Palaeontological Impact Assessment for the proposed Du Plessis Dam Solar PV1 and Du Plessis Dam Solar PV2 Grid Connections, De Aar, Northern Cape Province

Site Visit Report (Phase 2)

For

ASHA Consulting

15 May 2022

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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 33 years research; 25 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by ASHA Consulting, Muizenberg, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

A Palaeontological Impact Assessment was requested for the proposed Du Plessis Dam Solar PV1 and Du Plessis Dam Solar PV2 Grid Connections, east and south of De Aar, Northern Cape Province. There are two alternatives for the PV1 project and one option for PV2.

To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a site visit (Phase 2) Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed powerline route mostly lies on the potentially fossiliferous Tierberg Formation (Ecca Group, Karoo Supergroup) with a short section north of the Vetlaagte MTS that is on potentially highly fossiliferous rocks of the *Tapinocephalus* Assemblage Zone (Adelaide Subgroup, Beaufort Group, Karoo Supergroup). The site walk down in April confirmed that there were only a few scattered fragments of transported silicified wood on the surface in the Tierberg Formation but NO FOSSILS in the Adelaide Subgroup. These wood fragments can easily be put aside if any pole foundation will placed precisely on their location. It should be noted that the fossil wood is on the surface and transported so is likely to be tumbled naturally by any flooding or sheet wash.

Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, developer, environmental officer or other designated responsible person once excavations for foundations have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

Table of Contents

1. Background

There are two Solar Photo Voltaic facilities (PVs) to the east of De Aar in the Northern Cape Province (Figure 1). Grid connections via overhead 132kV power lines are required to feed from Du Plessis Dam Solar PV1 and Du Plessis Dam Solar PV2 to the Eskom Grid. Connection Projects are detailed below and shown in Figures 2 and 3.

Du Plessis Dam Solar PV1

- ±2km, 12m wide access road
    - Starting point at the R48 and ends at the PV1 switching station
    - This access road is existing but will be widened to 12m
- Du Plessis Eskom Switching Station of ± 0.5 hectares in size (50m x 100m)
    - Internal access roads of 6m wide
- 132kV power line of ±8km
    - The power line will connect the PV1 Eskom Switching Station with the Mulilo Cluster 1 Substation
    - Servitude width approximately 31m
- ±6m wide access road will be constructed along the line route for construction and maintenance purposes – *this road will be inside the servitude*
- A laydown area of ±1 hectares directly adjacent to the PV1 Switching Station
- Diesel storage of less than 80m^3 for the 132kV Switching Station:
    - During construction, diesel is required for construction vehicles as well as generators for the construction camp and commissioning whilst waiting for the Eskom grid connection works to be completed
    - During operations, diesel is required for Operations & Maintenance vehicles at the PV plants but also required for backup Diesel generators at the substations. The Generators supply auxiliary power to the substation's protection and communications systems, should there be outages on the grid. This is an Eskom requirement together with a battery room at the substations to act as UPS for these critical systems.

Du Plessis Dam Solar PV2

- ±3km, 12m wide access road
    - Starting point at the R48 and ends at the PV2 switching station
    - This access road is existing but will be widened to 12m
- PV2 Switching Station of ±1 hectares in size (100m x 100m)
    - Internal access roads of 6m wide
- 132kV power line of ±8km
    - The power line will connect the PV2 Switching Station with the Vetlaagte MTS
    - Servitude width approximately 31m
- ±6m wide access road will be constructed along the line route for construction and maintenance purposes – this road will be inside the servitude
- A laydown area of ±1 hectares directly adjacent to the PV2 Switching Station
- Diesel storage of less than 80m3 for the 132kV Switching Station:

- During construction, diesel is required for construction vehicles as well as generators for the construction camp and commissioning whilst waiting for the Eskom grid connection works to be completed
- During operations, diesel is required for O&M vehicles at the PV plants but also required for backup Diesel generators at the substations. The Generators supply auxiliary power to the substation's protection and communications systems, should there be outages on the grid. This is an Eskom requirement together with a battery room at the substations to act as UPS for these critical systems.

A Palaeontological Impact Assessment was requested for the two grid connections for the Du Plessis Dam Solar PV1 and PV2 projects. To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a site visit and walkthrough (Phase 2) Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (amended 2017)

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page 2
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
g	An identification of any areas to be avoided, including buffers	None
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;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
k	Any mitigation measures for inclusion in the EMPr	Section 8, Appendix A
l	Any conditions for inclusion in the environmental authorisation	Section 8
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6
nii	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Sections 6, 8
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies if any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A

Figure 1: Google Earth map of the proposed development showing the relevant land marks.

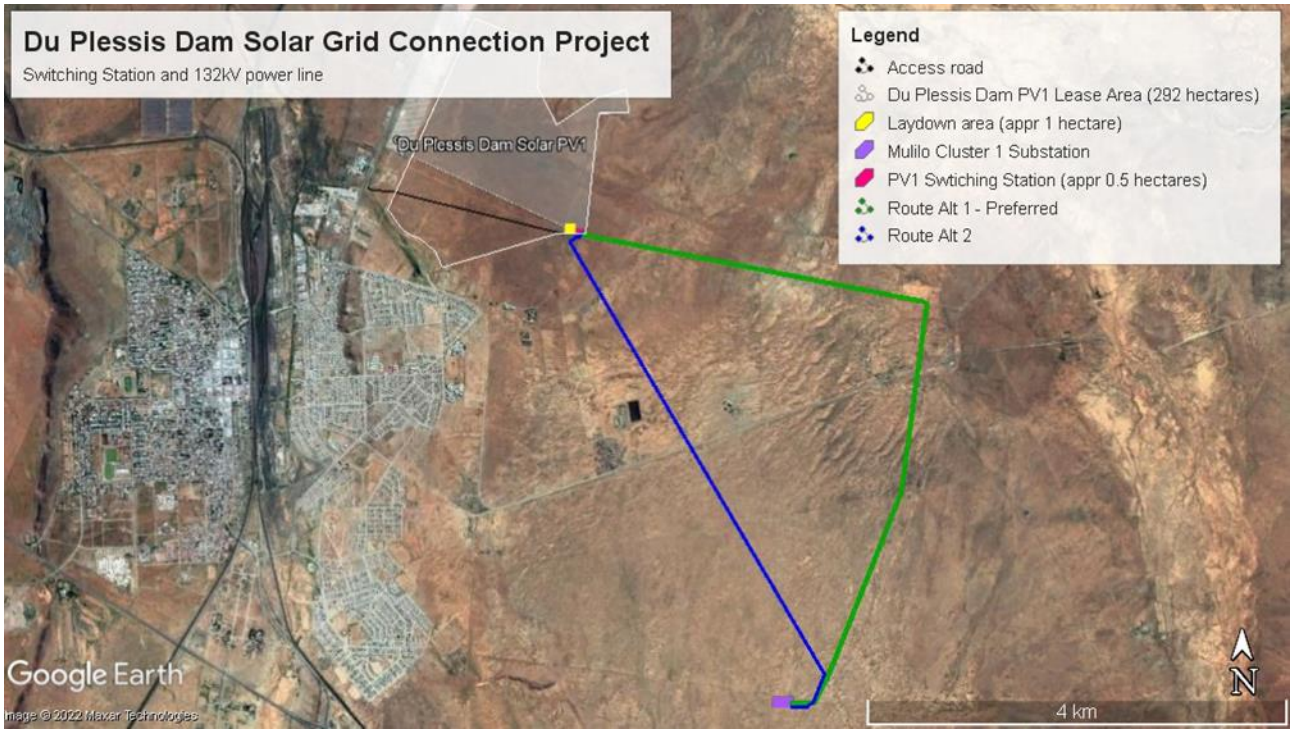

Figure 2: Google Earth map for the proposed grid connection for PV1.

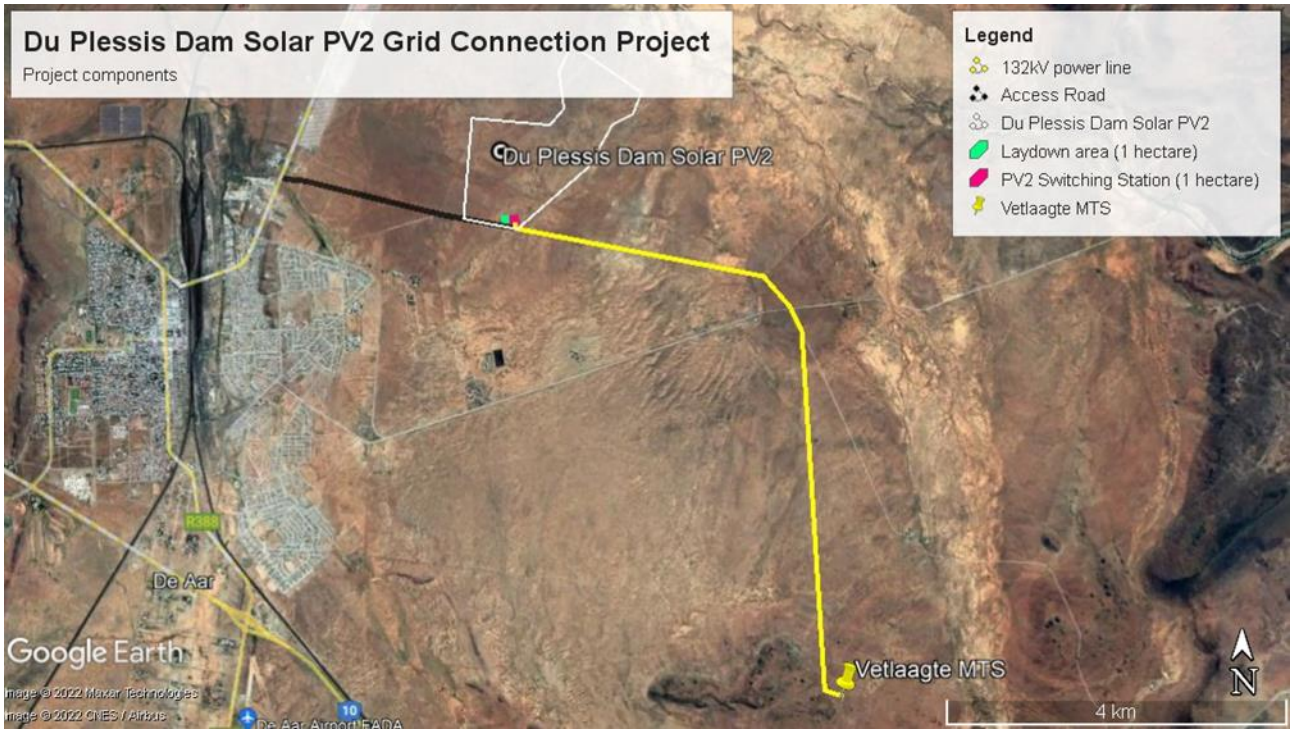

Figure 3: Google Earth map of the proposed PV2 grid connection to Vetlaagte MTS.

2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.
The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance, as is the case here;
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

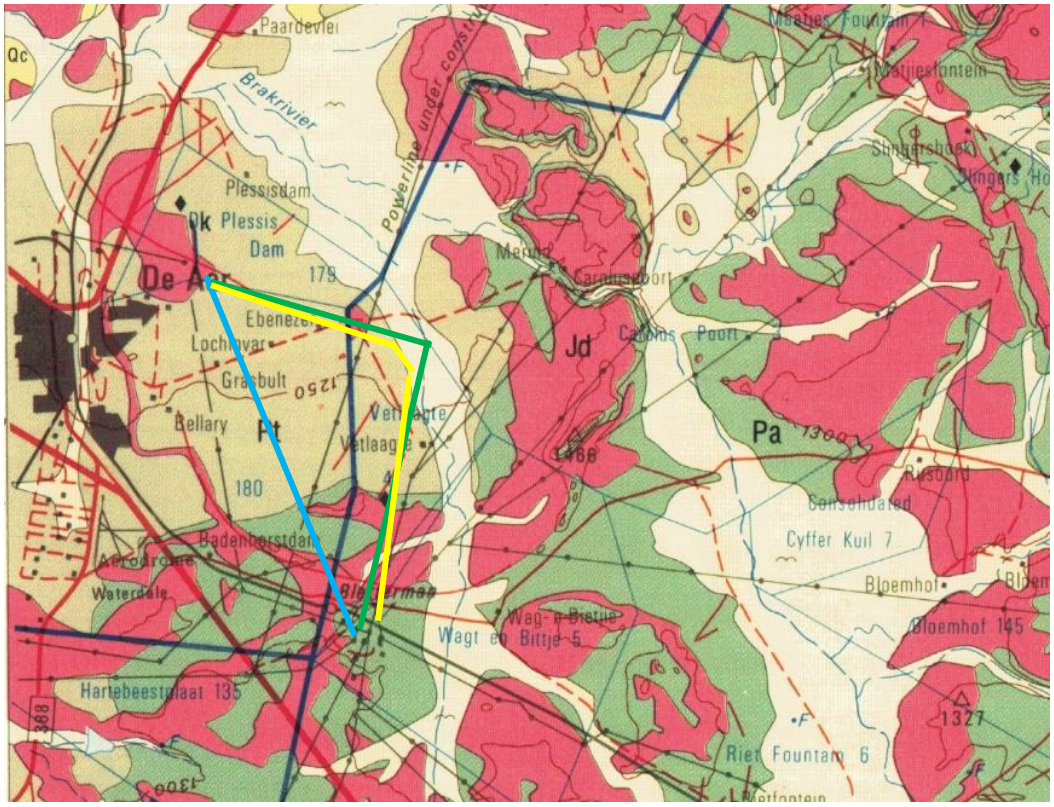

Figure 4: Geological map of the area around the Du Plessis Dam PV1 and PV2. Blue line is PV1 option 1; green line is PV1 option 2 and yellow line is for PV2 grid connections. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 3024 Colesburg.

Table 2: Explanation of symbols for the geological map and approximate ages (Johnson et al., 2006; Partridge et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
(white)	Recent	Alluvium and debris	Last few millenia
Qc	Quaternary	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pa	Adelaide Subgroup, Beaufort Group, Karoo SG	Blue-grey silty mudstone, subordinate brownish-red mudstone; sandstone	Late Permian
Pt	Tierberg Fm, Ecca Group, Karoo SG	Blue-grey to black shales with carbonate-rich concretions; subordinate siltstone and sandstone in the upper layers	Middle Permian

The site lies in the northwestern part of the Karoo basin where the middle Karoo Supergroup strata are exposed. Along the rivers and streams much young reworked sands and alluvium overlie the older strata.

The Karoo Supergroup rocks cover a very large proportion of South Africa and extend from the northeast (east of Pretoria) to the southwest and across to almost the KwaZulu Natal south coast. It is bounded along the southern margin by the Cape Fold Belt and along the northern margin by the much older Transvaal Supergroup rocks. Representing some 120 million years (300 – 183Ma), the Karoo Supergroup rocks have preserved a diversity of fossil plants, insects, vertebrates and invertebrates.

During the Carboniferous Period South Africa was part of the huge continental landmass known as Gondwanaland and it was positioned over the South Pole. These are the oldest rocks in the system and are exposed around the outer part of the ancient Karoo Basin, and are known as the Dwyka Group. They comprise tillites, diamictites, mudstones, siltstones and sandstones that were deposited as the basin filled (Johnson et al., 2006).

Overlying the Dwyka Group rocks are rocks of the Ecca Group that are Early Permian in age. There are eleven formations recognised in this group but they do not all extend throughout the Karoo Basin. In the west and central part are the following formations, from base upwards: Prince Albert Formation, Whitehill Formation, Collingham Formation, Laingsburg / Ripon Formations, **Tierberg** / Fort Brown Formations, and Waterford Formation. All of these sediments have varying proportions of sandstones, mudstones, shales and siltstones and represent shallow to deep water settings, deltas, rivers, streams and overbank depositional environments.

Overlying the Ecca Group are the rocks of the Beaufort Group that has been divided into the lower **Adelaide Subgroup** for the Upper Permian strata, and the Tarkastad Subgroup for the Early to Middle Triassic strata. As with the older Karoo sediments, the formations vary across the Karoo Basin.

There are only two formations in this part of the Karoo Basin in the Adelaide Subgroup west of 24°E, the basal Abrahamskraal Formation and the Teekloof Formation. The latter has been divided into four members, from the base upwards they are the Poortje, Hoedemaker, Oukloof and Steenkampsvlakte Members. There are no younger strata in this part of the basin.

Overlying the Beaufort Group are the three formations of the Stormberg Group. They are absent from the western part of the basin but are more uniform across the eastern part of the basin. Capping the Stormberg Group are the Drakensberg Group basalts and dykes that signalled the end of deposition in the Karoo basin. Large exposures of Jurassic dolerite dykes occur throughout the area. These intruded through the Karoo sediments around 183 million years ago at about the same time as the Drakensberg basaltic eruption.

With the uplift of the African continent over time much of the land surface has eroded away, the so-called African Surfaces of Partridge and Maud (review in Partridge at al., 2006). Although the timing of the orogeny has been challenged (Braun et al., 2014) the net result is a long hiatus and then only much more recent sediments being deposited during the **Quaternary**. These have been captured in some of the flat areas and river cuttings.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 5. The proposed routes for the power lines to connect to the grid commence in the Tierberg Formation in the northeast of De Aar and travel along this formation (orange in the SAHRIS palaeosensitivity map) to the Vetlaagte MTS which is in the Adelaide Subgroup rocks to the southeast (red in the map).

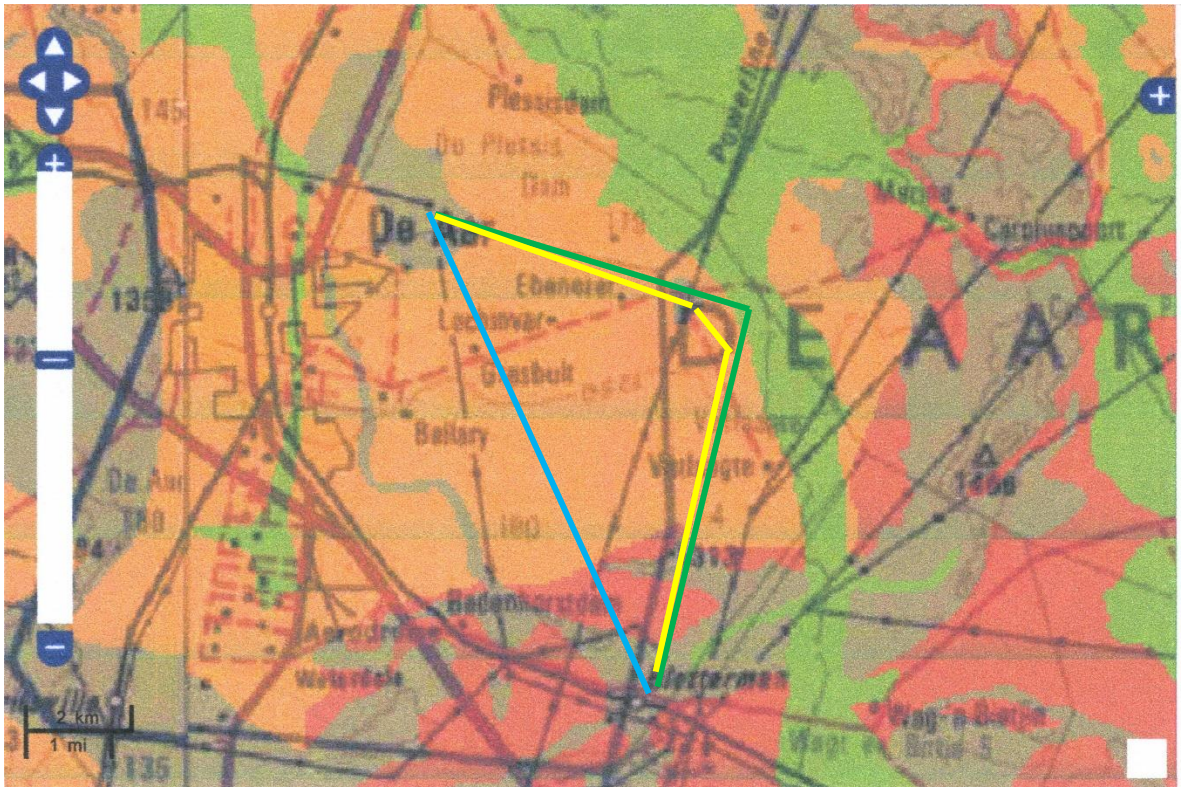

Figure 4: SAHRIS palaeosensitivity map for the site for the proposed grid connections for the PV1 and PV2 projects. Colours of lines as for previous maps. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

In the westernmost part of the basin the Tierberg Formation is predominantly argillaceous. In the northwest of its occurrence where it is in contact with the Collingham or Whitehill Formations, it grades up into the arenaceous overlying Waterford Formation (Johnson et al., 2006). Trace fossils of *Nereites, Planolites* and *Zoophycus* can be found in the fine mudstones (Johnson et al., 2006).

The Adelaide Subgroup is part of the eastern foredeep basin and was deposited in the overfilled or non-marine phase (Catuneanu et al., 2005) and so comprises terrestrial deposits. There are numerous fining-upward cycles, abundant red mudrocks and sedimentary structures that indicate deposition under fluvial conditions (Johnson et al., 2006). Some of the lower strata probably represent a subaerial upper delta-plain environment and the generally finer grained materials are typical of meandering rather

than braided rivers. Channel deposits are indicated by sandstones while overbank deposits are indicated by the mudstones (Johnson et al., 2006). From the updated Karoo Biostratigraphic map and biostratigraphy, De Aar is in the Abrahamskraal Formation and the *Tapinocephalus* Assemblage Zone (Smith et al., 2020). The main faunal groups that occur are the fish, amphibians, Parareptilia, Eureptilia, Biarmosuchia, Dinocephalia,
Anomodontia and Therocephalia. In separate areas one might find plants of the Glossopteris flora, especially fossil wood and rarely leaf impressions (Plumstead, 1969; Anderson and Anderson, 1985; Bamford, 2004;). Fossil plants and animals seldom occur together because different conditions are required for their preservation.

From the SAHRIS map above the southern part of the route is indicated as very highly sensitive (red) so a site visit is required.

iii. Site visit observations

Figure 5: Annotated Google Earth map for the site stops and observations (refer to Table 3).

Table 3: Site observations, GPS points and relevant figures

GPS	Observations	Figures
	Route between De Aar and northeast point. Open area, bare vegetation. No fossil bones and no fossil wood seen.	
	Route from Northeast point southwards towards	6

	Vetlaagte MTS. Open area, fairly flat and very little vegetation.	
Pt 940 30° 39’ 42.81”S 24° 05’ 23.93”E	Northern point: Photograph 940 (Orton). One fragment of silicified fossil wood, about 7cm maximum dimension. The growth rings are about 8mm wide and extrapolated from their curvature the tree would have been more than 50cm in diameter. This a transported fragment of wood as seen by the smooth corners and shiny, highly abraided surface.	6E
Pt 933 30° 39’ 44.55”S 24° 05’ 23.48”E	Fragment of silicified fossil wood, about 7cm wide. Growth rings about 8mm wide. Original tree more than 50 cm diameter.	6A
Pt 934 30° 40’ 12.42”S 24° 05’ 24.67”E	Three pieces of silicified fossil wood, each less than 3cm long, growth rings more than 5mm wide; pieces very shiny and abraided from transportation.	6B
Pt 938 30° 40’ 34.55”S 24° 05’ 30.18”S	Two pieces of fossil silicified wood, each less than 4cm long, growth rings about 10mm wide, weathered, rounded edges but not shiny. Transported.	6D
Pt 935 30° 40’ 44.44”S 25° 05’ 27.91”E	One piece of silicified wood, about 4cm long; very shiny and abraided from transportation.	6C

With the rather sparse vegetation, field conditions for looking for fossil bones and plants was optimal. Only a few pieces of small, transported fossil woods were found. Much larger logs are known from the Abrahamskraal Formation (Bamford, 2004) so these fragments are far from their original source. No fossil bones were seen.

It should be noted that the fossil wood pieces are small and on the ground surface, indicating that have been, and will be, naturally transported by any flooding or sheet wash. The source and context of the silicified woods are unknown so their scientific value is greatly reduced.

Figure 6: Photographs of the only fragments of fossil wood seen during the walk down (photographs taken by J Orton).

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table :

Table 4a: Criteria for assessing impacts

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

Table 4b: Impact Assessment

PART B: Assessment		
SEVERITY/NATURE	**H**	-
	M	-
	L	Soils and sands do not preserve plant fossils; so far there are no records from the Tierberg or Abrahamskraal Fms of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be very unlikely.
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.

PART B: Assessment		
SPATIAL SCALE	**L**	Since the only possible fossils within the area would be fossil plants from the *Glossopteris* flora or vertebrates of the *Tapinocephalus* AZ in the shales, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	It is extremely unlikely that any fossils would be found in the loose sand that will be excavated. Only fragments of transported silicified wood were found on the surface. Nonetheless, a Fossil Chance Find Protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are the correct age and type to preserve fossils. The site visit and walk through confirmed that there were a few fragments of transported silicified wood along the powerline route. Since there is a small chance that fossils from the Abrahamskraal Formation may be disturbed a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and some do contain fossil plant, insect, invertebrate and vertebrate material. The site visit and walk through in April 2022 confirmed that there are only a few scattered fragments of transported silicified fossil wood. The sands of the Quaternary period would not preserve fossils. It is not known if there are fossils below the ground surface.

6. Recommendation

Based on the fossil record but confirmed by the site visit and walk through there are only a few scattered pieces of transported silicified fossil wood even though fossils have been recorded from rocks of a similar age and type in South Africa. It is extremely unlikely that any fossils would be preserved in the overlying soils and sands of the Quaternary. There is a very small chance that fossils may occur in below the ground surface in the shales of the Tierberg and the Abrahamskraal Formations so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations and drilling have

commenced, then they should be rescued and a palaeontologist called to assess and collect a representative sample.

7. References

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Bamford, M.K. 2004. Diversity of woody vegetation of Gondwanan southern Africa. Gondwana Research 7, 153-164.

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Smith, R.M.H., Rubidge, B.S., Day, M.O., Botha, J., 2020. Introduction to the tetrapod biozonation of the Karoo Supergroup. South African Journal of Geology 123, 131-140. doi:10.25131/sajg.123.0009

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations / drilling activities begin.

1. The following procedure is only required if fossils are seen on the surface and when excavation commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, fossils of plants, insects, bone or coalified material) should be put aside in a suitably protected place. This way the project activities will not be interrupted.

3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossil plants, vertebrates, invertebrates or trace fossils in the shales and mudstones (for example see Figure 7, 8). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the contractor/environmental officer then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Appendix A – Examples of fossils from the Ecca and Beaufort Groups.

Figure 7: Photographs of fossil plants from the Ecca and Beaufort Groups.

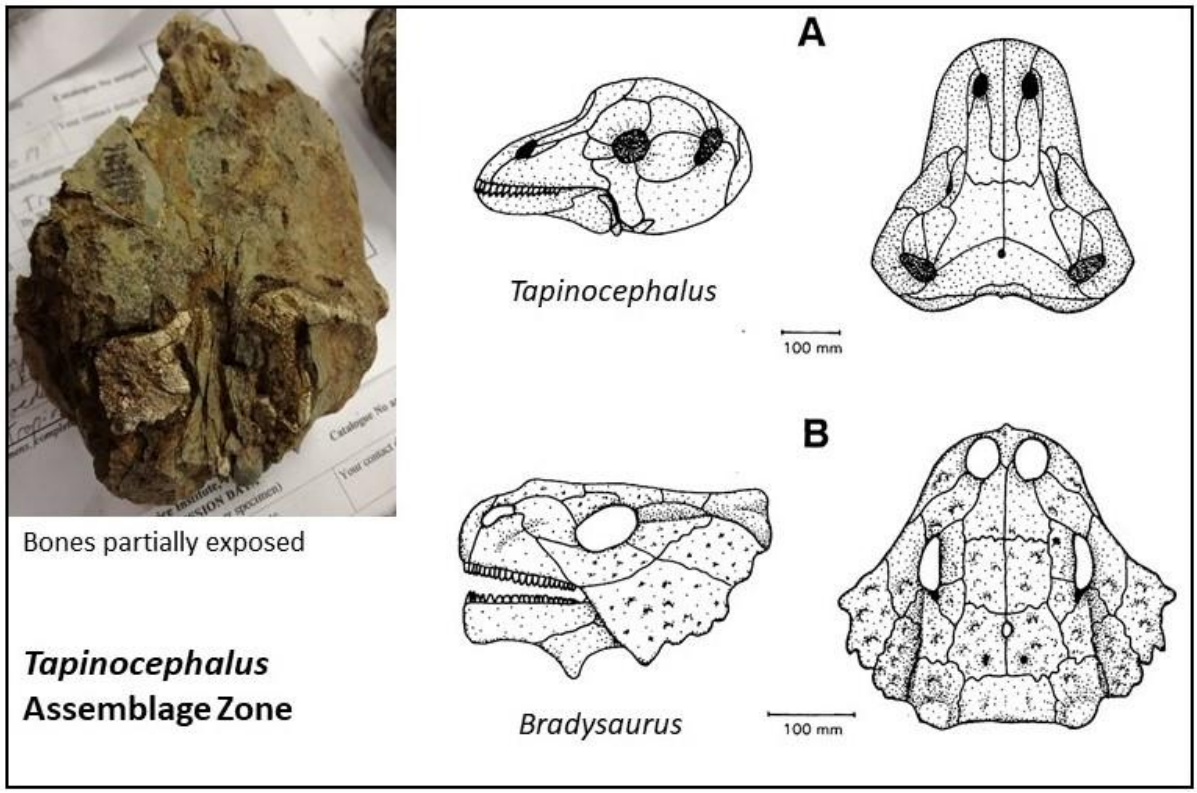

Figure 8: Photograph of bones as seen in the field and reconstruction diagrams of some examples from the *Tapinocephalus* Assemblage Zone.

9. Appendix B – Details of specialists

Marion Bamford (PhD)

Short CV for PIAs – Jan 2022

I) **Personal details**

Present employment: Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa

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ii) **Academic qualifications**

Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) **Professional qualifications**

Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) **Membership of professional bodies/associations**

Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+
Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative

ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

vii) **Supervision of Higher Degrees**
All at Wits University

Degree	Graduated/completed	Current
Honours	11	0
Masters	14	1
PhD	11	6
Postdoctoral fellows	12	2

viii) **Undergraduate teaching**
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 25 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 12 - 20 students per year.

ix) **Editing and reviewing**
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Associate Editor: Cretaceous Research: 2018-2020
Associate Editor: Royal Society Open: 2021 -
Review of manuscripts for ISI-listed journals: 25 local and international journals

x) **Palaeontological Impact Assessments**
Selected from recent project only – list not complete:

- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for Enviropro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World

- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for Enviropro
- Frankfort-Windfield Eskom Powerline 2020 for 1World
- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage
- Smithfield-Rouxville-Zastron PL 2021 for TheroServe
- Glosam Mine 2021 for AHSA

Xi) **Research Output**
Publications by M K Bamford up to January 2022 peer-reviewed journals or scholarly books: over 160 articles published; 5 submitted/in press; 10 book chapters.
Scopus h-index = 30; Google Scholar h-index = 36; -i10-index = 95
Conferences: numerous presentations at local and international conferences.