Palaeontological impact assessment for Proposed establishment of a Solar Energy facility on farm Naauwpoort*** near Noupoort, Eastern Cape

Prepared for: Savannah Environmental (Pty) Ltd
Unit 606, 1410 Eglin Office Park
14 Eglin Road
Sunninghill
2157

Compiled by: Robert Gess (PhD)
Rob Gess Consulting

(Research Associate of the Albany Museum, Grahamstown)
(Research Fellow BPI Wits University, Johannesburg)

Box 40
Bathurst
6166

robg@imaginet.co.za

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*** Report and survey originally undertaken for the Tollie Solar Energy Facility

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Background

Naauwpoort Solar Energy (Pty) Ltd has proposed the development of a 75 MW Photovoltaic (PV) facility on the remainder of portion 1 of Naauw Poort Farm 1, near Noupoort in the Northern Cape. The property is approximately 11 km south of Noupoort on the N9.

Rob Gess consulting were contracted to carry out a Palaeontological survey of the entire farm portion (the R/E of Farm Naauwpoort 1) when doing a Basic Assessment process for a 20MW PV Facility (the Tollie Solar Energy Facility) for the same developer on the same site. Therefore, the same report for the Tollie Solar Energy facility is entirely applicable to the Naauwpoort Solar Energy facility and was utilised during the EIA process.

Geology and Palaeontology

The entire study area is underlain by strata of the **Katberg Formation (Tarkastad Subgroup, Beaufort Group, Karoo Supergroup)**. These are intruded by dolerite dykes and sills implaced during the Jurassic. Much of the low lying 'flats' are overlain by quaternary alluvium.

The strata of the **Karoo Supergroup** were deposited within the Karoo sedimentary Basin, which resulted from shortening and thickening of the southern margin of Africa, with coeval folding and uplift of the Cape Supergroup strata along its southern margin. The Karoo Supergroup strata are between 310 and 182 million years old and span the Upper Carboniferous to Middle Jurassic Periods. During this interval the basin evolved from an inland sea flooded by a melting ice cap, to a giant lake (the Ecca Lake) fed by seasonal meandering (and at times braided) rivers. The Beaufort group consists of largely fluvial sediments deposited on the floodplains of these rivers. The lake steadily shrank as it filled with sediment and the basin's rate of subsidence stabilised. The land became increasingly arid and was covered with wind blown sand towards the end of the basin's cycle. Finally the subcontinent was inundated with basaltic lava that issued from widespread linear cracks within the crust, to form the capping basalts of the Jurassic aged Drakensberg Group.

The flood planes of the **Beaufort Group (Karoo Supergroup)** provide an internationally important record of life during the early diversification of land vertebrates. Giant amphibians coexisted with diapsid reptiles (the ancestors of dinosaurs, birds and most modern reptiles), anapsids (which probably include the ancestors of tortoises) and synapsids, the dominant group of the time which included the diverse therapsids (including the ancestors of mammals). Rocks of the Beaufort Group provide the world's most complete record of the important transition from early 'reptiles' to mammals

Therapsid diversity, along with that of most plant and animals was decimated during the end-Permian extinction event, a serious contender for the most severe extinction event to affect life on Earth. Ongoing research on the effects of this extinction event is facilitated by the detailed record, afforded by Beaufort Group strata, of life immediately before and after the event, as well as the gradual recovery of life afterwards.

The Katberg Formation strata differ from those of the underlying Balfour Formation in being far more sandstone dominated. Whereas the underlying Balfour Formation was largely deposited by meandering rivers the Kaberg Formation was deposited by braided river systems. This may be a result of the Permian-Triassic extinction event which occurred during deposition of the uppermost Balfour Formation. Extinction of the dominant *Glossopteris* – flora will have led to increased erosion and changed the sedimentation system.

The Beaufort Group is subdivided into a series of biostratigraphic units on the basis of its faunal content. The **Katberg Formation** is coincident with the ***Lystrosaurus* Assemblage Zone.** This zone is dominated by a single genus of dicynodont, *Lystrosaurus*, which together with the captorhinid reptile, *Procolophon*, characterise this zone. Biarmosuchian and gorgonopsian Therapsida do not survive into the *Lystrosaurus* Assemblage Zone, though therocephalian and cynodontian Therapsida exhibit moderate abundance. Captorhinid Reptilia are reduced, however an unprecedented diversity of giant amphibians characterises this interval.

The effects of the end Permian extinction event are also evident in the extensive and important record of fossil plants present in the rocks of the Karoo. Whereas faunas of Permian age are dominated by a wide range of early seed plants, the Glossopteridales (which probably include the ancestors of modern gymnosperms and ultimately angiosperms), this group appears to have gone entirely extinct during the end-Permian extinction. The rocks of the Karoo provide an unrivalled sequential record of these changes and the diversification of other groups of plants in the aftermath of the extinction. The strata of the Karoo basin have also yielded fossil insects and insect leaf damage of a range of ages.

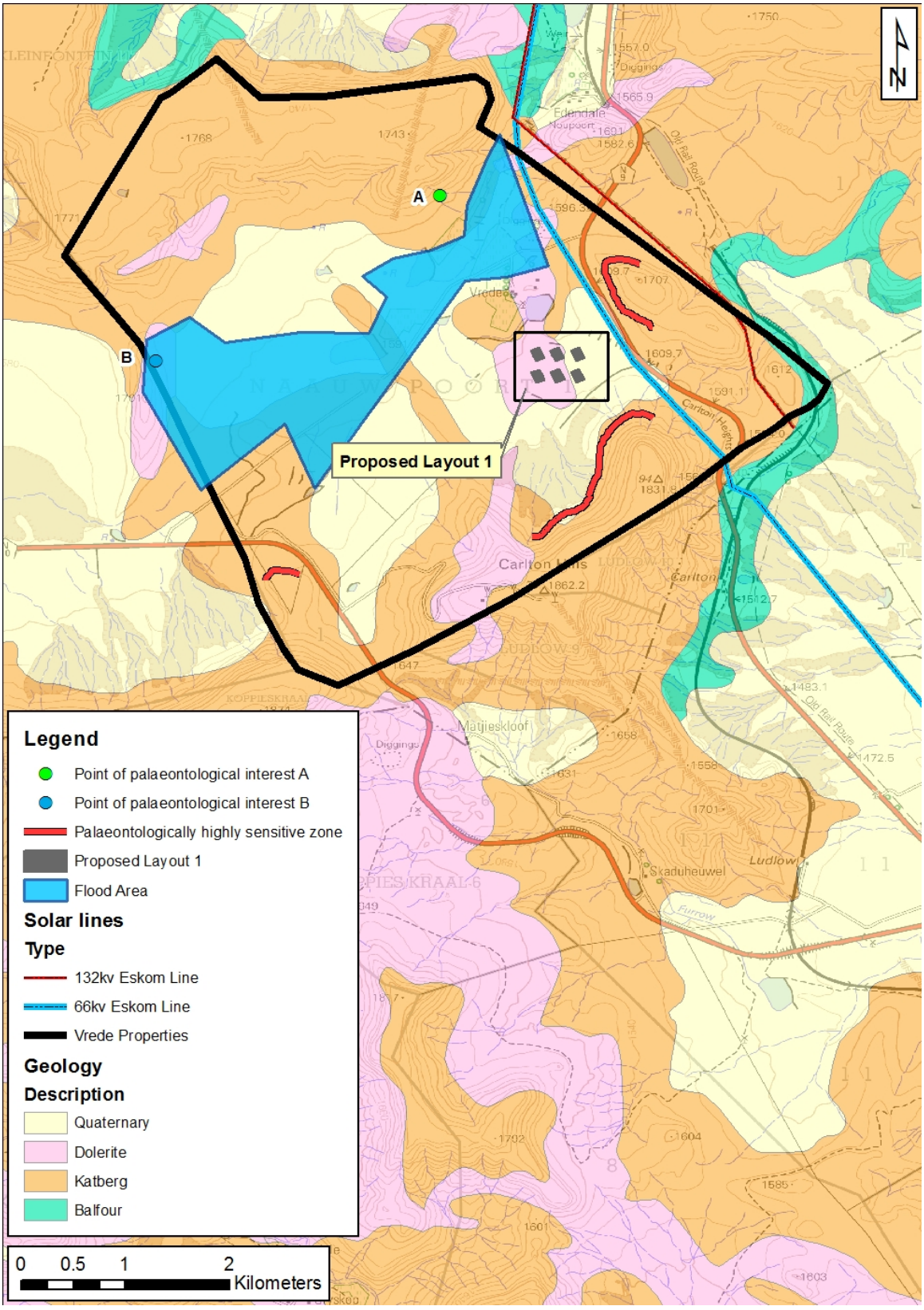

Figure 1. Map showing farm outline and topographical and geological survey data, in addition to site visit annotations.

Site visit

A survey of identified fossil material accessioned into repositories in South Africa revealed that both the South African Museum in Cape Town and the National Museum in Bloemfontein possess *Lystrosaurus* skulls collected on this and adjacent farm portions.

The entire farm portion was explored with a vehicle and on foot between the thirteenth and fifteenth of June 2012.

The central plane is covered in Quaternary alluvium which is not considered to be palaeontologically sensitive (Figure 2).

Figure 2: View from the foot of the northern hills towards the initial proposed site (green arrow) situated largely on alluvium (highlighted by yellowish grass) at the foot of the southern hill. The red arrow indicates the position of the horizontal package of most palaeontologically sensitive strata

Abundant vertebrate fossils were however found on the lower slopes of the hills surrounding the plain. These occurred in greatest concentration in a series of strata extending around the area (see Fig. 1, 'palaeontologically high sensitivity zone', Fig. 2, red arrow). Above the lowest sandstone exposed on the north facing slope of the southern hill is a package of greenish mudstones. Towards the top of this package *Lystrosaurus* skeletal remains are preserved (Fig. 3). Approaching the next sandstone these are often preserved encased in reddish nodules (Fig. 4).

Immediately below the sandstone is a discontinuous fine conglomeratic layer containing disassociated *Lystrosaurus* bones (Fig. 5,6). A similar layer, also containing dissociated

Lystrosaurus bones, is found a little way above the sandstone layer (Fig. 7). During the impact assessment visit remains of a small cynodont were also found in one of the red nodules found in the slope below the marker sandstone (Fig. 8). At one point extensive *in situ* fossil roots (Fig. 9) and remains of small therapsid burrows (Fig. 10) were found in green mudstones underlying the sandstone.

Figure 3: Semi disassociated Lystrosaurus skeleton including skull (top) exposed in green mudstone.

Figure 4: Weathered Lystrosausus skull in dorsal (top) view embedded in reddish nodular material.

Figure 5: Resistant (rounded weathering) conglomerate layer underlying marker sandstone.

Figure 6: Weathered partial *Lystrosaurus* lower jaw embedded in conglomerate layer underlying sandstone layer.

Figure 7: Portion of *Lystrosaurus* skull including tusk in conglomerate overlying sandstone.

Figure 9: Small probable cynodont skull (requiring preparation) in reddish nodule from below sandstone marker layer. *Top*: Lateral (side) view, *Bottom*: Ventral (underside) view.

Figure 9: Long *in situ* root in coarse mudstone below marker sandstone layer.

Figure 10: Small probable therapsid vertebrate burrow casts in greenish mudstones underlying marker sandstone layer.

Fossil bone remains were also found in green mudstones beneath a sandstone layer in the northern hills (Fig. 1: point A). This green mudstone probably corresponds to that from which abundant fossils were recorded on the lower slopes of the southern and eastern hills.

In addition loose mats of plant stems (Fig. 11) were noted in a thin sandstone in the west of the study area (Fig. 1: point B). This sandstone corresponds to that below the “marker” sandstone layer.

Figure 11: Plant stems preserved in sandstone at Point B (Figure 1).

Conclusions and Recommendations.

The entire farm portion was preliminarily surveyed between the 13th and 15th of July 2012. The central plane is covered in Quaternary alluvium which is not considered to be palaeontologically sensitive. Rich palaeontological resources were however located on the lower slopes of all the hills surrounding the plane.The alluvium in this area may also contain fossiliferous nodules washed down from the rich deposits on the slope above.

It is recommended that the construction team should be made aware of the possibility of uncovering important plant and bone fossils and should they do so they should contact SAHRA or a qualified palaeontologist.

Should extensive bedrock be exposed during the construction phase a short inspection by a palaeontologist should also be conducted before excavations are back filled.

Layoutsproposed near the lower slopes of the hills these should be inspected by a palaeontologist prior to the beginning of construction.

References

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Addendum to: "Gess, R.W. (2012). Palaeontological impact assessment for Proposed establishment of the Tollie Solar Park near Noupoort, Eastern Cape. 12pp Rob Gess Consulting, Grahamstown."

Dr Rob Gess, Rob Gess Consulting December 2012

At the time that this report was compiled only one array had been envisaged (Fig.1, layout 1). This area was therefore specifically examined although the entire land portion was surveyed (see report).

Subsequently, the client has proposed a further two arrays. The consultant has not revisited the study area however he is in a position to make the following comments.

Array 1, as indicated to the consultant, lies on the alluvial plain and is unlikely to affect palaeontological resources.

Array 2, as indicated to the consultant, backs onto the base of the Carlton Hills in the south. After consultation with this and other consultants its position has been adjusted off the steeper slopes to end a little below the most palaeontologically sensitive layer.

It's current position therefore has a fairly low chance of impinging on sensitive palaeontological material.

Without a site inspection it remains possible that palaeontological material exists as loose float in the study area, having gravitated down from the most sensitive layer.

It is therefore recommended that when the final array positions have been finalised, it should be required that array area two is specifically surveyed by a palaeontologist (and a report sent to the Eastern Cape Provincial Heritage Authority) prior to the beginning of construction.