the Grootrivier, Karee Kolk 174 (Scale is *c*. 15 cm long).

Figure 52: Finely-ribbed inner surface of the calcretised termitarium illustrated above (Scale is *c*. 15 cm long). The ribs would have originally supported closely-spaced shelves of the termite colony's fungus garden.

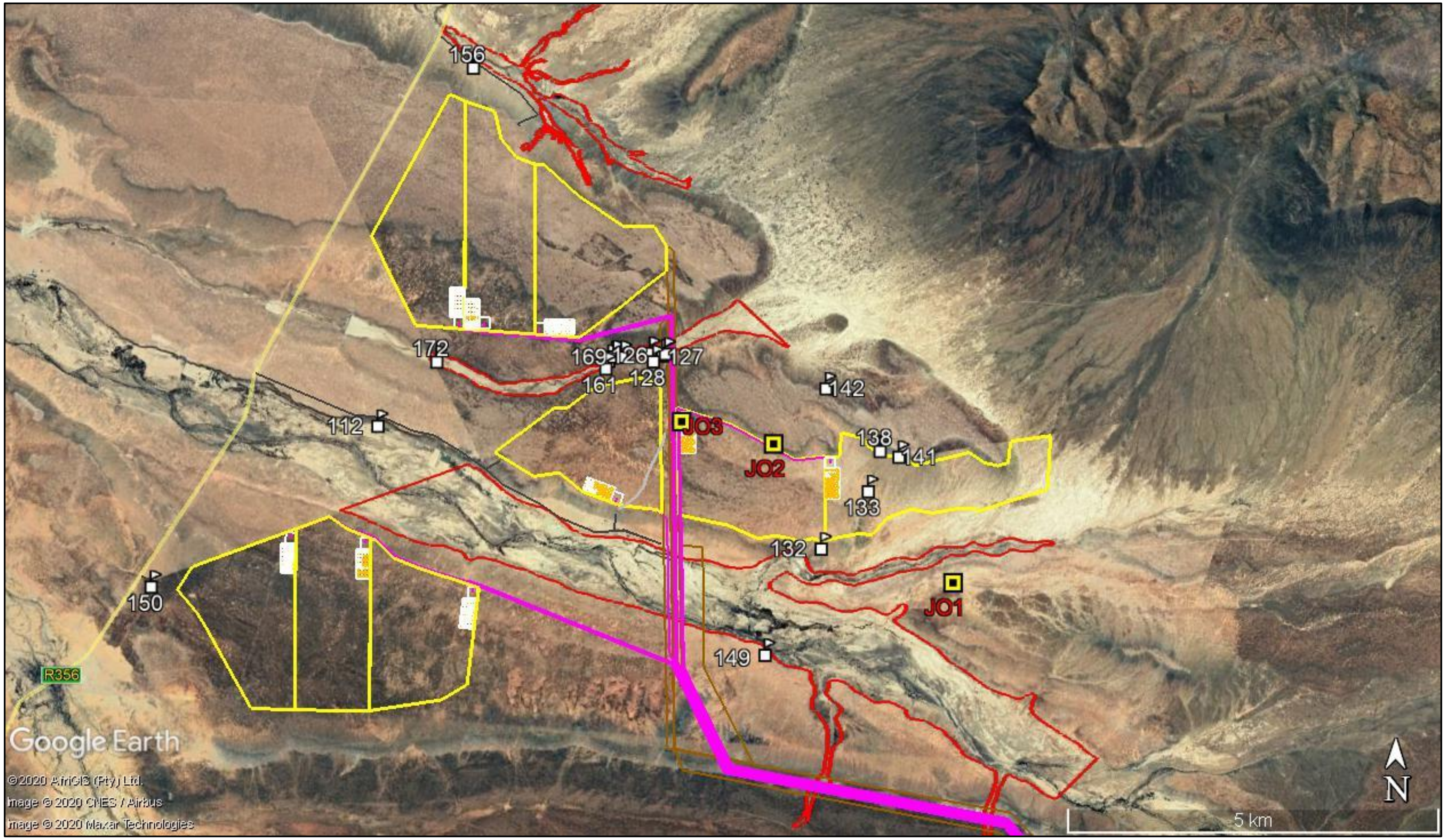


Figure 53: Google Earth© satellite image of the solar PV facility project areas (yellow polygons) with associated power lines (pink) in the corridor linking to the existing Eskom Kappa Substation. The numbered squares show new fossil sites, most of which are associated with drainage line exposures falling in No-Go areas *outside* the project footprint (See Appendix A for details of fossil sites). None of these sites (which represent only a small fraction of potential fossil sites in the area) are considered to be of high scientific or conservation value and no recommendations for their mitigation are proposed here.

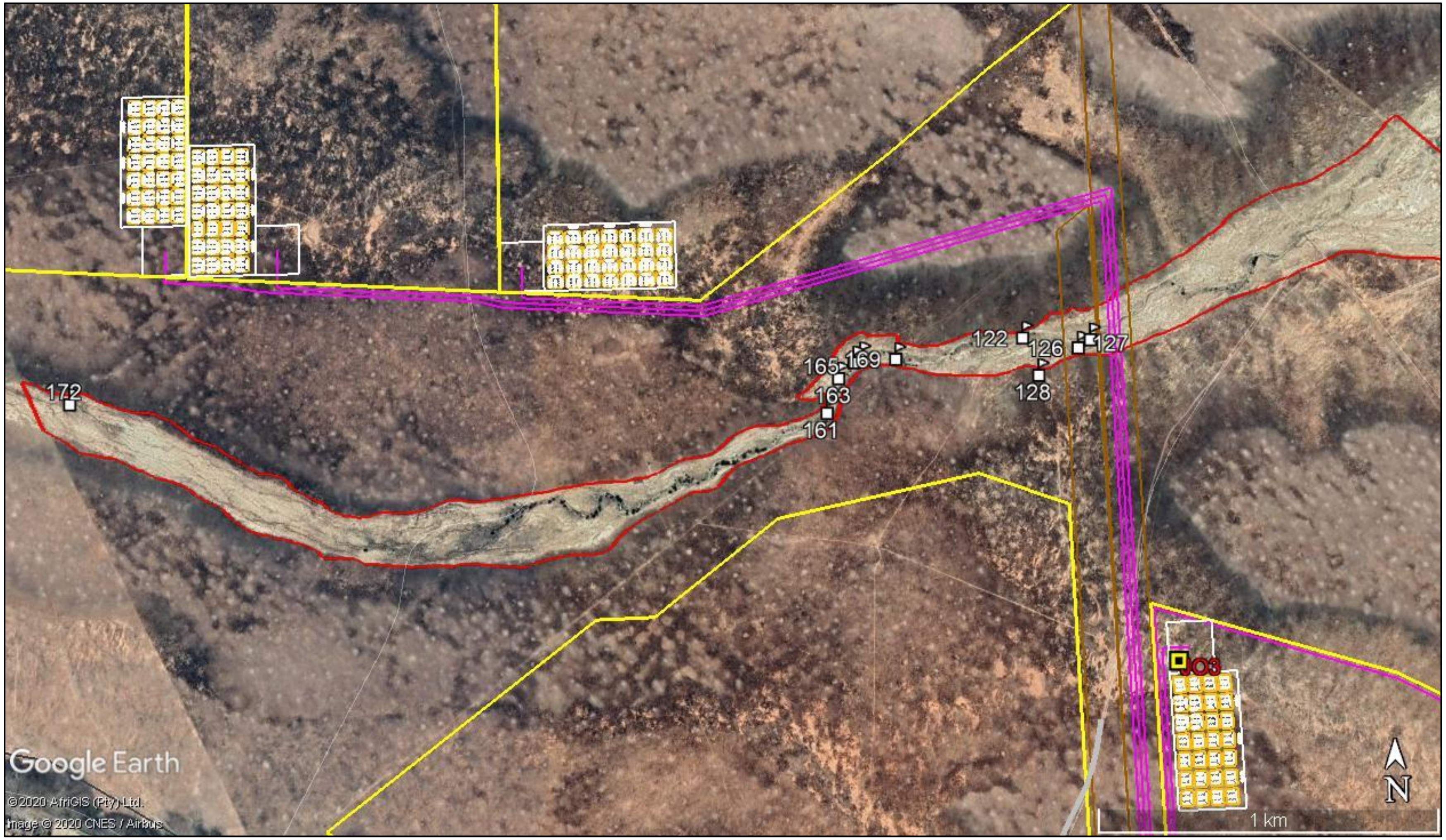


Figure 54: Google Earth© satellite image showing in more detail numbered fossil sites (reworked petrified wood, generally associated with gravels rich in ESA stone artefacts) along the Klein-Droëlaagte drainage line on Witte Wall 171 and Grootfontein 149. These sites lie within a designated No-Go area (identified by the Biodiversity Specialists) and should be protected within the anticipated buffer zone along drainage lines. No recommendations for their mitigation are therefore proposed here.

Table 1: Summary of known fossil record of the main sedimentary rock units represented in the proposed solar PV facility and power line study area. Note that palaeontological sensitivity is strongly dependent on local levels of bedrock weathering and tectonic deformation (*e.g.* cleavage).

GROUP	FORMATION & AGE	FOSSIL BIOTAS	PALAEONTOLOGICAL SENSITIVITY
SUPERFICIAL DEPOSITS	**High Level Gravels, alluvium, colluvium, pedocretes (*e.g.* calcrete)** **LATE TERTIARY TO RECENT**	Bones and teeth of wide range of mammals, including mammals (*e.g.* teeth & bones of mastodont proboscideans, rhinos, bovids, horses, micromammals), reptiles (crocodiles, tortoises), ostrich egg shells, fish, freshwater and terrestrial molluscs (unionid bivalves, gastropods), crabs, trace fossils (*e.g.* termitaria, horizontal invertebrate burrows, stone artefacts), reworked petrified wood, leaves, rhizoliths, diatom floras, peats and palynomorphs.	**LOW (but may be locally HIGH)**
ECCA GROUP	**Tierberg Formation** **E-M PERMIAN**	Rare palaeoniscoid fish, disarticulated microvertebrate remains (*e.g.* fish teeth, scales), sponge spicules, sparse vascular plants (esp. leaves, roots of glossopterids), silicified wood, low to moderate diversity trace fossil assemblages (*e.g.* large ribbed pellet burrows, arthropod scratch burrows, *Siphonichnus etc*).	**LOW-MODERATE**
	Collingham Formation **EARLY PERMIAN**	Low diversity but locally abundant ichnofaunas (horizontal "worm" burrows, arthropod trackways, including those of giant eurypterids), vascular plant remains (petrified and compressed wood, twigs, leaves *etc*).	**MODERATE**
	Whitehill Formation **EARLY PERMIAN**	Mesosaurid reptiles, rare cephalochordates, variety of palaeoniscoid fish, small eocarid crustaceans, insects, low diversity of trace fossils (*e.g.* king crab trackways, possible shark coprolites), palynomorphs, petrified wood and other sparse vascular plant remains (*Glossopteris* leaves, lycopods *etc*).	**HIGH**
	Prince Albert Formation **EARLY PERMIAN**	Low diversity marine invertebrates (bivalves, nautiloids, brachiopods), palaeoniscoid fish, sharks, fish coprolites, protozoans (foraminiferans, radiolarians), petrified wood, palynomorphs (spores, acritarchs), non-marine trace fossils (especially arthropods, fish, also various "worm" burrows), possible stromatolites, oolites.	**MODERATE**
DWYKA GROUP	**Elandsfontein Formation** **LATE CARBONIFEROUS TO EARLY PERMIAN**	Interglacial mudrocks occasionally with low diversity marine fauna of invertebrates (molluscs, starfish, brachiopods, coprolites *etc*), palaeoniscoid fish, petrified wood, leaves (rare) and palynomorphs of *Glossopteris* Flora. Well-preserved non-marine ichnofauna (traces of fish, arthropods) in laminated mudrocks. Possible stromatolites, oolites at top of succession. Limestone erratics with Cambrian archaeocyathid sponges, trilobites, small stromatolites.	**LOW**

6. PALAEONTOLOGICAL HERITAGE IMPACT ASSESSMENT

The anticipated impact significance of the proposed solar PV facilities and associated power lines on local fossil heritage resources is evaluated in Table 3 below. <u>The assessment applies equally to all nine of the 175 MW Solar Photovoltaic (PV) power generation facilities as well as to the associated power lines</u>.

The *key impacts* on local palaeontological heritage resources considered here are *direct* and concern:

- the potential disturbance, damage, destruction or sealing-in of scientifically-important and legally-protected fossils preserved at or beneath the surface of the ground due to construction phase excavations (*e.g.* PV module footings, building foundations, power line pylon footings, underground cables, stormwater channels), and ground clearance (*e.g.* access roads, solar arrays).

This assessment applies only to the *construction phase* of the developments since further significant impacts on fossil heritage during the planning, operational and decommissioning phases of the facilities are not anticipated.

In general, the destruction, damage or disturbance out of context of fossils preserved at the ground surface or below ground that may occur during construction represents a *direct*, *negative* impact that is limited to the development footprint (*site specific*). Such impacts can usually be mitigated but cannot be fully rectified or reversed (*i.e. permanent, irreversible*). Most of the sedimentary formations represented within the study area contain fossils of some sort, so impacts *at some level* on fossil heritage are *very likely*. However, most fossil occurrences encountered within the project footprint occur widely within the study region (*i.e. not unique / irreplaceable*) and are not considered to be of great scientific significance. Exceptional fossils such as well-preserved, well-articulated vertebrate skeletons, vertebrate trackways or substantial petrified logs that are scientifically valuable and conservation-worthy appear to be very rare in the study area. The probability of loss of such conservation-worthy fossil heritage due to the proposed development is considered to be *low*. This is because of (a) the very sparsely-scattered distribution of exceptional, well-preserved fossils within the bedrocks as well as within the overlying superficial sediments (*e.g.* older alluvium, surface gravels), (b) the mantling of the bedrocks with thick superficial sediments in most areas, so that major impacts on potentially-fossiliferous fresh (*i.e.* unweathered) bedrock are limited. The consequence of the anticipated impacts on palaeontological heritage is therefore assessed as *slight* without mitigation. The significance of slight but high (i.e. very likely) probability impacts on fossil heritage resources that are restricted to the development footprint and of permanent duration is rated as *very low (negative)* without mitigation.

Levels of confidence for this impact assessment are *medium* given (1) the unpredictable occurrence of well-preserved, scientifically-valuable fossils, (2) the limited scope and number of field-based palaeontological studies carried out in the broader region and (3) the low levels of bedrock exposure within the development footprint.

It should be noted that, should the recommended mitigation measures for the construction phase of the solar PV and power line developments (Section 7) be fully and consistently

implemented, the impact significance would remain *very low* but would entail both positive and negative impacts (Table 3). Residual negative impacts from inevitable loss of some fossil heritage would be partially offset by an improved palaeontological database for the study region as a direct result of appropriate mitigation. This is a *positive* outcome because any new, well-recorded and suitably-curated fossil material from this palaeontologically little-known region would constitute a useful addition to our scientific understanding of South African fossil heritage.

6.1. Assessment of cumulative impacts

A number of renewable energy and electrical infrastructure projects have been proposed for the Ceres Karoo region within a radius of 30 km of the project areas for the proposed solar PV facility and power line projects. Field-based palaeontological heritage assessments for these projects have been conducted by the author and palaeontological colleagues (*cf* PIAS for the Perdekraal East, Kolkies, Karee, Rietkloof / Indyebo, Tooverberg WEFs by Almond 2015, 2016a, 2016b, 2018 and Butler 2018). In addition, several further new solar energy facility and WEF project proposals (*e.g.* Pienaarspoort 1 WEF and Pienaarspoort 2 WEF) are currently being assessed in the Ceres Karoo area (Almond 2020 and two additional solar facility studies in progress). A tentative assessment of the potential cumulative impacts of the proposed projects in the context of these other developments (not all of which may be granted environmental authorisation) is provided in Table 4. This assessment provided here applies equally to all of the Veronica project components (PV solar facilities, power lines) considered individually and in conjunction.

It is noted that cumulative impact assessments only have real meaning if comparable resources are considered (*e.g.* fossil assemblages in the same geological formations), while developments other than renewable energy projects (*e.g.* borrow pits, roads, power lines) are also relevant (*cf* Almond 2010a-c for the Eskom Gamma-Omega 765kV transmission line and Kappa Substation). Several renewable energy developments in the Klein Roggeveldberge and Cape Fold Mountains which respectively affect Permian continental fossils within the Lower Beaufort Group and Devonian marine fossils within the Cape Supergroup are *not* considered to be relevant here. Furthermore, the cumulative impact assessment assumes – rather optimistically - that all the relevant palaeontological mitigation measures recommended for the authorised renewable energy projects considered are fully implemented.

Given the generally Low, but not negligible, impact significance assigned to the various *relevant* renewable energy developments in the Ceres Karoo listed above, as well as the Very Low impact significance assessed here for each of the nine proposed PV and power line developments themselves, a LOW (negative) cumulative impact significance for the latter projects is suggested in the absence of mitigation. Should the various mitigation measures proposed for these projects be fully implemented, the cumulative impact significance may fall to VERY LOW (negative). It is concluded that as far as fossil heritage resources are concerned, the proposed solar facility and power line projects, whether considered individually or together, will *not* result in an unacceptable loss or unacceptable additional impacts, considering all the authorised renewable energy projects proposed in the area.

6.2. Impact Assessment Summary

A summary of the overall impact significance findings (following mitigation) for the proposed solar facility and power line projects is provided in Table 2 below.

Table 2: Overall Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	Very Low
Operational	Not applicable
Decommissioning	Not applicable
Loss of palaeontological heritage	**Overall Impact Significance**
Cumulative - Construction	Very Low
Cumulative - Operational	Not applicable
Cumulative - Decommissioning	Not applicable

Table 3: Impact assessment summary table for the Construction Phase of each solar PV facility and associated power line [No further impacts anticipated during operational and decommissioning phases]

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Disturbance, damage or destruction of fossils within the development footprint due to excavations and surface clearance	*Status*	Negative	Very low impact (5)	Monitoring for fossil remains on on-going basis by the Environmental Control Officer (ECO) during the construction phase. See Chance Fossil Finds Procedure (Appendix C and EMPr)	Very low impact (5)	Medium
	Spatial Extent	Site specific				
	Duration	Permanent				
	Consequence	Slight				
	Probability	Very likely				
	Reversibility	Non-reversible				
	Irreplaceability	Low				

Table 4: Cumulative impact assessment summary table for each solar PV facility and associated power line in the context of the other proposed solar projects as well as other renewable energy developments in the area (≤ 30 km radius)

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Disturbance, damage or destruction of fossils within the development footprint due to excavations and surface clearance	*Status*	Negative	Low impact (4)	Monitoring for fossil remains on on-going basis by the ECO during the construction phase. See Chance Fossil Finds Procedure (Appendix C and EMPr)	Very low impact (5)	Medium
	Spatial Extent	Site specific				
	Duration	Permanent				
	Consequence	Moderate				
	Probability	Very likely				
	Reversibility	Non-reversible				
	Irreplaceability	Low				

7. MONITORING AND MITIGATION MEASURES FOR INCLUSION IN THE EMPr

Since unique, scientifically-valuable, conservation-worthy fossils are rare within the proposed solar facility and power line project areas, no further specialist palaeontological studies, monitoring or mitigation is recommended for this development, pending the potential discovery of significant new fossil material during the construction phase.

The following monitoring and mitigation measures are recommended for the construction phase of the developments, for inclusion in the EMPrs:

- Monitoring for fossil material of all major surface clearance and deeper (>1m) excavations by the Environmental Control Officer (ECO) on an on-going basis during the construction phase.

- Significant fossil finds should be safeguarded and reported at the earliest opportunity to Heritage Western Cape for recording and sampling by a professional palaeontologist (Contact details: Heritage Western Cape. Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 086-142 142. Fax: 021-483 9842. Email: hwc@pgwc.gov.za).

- Professional mitigation, involving the recording and judicious sampling of fossil material together with pertinent field data (stratigraphy, taphonomy), should conform to best practice. Fossil material collected must be curated within an approved repository (university or museum collection).

A tabulated summary of recommendations regarding palaeontological heritage for the construction phase of the proposed solar facility and power line developments is provided in Table 5 below. This table applies equally to all proposed solar PV facilities and associated power lines, as well as the grid connection at the Kappa Substation.

A general protocol for Chance Fossil Finds for this project is appended to this report (Appendix C).

There are no palaeontological monitoring or mitigation requirements for the operational and decommissioning phases of the developments.

7.1. Generic EMPr for Power Lines and Substations

Section 5.12 (Protection of Heritage Resources) in the Generic EMPr for Power Lines and Substations (GN 435), gazetted in 2019, adequately covers the generic palaeontological heritage monitoring and mitigation measures appropriate for the proposed solar PV facility power line and substation projects. There are no specific palaeontological heritage management actions that are important and not included in GN 435.

Table 5: Management Plan for the Construction Phase (Including pre- and post-construction activities) [This table applies equally to all solar PV facilities, power lines and substation grid connection]

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Palaeontological heritage					
Disturbance, damage, destruction or sealing-in of scientifically valuable fossil material embedded within bedrock or exposed at ground surface within development footprint.	Safeguarding, recording and sampling of scientifically-important fossil material encountered or exposed during development (Chance Fossil Finds)	a. Monitoring of all bedrock excavations and cleared sites for fossil remains during construction phase. Safeguarding of chance fossil finds.	Regular visual inspection of substantial excavations and cleared areas for fossil remains. Chance fossil finds to be safeguarded (site taped-off or fossils set aside) and reported to Heritage Western Cape (HWC) for possible mitigation.	Ongoing during Construction Phase	ECO
		b. Recording and judicious sampling of exceptional new fossil material and relevant geological data from the development footprint.	Standard palaeontological recording and collection methods (GPS / photos / field notes / careful wrapping of specimens for transport)	Following report of significant new fossil finds by ECO	Professional palaeontologist assisted by ECO
		c. Curation of fossil specimens at an approved repository (e.g. museum).	Cataloging and safe storage of fossils *plus* key field data in an approved repository (museum / university)	Following mitigation	Professional palaeontologist
		d. Final technical report on palaeontological heritage within study area submitted to HWC.	Minimum reporting requirements specified by heritage resources agency (*e.g.* SAHRA / HWC)	Following mitigation and preliminary analysis of fossil finds	Professional palaeontologist

8. CONCLUSIONS AND RECOMMENDATIONS

Given the very similar geological and palaeontological context and scale of each of the nine proposed solar PV facilities and the associated power lines, the impact assessments and mitigation recommendations for each project are identical.

The solar PV facility project area is situated on a flat to gently-sloping pediment surface of Late Caenozoic (Neogene – Pleistocene) age on the flanks of the Grootrivier Valley which drains this sector of the Ceres Karoo. The pediment surface has been planed-off by river erosion into the underlying fine-grained, non-marine, basinal to distal submarine fan sediments of the Tierberg Formation (Ecca Group) that are Middle Permian in age. Field surveys show that the Tierberg bedrocks beneath the thin (few dm to few meters maximum) capping of alluvial gravels, calcrete hardpans, sandy soils and downwasted surface gravels capping the pediment surface are weathered, folded and often tectonically-cleaved. The only fossil remains recorded from such pediment settings in the Ceres Karoo comprise (1) sparse, generally small blocks of reworked silicified fossil wood within alluvial and surface gravels of uncertain provenance (probably Ecca Group) and (2) occasional calcretised fossil termite nests of probable Pleistocene age that are found embedded within calcretised superficial sediments as well as weathered, calcrete-veined bedrocks. The majority of fossil sites recorded fall within designated No-Go areas lying *outside* the project footprint. These fossils are of widespread occurrence within the Ceres Karoo region and are not of high scientific interest or conservation value. No fossil sites of high sensitivity or No-Go areas were identified within the solar PV project areas during the palaeontological field survey and the palaeontological sensitivity of the project area is assessed as generally LOW.

The power line corridor between the solar PV sites and the existing Kappa Substation on Platfontein 240 traverses the outcrop areas of the Permo-Carboniferous, glacial-related Dwyka Group as well as the lower Ecca Group (Prince Albert, Whitehill and Collingham Formations). The potentially-fossiliferous Prince Albert, Whitehill Formations and Collingham Formations are highly weathered and cleaved in this region. No sensitive fossil sites have been recorded within or close to the proposed corridor on Die Brak 241 and Platfontein 240 during the present field survey or several previous field studies in the vicinity by Almond (2010a-c, 2016a) and the palaeontological sensitivity of the corridor is assessed as LOW.

As a consequence of (1) the paucity of irreplaceable, unique or rare fossil remains within the development footprint, as well as (2) the extensive superficial sediment cover overlying most potentially-fossiliferous bedrocks within the solar PV facility and power line project area, the overall impact significance of the construction phase of the proposed solar PV facility regarding legally-protected palaeontological heritage resources is assessed as *VERY LOW* (*negative status*), with and without mitigation. This assessment applies to all the associated solar PV facility and power line infrastructure within the project area. No significant further impacts on fossil heritage are anticipated during the operational and decommissioning phases of the solar PV energy facility and associated infrastructure. The No-Go alternative (*i.e.* no solar PV facility and power line development) will probably have a neutral impact on palaeontological heritage. Confidence levels for this assessment are MEDIUM, given the generally low exposure levels of potentially-fossiliferous bedrocks.

Anticipated cumulative impacts in the context of other renewable energy projects in the Ceres Karoo region – *including* the nine proposed solar PV facilities and power lines - are assessed as *LOW (negative)* without mitigation but *VERY LOW (negative)* with mitigation. It is concluded that as far as fossil heritage resources are concerned, the proposed solar facility and power line projects, whether considered individually or together, will *not* result in an unacceptable loss or unacceptable additional impacts, considering all the renewable energy projects proposed in the area. This analysis only applies *provided that* all the proposed monitoring and mitigation recommendations made for all these various projects are consistently and fully implemented.

No specialist palaeontological monitoring or mitigation is recommended for this development, pending the potential discovery of significant new fossil material here during the construction phase. The ECO should be made aware of the possibility of important fossil remains (bones, teeth, petrified wood, plant-rich horizons, fossil termitaria *etc.*) being found or unearthed during the construction phase of the development. Monitoring for fossil material of all major surface clearance and deeper (>1m) excavations by the ECO on an on-going basis during the construction phase is therefore recommended. Significant fossil finds should be safeguarded and reported at the earliest opportunity to Heritage Western Cape for recording and sampling by a professional palaeontologist. The palaeontologist concerned will need a Fossil Collection Permit from Heritage Western Cape and all fossil material collected must be properly curated in an approved repository (museum / university collection). These recommendations must be included within the EMPr for the proposed solar PV facility and power line developments. A protocol for Chance Fossil Finds is appended to this report (Appendix C).

There are no identified fatal flaws and no objections on palaeontological heritage grounds to authorisation of the proposed solar PV facilities with its associated power line connections to the Kappa Substation.

9. ACKNOWLEDGEMENTS

I am grateful to Ms Rohaida Abed of the CSIR- Environmental Management Services for commissioning this PIA project, for providing the relevant background information as well as indefatigable editorial and heritage management input. Ms Luanita Snyman van der Walt is thanked for drafting the consolidated geological map of the Ceres Karoo project area. Mnr Claude Bosman of Veroniva (Pty) Ltd is thanked for facilitating the fieldwork very effectively and Dr Jayson Orton of ASHA for helpful discussions regarding heritage management as well as providing additional fossil locality data and photographs. As always, logistical support, companionship and assistance in the field from Ms Madelon Tusenius is greatly appreciated.

10. KEY REFERENCES

N.*B. An extensive list of literature relevant to the palaeontology of the Ceres Karoo / southern Tanqua Karoo region has been provided by Almond (1015a, 2016a, 2018ë).*

ALMOND, J.E. 1998. Trace fossils from the Cape Supergroup (Early Ordovician – Early Carboniferous) of South Africa. Journal of African Earth Sciences 27 (1A): 4-5.

ALMOND, J.E. 2008a. Fossil record of the Loeriesfontein sheet area. Unpublished report for the Council for Geoscience, Pretoria, 32pp.

ALMOND, J.E. 2008b. Palaeozoic fossil record of the Clanwilliam sheet area. Unpublished report for the Council for Geoscience, Pretoria, 49pp.

ALMOND, J.E. 2010a. Eskom Gamma-Omega 765kV transmission line: Phase 2 palaeontological impact assessment. Sector 1, Tanqua Karoo to Omega Substation (Western and Northern Cape Provinces), 95 pp + appendix. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010b. Proposed Kappa electrical substation on Platfontein Outspan 240, Ceres Magesterial District, Western Cape Province, 17 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010c. Eskom Gamma-Omega 765kV transmission line: Phase 2 palaeontological impact assessment. Sector 2, Omega to Kappa Substation (Western Cape Province), 100 pp + appendix. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010d. Proposed Mainstream wind farm at Perdekraal, Ceres Karoo, Ceres Magisterial District, Western Cape Province. Palaeontological impact assessment: pre-scoping desktop study, 22 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010e. Proposed Mainstream wind farm at Konstabel near Touwsrivier, Laingsburg Magisterial District, Western Cape. Palaeontological impact assessment: pre-scoping desktop study, 19 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015a. Proposed Perdekraal East Wind & Solar Renewable Energy Facility near Touwsrivier, Ceres Magisterial District, Western Cape Province. Palaeontological impact assessment: field study, 68 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015b. Proposed 75 MW photovoltaic solar facility and associated infrastructure on remainder of Farm 34 Vredefort near Touwsrivier, Breede River District Municipality, Western Cape. Palaeontological heritage assessment: combined desktop & field study, 44 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2016a. Proposed Kolkies Wind Energy Facility near Touwsrivier, Witzenberg Local Municipality, Western Cape. Palaeontological input to heritage scoping assessment, 30 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2016b. Proposed Karee Wind Energy Facility near Touwsrivier, Witzenberg Local Municipality, Western Cape. Palaeontological input to heritage scoping assessment, 33 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2018. Proposed Rietkloof Wind Energy Facility near Laingsburg, Laingsburg Local Municipality, Western Cape. Palaeontological heritage assessment: combined desktop & field-based study, 85 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2019a. Upgrade of the N1 (Section 4) between Monument River (km 46.0) and Doornfontein (km 63.0), Laingsburg Local Municipality, Western Cape Province, 53 pp. Natura Viva cc for CTS Heritage, Cape Town.

ALMOND, J.E. 2019b. Proposed SANSA Space Operations on Portion 8 of Farm 148 near Matjiesfontein, Laingsburg Local Municipality, Western Cape Province. Palaeontological specialist study, 40 pp. Natura Viva cc for CTS Heritage, Cape Town.

ALMOND, J.E. 2020. Proposed Pienaarspoort 1 and Pienaarspoort 2 Wind Energy Facilities in the Ceres Karoo region (Boland District Municipality) near Touwsrivier, Western Cape. Palaeontological heritage: combined desktop & field-based assessment, 50 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. & PETHER, J. 2008. Palaeontological heritage of the Western Cape. Interim SAHRA technical report, 20 pp. Natura Viva cc., Cape Town.

ANDERSON, A.M. & McLACHLAN, I.R. 1976. The plant record in the Dwyka and Ecca Series (Permian) of the south-western half of the Great Karoo Basin, South Africa. Palaeontologia africana 19: 31-42.

ANDERSON, J.M. & ANDERSON, H.M. 1985. Palaeoflora of southern Africa. Prodromus of South African megafloras, Devonian to Lower Cretaceous, 423 pp. Botanical Research Institute, Pretoria & Balkema, Rotterdam.

BUTLER, E. 2018. Palaeontological impact assessment of the proposed construction of the 140MW Tooverberg Wind Energy Facility (WEF) and associated grid connection near Touws River in the Western Cape Province, 75 pp. Banzai Environmental (Pty) Ltd.

COLE, D.I. 2005. Prince Albert Formation. SA Committee for Stratigraphy, Catalogue of South African Lithostratigraphic Units 8: 33-36.

COLE, D.I. & BASSON, W.A. 1991. Whitehill Formation. Catalogue of South African Lithostratigraphic Units 3, 51-52. Council for Geoscience, Pretoria.

FOURIE, W., ALMOND, J. & ORTON, J. 2015. Heritage scoping assessment specialist report. Strategic environmental assessment for wind and solar photovoltaic energy in South Africa. Appendix 3, 79 pp. CSIR and Department of Environmental Affairs, RSA.

HERITAGE WESTERN CAPE 2016. Guide for minimum standards for archaeology and palaeontology reports submitted to Heritage Western Cape, 4 pp.

GRESSE, P.G. & THERON, J.N. 1992. The geology of the Worcester area. Explanation of geological Sheet 3319. 79 pp, tables. Council for Geoscience, Pretoria.

JOHNSON, M.R., VAN VUUREN, C.J., VISSER, J.N.J., COLE, D.I., WICKENS, H. DE V., CHRISTIE, A.D.M., ROBERTS, D.L. & BRANDL, G. 2006a. Sedimentary rocks of the Karoo Supergroup. In: Johnson. M.R., Anhaeusser, C.R. & Thomas, R.J. (eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Johannesburg & the Council for Geoscience, Pretoria.

KLEIN, R.G. 1984. The large mammals of southern Africa: Late Pliocene to Recent. In: Klein, R.G. (Ed.) Southern African prehistory and paleoenvironments, pp 107-146. Balkema, Rotterdam.

MACRAE, C. 1999. Life etched in stone. Fossils of South Africa, 305 pp. The Geological Society of South Africa, Johannesburg.

McCARTHY, T. & RUBIDGE, B. 2005. The story of Earth and life: a southern African perspective on a 4.6-billion-year journey. 334pp. Struik, Cape Town.

McLACHLAN, I.R. & ANDERSON, A. 1973. A review of the evidence for marine conditions in southern Africa during Dwyka times. Palaeontologia africana 15: 37-64.

OELOFSEN, B.W. 1987. The biostratigraphy and fossils of the Whitehill and Iratí Shale Formations of the Karoo and Paraná Basins. In: McKenzie, C.D. (Ed.) Gondwana Six: stratigraphy, sedimentology and paleontology. Geophysical Monograph, American Geophysical Union 41: 131-138.

PARTRIDGE, T.C., BOTHA, G.A. & HADDON, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.

SAHRA 2013. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.

SKEAD, C.J. 1980. Historical mammal incidence in the Cape Province. Volume 1: The Western and Northern Cape, 903pp. Department of Nature and Environmental Conservation, Cape Town.

THERON, J.N. 1983. Die geologie van die gebied Sutherland. Explanation of 1: 250 000 geological Sheet 3220, 29 pp. Council for Geoscience, Pretoria.

THERON, J.N., WICKENS, H. DE V. & GRESSE, P.G. 1991. Die geologie van de gebied Ladismith. Explanation of Sheet 3320. 99 pp. Geological Survey / Council for Geoscience, Pretoria.

VILJOEN, J.H.A. 1992. Lithostratigraphy of the Collingham Formation (Ecca Group), including the Zoute Kloof, Buffels River and Wilgehout River Members and the Matjiesfontein Chert Bed. South African Committee for Stratigraphy, Lithostratigraphic Series No. 22, 10 pp.

VILJOEN, J.H.A. 1994. Sedimentology of the Collingham Formation, Karoo Supergroup. South African Journal of Geology 97: 167-183.

VILJOEN, J.H.A. 2005. Tierberg Formation. SA Committee for Stratigraphy, Catalogue of South African Lithostratigraphic Units 8: 37-40.

VISSER, J.N.J. 1992. Deposition of the Early to Late Permian Whitehill Formation during a sea-level highstand in a juvenile foreland basin. South African Journal of Geology 95: 181-193.

VISSER, J.N.J. 1994. A Permian argillaceous syn- to post-glacial foreland sequence in the Karoo Basin, South Africa. In Deynoux, M., Miller, J.M.G., Domack, E.W., Eyles, N. & Young, G.M. (Eds.) Earth's Glacial Record. International Geological Correlation Project Volume 260, pp. 193-203. Cambridge University Press, Cambridge.

VISSER, J.N.J. 1997. Deglaciation sequences in the Permo-Carboniferous Karoo and Kalahari Basins of southern Africa: a tool in the analysis of cyclic glaciomarine basin fills. Sedimentology 44: 507-521.

VISSER, J.N.J. 2003. Lithostratigraphy of the Elandsvlei Formation (Dwyka Group). South African Committee for Stratigraphy, Lithostratigraphic Series No. 39, 11 pp.

VISSER, J.N.J., VON BRUNN, V. & JOHNSON, M.R. 1990. Dwyka Group. South African Committee for Stratigraphy Catalogue of South African Lithostratigraphic Units 2, 15-17. Council for Geoscience, Pretoria.

WICKENS, H. DE V. 1984. Die stratigraphie en sedimentologie van die Group Ecca wes van Sutherland. Unpublished MSc thesis, University of Port Elizabeth, viii + 86 pp.

WICKENS, H. DE V. 1994. Submarine fans of the Ecca Group. Unpublished PhD thesis, University of Port Elizabeth. 350 pp.

WICKENS, H. DE V. 1996. Die stratigraphie en sedimentologie van die Ecca Groep wes van Sutherland. Council for Geosciences, Pretoria Bulletin 107, 49pp.

11. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

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 in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. 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 palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest Province, Mupumalanga and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as a long-standing 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).

APPENDIX A: GPS FOSSIL LOCALITY DATA

All GPS readings were taken in the field using a hand-held Garmin GPSmap 64s instrument. The datum used is WGS 84. Please note that:

- The fossil sites recorded here represent only a small sample of potential sites present at or beneath the ground surface within the project area.
- This palaeontological site data is *not* for public release, due to conservation concerns.

LOC.	GPS DATA	COMMENTS
112	[redacted]	Karee Kolk 174. Partially *in situ*, sphaeroidal calcretised termitarium (fossil termite nest) embedded within weathered and calcrete-veined Tierberg Fm mudrocks exposed along steep pediment edge on N. banks of Grootrivier. Fragments downwasted further down slope. Proposed Field Rating IIIB Local Resource.
122		Hoek Doornen 172 (northern area). Locally common cylindrical to flattened horizontal, straight to gently-curved burrows (1-2 cm wide) with distinctive longitudinal surface ridges or wrinkles (*cf Palaeophycus*). Tierberg Formation exposures in bed of Klein-Droëlaagte. Proposed Field Rating IIIC Local Resource.
126		Hoek Doornen 172 (northern area). Oligomict coarse, silcrete-rich alluvial gravels along the bed of the Klein-Droëlaagte with sparse small blocks of silicified wood (probably reworked from the Tierberg Fm). Proposed Field Rating IIIC Local Resource.
127		Hoek Doornen 172 (northern area). Oligomict coarse, silcrete-rich alluvial gravels along the bed of the Klein-Droëlaagte with sparse small blocks of silicified wood (probably reworked from the Tierberg Fm). Proposed Field Rating IIIC Local Resource.
128		Hoek Doornen 172 (northern area). Sandy alluvium, possible heuweljie sands with sheetwash surface gravels on floodplain of Klein-Droëlaagte. Sparse scatter of small angular to slightly water-worn blocks of silicified wood. Proposed Field Rating IIIC Local Resource.
132		Witte Wall 171. Pediment surface gravels including abundant buff to yellowish-grey sandy to gritty silcrete, often flaked (ESA, MSA). Occasional small rolled clasts of petrified wood in same area. Possible trace of ancient coarse alluvial deposits. Proposed Field Rating IIIC Local Resource.
133		Witte Wall 171. Open patch with fine sheetwash gravels dominated by resistant cherty lithologies, occasional exotic Dwyka erratics, sparse small blocks of petrified wood. Proposed Field Rating IIIC Local Resource.
138		Witte Wall 171. Calcretised crest of upper pediment surface. Occasional small float blocks of petrified wood. Proposed Field Rating IIIC Local Resource.
141		Witte Wall 171. Detached angular blocks of large calcretised termitarium blocks reworked from calcretised crest of pediment surface nearby and extending downslope in float. Proposed Field Rating IIIC Local Resource.
142		Witte Wall 171. Fine surface gravels below elevation of upper pediment surface forming desert pavement (serir), with sparse small blocks of petrified wood. Proposed Field Rating IIIC Local Resource.
149		Witte Wall 171. Well-exposed Tierberg Formation siltstones with bedding plane assemblages of simple, sinuous, cross-cutting horizontal burrows with softer ferruginous mineral infill. Proposed Field Rating IIIC Local Resource.

LOC.	GPS DATA	COMMENTS
150	[redacted]	Hoek Doornen 172. Isolated small float block of petrified wood with well-developed seasonal growth lines. Mapped as Tierberg Fm but Collingham Fm outcrop with Matjiesfontein chert v. close by. Proposed Field Rating IIIC Local Resource.
156	[redacted]	Grootfontein 149. Sandy alluvial soils with fine surface gravels, including sparse small angular to subrounded blocks of petrified wood. Proposed Field Rating IIIC Local Resource.
158	[redacted]	Grootfontein 149. Calcretised soils near pediment escarpment edge. Largely embedded sphaeroidal calcretised termitarium with detached blocks extending downslope in float. Proposed Field Rating IIIC Local Resource.
161	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood and ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
163	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood and ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
165	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood and ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
166	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood and ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
169	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood, rare small petrified logs and ESA stone artefacts. Proposed Field Rating IIIB Local Resource.
172	[redacted]	Grootfontein 149. Coarse silcrete-rich oligomict alluvial gravel lenses in bed and banks of Klein-Drooelaagte drainage line. Sparse small blocks of petrified wood, ESA stone artefacts. Proposed Field Rating IIIC Local Resource.
JO1	[redacted]	Small block of petrified wood in surface gravels. Proposed Field Rating IIIC Local Resource.
JO2	[redacted]	Small block of petrified wood in surface gravels. Proposed Field Rating IIIC Local Resource.
JO3	[redacted]	Small block of petrified wood in surface gravels. Proposed Field Rating IIIC Local Resource.
JO4	[redacted]	Small block of petrified wood in surface gravels. Proposed Field Rating IIIC Local Resource.

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

Basic Assessments for the Proposed Development of two 175 MW Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure (i.e. Witte Wall 1 and Witte Wall 2), near Touws River, Western 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:	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)			
Professional affiliation/registration:	Palaeontolgical Society of Southern Africa, Association of Professional Heritage Practitioners (W Cape)			
Physical address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN			
Postal address:	PO Box 12410 Mill Street, Cape Town			
Postal code:	8010	Cell:	n/a	
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.

John E Almond

Signature of the Specialist

Natura Viva cc

Name of Company:

24th Octr 2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

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.

J. E. Almond

Signature of the Specialist

NATURA VIVA CC

Name of Company

24th October 2020

Date

Signature of the Commissioner of Oaths

2020-10-24

Date

SOUTH AFRICAN POLICE SERVICE
STATION COMMANDER
CAPE TOWN

2020 -10- 24

CAPE TOWN
STATION COMMANDER
SOUTH AFRICAN POLICE SERVICE

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

Basic Assessments for the Proposed Development of three 175 MW Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure (i.e. Grootfontein 1; Grootfontein 2; and Grootfontein 3), near Touws River, Western 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:	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)			
Professional affiliation/registration:	Palaeontolgical Society of Southern Africa, Association of Professional Heritage Practitioners (W Cape)			
Physical address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN			
Postal address:	PO Box 12410 Mill Street, Cape Town			
Postal code:	8010	Cell:	n/a	
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.

John E. Almond

Signature of the Specialist

Natura Viva cc

Name of Company:

24th October 2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

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

24th October 2020

Date

Signature of the Commissioner of Oaths

2020-10-24

Date

SOUTH AFRICAN POLICE SERVICE
STATION COMMANDER
CAPE TOWN
2020 -10- 24
CAPE TOWN
STATION COMMANDER
SOUTH AFRICAN POLICE SERVICE

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

Basic Assessments for the Proposed Development of four 175 MW Solar Photovoltaic Facilities and associated Electrical Grid Infrastructure (i.e. Hoek Doornen 1; Hoek Doornen 2; Hoek Doornen 3; and Hoek Doornen 4), near Touws River, Western 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:	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)			
Professional affiliation/registration:	Palaeontolgical Society of Southern Africa, Association of Professional Heritage Practitioners (W Cape)			
Physical address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN			
Postal address:	PO Box 12410 Mill Street, Cape Town			
Postal code:	8010	Cell:	n/a	
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.

John E Almond

Signature of the Specialist

Natura Viva cc

Name of Company:

24th March 2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

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.

Signature of the Specialist

NATURA VIVA CC

Name of Company

24th October 2020

Date

Signature of the Commissioner of Oaths

2020-10-24

Date

SOUTH AFRICAN POLICE SERVICE
STATION COMMANDER
CAPE TOWN

2020 -10- 24

CAPE TOWN
STATION COMMANDER
SOUTH AFRICAN POLICE SERVICE

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

<table>
<tr><td colspan="3">APPENDIX C: CHANCE FOSSIL FINDS PROCEDURE: Proposed solar PV facilities and associated power lines to Kappa Substation, Ceres Karoo</td></tr>
<tr><td>Province & region:</td><td colspan="2">Western Cape: Cape Winelands District Municipality / Witzenberg Local Municipality</td></tr>
<tr><td>Responsible Heritage Resources Agency</td><td colspan="2">HERITAGE WESTERN CAPE (Contact details: Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 086-142 142. Fax: 021-483 9842. Email: hwc@pgwc.gov.za)</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Dwyka Group, Ecca Group (Prince Albert, Whitehill, Collingham & Tierberg Formations), Late Caenozoic colluvium and alluvium.</td></tr>
<tr><td>Potential fossils</td><td colspan="2">In bedrocks: fossil fish, mesosaurid reptiles, shelly invertebrates, vascular plants (incl. petrified wood), trace fossil assemblages. In colluvium and alluvium: teeth, bones and horn cores of mammals, non-marine molluscs, calcretised trace fossils (e.g. termitaria), reworked fossil wood.</td></tr>
<tr><td rowspan="5">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 D: SITE SENSITIVITY VERIFICATION

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 for the proposed solar PV facility and associated power line projects was undertaken in order to confirm the current palaeontological heritage sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool) (Figure D1).

The details of the site sensitivity verification are noted below:

Date of Site Visit	7-10 September 2020
Specialist Name	Dr John E. Almond
Professional Registration Number	Not registered
Specialist Affiliation / Company	*Natura Viva* cc

- **Information sources**

The palaeontological heritage site sensitivity verification is based on the following information sources:

1. Site paleosensitivity map produced by the DEFF screening tool (Figure D1);

2. A brief project outline, kmz files and maps provided by CSIR - Environmental Management Services;

3. A desktop review of (a) the relevant 1: 50 000 and 1: 250 000 scale topographic maps, (b) Google Earth© satellite imagery, (c) published geological and palaeontological literature, including 1: 250 000 geological maps and accompanying sheet explanations as well as (d) several previous and on-going fossil heritage assessments in the Ceres Karoo region by the author and colleagues;

4. The author's field experience with the formations concerned and their palaeontological heritage;

5. A four-day field assessment of the study area, including all land parcels involved, by the author and an experienced field assistant.

- **Outcome of the site sensitivity verification**

On the basis of information sources listed previously the screening tool palaeosensitivity map in Figure D1 is disputed and *rejected* here as an accurate reflection of palaeosensitivity within the present study area. The main reasons for this are:

1. The inaccurate overlay of the project area on the palaeosensitivity map (which is based primarily on the relevant geological maps);

2. The Dwyka Group (indicated in red) is generally regarded as of LOW palaeosensitivity whereas the Tierberg Formation is of MEDIUM sensitivity, at most. Field data for the proposed project suggest a LOW palaeosensitivity for the Tierberg Formation outcrop area here due to weathering and extensive cover by low-sensitivity calcrete, gravels and soils.

3. Potentially-sensitive rock units such as the basal Prince Albert Formation and Whitehill Formation are not rated as high sensitivity on the map (Field data suggests these are generally of LOW palaeosensivity in this region, mainly due to weathering and cleavage development).

4. The map does not address the Late Caenozoic sediments that mantle the bedrocks in the project area, and in particular the pediment gravels (ancient alluvium) underlying almost the entire solar PV study areas as well as younger alluvium along the Grootrivier and its tributaries. Almost all the new fossil occurrences noted during the recent field survey were found in such settings. However, these fossils are of low conservation value and the palaeosensitivity of the Late Caenozoic sediments is according rated as LOW.

As motivated in the relevant palaeontological heritage Basic Assessment report, it is concluded that the entire combined project area for the proposed solar PV facilities and associated power line to Kappa Substation is in practice of LOW palaeosensivity. Potentially fossiliferous rock units underlying the project footprint such as the Prince Albert and Whitehill Formations are too weathered and tectonically deformed (cleaved) to contain scientifically valuable fossils in the project area. No significant, conservation-worthy fossil sites or palaeontological No-Go areas were recorded during the field survey.

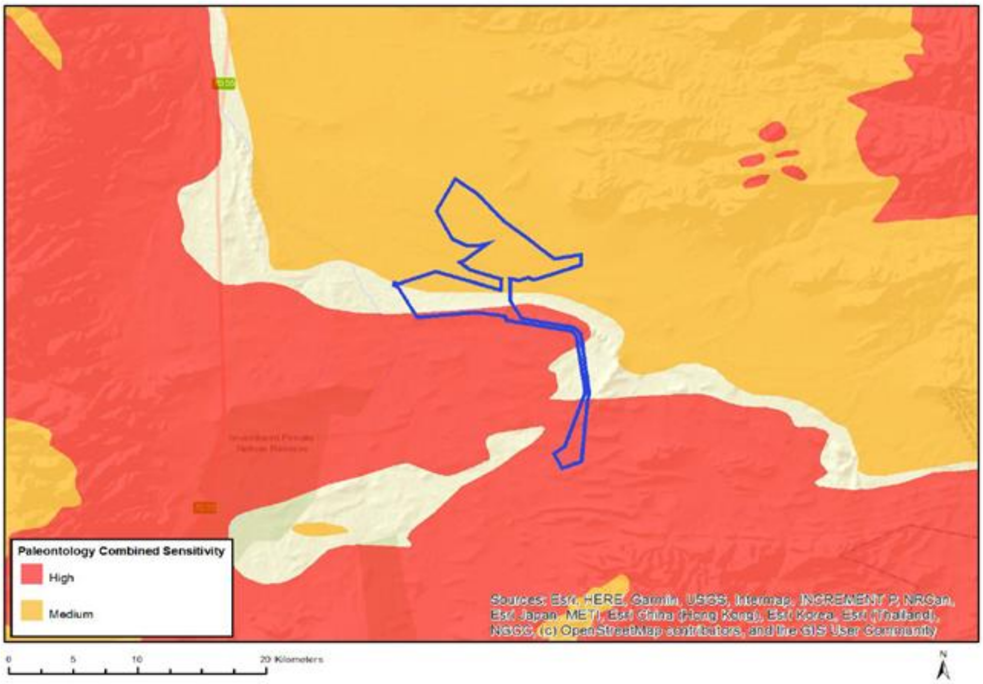


Figure D1: Palaeosensitivity map for the combined proposed solar PV facility and associated power line project area (blue polygon) produced from the DEFF screening tool. Data from several recent field surveys in the Ceres Karoo as well as desktop studies indicate that in practice the entire project area is of LOW palaeosensitivity.

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 11***
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 base data used for the specialist report;	***Section 2.1***
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	***Sections 4 to 6***
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	***Section 2.1***
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;	***Sections 4 & 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;	***Figs. 53 & 54***
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	***Section 2.2***
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	***Sections 4, 5 & 6***
k) any mitigation measures for inclusion in the EMPr;	***Sections 7 & 8***
l) any conditions for inclusion in the environmental authorisation;	***Section 8***
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	***Sections 7 & 8***
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***	***Section 8***

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***
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	***N/A (Refer to BA Report)***
q) any other information requested by the competent authority.	***N/A (Refer to BA 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.	***Part A of the Assessment Protocols published in GN 320 on 20 March 2020 are applicable (i.e. Site sensitivity verification requirements where a specialist assessment is required but no specific assessment protocol has been prescribed). See Appendix D***

APPENDIX 5 – Visual Impact Assessment

Refer to Appendix C.2 of the BA Report for the Visual Impact Assessment.