Palaeontological Heritage Impact Assessment of the proposed Deep River Wind Energy Facility on a site east of Humansdorp, Eastern Cape.

Assessment conducted in terms of
Section 38 (8) of the National Heritage Resources Act (Act 25 of 1999)

Prepared for:
Savannah Environmental (Pty) Ltd
On behalf of VentuSA Energy (Pty) Ltd

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ALBANY
MUSEUM
EARTH SCIENCES

Report by

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EXECUTIVE SUMMARY

Dr Billy de Klerk, Curator of Earth Sciences at the Albany Museum, Grahamstown was appointed by Savannah Environmental (Pty) Ltd of behalf of VentuSA Energy (Pty) Ltd who is proposing the establishment of a commercial wind energy facility and associated infrastructure on a site located ~ 18 km west of Humansdorp in the Eastern Cape. The proposed wind energy facility is to be developed by VentuSA Energy and is referred to as the Deep River Wind Energy Facility. The proposed wind energy facility would consist of up to 50 wind turbines with a proposed total generating capacity of ~ 100 MW.

Declaration

Dr W.J. (Billy) de Klerk (PhD) is a Palaeontologist, Specialist Scientist, employed by the Eastern Cape Department of Sport Recreation Arts and Culture (DSRAC) and is also an Associate Researcher in the Department of Geology at Rhodes University, Grahamstown. He has 34 years of working experience in the Earth Sciences and having served two terms as President of the Palaeontological Society of Southern Africa, is accredited by the society to conduct Palaeontological Heritage Impact assessments. He occasionally does independent specialist consulting and is in no way connected with the proponent, other than delivery of consulting services.

Glossary

Fossil: *Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.*
Heritage: *That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999.*
Permian: *A geological time period dated between 299 – 251 Ma (million years ago).*
National Estate: *The collective heritage assets of the Nation*
Palaeontology: *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.*
SAHRA: *South African Heritage Resources Agency – the compliance authority which protects national heritage.*

1. INTRODUCTION

VentuSA Energy (Pty) Ltd is proposing the establishment of a commercial wind energy facility and associated infrastructure on a site located ~ 18 km west of Humansdorp in the Eastern Cape. The locality of the proposed Deep River Wind Energy Facility is illustrated in (Figure 1). The brief was to conduct a data survey / database assessment of the palaeontology and the fossil potential within the Deep River footprint as outlined in Figure 1.

Location

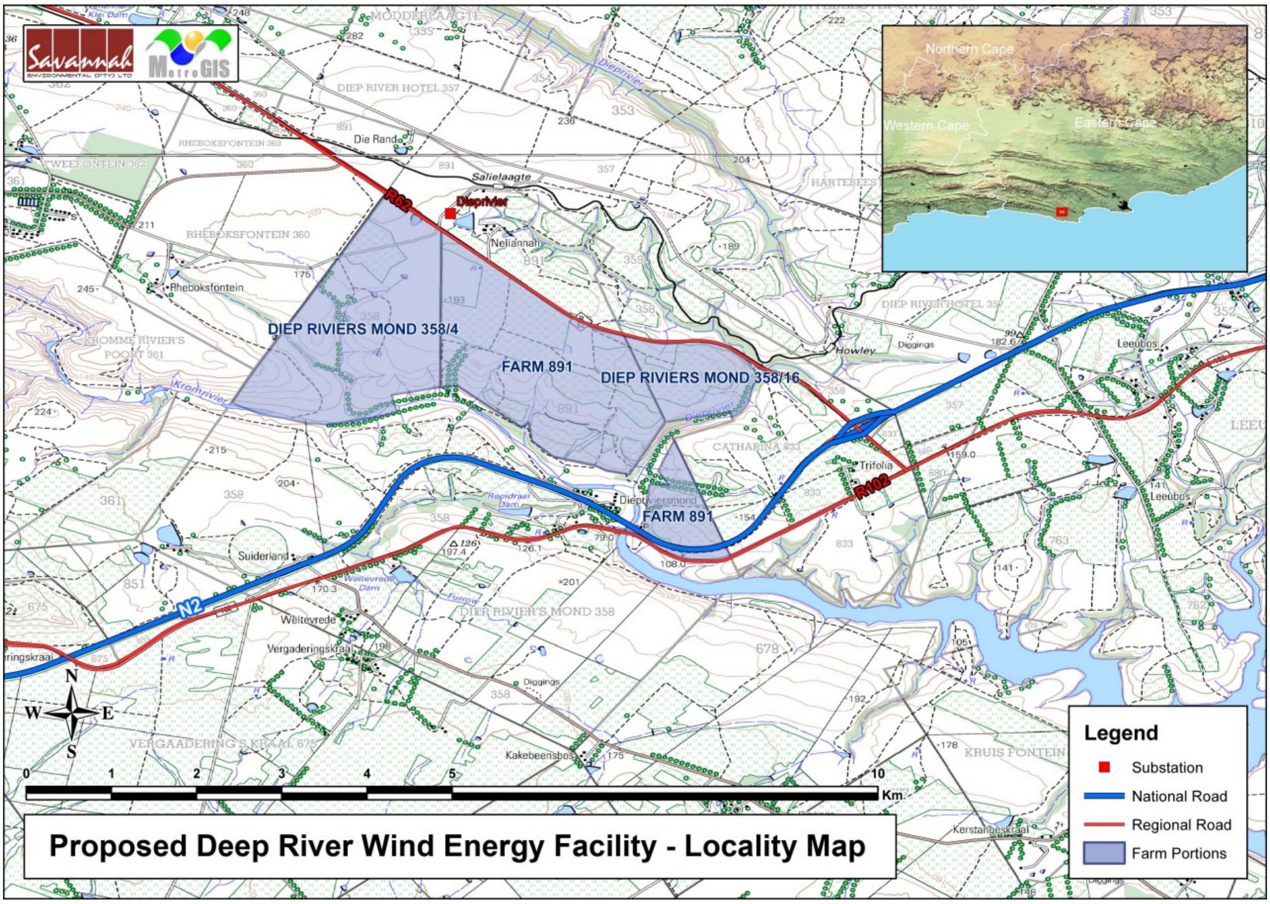

Figure 1. Locality map showing the footprint of the proposed Deep River Wind Energy Facility east of Humansdorp, Eastern Cape.

The area in question is underlain by Palaeozoic sandy sediments of the Table Mountain Group (“Table Mountain Sandstones”) and a very small lower section of the Bokkeveld Group. The Table Mountain Group rocks are generally sparsely fossiliferous. Fossils of marine organisms have over the past 150 years been collected from these sedimentary rock and are today preserved in South African museum and universities, making up part of the National Estate.

2. GEOLOGICAL BACKGROUND & SETTING

Rifting occurred across what is today known as the southern Cape about 450 million years ago. This rifting had the effect of thinning the crust and resulted in the invasion of the sea, giving rise to the “Agulhas Sea” across the southern Cape. Sediments that subsequently accumulated in this newly formed basin produced what is today seen as the Cape Supergroup of rock (Figure 2).

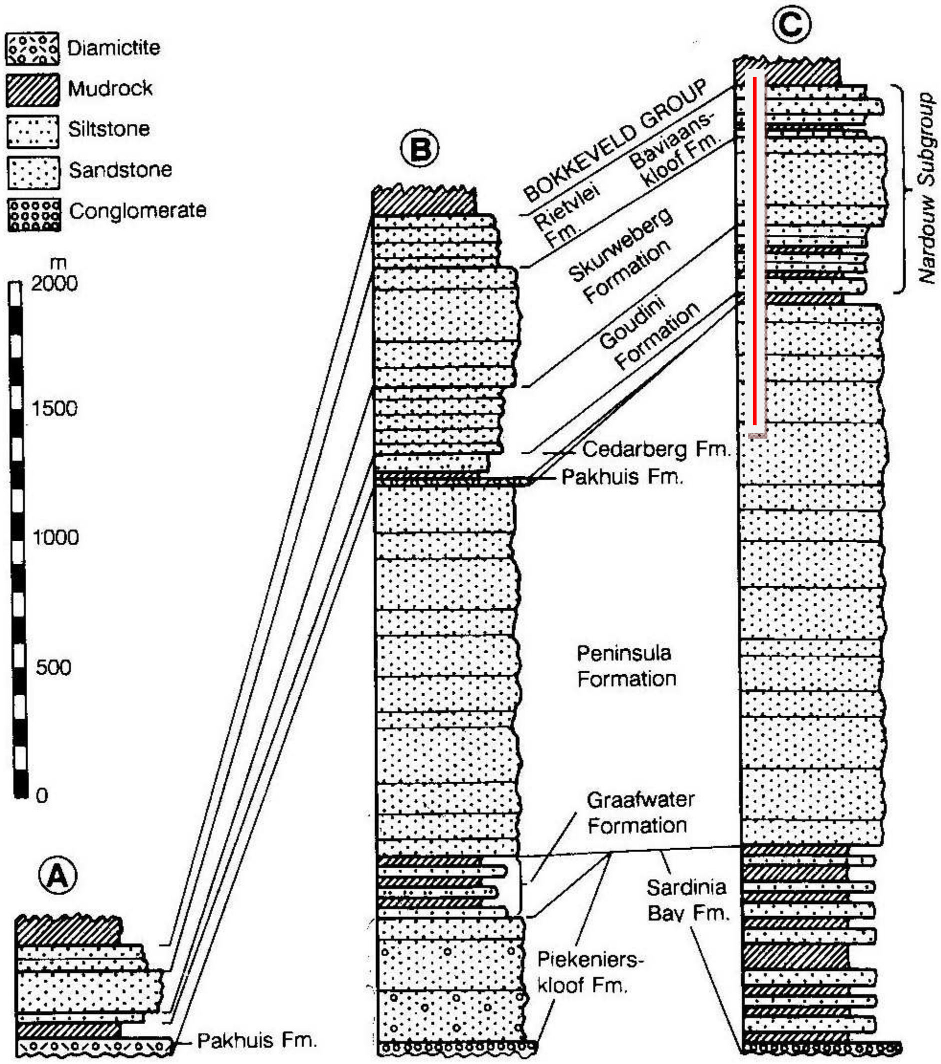

Figure 2. Stratigraphic subdivision of the Table Mountain Group (From Johnson *et al.* 1999). Column C, measured in the Eastern Cape, is most relevant to the present field study. The six formations that occur in Figure 3 are indicated here by the vertical red line.

As indicated on the 1: 250 000 geological map 3324 Port Elizabeth (Figure. 3), the Deep River area is entirely underlain by mid-early Palaeozoic (Ordovician – lower Devonian) sediments of the **Table Mountain Group** (Cape Supergroup) and the basal part of the **Bokkeveld Group**. Relevant geological references include Rust (1967), Hiller (1982), Malan & Theron (1989), Broquet (1992), Johnson *et a*l., (1999), De Beer (2002), Thamm & Johnson (2006), and Tankard *et al*., (2009). These rocks are mostly craggy, resistant-weathering fluvial sandstones and minor pebbly conglomerates of the **Peninsula Formation** (Ordovician) and **Nardouw Subgroup** (Silurian) that respectively underlie and overlie the thin **Cederberg Formation**. This last unit consists of much softer-weathering mudrocks (laminated claystones and siltstones) grading up into interbedded fine sandstones and mudrocks which contain and abundance of invertebrate fossils.

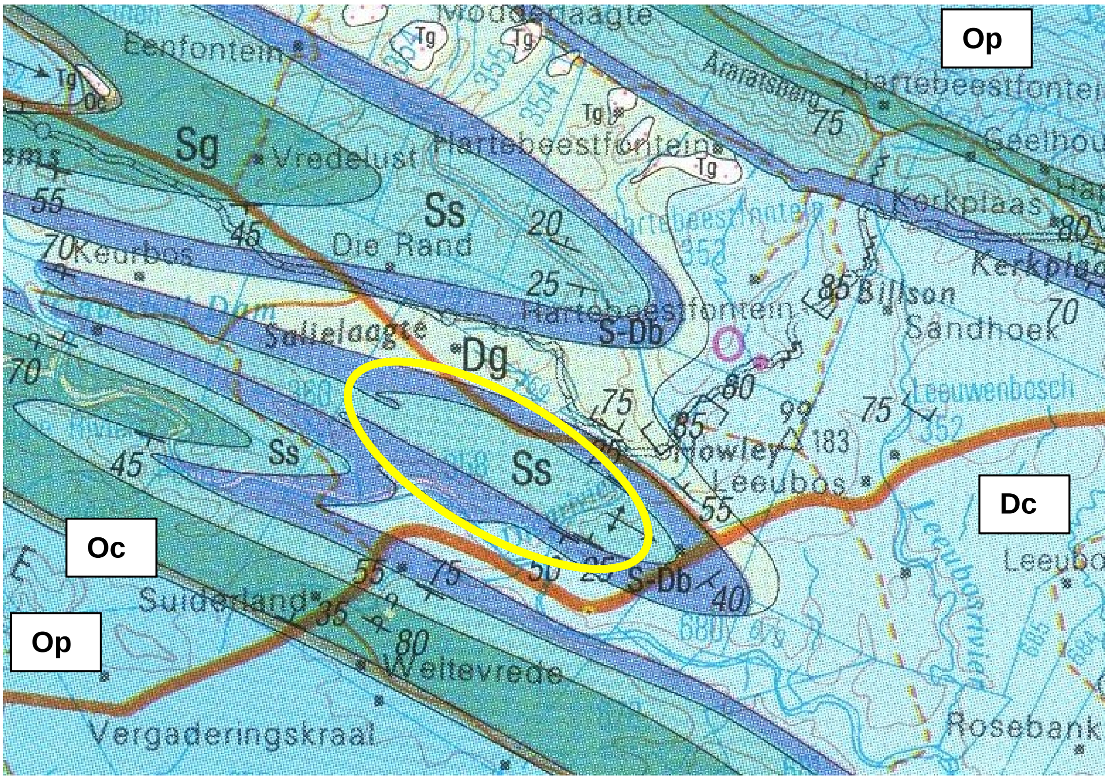

Figure 3. Portion of the 1: 250 000 scale geological map 3324 Port Elizabeth (Published by the Council for Geoscience, Pretoria, 1991) showing bedrock geology of the study region (indicated by yellow circle). From oldest to youngest: Table Mountain Group. Nardouw Subgroup – Peninsula Frm = **Op**; Cedarberg Frm = **Oc** (grey); Goudini Frm. = **Sg** (dark green); Skurweberg Frm. = **Ss**; Baviaanskloof Frm. = **Db** (dark blue). Bokkeveld Group, Ceres Subgroup (**Dc**) – basal Gydo Frm. = **Dg** (pale blue). The outcrop of the palaeontologically sensitive Cederberg Formation (**Oc**) occurs as the thin grey line south-west of the Deep River footprint. For the rest, most of the sandstones of the Table Mountain Group, the Peninsula Formation and Nardouw Subgroup are only sparsely fossiliferous.

Fossil Potential

The area on which the Deep River wind turbines are planned to be erected, is underlain by sediments and meta-sediments of the Cape Supergroup (Figure 3). Specifically they are the very basal succession of the Bokeveld Group (Ceres Formation, Gydo member **(Dg)** of lower Devonian age - 400 Ma) and the upper part of the Table Mountain Group, the Nardouw Subgroup (Skurweberg (**Ss**) and Baviaanskloof (**Db**) Formations) of upper Silurian age (420 Ma). The bulk of sediment that makes up these rocks are generally sandy in nature (MacRay, 1999, p.106) and apart from occasional trace fossils are generally devoid of invertebrate body fossils. The Baviaanskloof Formation (**Db**) however has, in the past, yielded trilobites, gastropods, bivalves and bryozoans and inarticulate brachiopods.

Tectonic Deformation

As can be seen in Figure 3 the rocks of the Cape Supergroup have been severely deformed (folded and faulted) during the Cape Folding Event which took place approximately 310 million years ago (McCarthy and Rubidge, 2005). The greater temperatures and pressures experienced by the Cape Supergroup sediments resulted in regional low-grade metamorphic recrystallization of the sediments. The tectonism and low-grade metamorphic overprint effectively contributed to the destruction of any fossils in the original sediment. It is only in the low pressure zones of the folds that there is any possibility of finding undamaged fossils.

Weathering

The generally flat lying surface of the Deep River footprint forms part of the African Erosion Surface which developed between the late Jurassic (145 Ma) until the end of the early Miocene at approximately 15 Ma (Partridge and Maud, 1987). The end result of this prolonged erosion event resulted in advanced planation throughout the subcontinent. This prolonged weathering and erosion event also resulted in the development of a deep-weathered profile generally consisting of (1) a thin soil profile at surface followed by (2) a layer silcrete / ferricrete (variable thickness) this in turn followed by a (3) clay rich horizon grading downward into (4) fresh unweathered sedimentary bedrock. The end result, of this deep and prolonged weathering event, has effectively destroyed most of the potential fossils that were originally in these rocks.

3. METHODS

1. Literature review & Museum Catalogue Search. A comprehensive review of the literature pertaining to the Peninsula Formation and the Nardouw and Ceres Subgroups was undertaken. In addition, a search of known fossils, housed in Eastern Cape museums, was undertaken from the accession catalogues.

2. Field Work. A full field day (6th December 2010) was spent in the footprint area to ascertain what the nature of the geology was and, more importantly, what the fossil potential would be.

4. OBSERVATIONS

Landscape and bedrock exposures.

By far the greater extent of the footprint under consideration consists of generally flat countryside with little or no sedimentary rock outcrop (Figure. 3).

Figure 3. General view (looking south-east) of the proposed Deep River Wind Energy Facility area showing the paucity of bedrock outcrop and the flat-lying nature of the erosion plain.

Figure 4. Isolated small resistant quartzite outcrops do occur on the higher ground (34°01.399’S; 24°34.365’E).

Subsurface geology is well illustrated in the road cuttings of the R62 tar road on the north-eastern flank of the footprint (Figure 5.)

Figure 5. Subsurface weathered profile of the underlying rock types at Deep River (34°01.237’S; 24°35.259’E).

Figure 6. Typical detail of first 2m of the soil profile underlying the Deep River footprint (34°01.237'S; 24°35.259'E). The upper half meter consists of sandy soil underlain by silica-rich nodular silcrete / ferricrete. This is in turn underlain by a clay rich horizon of variable thickness, in excess of 3m.

Figure 7. Surface expression of the silcrete / ferricrete where the overlying soil has been washed away. (34°00.511'S; 24°33.298'E).

Figure 8. Fresh white clay rubble located at one of the exploratory boreholes that must have been derived from at least 2 – 3m below surface (34°00.577'S; 24°35.259'E).

5. CONCLUSIONS AND RECOMMENDATIONS

As outlined in the section 2 above (p.4 - Geological Background and Setting), this area is underlain by sedimentary rocks of the Cape Supergroup – mainly of the Table Mountain group and a small lower section of the overlying Bokkeveld Group. Fossil have in the past been recovered from these sediments throughout the southern Cape but in particular within the Western Cape. However, within the Deep River area two geological factors have effectively eliminated fossils from the underlying rocks - firstly the tectonic overprint of the Cape Folding Event that took place around 310 million years ago and secondly, the long period of weathering and erosion that produced the African Land Surface. There is therefore a very low likely hood of finding well preserved fossils at Deep River.

There is also a remote chance that a trace or invertebrate body fossil may well be found in the development phase of foundation excavation, road building or trenching. There is no major palaeontological reason why this development canot take place. If at any stage during the construction phase of the wind turbines and the associated infrastructure like roads and trenching for cables, any semblance of a fossil were to be observed, it would be vital to recover the fossil and report the occurrence to the geological staff at either the Albany Museum or Rhodes University in Grahamstown. Alternatively it can be reported to staff at the Council for Geosciences in Port Elizabeth. Generally fossils can be removed quickly and would therefore not delay or hinder construction operations.

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