Annex H

Palaeontology Specialist Study

Heritage Impact Assessment

PALAEONTOLOGICAL POTENTIAL OF PROPOSED GROENWATER SOLAR PV FACILITY, NORTHERN CAPE

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Prepared for

Environmental Resources Management
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1. Introduction

1.1 Intikon Energy proposes to develop a solar power farm near Groenwater, approximately 30 km east of Postmasburg in the Northern Cape Province. The site is located adjacent to the R385 and straddles a secondary road, the D3381. The site is situated within the boundaries of Humansrus farm. The approximate site boundary is shown in *Figure 1*. Environmental Resources Management (ERM) commissioned Dr Duncan Miller to carry out a desk-based heritage assessment of the palaeontological potential of the Study Area, which was followed up with a one-day site visit.

1.2 Dr Miller is a research scientist with PhDs in both Materials Engineering and Archaeological Science. Currently he is an Honorary Research Associate of the University of Cape Town. He has published over 50 peer-reviewed scientific papers on various topics, including the palaeontology of elevated beach deposits on the West Coast of South Africa, as well as producing numerous technical reports.

Figure 1 Google Earth image showing the approximate boundaries of the proposed Groenwater Solar PV Facility, some 30 km east of Postmasburg in the Northern Cape Province. The vertical change in colour cast is due to the juxtaposition of two adjacent photographs.

2. Methodology

2.1 The study commenced with the collection of relevant literature, including the 1:250 000 Geological Map (Sheet 2822 Postmasburg). The geological formations and strata underlying the Study Area were identified. The palaeontological potential of any palaeontologically un-surveyed area is best predicted by comparison with similar geological horizons in which fossils already have been found (Pether and Almond, 2008). Hence, a search of the palaeontological literature was aimed at revealing if any fossils have been found in similar local geological terrains; and if so, the nature of the deposits and their fossils. This informed a preliminary assessment of the possible impacts of the proposed development on any potentially fossiliferous deposits.

2.2 No comprehensive database of known fossil sites in South Africa exists. A fairly recently published text describes the most important fossil sites (MacRae, 1999) and information from this reference work was augmented by other standard geological publications.

2.3 A follow-up visit was made possible by Dr Miller's participation in a one-day archaeological field trip to the Study Area. This allowed an *in situ* assessment of exposures on the farm. The outcomes of this assessment are included in this report, which includes recommendations for any necessary intervention to be made.

3. Regulatory and Legislative Overview

3.1 In terms of the National Heritage Resources Act No. 25 of 1999, all palaeontological material is protected. In terms of the Act, "*palaeontological* means 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".

The Act stipulates that "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."

Section 35 states that "Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development 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."

3.2 Control over palaeontological resources resides with the relevant provincial heritage authority, where such exists, otherwise with the national South African Heritage Resources Agency (SAHRA). In this case the relevant authority is SAHRA. The provisions of the Act are complex, and the Act should be referred to directly for details about applications to collect or destroy palaeontological material.

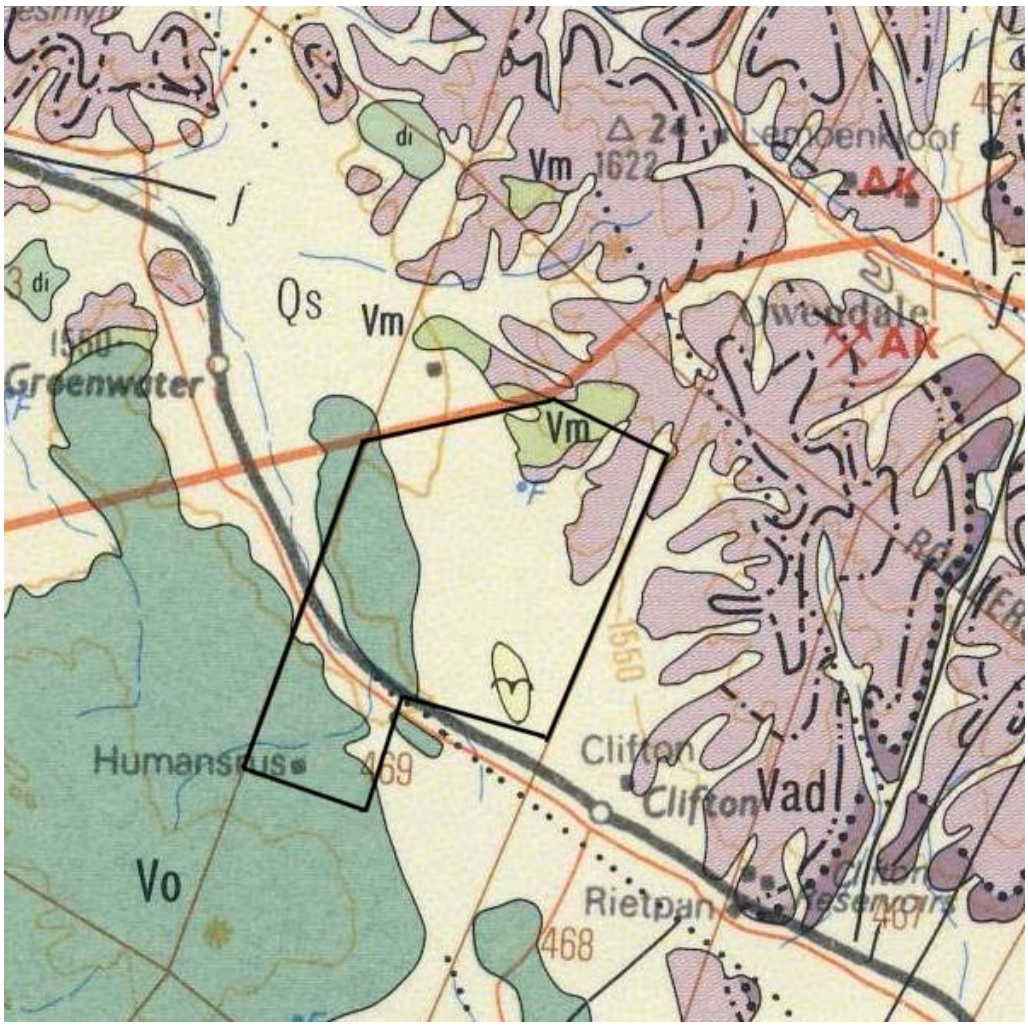
4. Description of the Affected Environment

4.1 The geology of the Study Area is illustrated in *Figure 2*. The oldest rocks exposed are the Daniëlskuil Formation, Asbestos Hills Subgroup, Ghaap Group. These consist mainly of granular banded ironstone, some 2,432 million years (Ma) old with intervening layers of jasper rock. They are overlain by diamictites and conglomerates of the Makganyene Formation, Postmasburg Group (Eriksson *et al.*, 2006). Together, rocks of these two formations make up the hills to the northeast of Humansrus Farm, rising some 150 m above the sandy valley in the middle of the demarcated area (*Figure 1*). The western part of the area is underlain by the volcanic rocks of the Ongeluk Formation, Postmasburg Group, which overlie buried Daniëlskuil Formation jasper rock. The volcanics are dated to 2,222 Ma (Eriksson *et al.*, 2006) and here occupy the nose of a broad synclinal (U-shaped) structure.

4.2 The sandy cover of red wind-blown sand and alluvium is part of the widely occurring Gordonia Formation of the Kalahari Group. The Cenozoic age sediments extend from the Northern Cape to 2° north of the equator (Partridge *et al.*, 2006). There has been debate about the origin of these sands, but the current consensus is that they are largely locally derived. This means that in the Study Area they probably represent outwash from the hilly region to the northeast. This is borne out by the gravels exposed in the centre of the area, which contain numerous water worn pebbles of jasper.

4.3 A seasonal drainage crosses the central part of the farm and a watering point is located at 28° 17′ 29.25″S; 23° 22′ 31.30″E at the foot of the eastern hills, and is marked F on the geological map (*Figure 2*).

Figure 2 The geology of the Humansrus Farm, showing the approximate boundaries of the proposed Groenwater Solar PV Facility. Vad = jaspilite with alternating layers of shale and mudstone (Daniëlskuil Formation); Vm = diamictite, conglomerate (Makganyene Formation); Vo = andesitic lava (Ongeluk Formation); Qs = red wind-blown sand and alluvium (Gordonia Formation) (from 1:250 000 Geological Series 2822 Postmasburg; Johnson *et al.*, 2006).



4.4 The banded ironstones of the Asbestos Hills Subgroup of the Ghaap Group formed in an ancient sea, through precipitation from the sea water. Cyanobacteria, or so-called blue-green algae, are thought to have played an important part in this, and microfossils have been identified in banded iron formations of the Asbestos Hills Subgroup near Kuruman (MacRae, 1999). Certainly, microorganisms were present because these photosynthesising algae were responsible not only for the oxygenation of the atmosphere and oceans around 2,500 million years ago but also for the stromatolitic limestones and dolomites that make up the Campbell Rand Subgroup immediately preceding the Asbestos Hills Subgroup. Therefore, the rocks of the Ghaap Group generally are of intense palaeontological interest.

4.5 The Makganyene Formation is largely glacial and unfossiliferous, although the minor dolomite with chert noted in the legend of the geological map (2822 Postmasburg) may contain microfossils and stromatolites. The overlying Ongeluk volcanic rocks are not fossiliferous.

4.6 In places the sediments of the Kalahari Group are highly fossiliferous, particularly where basal gravels fill palaeovalleys. Basal layers exposed at diamond mines like Bosluis Pan contain Miocene (17-15 Ma) vertebrate fossils, including early elephants; and the gravel terraces of the Vaal and Orange River also are fossiliferous (Partridge *et al.*, 2006). Spring and tufa deposits, such as at Florisbad, Wonderkrater, and at several locations along the Ghaap

Escarpment, may contain Pleistocene mammalian fossils and peats with preserved pollen. Deposits associated with seasonal pans also may contain Pleistocene mammalian fossils, such as at Bundu Pan near Marydale (Kiberd, 2006) and at Kathu Pan (Beaumont *et al.*, 1984; Porat *et al.*, 2010) to the north of Postmasburg. Any such deposits are of high palaeontological importance.

5. Impact Identification and Assessment

5.1 Any impact on what palaeontological resources there may be in the area will be confined to levelling and excavations for roads and foundations. If fossiliferous deposits are present, and if the recommended remediation is carried out, then this will represent a positive impact. Palaeontology benefits from excavation for roads and construction if this is carried out with the necessary collaboration and cooperation.

5.2 All planned development is southwest of the low hills to the northeast of the Study Area. These appear as dark fingers of Daniëlskuil Formation ironstones on the aerial photograph *(Figure 1)*. This formation is also exposed in an active red jasper mining area on a rise in the west-central part of the farm, mapped as Ongeluk volcanics *(Figure 2)*. Here the volcanics form a sheet about 2 m deep, overlying the Daniëlskuil Formation *(Figure 3)*. The ironstones of the Daniëlskuil Formation occur widely in the Postmasburg area, where in the past they were mined in numerous places for their asbestos content, apart from the extant jasper mine on Humansrus. Any possible excavations into this formation in the Study Area, for foundations or road metal, will make a negligible impact on any potential palaeontology. This anyway would be restricted to the possible recovery of microfossils, which requires small samples collectable from numerous extant outcrops. The palaeontological potential and possible impact for the Daniëlskuil Formation are considered to be **negligible**.

Figure 3 The jasper mine on Humansrus Farm. The lighter coloured Ongeluk volcanics overlie the red jasper rock of the Daniëlskuil Formation. The bench height is about 3 metres.

5.3 The diamictites and conglomerates of the Makganyene Formation have more limited outcrop, but apart from possible stromatolites in dolomite and microfossils in chert layers, these predominantly glacial sediments are not expected to be fossiliferous. Any sampling for possible microfossils would be driven by external research interests and not rescue. The mapped outcrop of the Makganyene Formation falls outside the area with planned infrastructure, and hence the palaeontological impact is considered to be **negligible**.

5.4 The Ongeluk volcanics are exposed not only in the jasper mine, but also as flat carapaces and scree on the slopes around the abandoned southern Humansrus farmstead *(Figure 4)*. These volcanic rocks are fossiliferous. The palaeontological potential is **negligible**.

Figure 4 Ongeluk volcanics scree on the slopes near the abandoned southern Humansrus farmstead.

5.4 The sandy valley fill of the Gordonia Formation of the Kalahari Group may contain Cenozoic terrestrial molluscan (snail) and mammalian fossils. It is not possible to predict if they are present, or if present, whether excavation will be deep enough to encounter them. A shallow seasonal watercourse crosses the central low-lying area of the farm. In various places subsurface gravel is exposed in a series of very shallow gullies and in one place in a dam excavation. Although these exposures contain scatters of stone artefacts, no fossil material was found in any of these exposures (*Figure 5)*. The area around the water point was visited, as it was thought it may represent a former natural spring. There was no evidence of spring deposits, and the farmer indicated it was fed by a borehole. The palaeontological potential and possible impact for the valley fill sediments are considered to be **low to negligible**.

Figure 5 Gravel exposure in the low-lying central area of Humansrus Farm. The sparsely vegetated and slightly deflated area contains numerous stone age artefacts, but no fossil remains.

Table 5.1 Summary Impact Assessment: Palaeontology

Type	The excavation activities associated with the construction of the Groenwater Solar PV Facility have the potential to have a direct negative impact on palaeontological finds if these occur in the affected areas. The discovery of palaeontological finds is positive in terms of increasing the body of knowledge related to palaeontology in the area if the recommended intervention is performed.
Magnitude	***Extent*****:** On-site ***Duration:*** **P**ermanent if fossils are encountered and destroyed. ***Intensity*****:** Low
Likelihood	Possible/unlikely
Significance	Minor
Degree of confidence	Medium (it is difficult to state confidently whether finds are likely or not)

6. Conclusion and Recommendations

6.1 The impact on the possible palaeontological potential of the hard rock formations is considered to be negligible, and no intervention or remediation is recommended.

6.2 The sandy and gravelly valley fill sediments may contain Cenozoic molluscan and/or mammalian fossils. This cannot be predicted with any confidence, but if excavations reveal such fossils reporting the find to the relevant heritage authorities (SAHRA in this case) and the intervention of a suitably trained palaeontologist are mandatory. The developers, site managers, and any operators of excavation equipment, need to be alerted to this possibility.

7. List of Definitions and Abbreviations

andesite – a variety of volcanic rock, originally erupted on the surface as lava
Cenozoic – the past 65 million years
conglomerate – a sedimentary rock composed of pebble to cobble sized stones cemented together
diamictite – a sedimentary rock of mixed stone sizes in a fine grained matrix, often but not always a glacial tillite
dolomite – a sedimentary carbonate rock
ironstone – a sedimentary rock composed predominantly of iron oxide and jasper
jaspilite – a sedimentary rock composed of very fine grained jasper and iron oxide
Ma – million years
Pleistocene – 2.6 million to 10,000 years ago
stromatolite – a fossilised layered algal mat
tufa – a surface limestone

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