RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES:

PROPOSED AMDA DELTA SOLAR PV DEVELOPMENT ON THE REMAINING EXTENT OF KLONDIKE NO. 670-IN, NALEDI LOCAL MUNICIPALITY, NORTHWEST PROVINCE.

John E. Almond PhD (Cantab.)
***Natura Viva* cc,**
PO Box 12410 Mill Street,
Cape Town 8010, RSA
naturaviva@universe.co.za

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EXECUTIVE SUMMARY

The study area for the proposed AMDA Delta Solar PV Development on the Remaining Extent of Klondike No. 670 near Vryburg, Naledi Local Municipality, Northwest Province is underlain at depth by Precambrian sediments of the Schmidtsdrif Subgroup (probably Vryburg Formation) as well as Permo-Carboniferous glacial sediments of the Dwyka Group (Karoo Supergroup). The bedrocks are mantled by Late Caenozoic superficial sediments including calcretes, alluvial gravels and sandy soils. Desktop analysis as well as field studies in the vicinity indicate that all these sedimentary rocks are of low palaeontological sensitivity. Significant impacts on local palaeontological heritage are therefore not expected as a consequence of the proposed alternative energy development, including the *c*. 5 km long 132 kV overhead transmission line connection to the existing Mokoodi Substation. It is recommended that, pending the discovery of substantial new fossils remains (*e.g.* stromatolites, mammalian bones or teeth) during construction of the proposed solar energy facility and of the associated 132 kV transmission lines, exemption from further specialist palaeontological studies and mitigation be granted for this project.

Should any substantial fossil remains (*e.g.* well-preserved stromatolites, mammalian bones and teeth) be encountered during excavation, these should be safeguarded, preferably *in situ*, and reported by the ECO to the South African Heritage Resources Authority, as soon as possible (SAHRA contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000. Tel: 021 462 4502. Email: cscheermeyer@sahra.org.za). This is to ensure that appropriate mitigation action can be taken by a professional palaeontologist, at the developer's expense. Mitigation would normally involve the scientific recording and judicious sampling or collection of fossil material as well as associated geological data (*e.g.* stratigraphy, sedimentology, taphonomy) by a professional palaeontologist. These recommendations should be incorporated into the Environmental Management Plan for the proposed solar energy facility.

1. OUTLINE OF THE PROPOSED DEVELOPMENT

The company AMDA Delta (Pty) Ltd is proposing to develop a photovoltaic (PV) solar energy facility of 75 MWac net generating capacity - to be known as the AMDA Delta Solar PV Development - on the Remaining Extent of Klondike No. 670, IN Registration Division near Vryburg, Naledi Local Municipality, Northwest Province (Fig. 1). The project area is located on the southern side of the N14 tar road from Vryburg to Kuruman and *c*. 7.5 km southwest of Vryburg

town centre. The development site of the Delta solar facility is approximately 900 Ha in area, and the development footprint is *c*. 185 Ha. Key infrastructural components of the development include:

- Solar PV field - solar PV panels on fixed tilt structures or single axis tracking technology;
- Project and collector substations (*c*. 1 Ha each), connected by a single 132 kV overhead transmission line;
- Buildings (1.5 Ha);
- Access roads – 22 km long, 6 m wide (total 13.2 Ha) using the existing access from the N14 or a new access off the Vryburg - Reivilo district road;
- Permanent and construction laydown areas (7 Ha and 12 Ha respectively);
- Perimeter fence;
- Water supply from the Municipality or a borehole.

The solar PV development would be connected *via* a double 132 kV overhead transmission line to the existing Eskom Mookodi MTS Substation which situated on the farm Rosendal 673-IN, on the western side of the N18 tar road between Vryburg and Kimberley and *c*. 5.7 km south of Vryburg (Figs. 1 & 2).

This palaeontological heritage assessment comment was commissioned as part of a EIA process for the proposed alternative energy development that is being co-ordinated by Cape EAPrac, George (Contact details: Mr Dale Holder. Cape EAPrac. 5 Progress Street, Eagle View Building, 1st floor. P.O. Box 2070, George, 6530. Tel: 044 874 0365. Fax: 044 874 0432).

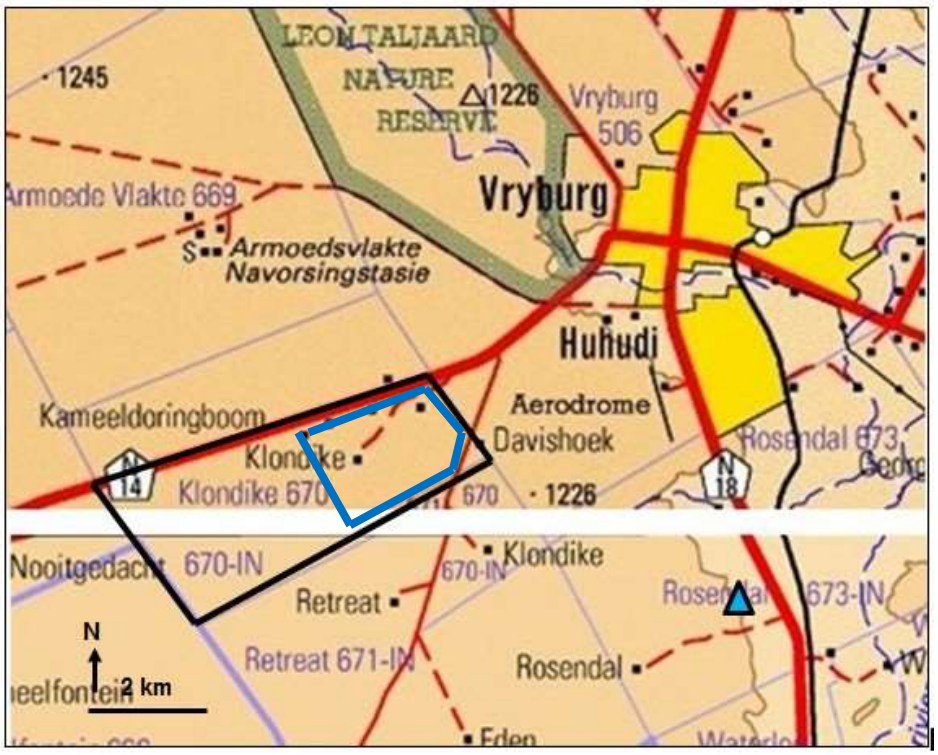

Figure 1. Extract from the adjoining 1: 250 000 topographical maps 2624 Vryburg and 2724 Christiana (Chief Directorate: National Geospatial Information, Mowbray) showing the location of the farm Klondike 670-IN on the south-western outskirts of Vryburg, Northwest Province (black polygon) as well as the study area within it for the proposed AMDA Delta Solar PV Development (blue polygon; see also Fig. 2). The blue triangle on Farm Rosendal 673-IN marks the location of the existing Mookodi Substation.

Figure 2: Google earth© satellite image showing the location of the proposed AMDA Delta Solar PV Development in flat terrain on the south-western outskirts of Vryburg, Northwest Province (purple polygon). The red line shows the route for the proposed 132 kV transmission line connecting the solar projects on farm Klondike 670-IN to the existing Mookodi Substation south of Vryburg.

2. GEOLOGICAL BACKGROUND

The study area on the Remaining Extent of Klondike No. 670-IN near Vryburg consists of typical flat-lying terrain of the Ghaap Plateau region at an elevation of *c*. 1230 – 1250 m amsl that is currently used for agricultural purposes (principally cattle farming) (Fig. 2). The climate is semi-arid and the dense vegetation cover of grassy thornveld is mapped as Ghaap Plateau Vaalbosveld. There are several small to large pans, often associated with substantial calcrete deposits (grey on satellite images, Fig. 3) within or just outside the study area. Bedrock exposure within the study area is more or less non-existent due to extensive cover by superficial deposits such as sandy soils and calcrete. A field study of very similar terrain on the adjacent farm Retreat 671-IN has recently been carried out by the author (Almond 2016) who has previously submitted a desktop palaeontological assessment for Farm Rosendal 673-IN where the Mookodi Substation is located (Almond 2013b).

The geology of the study area to the southwest of Vryburg is shown on the adjoining 1: 250 000 geology maps 2624 Vryburg and 2724 Christiana (Council for Geoscience, Pretoria) (Fig. 3). An explanation for the Vryburg geological map has been published by Keyser & Du Plessis (1993) and that for the adjoining Christiana sheet 2724 to the south by Schutte (1994). The entire study area is underlain *at depth* by ancient Precambrian sedimentary rocks of the **Schmidtsdrif Subgroup** that are almost flat-lying in this area. These Precambrian bedrocks are unlikely to be directly impacted

by the proposed solar facility development on Klondike No. 670-IN since they are largely or entirely mantled by much younger superficial deposits. These include Tertiary (Neogene) to Quaternary **calcrete hardpans** in the west and centre (T-Qc, middle yellow in Fig. 3) and **alluvial gravels** of probable Quaternary age in the east (Qa, dark yellow in Fig. 3).

Calcrete occurs widely in the Vryburg area, especially overlying the Ventersdorp, Boomplaas and Dwyka outcrop areas, notably in association with ancient drainage lines and pans. The most extensive calcrete deposits occur on the south-western side of pans as a consequence of the prevailing northwest winds (Keyser & Du Plessis 1993). Schutte (1994) notes that terraces of well-indurated calcrete occur in the valley of the Dröe Harts River some 30 km south of the present study area. The calcretes there contain rounded clasts of various rock types that have a probable Dwyka provenance. Calcretes on the farm Rosendal to the southeast of the present study area contain embedded “Palaeolithic stone tools” indicating a Quaternary or younger age for these deposits. River terrace alluvial gravels in the Vryburg area are typically dominated by clasts of brown quartzite that are probably derived from the Vryburg Formation (Keyser & Du Plessis 1993, Schutte 1994, Almond 2016). They also contain agates from the Ventersdorp lavas, and sometimes diamonds too. Based on field studies on the adjacent farm Retreat 671-In (Almond 2016) much of the present study area is probably mantled in pale orange-brown sandy soils, in part of aeolian origin since the region lies on the margins of the Kalahari Basin, with sparse surface gravels of calcrete, ferricrete and quartzite.

The proposed short 132 kV transmission line connection between the solar project area on Klondike No. 670-IN and the existing Mookodi Substation to the south of Vryburg will traverse outcrop areas of the Archaean **Vryburg Formation** and the Permo-Carboniferous **Dwyka Group** (respectively grey and dark blue in Fig. 3).

Smit *et al.* (1991) give a useful summary of the geology and sedimentology of the Vryburg Formation succession in its type area near Vryburg itself. The lower portion comprises a basal conglomerate followed by a 20 m-thick, prominent-weathering package of cross-bedded feldspathic quartzites known as the Kobaga beds. This is overlain by *c*. 20 m of andesitic or basaltic lavas (the Rosendal Member) and pyroclastic sediments and then another 20 m package of varied siliciclastic rocks including conglomerates, quartzites, grits, flaggy sandstones (often ripple marked) and shales. These last are often pitch black and calcitic. The overlying Waterloo Member consists of c. 20-50 m of amydaloidal and non-amydaloidal basaltic / andesitic lavas and is overlain by 14 m of interbedded pyroclastic sediments and thin lenticular limestones.

In the Vryburg region the Dwyka succession mainly consists of glacial tillite (boulder mudstone) and interglacial shale. Exposures levels are typically very poor, since the mudrock matrix weathers very readily, and consequently the Dwyka outcrop area represented at surface only by scattered erratic boulders (Keyser & Du Plessis 1993). Glacial striations of Dwyka age that are incised into older resistant quartzitic rocks of the Vryburg Formation near Mookodi Substation on the farm Rosendal 673 indicate southerly ice transport directions (circular symbol with arrow on geological map, Fig. 3) (Schutte 1994).

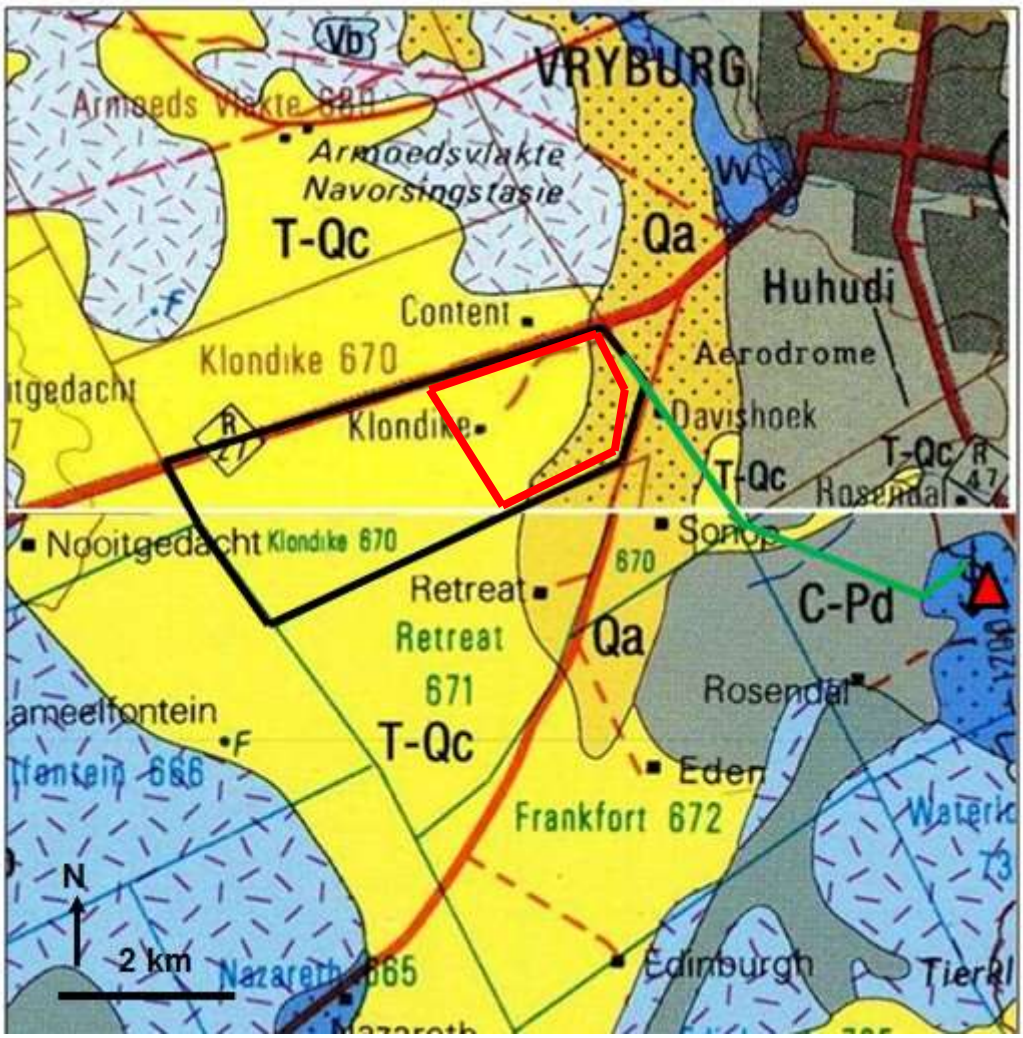

Figure 3. Extract from the adjoining 1: 250 000 geological maps 2624 Vryburg and 2724 Christiana (Council for Geoscience, Pretoria) showing the *approximate* outline of the study area for the proposed AMDA Delta Solar PV Development on the Remaining Extent of Klondike No. 670-IN, some 5.5 km southwest of Vryburg (red polygon). The green line shows the route for the proposed 132 kV transmission line connection to the existing Mookodi Substation (red triangle). The entire project area for the solar development is mantled by Late Caenozoic calcrete (pedogenic limestone) and alluvial gravels of probable Quaternary age (medium yellow / dark yellow). The main geological units represented mapped in the study region include:

Vryburg Formation (Vv, middle and dark blue) – late Archaean fluvial and shallow marine quartzites, mudrocks, conglomerates with two intervals of andesitic volcanics (stippled)

Boomplaas Formation (Vb, pale & middle blue with dashes) – late Archaean dolomites (locally stromatolitic or oolitic) interbedded with siliciclastics (quartzite, shale, flagstone)

Dwyka Group (C-Pd, middle grey) – Permo-Carboniferous glacial sediments (tillites, interglacial mudrocks)

Calcrete (T-Qc, medium yellow) – Late Caenozoic calcrete hardpans
Alluvial gravels (Qa, dark yellow with or without stipple) – Quaternary relict or high level gravels

3. PALAEONTOLOGICAL HERITAGE

Minor carbonate interbeds within the upper Vryburg Formation in its southern, more distal outcrop area (*e.g.* near Douglas) contain microbial stromatolites, and these are also recorded from the holostratotype section some 40 km south of Vryburg (Smit *et al.* 1991). The stromatolitic carbonates within the Vryburg succession interfinger with and pass up into siliclastic sediments and are interpreted as intertidal in setting (Altermann & Wotherspoon 1995). In the Vryburg area itself the succession is dominated by quartzites and lavas and does not appear to contain fossil stromatolites (Almond 2013a).

Outcrops of the Dwyka Group in the northern part of the Main Karoo Basin may contain low diversity non-marine trace fossil assemblages within interglacial mudrocks (predominantly fish and arthropod traces, *Rhizocorallium*) as well as scattered vascular plant remains (*e.g. Glossopteris* leaves, petrified wood) but the likelihood of significant fossil heritage in the Vryburg area is considered to be low.

Recent field examination of calcretes in the vicinity of the study area did not reveal any fossil material such as calcretised trace fossils (*e.g.* termitaria), land snails, or mammalian bones, teeth or horn cores (Almond 2016). Likewise no fossil bones or teeth were found in association with the fluvial gravels or pan sediments on Retreat 671 bordering the Klondike 670 study region on the southern side; these sediments do contain crudely-flaked stone artefacts of probable Pleistocene / ESA affinities, however (*ibid.*).

It is concluded that the bedrocks and superficial sediments underlying the study area are of low palaeontological sensitivity.

4. CONCLUSIONS & RECOMMENDATIONS

The AMDA Delta Solar PV Development study area, including the solar power plant as well as the 132 kV transmission line corridor to the Mookodi Substation, is underlain *at depth* by (1) late Archaean (*c*. 2.6 billion year-old) sedimentary rocks of the Schmidtsdrif Subgroup (Ghaap Group, Transvaal Supergroup) such as the Vryburg Formation and also by (2) Dwyka Group glacial rocks of Permo-Carboniferous age. These ancient bedrocks are entirely mantled by much younger, Late Caenozoic calcrete hardpans, sandy soils of possible aeolian origin and relict alluvial gravels related to the Dröe Harts River.

No fossil remains have been recorded from these rocks during recent palaeontological field assessments in the area and it is inferred that they are all of low palaeontological sensitivity. It is concluded that, with or without mitigation, the overall impact of the proposed solar energy facility on Farm Klondike No. 670 is of **NEGATIVE LOW SIGNIFICANCE** in palaeontological heritage terms; the proposed development, including the *c*. 5 km long 132 kV overhead transmission line connection to the existing Mokoodi Substation, is unlikely to have significant impacts on local palaeontological heritage resources.

It is therefore recommended that, pending the discovery of substantial new fossils remains during construction of the proposed AMDA Delta Solar PV Development on Farm Klondike No. 670 and of the associated 132 kV transmission lines, exemption from further specialist palaeontological studies and mitigation be granted for this project.

Should any substantial fossil remains (*e.g.* well-preserved stromatolites, mammalian bones and teeth) be encountered during excavation, these should be safeguarded, preferably *in situ*, and reported by the ECO to the South African Heritage Resources Authority, as soon as possible (SAHRA contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000. Tel: 021 462 4502. Email: cscheermeyer@sahra.org.za). This is to ensure that appropriate mitigation action can be taken by a professional palaeontologist, at the developer's expense. Mitigation would normally involve the scientific recording and judicious sampling or collection of fossil material as well as associated geological data (*e.g.* stratigraphy, sedimentology, taphonomy) by a professional palaeontologist.

These recommendations should be incorporated into the Environmental Management Plan for the proposed solar energy facility.

5. KEY REFERENCES

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6. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest, Gauteng, Mpumalanga and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development 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 the objectivity of my performing such work.

Dr John E. Almond
Palaeontologist, *Natura Viva* cc