PALAEONTOLOGICAL IMPACT ASSESSMENT OF THE PROPOSED GENOEGSAAM SOLAR FARM, CHRIS HANI DISTRICT MUNICIPALITY, EASTERN CAPE PROVINCE

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EXECUTIVE SUMMARY

A solar farm is planned at the substation Genoegsaam in the Eastern Cape Province. Due to the National Heritage Resources Act, a palaeontological impact assessment is required to detect the presence of fossil material at the proposed development. The Genoegsaam solar farm will affect Upper Permian and Quaternary deposits. The low-lying relief and absence of potentially fossiliferous gulleys suggests that fossils are absent in the proposed development area. However, fossils are potentially present on exposures to the north of Genoegsaam, and may role down the slopes onto the area under construction when they weather out. Thus, if any surface fossils are discovered during construction, a professional palaeontologist must be consulted to ensure proper conservation of the material. Consequently, as long as due diligence is taken to observe loose fossils on Genoegsaam and considering the rarity of fossil-bearing sediments and lack of appropriate exposure (i.e. steep-sided gulleys) on the actual site, the impact on palaeontological material will be negligible.

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1. INTRODUCTION

A solar development is proposed at the substation Genoegsaam in the Eastern Cape Province, approximately 35 km south-east of Middelburg. This development will involve excavating and will thus modify the existing topography. As palaeontological material is unique and non-renewable, it is protected by the National Heritage Resources Act (Act No. 25 of 1999, section 35). A Palaeontological Impact Assessment (PIA) of the proposed development is thus necessary to ensure that palaeontological material is either removed, or is not present.

1.1 Objective

To conduct a desktop study on the Genoegsaam, Chris Hani District Municipality, Eastern Cape Province, to determine the impact on potential palaeontological material at this site.

2. BACKGROUND TO THE GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

Genoegsaam Solar Farm, Eastern Cape Province

The geology of Genoegsaam contains Late Permian rocks, which are between 255 and 252 million years old and belong to the Balfour Formation of the Beaufort Group, Karoo Supergroup. These rocks consist mostly of mudstones and siltstones with subordinate lenticular and tabular sandstones, deposited by various fluvial systems (Catuneanu et al., 2005). The Beaufort Group is world-renowned for its rich fossil record. They contain some of the most significant evidence of the origins of dinosaurs, mammals and turtles. The rocks of the Beaufort Group are subdivided into assemblage zones according to the various vertebrate fossils found in each zone. Genoegsaam falls within the *Dicynodon* Assemblage Zone, named after the most common dicynodont therapsid fossil found in the zone. The *Dicynodon* Assemblage Zone fauna include fish, amphibians, reptiles and numerous species of therapsids (the ancient ancestors of mammals) (Appendix 1).

A tiny portion of the sediments on Genoegsaam are intruded by non-fossiliferous Early Jurassic Karoo dolerite. The Karoo Dolerite Suite comprises a network of igneous intrusions (dykes, sills) that intruded into older sediments of the Beaufort Group in the main Karoo Basin. These intrusions represent major eruptions of volcanic lava, which were triggered by the separation of Gondwana (an amalgamation of today's southern continents) approximately 183 million years ago.

Superficial deposits of non-fossiliferous alluvium cover approximately 40% of Genoegsaam.

3. NAME AND GEOGRAPHICAL LOCATION OF THE SITE

Genoegsaam Solar Farm: Genoegsaam Substation, Chris Hani District Municipality, Eastern Cape Province (31° 45′ 40.14″ S, 25° 18′ 24.64″ E).

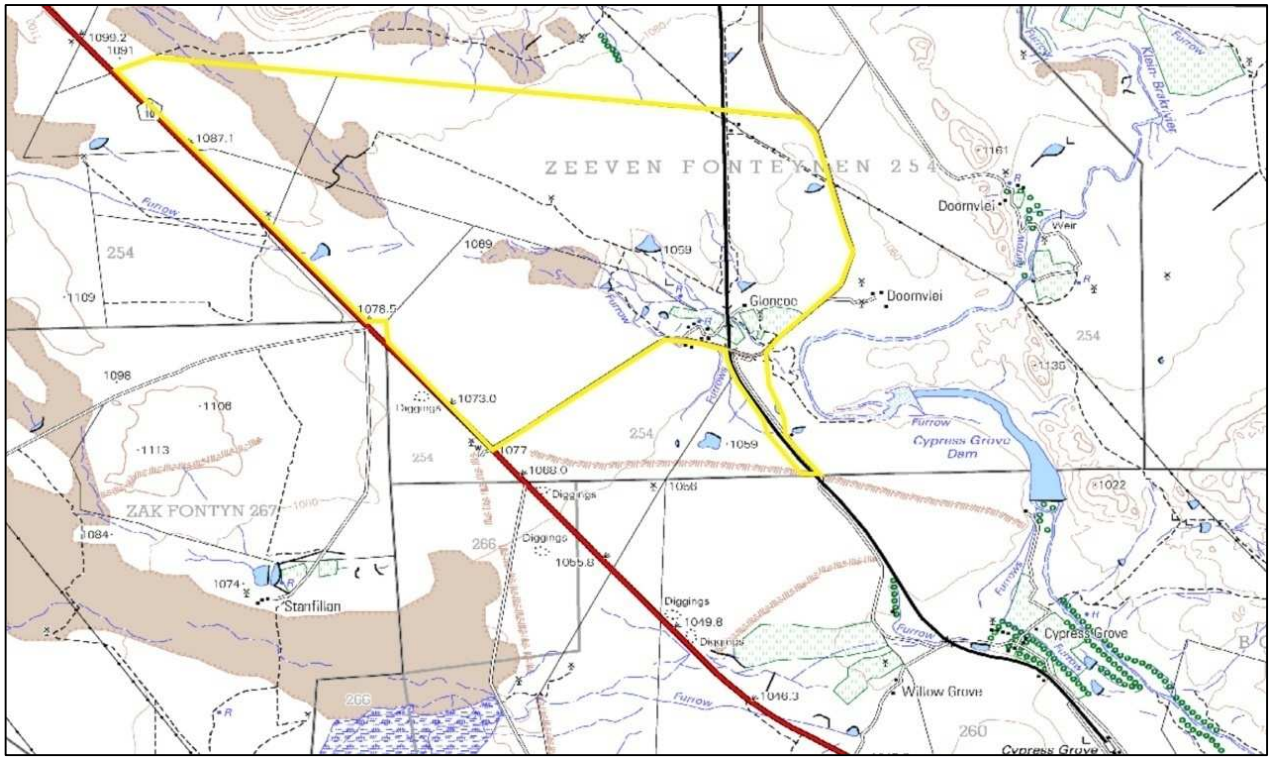

Figure 1. Proposed Genoegsaam Solar Farm, Middleburg District, Eastern Cape (1: 50 000 map of Visrivier 3125CD).

Figure 2. Google Earth satellite image of Genoegsaam Solar Farm (bordered in yellow), Middelburg District, Eastern Cape, showing relatively flat relief to the north of the Venterspossprui t.

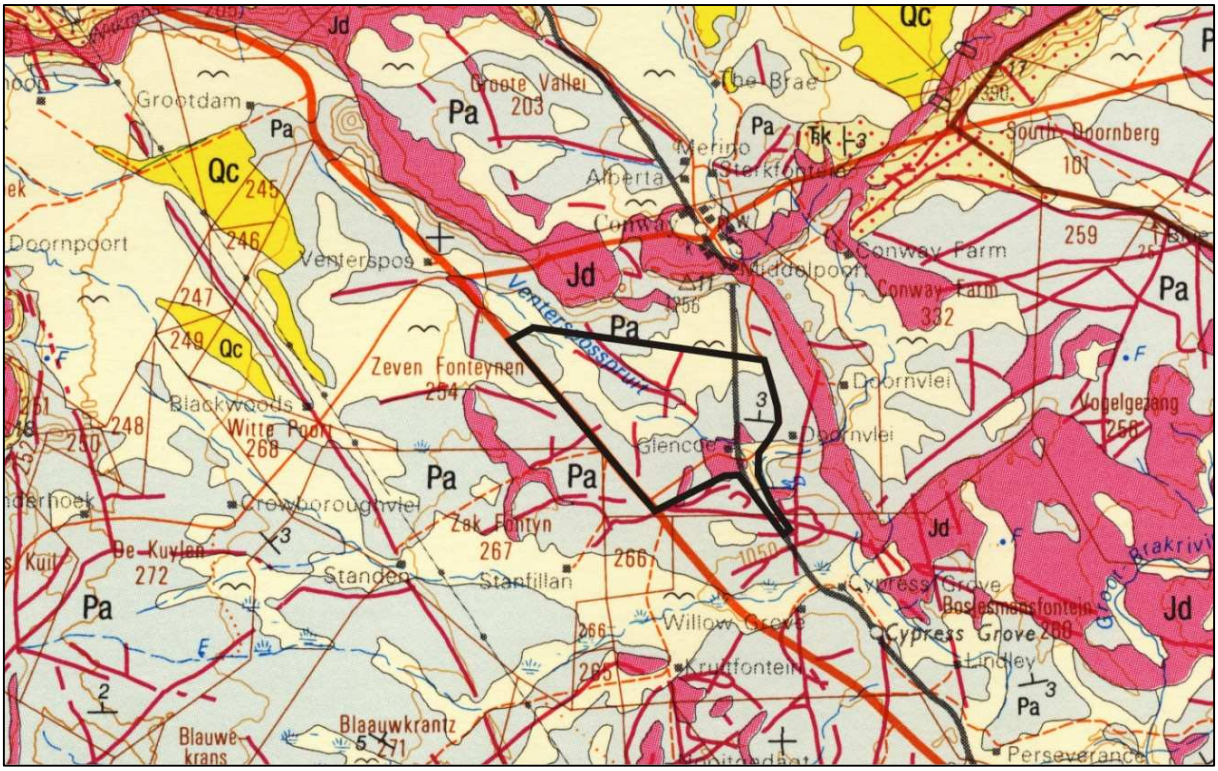

Figure 3. Geological map (1: 250 000, Middelburg 3124), showing the geology of Genoegsaam (bordered in black). Jd (pink), Jurassic dolerite; Pa (light blue), Upper Permian; pale yellow, alluvium.

4. METHODS

A desktop study was conducted to assess the potential risk to palaeontological material (fossils, trace fossils) in the proposed area of development. The author's experience, aerial photos (using Google, 2012), topographical and geological maps were used to assess the proposed area of development. Where necessary, experts in particular specialized palaeontological fields were also consulted.

4.1 Assumptions and Limitations

The accuracy of Palaeontological Impact Assessments may be limited by old fossil databases that have not been kept up-to-date or are not computerized and/or do not include pertinent locality or geological information, and the accuracy of geological maps where information may be based solely on aerial photographs and small areas of significant geology have been overlooked. Much of South Africa has not been studied palaeontologically due to there being so few palaeontologists in the field. As with most desktop studies, this PIA infers the presence of fossil heritage in the development area based on the presence of such heritage in the same rock units elsewhere.

5. FINDINGS AND RECOMMENDATIONS

Genoegsaam Solar Farm, Eastern Cape

The solar farm will affect sediments that are Late Permian, Jurassic and Quaternary in age. The Jurassic dolerite is non-fossiliferous and thus not palaeontologically sensitive. Quaternary deposits are slightly more sensitive, but the proposed development will cover an area of low relief that is devoid of potentially fossiliferous gulleys. The Permian deposits are significantly more sensitive, but again the proposed development will not encroach into areas with gulleys, exposures or areas of high relief that tend to contain fossils. Thus, the palaeontological impact on the area under direct construction is negligible (rated Low or negative). However, there is a potentially sensitive area just to the north of the proposed construction (see Figure 4). This area comprises steep slopes with good exposures of Upper Permian sediments and thus, it potentially contains fossils. Fossils tend to weather out of steep slopes and roll down to areas of low-lying relief, such as the area on Genoegsaam that will be developed. Thus, if any surface fossils are discovered during construction, it is essential that a professional palaeontologist be consulted to ensure adequate conservation of the material.

Figure 4. Google satellite image of the steep exposures north of Genoegsaam. The dotted yellow line indicates the northern border of Genoegsaam below which, construction will take place. The arrows indicate regions that potentially contain fossils.

Thus, pending the discovery of significant new fossil material at these sites, no further specialist palaeontological studies are considered to be necessary.

It is recommended that:
The ECO responsible for the development must remain aware that all sedimentary deposits have the potential to contain fossils and he/she should thus monitor all substantial excavations into sedimentary bedrock for fossil remains;

In the case of any significant fossils (e.g. vertebrate teeth, bones, burrows, petrified wood) being found during construction, they must be safeguarded and the relevant heritage management authority (SAHRA) be informed so that a professional palaeontologist be consulted in order to facilitate the necessary rescue operations.

6. REFERENCES

Catuneanu, O., H. Wopfner, P. G. Eriksson, B. Cairncross, B. S. Rubidge, R. M. H. Smith and R. J. Hancox. 2005. The Karoo basins of south-central Africa. Journal of African Earth Sciences 43: 211-253.

QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Jennifer Botha-Brink has an Honours Degree in Zoology and a PhD in Palaeontology from the University of Cape Town, South Africa. She has conducted extensive field work in South Africa for the past 14 years and currently holds the position of Head of the Karoo Palaeontology Department at the National Museum in Bloemfontein. Her current research interests comprise Permo-Triassic vertebrate palaeobiology, with a special focus on the end-Permian mass extinction. She is also trained in the specialized field of palaeohistology (the study of fossil bone microstructure). Dr Botha-Brink has published more than 30 scientific articles in both national and internationally accredited journals, has written several popular articles on palaeontology and is currently lecturing Zoology students in Vertebrate Evolution at the University of the Free State. Dr Botha-Brink began conducting palaeontological impact assessments for developments in 2011. She is currently the President of the Palaeontological Society of Southern Africa (PSSA) and is registered with the South African Heritage Resources Agency.

Declaration of Independence

I, Dr Jennifer Botha-Brink, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise my objectivity in this work.

Sincerely,

Dr Jennifer Botha-Brink

Palaeontologist

Appendix 1. Fossil taxon list for the Upper Permian *Dicynodon* Assemblage Zone, Beaufort Group, Karoo Supergroup, South Africa.

Group	Genus
Pisces	*Atherstonia*
	Namaichthys
Amphibia	*Rhinesuchus*
	Laccosaurus
	Laccocephalus
	Uranocentrodon
Parareptilian Reptiles	*Pareiasaurus*
	Milleretta
	Millerosaurus
	Anthodon
	Spondylolestes
	Owenetta
Diapsid Reptiles	*Acanthotoposaurus*
	Youngina
	Saurosternon
Therapsida	
Dicynodontia	*Diictodon*
	Dicynodontoides
	Pristerodon
	Emydops
	Aulacephalodon
	Oudenodon
	Pelanomodon
	Dicynodon
	Dinanomodon
	Cistecephaloides
	Propelanomodon
	Kwazulusaurus
	Lystrosaurus maccaigi
	Lystrosaurus curvatus
Biarmosuchia	*Burnetia*
	Ictidorhinus

Gorgonopsia	*Arctops*
	Lycaenops
	Aelurognathus
	Cyonosaurus
	Prorubidgea
	Clelandina
	Dinogorgon
	Rubidgea
	Broomicephalus
	Leontocephalus
	Paragalerhinus
Therocephalia	*Ictidosuchoides*
	Lycideops
	Mirotenthes
	Pelictosuchus
	Ictidosuchops
	Theriognathus
	Akidnognathus
	Scaloporhinus
	Scaloposuchus
	Nanictidops
	Cerdops
	Cerdosuchus
	Proalopecopsis
	Tetracynodon
	Nanictosuchus
	Ictidochampsa
	Notosallasia
	Promoschorhynchus
	Moschorhinus
Cynodontia	*Procynosuchus*
	Cynosaurus
	Nanictosaurus