Palaeontological Impact Assessment for the proposed Grid Connection for Visserspan, north of Dealesville, Free State Province

Desktop Study (Phase 1)

For

ACRM Consulting

05 June 2022

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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 32 years research; 24 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by ACRM Consulting, 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: MKBamford

Executive Summary

A Palaeontological Impact Assessment was requested by SAHRA (Case ID:17969) for the proposed Grid Connection for the Visserspan Solar Energy Facility north of Dealesville, to the Perseus Substation just south of the SEF.

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 desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

Ventura Renewable Energy (Pty) Ltd is proposing to develop up to four solar PV facilities, each of up to 100 MW generation capacity, on the farm Visserspan No. 40, c. 10 km northwest of Dealesville and 70 km northwest of Bloemfontein, in the Tokologo Local Municipality, Free State Province. The facility requires a grid connection to the Perseus Substation. The Visserspan Grid Connection will traverse the farms Visserspan No. 40, Mooihoek No. 1547, Vasteveld No. 1548, and Kinderdam No. 1685.

The proposed site lies mostly on the Quaternary calcrete and aeolian sands, and partly on the shales of the Tierberg Formation (Early Permian Ecca Group, Karoo Supergroup; trace fossils). There are Quaternary pans and dunes in the area and these might trap more robust but fragmentary fossils. None was seen during the site visit and walk through by an archaeologist. 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 developer/ environmental officer/ other designated responsible person once excavations/drilling activities have commenced. As far as the palaeontology is concerned, the project should be authorised for all seven PV facilities in this cluster. There is no no-go area.

Table of Contents

1. Background

The proposed Visserspan Grid Connection is primarily a linear development and includes the construction of two new substations located at each end of the grid connection line. A combined switching station and high voltage substation on the Farm Visserspan 40 will serve as the collection point for electricity generated from the proposed Visserspan Solar PV Facility (Kaplan 2020). From the switching station, electricity will be fed via overhead power lines to the east, turning north east to trace the northern boundary of the Farms Mooihoek No. 1547 and Vasteveld No. 1548, before turning north east and running along the southern boundary of the Farm Kinderdam No. 1685, finally connecting to the proposed new Kinderdam main transmission substation (MTS). From the Kinderdam MTS, electricity will feed into the existing Eskom Perseus/Theseus 400kV overhead powerline that runs adjacent the site. The estimated total length of the grid connection line is about 6km and will be either via 132kV steel monopole, or 400kV pylon overhead power lines. The servitude for the proposed grid connection will be ± 55m wide. Existing farm roads and farm maintenance roads will be used, and no new roads will need to be constructed.

A site visit (phase 2) palaeontological impact assessment (PIA) was completed by a professional palaeontologist for the Visserspan Solar Energy Facility (SEF) (Almond, 2020) and referred to in the HIA report (Kaplan, 2021) however SAHRA has requested a new palaeontological desk assessment for the grid connection. This report provides this.

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 desktop 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 1
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 4

d	The date, duration 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, inclusive of equipment and modelling used.	Section 2
f	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 3
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 or activities, 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	N/A
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 activities or portions thereof should be authorised regarding the acceptability	Section 6
nii	If the opinion is that the proposed activity or activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Sections 6, 8
o	A description of any consultation process that was undertaken during the course of carrying out the study	None for the PIA but seethe DBAR
p	A summary and copies if any comments that were received during any consultation process	None to date but see the dbar
q	Any other information requested by the competent authority.	N/A

Figure 1: Google Earth map of the proposed Grid Connection for the Visserspan PV facilities, with the study area shown by the yellow lines.

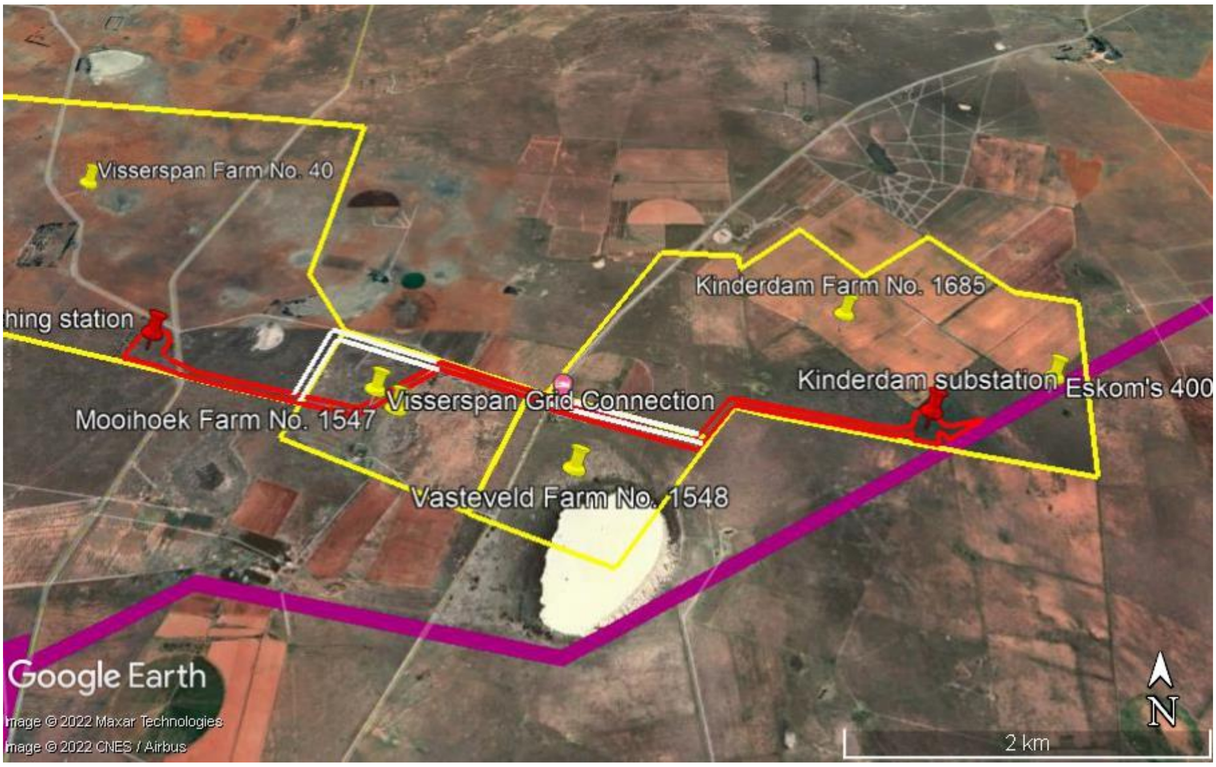

Figure 2: Google Earth map to show the proposed grid route (red lines) with the alternatives (white lines) for the Visserspan Grid Connection.

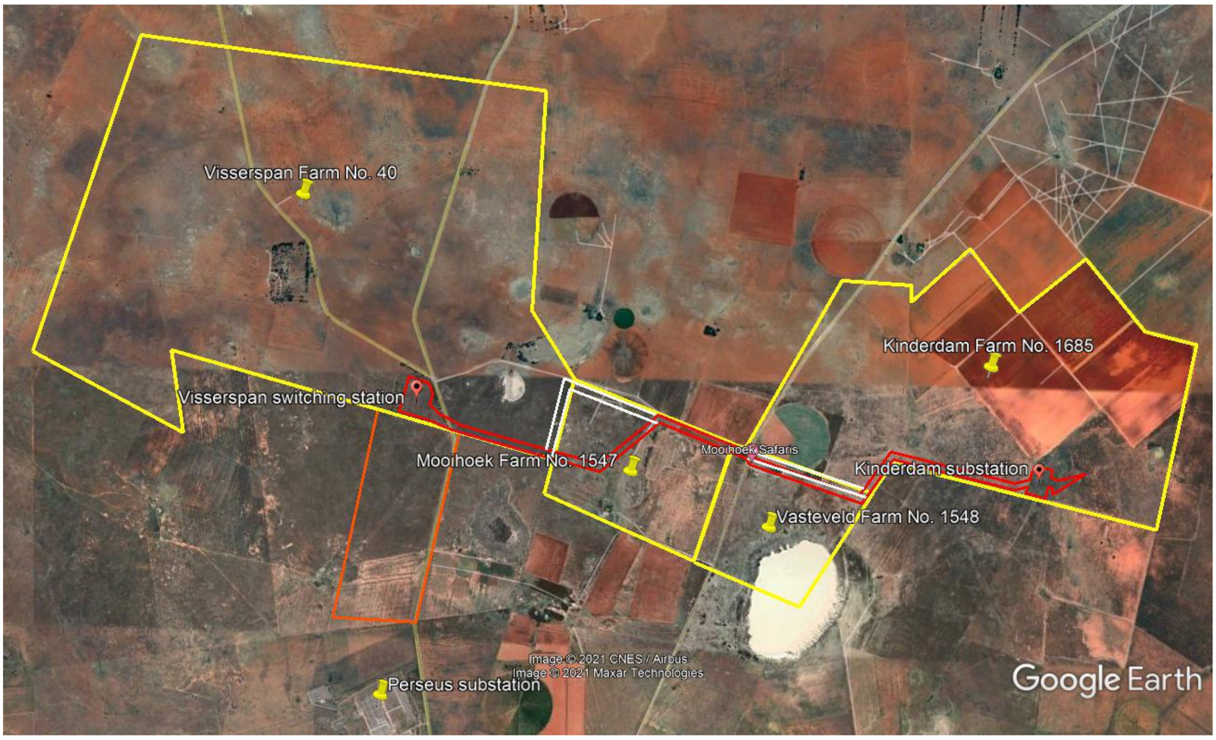

Figure 3: Google Earth map showing the proposed layouts of the Visserspan solar energy facilities, the grid route and alternative location of the Visserspan Collector substation (orange polygon).

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 (*not applicable to this assessment, but field observations from the archaeologist have been included*);
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

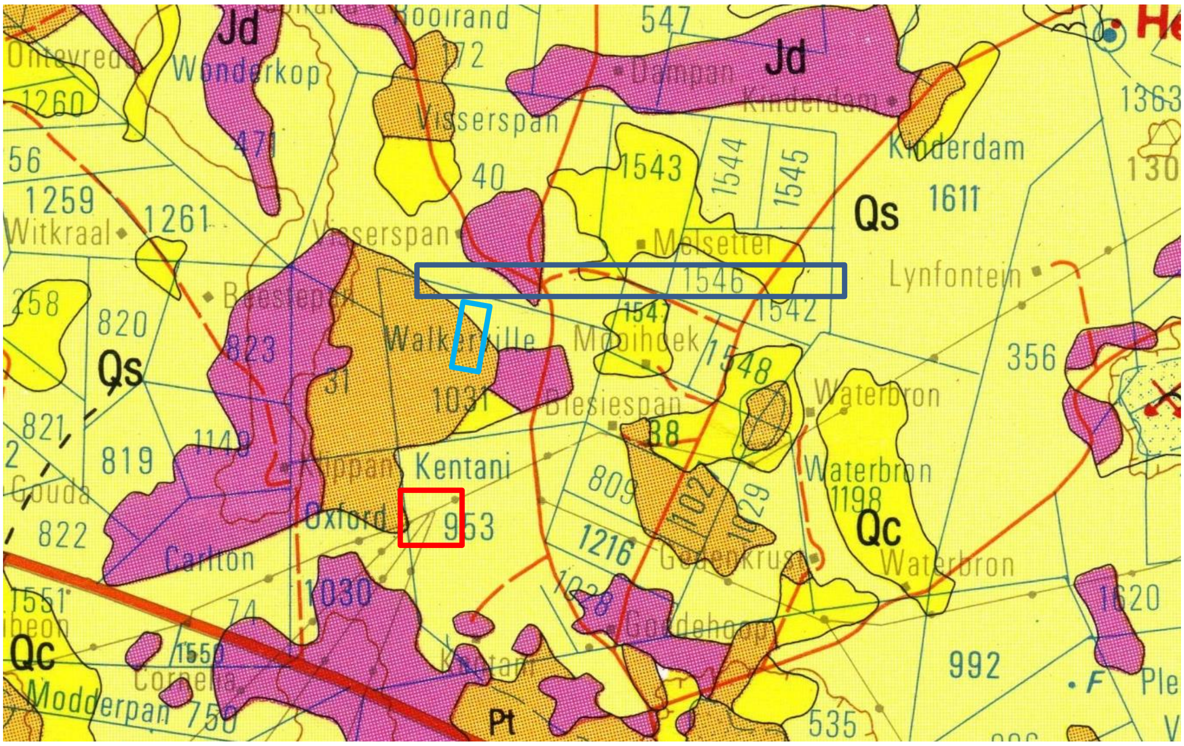

Figure 4: Geological map of the area north of Dealesville where the Visserspan PV facilities will be situated. The grid connection route is indicated within the dark blue polygon and alternate collector substation in orange. Perseus Substation is indicated by the red polygon. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2824 Kimberley.

Table 2: Explanation of symbols for the geological map and approximate ages (Johnson et al., 2006; Matmon et al., 2015; Partridge et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Quaternary	Alluvium, sand, calcrete	Quaternary, ca 1.2 – 1.0 Ma
Qc	Kalahari sands	Calcrete. Calcified pan dune	Quaternary, ca 1.2 – 1.0 Ma
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pt	Tierberg Fm, Ecca Group, Karoo SG	Shales, siltstones, sandstone,	Early Permian, ca 290 Ma

The project is located in the north central part of the Karoo Basin where Karoo Supergroup rocks cover a very large proportion of South Africa and 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. As a result, there were several ice sheets that formed and melted, and covered most of South Africa. Gradual melting of the ice as the continental mass moved northwards and the earth warmed, formed fine-grained sediments in the large inland sea. 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. In the eastern Free State and KwaZulu Natal, from the base upwards are the Pietermaritzburg Formation, Vryheid Formation and the Volksrust 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.

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.

The Quaternary Kalahari sands form an extensive cover of much younger deposits over much of Botswana, the Northern Cape Province and the Free State Province. Haddon and McCarthy (2005) proposed that the Kalahari basin formed as a response to down-warp of the interior of the southern Africa, probably in the Late Cretaceous. This, along with possible uplift along epeirogenic axes, back-tilted rivers into the newly formed Kalahari basin and deposition of the Kalahari Group sediments began. Sediments included basal gravels in river channels, sand and finer sediments. A period of relative tectonic stability during the mid-Miocene saw the silcretisation and calcretisation of older Kalahari Group lithologies, and this was followed in the Late Miocene by relatively minor uplift of the eastern side of southern Africa and along certain epeirogenic axes in the interior. More uplift during the Pliocene caused erosion of the sand that was then reworked and redeposited by aeolian processes during drier periods, resulting in the extensive dune fields that are preserved today.

There are numerous pans in the Kalahari Group sediments, generally 3–4 km in diameter (Haddon and McCarthy, 2005). According to Goudie and Wells (1995) there are two conditions required for the formation of pans. Firstly, the fluvial processes must not be integrated, and second, there must be no accumulation of aeolian material that would fill the irregularities or depressions in the land surface. Favoured materials or substrates for the formation of pans in South Africa are Dwyka and Ecca shales and sandstones (ibid).

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 5. 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 Tertiary calcretes can trap fossils and artefacts when associated with palaeo-pans and dunes or palaeo-springs (Partridge et al., 2006). Where deflation has occurred, for example along the west coast of South Africa, any trapped materials in the different levels can be concentrated in the depo-centre of the pan or dune and thus it can be challenging to interpret the deposit (Felix-Henningsen et al., 2003).

The aeolian sands of the Gordonia Formation do not preserve fossils because they have been transported and reworked, but in some regions these too may have covered pan or spring deposits and these can trap fossils, and more frequently archaeological artefacts. Usually these geomorphological features can be detected using satellite imagery. Several pans are in the project area so they were surveyed by Dr John Almond. He reported finding a few pieces of Tierberg fossil wood around the pan, but the pan is not in the footprint of the proposed grid connection.

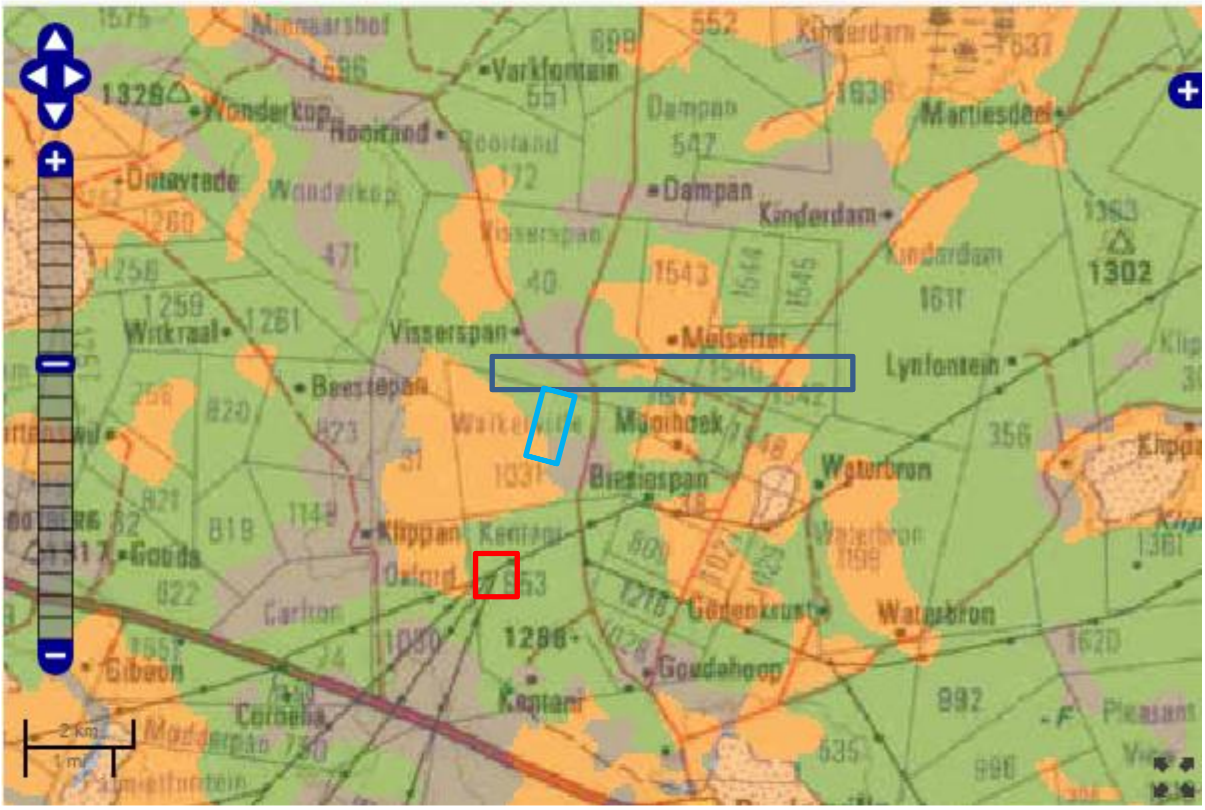

Figure 5: SAHRIS Palaeosensitivity map for the site for the proposed Visserspan Grid Connection show within the blue polygon (same colours as for Fig 4). Background colours indicate the

following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as highly sensitive (orange) for the Quaternary calcrete, moderately sensitive (green) for the Tierberg Formation and of zero sensitivity (grey) for the Jurassic dolerite dykes. Since there are no pans indicated in the project footprint, it is extremely unlikely that any fossils occur in the proposed Grid route.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3.

Table 3a: Impact assessment criteria

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 3b: Results of Palaeontological Impact Assessment

PART B: Assessment		
SEVERITY/NATURE	**H**	-
	M	-

PART B: Assessment		
	L	Soils and sands do not preserve fossils; so far there are no records of pans in the footprint or of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be negligible.
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	Since the only possible fossils within the area would be transported fossil fragments in the Quaternary sands and calcrete or trace fossils in the Tierberg Fm shales or sandstones, 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 soils and sands that cover the area or in the Tierberg shales that will be excavated for foundations. 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 either the wrong type to contain fossils (dolerite) or might only trap fossils in palaeo-pans, palaeo-dunes or palaeo-springs. Since there is an extremely small chance that fossils from the pans, or the shales of the Tierberg 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 for the whole study site and there are no no-go areas.

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 dolorites, sandstones, shales, calcrete and sands are typical for the country and only some do contain fossil traces, plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period would not preserve fossils because they are aerobic and any organic matter would be decomposed. The site inspection by Dr Almond confirms that there were no fossils, therefore, we have a high confidence level in this reporting.

6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the aeolian sands of the Quaternary but might be trapped in pans or their associated dunes, all of which are avoided by the proposed facilities. There is a very small chance that trace fossils may occur in the shales of the early Permian Tierberg Formation so a Fossil Chance Find Protocol (see Section 8 below) should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations for foundations and infrastructure have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. This is applicable equally to the PV facilities and the grid connection route and alternative. There are no no-go areas.

7. References

Almond, J.E. January 2020. Palaeontological Specialist Study: Combined desktop and field-based assessment - Four proposed solar PV projects on Farm Visserspan No. 40 near Dealesville, Tokologo Local Municipality, Free State Province. Report for EnviroAfrica CC.

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodromus of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Felix-Henningsen, P., Kandel, A.W., Conard, N.J., 2003. The significance of calcretes and paleosols on ancient dunes of the Western Cape, South Africa, as stratigraphic markers and paleoenvironments. In: G. Füleky (Ed.) Papers of the 1st International Conference on Archaeology and Soils. BAR International S1163, pp. 45-52.

Goudie, A.S., Wells, G.L., 1995. The nature, distribution and formation of pans in arid zones. Earth Science Reviews 38, 1–69.

Haddon. I.G., McCarthy, T.S., 2005. The Mesozoic–Cenozoic interior sag basins of Central Africa: The Late-Cretaceous–Cenozoic Kalahari and Okavango basins. Journal of African Earth Sciences 43, 316–333.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

Kaplan, J., Septmeber 2021. Archaeologial Impact Assemment porposed Visserspan Grid Connection on the Farms Visserspan No 40, Mooihoek No 1547, Vasteveld No 1548 and Kinderdam No 1685, near Dealesville, Toologo Local municipality, Free State Province. For ENVIROAFRICA CC.

Matmon, A., Hidy, A.J., Vainer, S., Crouvi, O., Fink, D., 2015. New chronology for the southern Kalahari Group sediments with implications for sediment-cycle dynamics and early hominin occupation. Quaternary Research. 84 (1), 118–132. http://dx.doi.org/10.1016/j.yqres.2015.04.009.

Partridge, T.C., Botha, G.A., Haddon, I.G., 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 585-604.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once construction activities begin.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations 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, plants, insects, bone) 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 Figures 6-7). 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 developer/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 Tierberg Formation and Quaternary period.

Figure 6: Some trace fossils from the Early Ecca sediments.

Figure 7: Examples of robust fossils that could be trapped in Quaternary pans, dunes or springs. Note their fragmentary nature.

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
July 2021

I) Personal details

Surname	:	**Bamford**
First names	:	**Marion Kathleen**
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-
Telephone	:	+27 11 717 6690
Fax	:	+27 11 717 6694
Cell	:	082 555 6937
E-mail	:	marion.bamford@wits.ac.za ; marionbamford12@gmail.com

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	10	4
PhD	11	4
Postdoctoral fellows	10	5

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 2-8 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 –

Review of manuscripts for ISI-listed journals: 25 local and international journals

x) Palaeontological Impact Assessments

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources
- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells

- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- 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

xi) Research Output

Publications by M K Bamford up to July 2021 peer-reviewed journals or scholarly books: over 160 articles published; 5 submitted/in press; 10 book chapters.
Scopus h-index = 29; Google scholar h-index = 35; -i10-index = 92
Conferences: numerous presentations at local and international conferences.

xii) NRF Rating

NRF Rating: B-2 (2016-2020)

NRF Rating: B-3 (2010-2015)
NRF Rating: B-3 (2005-2009)
NRF Rating: C-2 (1999-2004)