Palaeontological Survey and Impact Assessment for proposed Wind and Solar Energy Facility to be located in Wesley Town off the R72, from East London to Port Elizabeth.

Prepared for: USK Consulting
Environmental & Waste Engineering

23 Ray Craib Cr. Beacon Bay
East London 5241
Mobile: +27 72 256 3230
Tel: +27 (043) 748 5545
Fax: (043) 748 1114
Fax2Email: 0862703976

Compiled by: Robert Gess

* Rob Gess Consulting
* Research Associate of the Albany Museum)

Box 40
Bathurst 6166
robg@imaginet.co.za
Mobile: 0827595848
Tel: 046 6250009

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Background

Canyon Springs Investments 71 (Pty) Ltd are proposing to establish a hybrid Wind and Solar Energy Generation Facility of a total capacity of approximately 90 MW. This proposed renewable energy facility is to be developed on Portions 18, 19, 20 and 21 of Farm 258 Peddie located in Wesley Town in the Eastern Cape Province (Figure 1). Environmental Impact Assessment studies have been conducted by USK Consulting in accordance with the National Environmental Management Act, Environmental Impact Assessment Regulation of 2010.

The SAHRA requested for a Paleontological Impact Assessment to be undertaken and submitted for their comment. Rob Gess consulting was subcontracted to carry out a palaeontological survey and make recommendations regarding palaeontological heritage. Survey work was performed between the 12th and 14th of November

Geology and Palaeontology

According to Geological Survey of South Africa map '3326 Grahamstown', the entire area is underlain by strata belonging to the **Middleton Formation (Adelaide Subgroup, Beaufort Group, Karoo Supergroup)** (see Figure 2).

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. This 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 its 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 Drakensberg Group.

As the Ecca Lake silted up a subaerial (exposed) shoreline began to develop, initially in the south east of the basin. The lake steadily shrank towards the centre of the basin, leaving behind flat silty plains across which long rivers meandered from the Cape Mountains towards the much reduced lake. Sands were deposited along the river channels whereas periodic flooding deposited muds on the broad flood planes. These in time came to form the interbedded sandstones and mudstones of the Koonap Formation, **Middleton Formation** and Balfour Formation (Adelaide Subgroup, Beaufort Group, Karoo Supergroup).

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 worlds most complete record of the important transition from early reptiles to mammals

The Beaufort Group is subdivided into a series of biostratigraphic units on the basis of its faunal content.

The mid-Permian aged **Middleton Formation** (**Adelaide Subgroup, Beaufort Group, Karoo Supergroup)** includes the upper *Pristerognathus*, *Tropidostoma* and lower *Cistecephalus* (biostratigraphic) Assemblage zones. These zones are characterised by a changing cast of captorhinind and eosuchian reptiles as well as therapsids of the Dicynodontia, Biarmosuchia, Gorgonopsia and Therocephalia. Small numbers of fish and Amphibia are also known. A diversity of plant fossils of the Glossopteris fauna, as well as a number of trace fossils have also been described.

Whereas the Karoo Basin has been well studied in the western Eastern Cape, Western Cape, Northern Cape, Free State and Kwazulu Natal, the former Ciskei and Transkei areas of the eastern Eastern Cape are hardly known palaeontologically. To no small degree this may be attributed to the socio-political history of the area, though the (perhaps valid) perception that this portion of the basin is far more palaeontologically sparse than other parts of the basin has also tended to draw researchers away from it. As a result our understanding of the basin as a whole is now hampered by lack of palaeontological (and geological) information regarding the eastern Eastern Cape, and any material that may be recovered therefrom is of value.

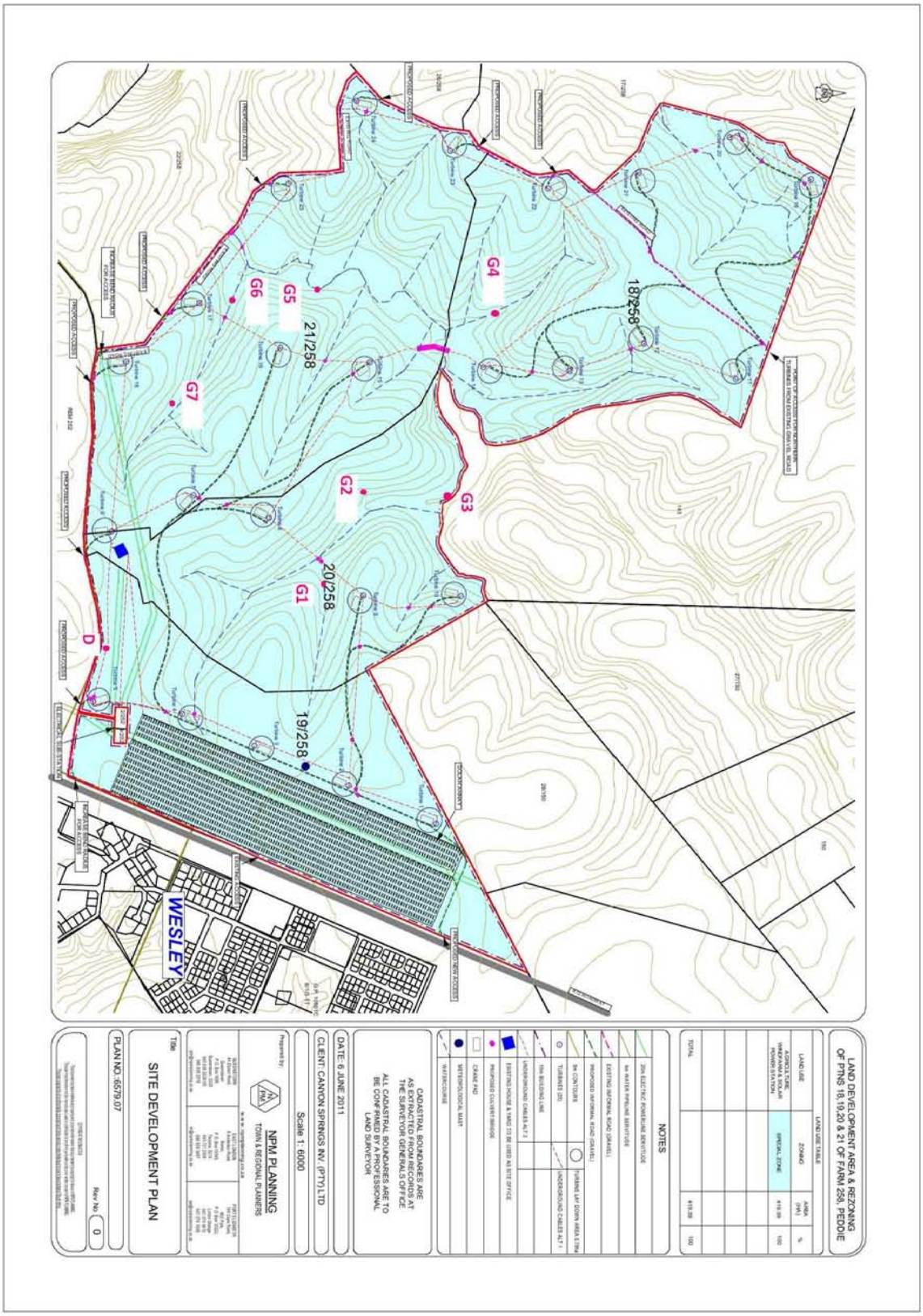

Figure 1. Map of the study area annotated with geological reference points, D and G1 to G7

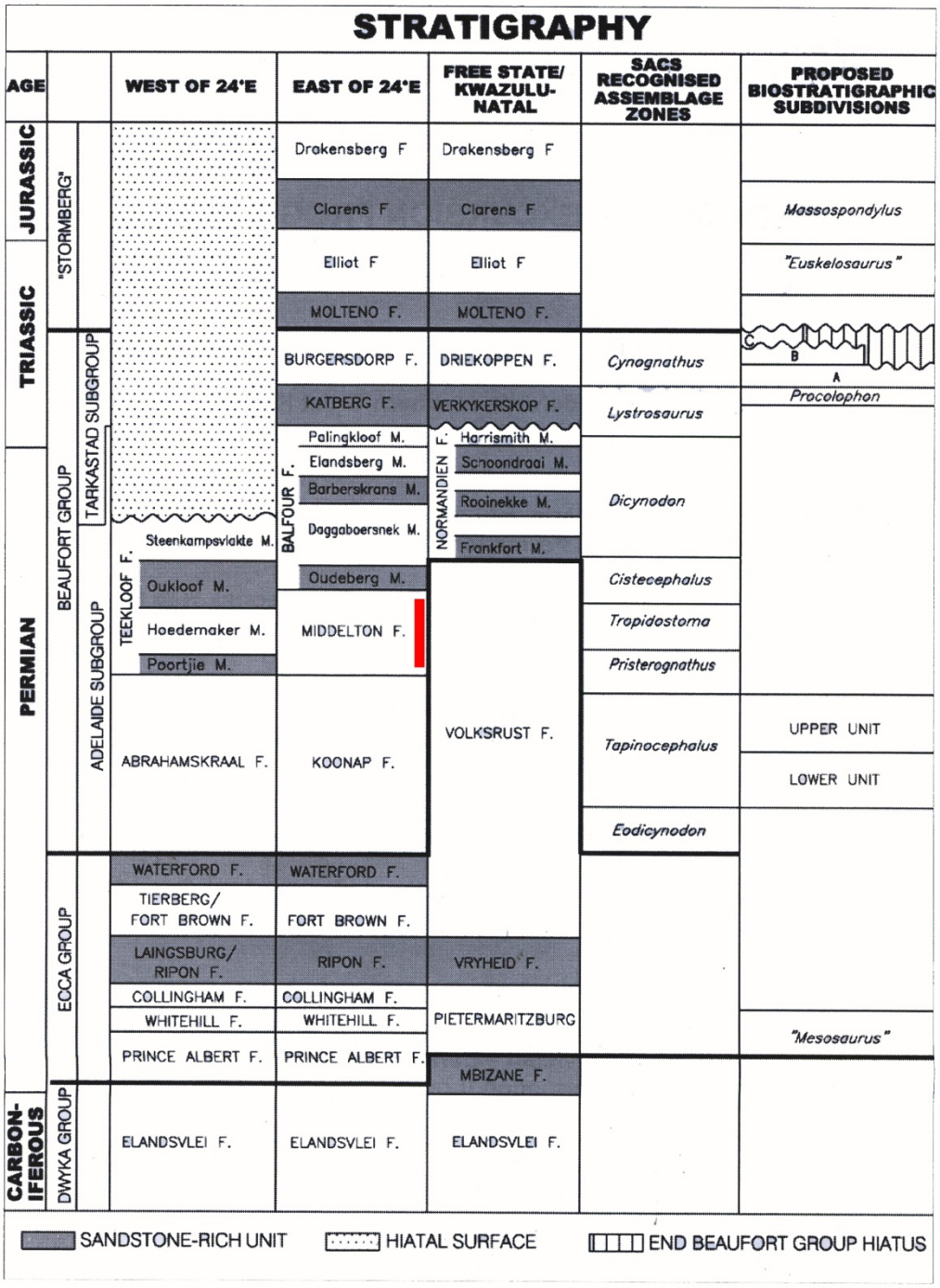

Figure 2. Stratigraphic column and corresponding biostratigraphy of the Karoo Supergroup (modified after Rubidge, B.S. 2005. *South African Journal of Science*. 108: 135-172). Red line indicates the probable range of strata affected by the project.

Site Visit and Survey

The area was systematically surveyed on foot over a three day period and all outcrops discovered were minutely examined for palaeontological material.

A small dam (Figure 1, D) just west of the current Eskom transformer reveals thick brownish soil and displaced heaps of yellowish clayey subsoil, derived from deep weathering of Middleton Formation mudstones or possibly relict quaternary deposits (Figure 3).

Figure 3. Yellowish clays excavated in the creation of a small dam or quarry in the south east of the study area (see Fig. 1, D)

In general no outcrops of bedrock were found on the tops of the hills in the study area (where most wind turbines will be situated.

Numerous outcrops were, however, found in the river drainage system that is incised into the landscape (and which is to be cut by a network of access roads and buried cables). Except for the valley in the extreme north west of the study area, the valleys in the project area consist of a single river and its tributaries. Outcrops of Middleton Formation mudstones and sandstones are

most abundant in the bottom two thirds of tributaries of the main river (Fig. 4). Outcrops are less abundant in the main valley as it meanders slowly across a broad valley bottom comprised of recent alluvium. Outcrops in the main valley are chiefly found where the outer curve of the river's meanders cut back into the flanking hills (Fig. 5).

Figure 4. Middleton Formation purplish and green mudstones exposed in a tributary valley in the project area. (see Fig 1, G6)

Figure 5. Middleton Formation greenish mudstones and sandstones exposed in the main valley. (see Fig. 1, G5)

In addition a large exposure of Middleton Formation outcrop was exposed at one point well above the tributary the stream bed (see Fig 6, Fig. 1, G4).

Figure 6. Middleton Formation mudstones exposed on a hillside (see Fig. 1, G4)

No vertebrate remains were found during the survey. A number of structures of potential palaeontological interest were however noted. These included **probable vertebrate burrows** located at point **G4** (Figure1, G4). These structures originally consisted of galleries that descended from a muddy surface at approximately 45 degrees, and were infilled with sandy sediment (Figures 7). This sandy sediment forms an overlying layer with which they putative burrows are continuous. Plant stem fragments were noted on the palaeosurface into which the galleries were excavated (Figure 8). A slightly stratigraphically higher layer at this point shows evidence for possible bioturbation (Figure 9).

Figure 7. Probable vertebrate burrows in Middleton Formation mudstone, infilled with sandy sediment deposited in overlying layer (see Fig. 1, G4)

Figure 8. Plant stems fragments preserved on the mudstone surface into which putative vertebrate burrows were excavated at G4 (see Fig. 1)

Figure 9. Possible bioturbation of sediments at G4 (see Fig. 1)

Fossilised root casts (Fig. 10) were discovered in Middleton Formation mudstones in the stream bed at G1 (Fig. 1, G1).

Figure 10. Fossil root casts in Middleton Formation mudstones at G1 (see Fig.1, G1).

A fragmentary possible burrow fill was observed at G2 (see Fig. 1, G2) and a root cast or possibly burrow fill (Figure 11) was located at G3 (see Fig. 1, G3).

In addition shallow water ripples (Figure 12) were noted in strata at G7 (see Fig. 1, G7).

Figure 11. Sandstone burrow or root cast (in foreground), partially exposed at G5

Figure 12. Shallow water ripple marks preserved on thin sandstone beds within the Middleton Formation mudstones at G7.

Conclusions and Recommendations

Although Middleton Formation outcrops are abundant in drainage channels in the study area very few sites of palaeontological significance were discovered

In addition alluvium and deeply weathered substrata on top of the hills, where most towers are to be situated, thickly cover bedrock.

It may be concluded that this project is unlikely to affect palaeontological heritage resources.

Material of palaeontological interest was only encountered at localities designated G1, G4 and G5 (see Figure 1). None of these will be impacted by the current layout of the facility. No adjustments which might affect these three sites should be made to the layout.

In the event of suspected fossil material (such as fossil bones) being encountered during excavations, SAHRA and a professional palaeontologist should be notified.