RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES:

PROPOSED 300 MW PHOTOVOLTAIC ELECTRICITY GENERATION FACILITY & ASSOCIATED 132 kV POWER LINE ON PORTIONS 6 AND 3 OF FARM 187 OLYVENKOLK, KENHARDT DISTRICT, NORTHERN CAPE

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EXECUTIVE SUMMARY

Solar Energy Land (Pty) Ltd is proposing to construct a 300 MW Photovoltaic Electricity Generation Facility and an associated 132 kV power line (*c*. 7.8 km long) on Portion 6 and Portion 3 of Farm Olyvenkolk 187, located approximately 35 km southwest of the town of Kenhardt in the Kenhardt District, Northern Cape Province.

The site of the proposed PV solar facility is underlain at depth by glacial-related sediments of the Permo-Carboniferous Dwyka Group (Mzibane Formation) that are generally of low palaeontological sensitivity. The main categories of fossils recorded from the Mbizane beds include a small range of interglacial trace fossils, petrified woods and other plant materials, palynomorphs and supposed stromatolites (the last possibly spurious). Quaternary to Recent aeolian sediments of the Gordonia Formation (Kalahari Group), as well as alluvial gravels and calcretes along shallow drainage lines and around pans, all of generally low palaeontological sensitivity, are also encountered near-surface in the study area. Two billion year-old granites and metasediments of the Namaqua-Natal Province crop out in a small portion of the study area but these rocks are unfossiliferous, and in any case will not be directly affected by the proposed development.

The overall palaeontological sensitivity of the entire Olyvenkolk 187 (Portions 6 and 3) Solar Facility project area, including the various PV solar array site options as well as the associated 132 kV overhead transmission line corridor to Aries Substation, is assessed as LOW. Small pockets of locally HIGH sensitivity might occur along drainage lines and around any pans; Plio-Pleistocene calcretised gravels and finer-grained alluvium as well as calcrete hardpans in these last settings might contain mammalian remains such as bones, teeth and horn cores in addition to abundant, low-diversity trace fossil assemblages but these are rare and inherently unpredictable.

It is concluded that the overall impact significance (pre-mitigation) of the proposed PV Solar Facility on Olyvenkolk 187 Portions 6 and 3 is LOW (-). This assessment applies equally to all the PV solar array site options as well as the proposed 132 kV transmission line. There is no preference on palaeontological heritage grounds for any of the PV array site options or any particular transmission line route option to the Aries Substation. Given the generally low impact significance assigned to other comparable solar facility projects in the Kenhardt region, the cumulative impact significance of the current project is likewise assessed as low. The No-Go option (no PV facility) would have a neutral impact on local fossil heritage resources. Providing that the construction

phase mitigation recommendations outlined below are followed through, there are no objections on palaeontological heritage grounds to authorisation of the proposed development.

The following mitigation measures to safeguard any fossils exposed on site during the construction phase of the development are proposed (See also tabulated Fossil Finds Procedure appended to this report):

- The ECO responsible for the development must remain aware that all sedimentary deposits have the potential to contain fossils and he/she should thus monitor all deeper (> 1 m) excavations into sedimentary bedrock for fossil remains on an on-going basis. If any substantial fossil remains (*e.g.* vertebrate bones, teeth, stromatolites, petrified wood, shells) are found during construction SAHRA should be notified immediately (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web : www.sahra.org.za). This is in order that that appropriate mitigation (*i.e.* recording, sampling or collection) by a palaeontological specialist can be considered and implemented, at the developer's expense.

- A chance-find procedure should be implemented so that, in the event of fossils being uncovered, the ECO/Site Engineer will take the appropriate action, which includes:
    - Stopping work in the immediate vicinity and fencing off the area with tape to prevent further access;
    - Reporting the discovery to the provincial heritage agency and/or SAHRA;
    - Appointing a palaeontological specialist to inspect, record and (if warranted) sample or collect the fossil remains;
    - Implementing further mitigation measures proposed by the palaeontologist; and
    - Allowing work to resume only once clearance is given in writing by the relevant authorities.

- During maintenance and servicing of infrastructure, if excavation is required, it shall be limited to the disturbed footprint as far as practicable. Should bulk works exceed the existing disturbed footprint, SAHRA shall be notified.

If the mitigation measures outlined above are adhered to, the residual impact significance of any construction phase impacts on local palaeontological resources is considered to be very low.

The mitigation measures proposed here should be incorporated into the Environmental Management Plan (EMP) for the Olyvenkolk 187 (Portions 6 & 3) PV solar facility project.

The palaeontologist concerned with mitigation work will need a valid collection permit from SAHRA. All work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere to the minimum standards for Phase 2 palaeontological studies recently published by SAHRA (2013).

1. PROJECT OUTLINE & BRIEF

The company Solar Energy Land (Pty) Ltd is proposing to construct a 300 MW Photovoltaic Electricity Generation Facility and an associated 132 kV power line (*c*. 7.8 km long) on Portion 6 and Portion 3 of Farm Olyvenkolk 187, located approximately 35 km southwest of the town of Kenhardt in the Kenhardt District, Northern Cape Province (Figs. 1 & 2). The proposed development area is currently used for agricultural purposes (mainly small stock grazing) and is largely is covered by indigenous vegetation that will be cleared over an estimated footprint of approximately 600 ha. The proposed development will be constructed closer than 32 meters from watercourses. The facility and associated infrastructure will be accessed on a 6 m-wide road with direct access off the Kenhardt to Pofadder gravel road. Water will be sourced from existing boreholes.

The main infrastructure relevant to the present palaeontological heritage study includes:

- Solar panels arranged in units with a generating capacity of approximately 300 MW and a total footprint of approximately 600 ha. The panels would be mounted on the ground using a ground screw. A concrete foot piece secured to a steel pin driven into the ground would be used where it is not feasible to use ground screws.
- Underground electricity cables connecting the panels to each other.
- A 5 m-wide management track surrounding each block of photovoltaic arrays, totaling approximately 9 km of gravel road. The access roads will be constructed through some of the drainage lines.
- A 132 kV power line (mono-pole structures) of approximately 7 km length that crosses Portions 6 and 3 of Farm 187 to feed the electricity generated by the solar facility into the existing Aries substation;
- Expansion of the Aries substation to receive the generated electricity into the ESKOM grid; and
- Ancillary infrastructure such as inverters and transformers, conductors (cables), a central bushbar, isolators, switch gear, protection infrastructure, measurement devices and maintenance facility and security and control room.

All palaeontological heritage resources in the Republic of South Africa are protected by the National Heritage Resources Act (Act 25 of 1999) (See Section 1.2 below). Heritage resource management in the Northern Cape is the responsibility of the South African Heritage Resources Agency or SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). A Palaeontological Desk Top study to assess whether or not the proposed development will impact upon palaeontological resources has been requested by the South African Heritage Resources Agency (SAHRA Case ID: 11247; Interim Comment of July 24, 2017).

The present report has accordingly been commissioned as part of the Scoping and EIA process for this development by the Agency for Cultural Resource Management, ACRM (Contact details: Mr Jonathan Kaplan. Address: 5 Stuart Road, Rondebosch. P/F: 021 685 7589. M: 082 321 0172. Email: acrm@wcacces.co.za). It contributes to the broader environmental assessment process for the project that is being co-ordinated by Eco Impact Legal Consulting (Pty) (Contact details: Mr Nicolaas Hanekom**.** Eco Impact Legal Consulting (Pty) Ltd. P.O. Box 45070 Claremont 7735 . Tel: 021 671 1660. Fax: 021 671 9976. E-mail: nicolaas@ecoimpact.co.za).

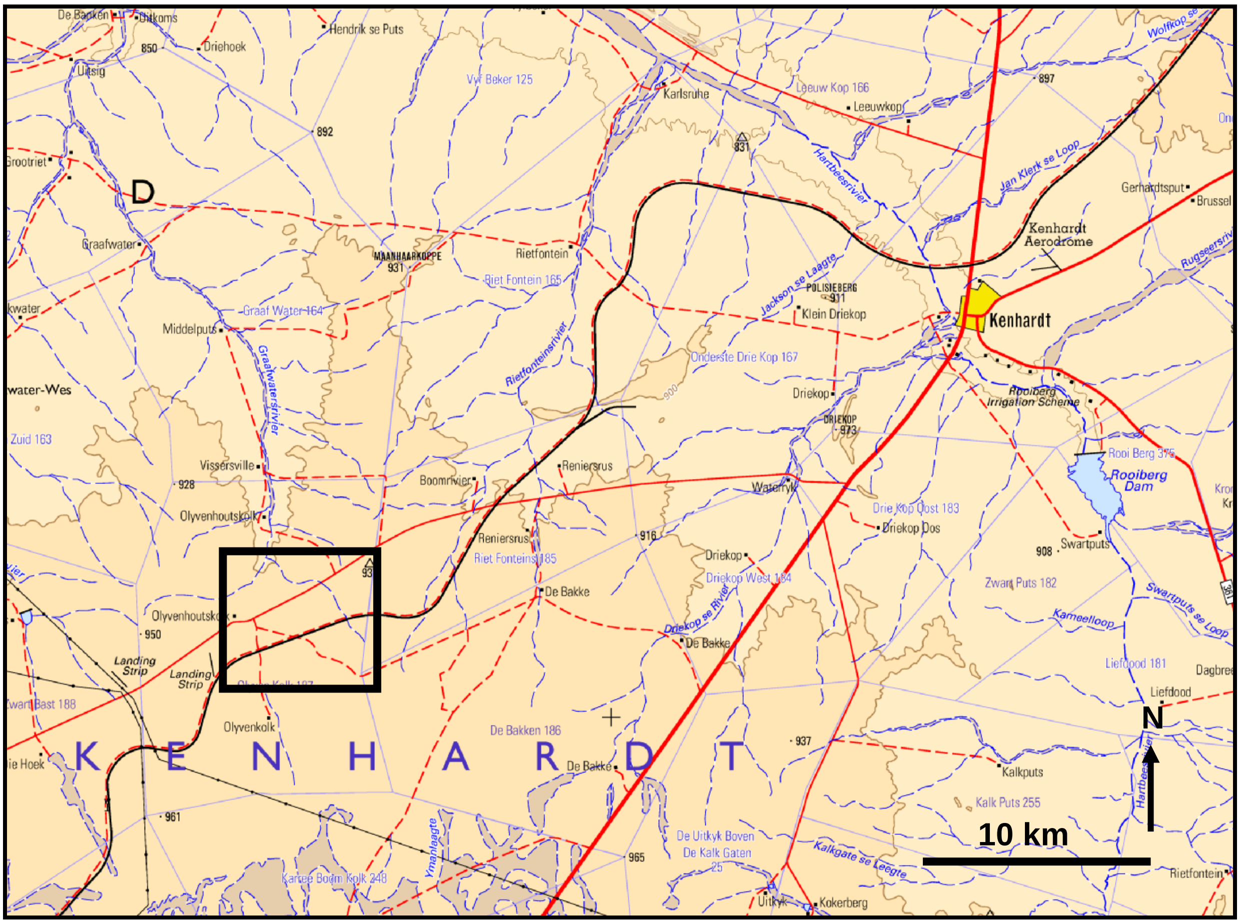

Figure 1. Extract from 1: 250 000 topographical sheet 2920 Kenhardt (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the *approximate* location of solar PV facility study area Farm Olyvenkolk 187, situated *c*. 35 km southwest of Kenhardt, Northern Cape Province.

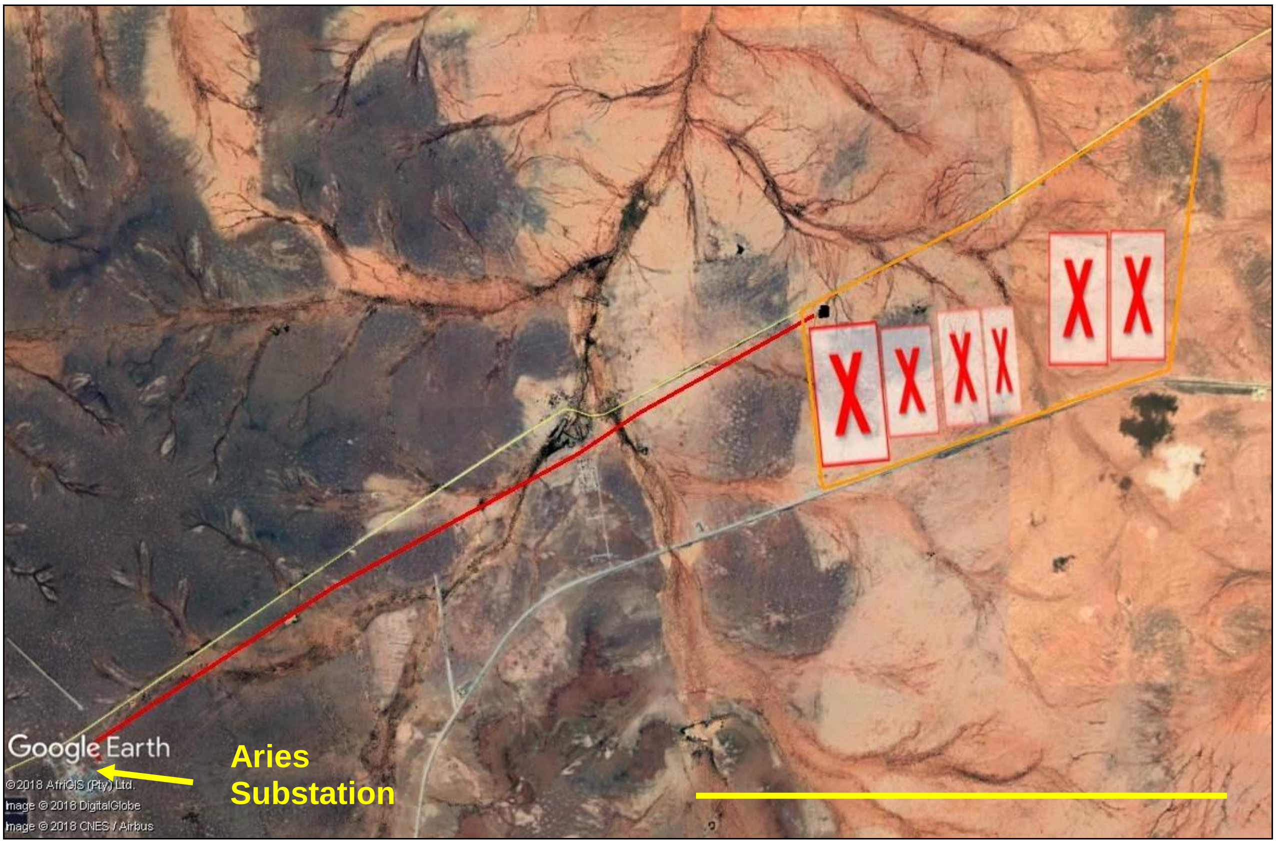

Figure 2. Google Earth© satellite image of the PV solar facility project area (orange polygon) and associated 132 kV transmission line (red line) on Portions 6 and 3 of Farm Olyvenkolk 187 near Kenhardt. Potential solar panel array sites are indicated by the white rectangles. Scale bar = 5 km. N towards the top of the image.

1.2. Legislative context for palaeontological assessment studies

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act (Act 25 of 1999) include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites;
- palaeontological objects and material, meteorites and rare geological specimens.

According to Section 35 of the National Heritage Resources Act, dealing with archaeology, palaeontology and meteorites:
(1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
(2) All archaeological objects, palaeontological material and meteorites are the property of the State.
(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity 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.
(4) 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.
(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—
(a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
(b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;
(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph *(a)* to apply for a permit as required in subsection (4); and
(d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have been published by SAHRA (2013).

1.3. Approach to the desktop palaeontological heritage study

The approach to this desktop palaeontological heritage study is briefly as follows. Fossil bearing rock units occurring within the broader study area are determined from geological maps and satellite images. Known fossil heritage in each rock unit is inventoried from scientific literature, previous assessments of the broader study region, and the author's field experience and palaeontological database (Table 1). Based on this data as well as field examination of representative exposures of all major sedimentary rock units present, the impact significance of the proposed development is assessed with recommendations for any further studies or mitigation.

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations *etc.*) represented within the study area are determined from geological maps and satellite images. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author's field experience (consultation with professional colleagues as well as examination of institutional fossil collections may play a role here, or later following field assessment during the compilation of the final report). This data is then used to assess the palaeontological sensitivity of each rock unit to a development (Provisional tabulations of palaeontological sensitivity of all formations in the Western, Eastern and Northern Cape have already been compiled by J. Almond and colleagues; *e.g.* Almond & Pether 2008).

The likely impact of the proposed development on local fossil heritage is then determined on the basis of (1) the palaeontological sensitivity of the rock units concerned, and (2) the nature and scale of the development itself, most significantly the extent of fresh bedrock excavation envisaged. When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a Phase 1 field assessment study by a professional palaeontologist is usually warranted to identify any palaeontological hotspots and make specific recommendations for any mitigation required before or during the construction phase of the development.

On the basis of the desktop and Phase 1 field assessment studies, the likely impact of the proposed development on local fossil heritage and any need for specialist mitigation are then determined. Adverse palaeontological impacts normally occur during the construction rather than the operational or decommissioning phase. Phase 2 mitigation by a professional palaeontologist – normally involving the recording and sampling of fossil material and associated geological information (*e.g.* sedimentological data) may be required (a) in the pre-construction phase where important fossils are already exposed at or near the land surface and / or (b) during the construction phase when fresh fossiliferous bedrock has been exposed by excavations. To carry out mitigation, the palaeontologist involved will need to apply for a palaeontological collection permit from the relevant heritage management authority (*e.g.* SAHRA for the Northern Cape). It should be emphasized that, *provided that appropriate mitigation is carried out*, the majority of developments involving bedrock excavation can make a *positive* contribution to our understanding of local palaeontological heritage.

1.4. Assumptions & limitations

The accuracy and reliability of palaeontological specialist studies as components of heritage impact assessments are generally limited by the following constraints:

1. Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant ("mappable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil *etc.*), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.

3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information.

4. The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (*e.g*. of commercial mining companies) - that is not readily available for desktop studies.

5. Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:
(a) *underestimation* of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
(b) *overestimation* of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium *etc.*).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails *inferring* the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist. In the present case, site visits to the various loop and borrow pit study areas in some cases considerably modified our understanding of the rock units (and hence potential fossil heritage) represented there.

In the case of the study area near Kenhardt a major limitation for fossil heritage studies is the low level of surface exposure of potentially fossiliferous bedrocks, as well as the paucity of previous field-based specialist palaeontological studies in the Northern Cape region as a whole.

1.5. Information sources

The information used in this desktop study was based on the following:

1. A short project outline (Draft Scoping Report) and kmz files provided by Eco Impact Legal Consulting (Pty);
2. A review of the relevant scientific literature, including published geological maps and accompanying sheet explanations as well as several desktop and field-based palaeontological assessment studies in the broader Kenhardt region of the Northern Cape by the author (See References);
3. Examination of relevant topographical maps and satellite images, as well as several field images kindly provided by Dr Jayson Orton of ASHA Consulting;
4. The author's previous field experience with the formations concerned and their palaeontological heritage (See also review of Northern Cape fossil heritage by Almond & Pether 2008).

2. GEOLOGICAL BACKGROUND

The study area for the proposed PV solar energy facility as well as of the associated 132 kV transmission line corridors to Aries Substation on Farm Olyvenkolk 187 (Portions 6 & 3), located some 35 km southwest of Kenhardt, is situated at an elevation of *c*. 900-950 m amsl. in semi-arid, flat-lying terrain of the Bushmanland region of the Northern Cape (Northern Cape Pan Veld geomorphic region of Partridge *et al.* 2010). The region is drained by a dendritic network of shallow, broadly north-flowing tributary streams of the Hartbeesrivier such as the Graafwatersrivier and other unnamed drainage lines (Fig. 2).

The geology of the study area is outlined on the 1: 250 000 geology map 2920 Kenhardt (Council for Geoscience, Pretoria; Fig. 3 herein). An explanation to the Kenhardt geological map has been published by Slabbert *et al.* (1999). Several of the relevant rock units are also treated in the explanations for the adjacent 1: 250 000 sheets such as the Britstown sheet to the southeast (Prinsloo 1989), the Pofadder sheet to the west (Agenbacht 2007) and the Sakrivier sheet to the south (Siebrits 1989).

According to the 1: 250 000 geology map 2920 Kenhardt (Fig. 3) the project area for the proposed PV solar facility on Portions 6 and 3 of Farm Olyvenkolk 187 is underlain at depth by glacially-relaetd sediments of the Permo-Carboniferous **Dwyka Group** (Karoo Supergroup, **C-Pd**). Small exposures of Mokolian (Mid Proterozoic) basement rocks of the **Namaqua-Natal Province** (De Bakken Granite, **Mdk**, and the Kokerberg Formation, **Mko**) occur in the north-eastern portion of farm Olyven Kolk 187, albeit outside the footprint of the proposed solar facility on Portion 6. They comprise two billion year old granitoid intrusions and highly metamorphosed sediments (*cf* Cornell *et al.* 2006) that are of no palaeontological interest, so they will not be treated further here. **Quaternary alluvium** associated with shallow water courses as well as more widespread wind-blown sands of the **Gordonia Formation** (**Kalahari Group**) (Q) *plus* other Late Caenozoic superficial sediments - mostly unmapped at 1: 250 000 scale - such as surface downwasted surface gravels and calcrete hardpans mantle a large proportion of the Namaqua-Natal and Dwyka bedrocks here (Fig. 5). Small outcrop areas of **Karoo Dolerite** (**Jd**) outside and to the east of the study area.

2.1. Dwyka Group

Permo-carboniferous glacially-related sediments of the **Dwyka Group** (**C-Pd** in Fig. 3) underlie the thin, superficial cover of Gordonia sands, calcrete and Late Caenozoic alluvium and crop out at surface within the study area southwest of Kenhardt. The geology of the Dwyka Group has been summarized by Visser (1989), Visser *et al.* (1990) and Johnson *et al.* (2006), among others. The geology of the Dwyka Group along the north-western margin of the Main Karoo Basin as far east as Prieska has been reviewed by Visser (1985). Other studies on the Dwyka in or near the Prieska Basin include those by Visser *et al.* (1977-78; summarized by Zawada 1992) and Visser (1982). Fairly detailed observations by Prinsloo (1989) on the Dwyka beds on the northern edge of the Britstown 1: 250 000 geology sheet are in part relevant to the more proximal (near-source) outcrops at Kenhardt. Massive tillites at the base of the Dwyka succession (**Elandsvlei Formation**) were deposited by dry-based ice sheets in deeper basement valleys. Later climatic amelioration led to melting, marine transgression and the retreat of the icesheets onto the continental highlands in the north. The valleys were then occupied by marine inlets within which drifting glaciers deposited dropstones onto the muddy sea bed ("boulder shales"). The upper Dwyka beds (**Mbizane Formation**) are typically heterolithic, with shales, siltstones and fine-grained sandstones of deltaic and / or turbiditic origin. These upper successions are typically upwards-coarsening and show extensive soft-sediment deformation (loading and slumping). Varved (rhythmically laminated) mudrocks with gritty to fine gravely dropstones indicate the onset of highly seasonal climates, with warmer intervals leading occasionally even to limestone precipitation.

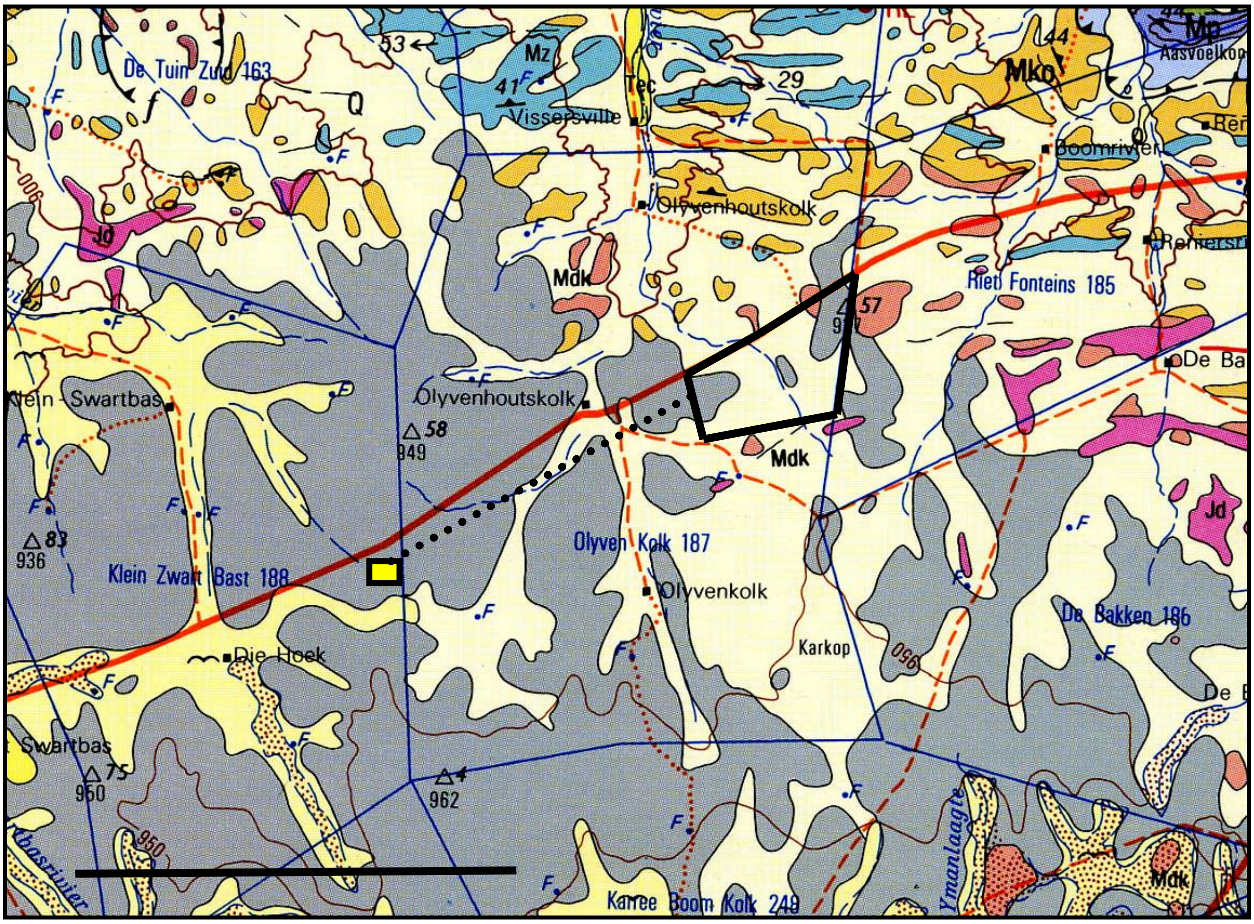

Figure 3. Extract from 1: 250 000 geological map 2920 Kenhardt (Council for Geoscience, Pretoria) showing the *approximate* location of proposed PV solar facility study area on Portion 6 of Farm Olyven Kolk 187 (black polygon) as well as the associated 132 kV transmission line (black dotted line) to Aries Substation (yellow rectangle). The development footprint is underlain by Quaternary alluvium (Q, pale yellow) and Dwyka Group glacial deposits at depth (C-Pd, grey). Scale bar = 10 km. N towards the top of the image.

MAIN GEOLOGICAL UNITS:
Orange (Mdk) = De Bakken Granite (Mokolian Basement, De Kruis Fragment)
Dark yellow (Mko) = Kokerberg Formation (De Kruis Group, De Kruis Fragment of Mokolian Basement)
Grey (C-Pd) = Mbizane Formation (Permo-Carboniferous Dwyka Group, Karoo Supergroup)
Pale yellow (Q) = Quaternary to Recent sands and sandy soil of the Gordonia Formation (Kalahari Group).
Purple (Jd) = Karoo Dolerite Suite

According to maps in Visser *et al.* (1990) and Von Brunn and Visser (1999; Fig. 4 herein) the Dwyka rocks in the Kenhardt area close to the northern edge of the Main Karoo Basin belong to the **Mbizane Formation**. This is equivalent to the “Northern (valley and inlet) Facies” of Visser *et al*. (1990). The Mbizane Formation, up to 190 m thick, is recognized across the entire northern margin of the Main Karoo Basin where it may variously form the whole or only the *upper* part of the Dwyka succession. It is characterized by its extremely heterolithic nature, with marked vertical and horizontal facies variation (Von Brunn & Visser 1999). The proportion of diamictite and mudrock is often low, the former often confined to basement depressions. Orange-tinted sandstones (often structureless or displaying extensive soft-sediment deformation, amalgamation and mass flow processes) may dominate the succession. The Mbizane-type heterolithic successions characterize the thicker Dwyka of the ancient palaeovalleys cutting back into the northern basement rocks. The key Reference Stratotype C section for the valley fill facies of the Mbizane Formation is located a few kilometres west of Douglas on the northern side of the Vaal River (Von Brunn & Visser 1999). The composite section, which overlies glacially-striated Precambrian bedrock, is some 25-30m thick. The lower part of the section consists of massive diamictites with subordinate conglomerates and siltstones. The upper half is dominated by laminated mudrocks with thin diamictites, lonestones (dropstones) and calcareous concretions. The section is conformably overlain by mudrocks of the Prince Albert Formation (Ecca Group) which is not represented in the study area.

For details of the Dwyka Group rocks in the Kenhardt area the reader is referred to the accounts of Visser (1985) and Slabbert *et al.* (1999). The study area *c*. 35km southwest of Kenhardt lies close to the eastern edge of the Sout River palaeovalley identified by Visser (1985, fig. 12 therein). The Dwyka succession in this area comprises both massive, muddy diamictites ("boulder shales") as well as heterolithic intervals dominated by interbedded reddish-brown, pebbly sandstones, conglomerates, and diamictite (ibid., figs. 2, 4). Slabbert *et al.* (1999, p. 107) report that the uppermost Dwyka beds contain stromatolites, oolites and calcareous concretions.

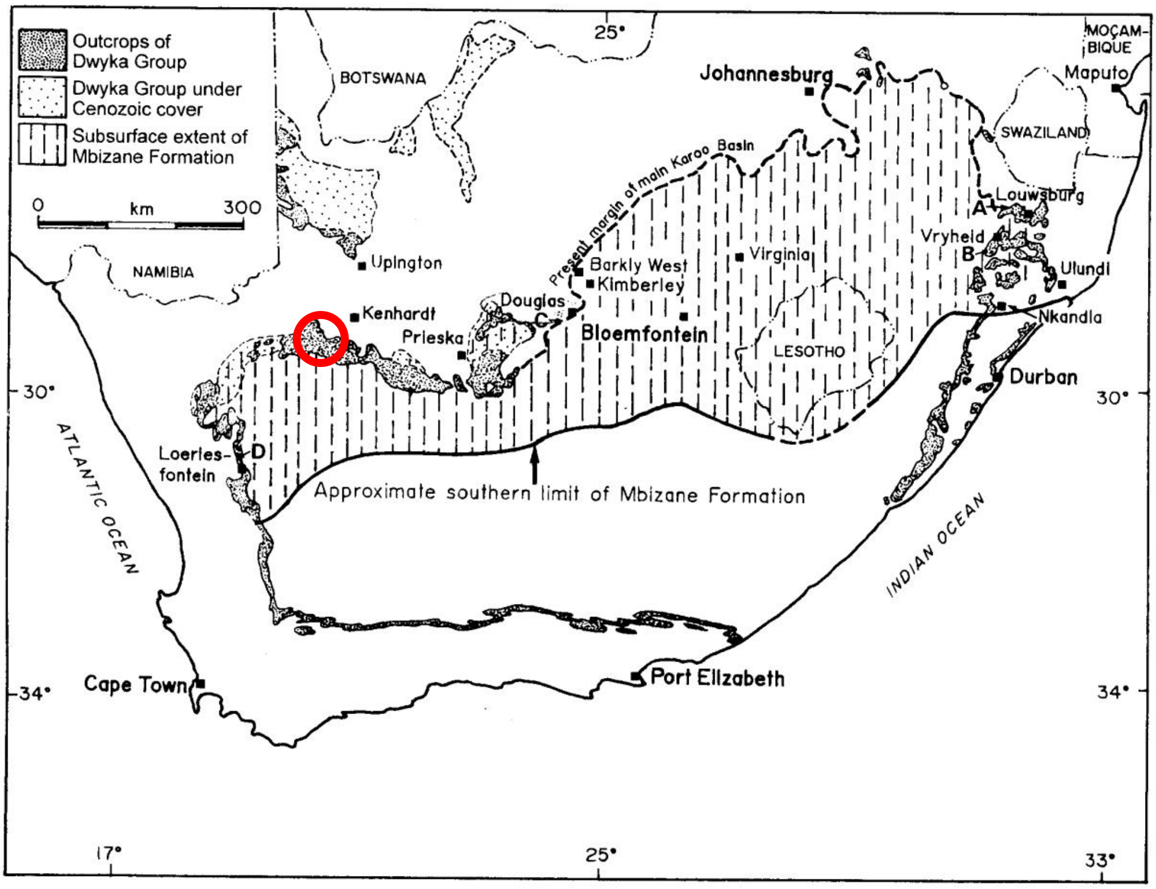

Figure 4. Outcrop map of the Dwyka Group within the Main Karoo Basin of South Africa. Exposures in the study area southwest of Kenhardt (red circle) are assigned to the outcrop area of the Mbizane Formation (From Von Brunn & Visser 1999).

2.2. Late Caenozoic superficial deposits

Unconsolidated, reddish-brown aeolian (*i.e.* wind-blown) sands of the Quaternary **Gordonia Formation** (**Kalahari Group**) (**Q** in Fig. 3) blanket large areas of the landscape in the Kenhardt area (Slabbert *et al.* 1999). The geology of the Late Cretaceous to Recent Kalahari Group is reviewed by Thomas (1981), Dingle *et al.* (1983), Thomas *et al.* (1988), Thomas & Shaw 1991, Haddon (2000) and Partridge *et al.* (2006). The Gordonia dune sands are considered to range in age from the Late Pliocene / Early Pleistocene to Recent, dated in part from enclosed Middle to Later Stone Age stone tools (Dingle *et al*., 1983, p. 291). Note that the recent extension of the Pliocene - Pleistocene boundary from 1.8 Ma back to 2.588 Ma places the Gordonia Formation within the Pleistocene to Recent Epoch.

According to Slabbert *et al.* (1999, p. 109) Gordonia wind-blown sands in the Kenhardt area, far to the south of the main Kalahari Basin, are thin, rarely preserve longitudinal dune bedforms (these are seen along the Hartbeesrivier near Kenhardt but not further west), and are probably of Holocene age. In the study area the thin superficial blanket of sandy sediments is admixed with local weathering products of the Karoo and other bedrocks. According to these geological survey authors, the sands capping the plains west of the Hartbeesrivier might not in fact be correlated with the Gordonia Formation proper, although they are at least in part derived from the Kalahari Basin.

Figure 5. Calcrete hardpan and dark-patinated downwasted surface gravels exposed in Portion 6 of Olyvenkolk 187 (Image kindly provided by Dr Jayson Orton of ASHA Consulting (Pty) Ltd).

Late Caenozoic **alluvial deposits** of the Hartbeesrivier tributaries are not described or discussed in detail by Slabbert *et al.* (1999). In addition to finer-grained silts and sands, in the study area they probably include an admixture of coarser gravels derived from weathering of the Karoo rocks (*e.g.* polymict, bouldery erratics and pebbles from diamictites and conglomerates of the Dwyka Group).

De Wit (1999) discusses the post-Gondwana evolution of the drainage systems in the Bushmanland region, including pans between Kenhardt and Brandvlei that fed floodwaters from the region *via* the Sakrivier and Hartbees Rivers into the Orange from at least the Plio-Pleistocene times (Ibid., fig. 13. See also De Wit *et al.* 2000).

3. PALAEONTOLOGICAL HERITAGE

The fossil heritage recorded within each of the main sedimentary rock successions occurring within the broader study region near Kenhardt is outlined here (See also summary provided in Table 1 below, abstracted from Almond 2011).

3.1. Fossils in the Dwyka Group

The generally poor fossil record of the Dwyka Group (McLachlan & Anderson 1973, Anderson & McLachlan 1976, Visser 1989, Visser *et al*., 1990, Von Brunn & Visser 1999, Visser 2003, Almond & Pether 2008) is hardly surprising given the glacial climates that prevailed during much of the Late Carboniferous to Permian Periods in southern Africa. However, most Dwyka sediments were deposited during periods of glacial retreat associated with climatic amelioration. Sparse, low diversity fossil biotas from the Mbizane Formation in particular mainly consist of arthropod trackways associated with interglacial to post-glacial dropstone laminites and sporadic vascular plant remains (drifted wood and leaves of the *Glossopteris* Flora), while palynomorphs (organic-walled microfossils) are also likely to be present within finer-grained mudrock facies. Glacial diamictites (tillites or "boulder mudstones") are normally unfossiliferous but do occasionally contain fragmentary transported plant material as well as palynomorphs in the fine-grained matrix. There are interesting records of limestone glacial erratics from tillites along the southern margins of the Great Karoo (Elandsvlei Formation) that contain Cambrian eodiscid trilobites as well as archaeocyathid sponges. Such derived fossils provide important data for reconstructing the movement of Gondwana ice sheets (Cooper & Oosthuizen 1974, Stone & Thompson 2005).

A limited range of marine fossils are associated with the later phases of several of the four main Dwyka deglaciation cycles (DSI to DSIV). These are especially well known in the Kalahari Basin of southern Namibia but also occur sporadically within the Main Karoo Basin in South Africa (Oelofsen 1986, Visser 1989, 1997, Visser *et al*. 1997, Bangert *et al*. 1999 & 2000, Stollhofen *et al*. 2000, Almond 2008a, b). These deglaciation sequences are estimated to have lasted five to seven million years on average (Bangert *et al*. 1999). A range of stenohaline (*i.e.* exclusively salt water) invertebrate fossils indicates that fully marine salinities prevailed at the end of each sequence, at least in the western outcrop area (Namibia, Northern Cape). These invertebrates include echinoderms (starfish, crinoids, echinoids), cephalopods (nautiloids, goniatites), articulate brachiopods, bryozoans, foraminiferans, and conulariids, among others. Primitive bony fish (palaeoniscoids), spiral "coprolites" attributable to sharks or eurypterids, as well as wood and trace fossils are also recorded from mudrock facies at the tops of DSII (Ganikobis Shale Member), DS III (Hardap Member) and DSIV (Nossob Shale Member), as well as base of the Prince Albert Formation (Ecca Group) in southern Namibia and, in the last case at least, in the Northern Cape near Douglas (McLachlan and Anderson 1973, Veevers *et al*. 1994, Grill 1997, Bangert *et al*. 1999, Pickford & Senut 2002, Evans 2005). The Ganikobis (DSII) fauna has been radiometrically dated to *c*. 300 Ma, or end-Carboniferous (Gzhelian), while the Hardap fauna (DSIII) is correlated with the *Eurydesma* transgression of earliest Permian age (Asselian) that can be widely picked up across Gondwana (Dickens 1961, 1984, Bangert *et al*. 1999, Stollhofen *et al*. 2000). The distinctive thick-shelled bivalve *Eurydesma*, well known from the Dwyka of southern Namibia, has not yet been recorded from the main Karoo Basin, however (McLachlan and Anderson 1973). The upper part of DSIV, just above the Dwyka / Ecca boundary in the western Karoo Basin (*i.e.* situated within the basal Prince Albert Formation), has been radiometrically dated to 290-288 Ma (Stollhofen *et al*. 2000).

Low diversity ichnoassemblages dominated by non-marine arthropod trackways are widely associated with cold water periglacial mudrocks, including dropstone laminites, within the Mbizane Formation in the Main Karoo Basin (Von Brunn & Visser, 1999, Savage 1970, 1971, Anderson 1974, 1975, 1976, 1981, Almond 2008a, 2009). They are assigned to the non-marine / lacustrine *Mermia* ichnofacies that has been extensively recorded from post-glacial epicontinental seas and large lakes of Permian age across southern Gondwana (Buatois & Mangano 1995, 2004). These Dwyka ichnoassemblages include the arthropod trackways *Maculichna*, *Umfolozia* and *Isopodichnus*, the possible crustacean resting trace *Gluckstadtella*, sinuous fish-fin traces (*Undichna*) as well as various unnamed horizontal burrows. The association of these interglacial or post-glacial ichnoassemblages with rhythmites (interpreted as varvites generated by seasonal ice melt), the absence of stenohaline marine invertebrate remains, and their low diversity suggest a restricted, fresh- or brackish water environment. Herbert and Compton (2007) also inferred a freshwater depositional environment for the Dwyka / Ecca contact beds in the SW Cape based on geochemical analyses of calcareous and phosphatic diagenetic nodules within the upper Elandsvlei and Prince Albert Formations respectively. Well-developed U-shaped burrows of the ichnogenus *Rhizocorallium* are recorded from sandstones interbedded with varved mudrocks within the upper Dwyka Group (Mbizane facies) on the Britstown sheet (Prinsloo 1989). Similar *Rhizocorallium* traces also described from the Dwyka Group of Namibia (*e.g.* the Hardap Shale Member, Miller 2008). References to occurrences of the complex helical spreiten burrow *Zoophycos* in the Dwyka of the Britstown sheet and elsewhere (*e.g.* Prinsloo 1989) are probably in error, since in Palaeozoic times this was predominantly a shallow marine to estuarine ichnogenus (Seilacher 2007).

Scattered records of fossil vascular plants within the Dwyka Group of the Main Karoo Basin record the early phase of the colonisation of SW Gondwana by members of the *Glossopteris* Flora in the Late Carboniferous (Plumstead 1969, Anderson & McLachlan 1976, Anderson & Anderson 1985 and earlier refs. therein). These records include fragmentary carbonized stems and leaves of the seed ferns *Glossopteris* / *Gamgamopteris* and several gymnospermous genera (*e.g. Noeggerathiopsis, Ginkgophyllum*) that are even found within glacial tillites. More "primitive" plant taxa include lycopods (club mosses) and true mosses such as *Dwykea*. It should be noted that the depositional setting (*e.g.* fluvial *versus* glacial) and stratigraphic position of some of these records are contested (*cf* Anderson & McLachlan 1976). Petrified woods with well-developed seasonal growth rings are recorded from the upper Dwyka Group (Mbizane Formation) of the northern Karoo Basin (*e.g.* Prinsloo 1989) as well as from the latest Carboniferous of southern Namibia. The more abundant Namibian material (*e.g. Megaporoxylon*) has recently received systematic attention (Bangert & Bamford 2001, Bamford 2000, 2004) and is clearly gymnospermous (pycnoxylic, *i.e.* dense woods with narrow rays) but most woods cannot be assigned to any particular gymnosperm order.

Borehole cores through Dwyka mudrocks have yielded moderately diverse palynomorph assemblages (organic-walled spores, acanthomorph acritarchs) as well as plant cuticles. These mudrocks are interbedded with diamictites in the southern Karoo as well as within Dwyka valley infills along the northern margin of the Main Karoo Basin (McLachlan & Anderson 1973, Anderson 1977, Stapleton 1977, Visser 1989, Anderson & Anderson 1985). Thirty one Dwyka palynomorph species are mentioned by the last authors, for example. Anderson's (1977) Late Carboniferous to

Early Permian Biozone 1 based on Dwyka palynomorph assemblages is characterized by abundant *Microbaculispora*, monosaccate pollens (*e.g. Vestigisporites*) and nontaeniate bisaccate pollens (*e.g. Pityosporites*) (Stephenson 2008). Prinsloo (1989) mentions stromatolitic limestone lenses within the uppermost Dwyka Group in the Britstown sheet area while stromatolites are also recorded within the uppermost Dwyka beds in the Kenhardt area (Slabbert *et al.* 1999). These may be comparable to interglacial microbial mats and mounds described from the Ganikobis Shale Member (DSII) of southern Namibia by Grill (1997) and Bangert *et al.* (2000). However, it should be noted that abiogenic cone-in-cone structures developed within ferruginous diagenetic carbonate nodules have also been frequently mistaken for stromatolites in the past. Some of these Karoo stromatolite records may therefore in fact refer to pseudofossils.

Although a wide range of fossils are now known from the Dwyka Group, most sediments assigned to this succession are unfossiliferous (with the possible exception of microfossils). The overall palaeontological sensitivity of the Dwyka Group is therefore rated as low (Almond & Pether 2008). Any interglacial mudrocks and heterolithic successions (*i.e.* interbedded sandstones and mudrocks) are worth investigating for fossils, however, and the more proximal Mbizane Formation may be considered to be of moderate palaeontological sensitivity.

3.2. Fossils within the superficial deposits

The fossil record of the **Kalahari Group** is generally sparse and low in diversity. The **Gordonia Formation** dune sands were mainly active during cold, drier intervals of the Pleistocene Epoch that were inimical to most forms of life, apart from hardy, desert-adapted species. Porous dune sands are not generally conducive to fossil preservation. However, mummification of soft tissues may play a role here and migrating lime-rich groundwaters derived from the underlying Dwyka Group may lead to the rapid calcretisation of organic structures such as burrows and root casts. Occasional terrestrial fossil remains that might be expected within this unit include calcretized rhizoliths (root casts) and termitaria (*e.g. Hodotermes*, the harvester termite), ostrich egg shells (*Struthio*) and shells of land snails (*e.g. Trigonephrus*) (Almond 2008a, Almond & Pether 2008). Other fossil groups such as freshwater bivalves and gastropods (*e.g. Corbula, Unio*) and snails, ostracods (seed shrimps), charophytes (stonewort algae), diatoms (microscopic algae within siliceous shells) and stromatolites (laminated microbial limestones) associated with local watercourses and pans. Microfossils such as diatoms may be blown by wind into nearby dune sands (Du Toit 1954, Dingle *et al*., 1983). These Kalahari fossils (or subfossils) can be expected to occur sporadically but widely, and the overall palaeontological sensitivity of the Gordonia Formation is therefore considered to be low. Underlying **calcretes** might also contain trace fossils such as rhizoliths, termite and other insect burrows, or even mammalian trackways. Mammalian bones, teeth and horn cores (also tortoise remains, and fish, amphibian or even crocodiles in wetter depositional settings) may be expected occasionally expected within Kalahari Group sediments and calcretes, as well as in associated ancient alluvial gravels. A brief review of fossil biotas within Neogene alluvial deposits of the Loeriesfontein / Bushmanland region has been given by Almond (2008a; see also papers by Cooke 1949, Wells 1964, Butzer *et al.* 1973, Helgren 1977, Klein 1984, Macrae 1999). They include remains of fish, reptiles, mammals, freshwater molluscs, petrified wood and trace fossils (*e.g.* De Wit 1990, 1993, De Wit & Bamford 1993, Bamford 2000, Bamford & De Wit 1993, Senut *et al.* 1996).

GEOLOGICAL UNIT	ROCK TYPES & AGE	FOSSIL HERITAGE	PALAEONT-OLOGICAL SENSITIVITY	RECOMMENDED MITIGATION
Quaternary alluvium	**sands, silts, gravels**	**sparse remains of fish, reptiles, mammals, freshwater molluscs, petrified wood and trace fossils**	**LOW**	**None recommended** **Any substantial fossil finds to be reported by ECO to SAHRA**
Gordonia Formation **KALAHARI GROUP** ***plus*** **SURFACE CALCRETE**	**mainly aeolian sands *plus* minor fluvial gravels, freshwater pan deposits, calcretes** **PLEISTOCENE to RECENT**	**calcretised rhizoliths & termitaria, ostrich egg shells, land snail shells, rare mammalian and reptile (*e.g.* tortoise) bones, teeth** **freshwater units associated with diatoms, molluscs, stromatolites *etc***	**LOW**	**None recommended** **Any substantial fossil finds to be reported by ECO to SAHRA**
Mbizane Formation **DWYKA GROUP**	**tillites, interglacial mudrocks, deltaic & turbiditic sandstones, minor thin limestones** **LATE CARBONIFER-OUS – EARLY PERMIAN**	**sparse petrified wood & other plant remains, palynomorphs, trace fossils (*e.g.* arthropod trackways, fish trails, U-burrows)** **possible stromatolites in limestones**	**LOW TO MODERATE**	**None recommended** **Any substantial fossil finds to be reported by ECO to SAHRA**
De Bakken Granite & Kokerberg Formation **NAMAQUA-NATAL PROVINCE**	**highly metamorphosed sediments, intrusive granites** **MID-PROTEROZOIC (*c.* 2 billion yrs old)**	**none**	**ZERO**	**None recommended**

Table 1. Summary of the fossil record of rock units represented in the broader study region to the southwest of Kenhardt (From Almond 2011).

The only fossil remains recorded during a recent palaeontological field assessment by Almond (2014b) of a substantial area of Bushmanland just to the southwest of the present project area were (1) small-scale fossil burrows within Ecca Group mudrocks, (2) downwasted, ice-transported blocks (erratics) of stromatolitic carbonate within surface gravels overlying the Dwyka Group tillites, and (3) rare calcretised termitaria of probable Pleistocene or younger age embedded within weathered Dwyka bedrocks. These fossils are all of widespread occurrence within Bushmanland and special protection or mitigation measures for the very few known fossil sites were therefore not considered warranted.

The overall palaeontological sensitivity of the entire Olyvenkolk 187 solar facility and associated 132 kV transmission line corridor project area is assessed as LOW. Pockets of locally high sensitivity along drainage lines and around pans are not expected here, although their presence cannot be entirely discounted. Plio-Pleistocene calcretised gravels and finer-grained alluvium in such settings might contain mammalian remains such as bones, teeth and horn cores in addition to abundant, low-diversity trace fossil assemblages.

4. IMPACT ASSESSMENT

An assessment of impacts on local palaeontological heritage resources, before and after mitigation, for the construction phase of the proposed solar facility on Olyvenkolk 187 (Portions 6 & 3) is provided in Table 2 below. This assessment applies equally to all proposed PV sites on Portion 6 as well as the associated 132 kV transmission line to Aries Substation, as shown in Figure 2.

On the basis of the overall low palaeontological sensitivity of the project area, the anticipated impact significance of the construction phase of the proposed solar facility development is LOW. Further palaeontological impacts during the pre-construction, operational and decommissioning phases are not anticipated.Given the generally low impact significance assigned to other comparable solar facility projects in the Kenhardt region (see References under Almond), the cumulative impact significance of the current project is likewise assessed as low. The No-Go option (no PV facility) would have a neutral impact on local fossil heritage resources.

NATURE	Disturbance, damage or destruction of scientifically-valuable fossils preserved at of beneath the ground surface due to ground clearance and excavations	
STATUS	Negative (direct)	
EXTENT	Local	Restricted to development footprint
DURATION	Permanent	Cannot be rectified
INTENSITY	Low	Sensitive fossil sites are very rare within the development footprint
PROBABILITY	Improbable	Refers to impacts on scientifically-important fossil heritage
CUMULATIVE	Low	Region is of generally low palaeontological sensitivity
CONFIDENCE	Moderate	Occasional high sensitivity fossil sites are inherently unpredictable. Few palaeontological field studies undertaken within Bushmanland region.
SIGNIFICANCE (before mitigation)	LOW	No objection to authorisation of proposed development. No specialist monitoring or mitigation recommended.
MITIGATION	Monitoring by ECO	Monitoring of substantial excavations for fossil material by ECO on an on-going basis during construction phase. Application of Palaeontological Chance Finds Procedure (*See* Appendix). No specialist mitigation or monitoring necessary, pending the potential discovery of substantial new fossil material during the construction phase.
SIGNIFICANCE (after mitigation)	VERY LOW	New fossil data resulting from appropriate mitigation represents a positive impact that partially offsets any loss of palaeontological heritage.

Table 2. Assessment of anticipated impacts on palaeontological heritage for the Construction Phase of the proposed PV Solar Facility and associated 132 kV transmission line on Olvenkolk 187 (Portions 6 and 3).

5. CONCLUSIONS & RECOMMENDATIONS

The overall palaeontological sensitivity of the entire Olyvenkolk 187 (Portions 6 and 3) Solar Facility project area, including the various PV solar array site options as well as the associated 132 kV overhead transmission line corridor to Aries Substation, is assessed as LOW. Small pockets of locally HIGH sensitivity might occur along drainage lines and around any pans. Plio-Pleistocene calcretised gravels and finer-grained alluvium as well as calcrete hardpans in these last settings might contain mammalian remains such as bones, teeth and horn cores in addition to abundant, low-diversity trace fossil assemblages but these are rare and inherently unpredictable.

It is concluded that the overall impact significance (pre-mitigation) of the proposed PV Solar Facility on Olyvenkolk 187 Portions 6 and 3 is LOW (-). This assessment applies equally to all the PV solar array site options as well as the proposed 132 kV transmission line. There is no preference on palaeontological heritage grounds for any of the PV array site options or any particular transmission line route option to the Aries Substation. Given the generally low impact significance assigned to other comparable solar facility projects in the Kenhardt region (see References under Almond), the cumulative impact significance of the current project is likewise assessed as low. The No-Go option (no PV facility) would have a neutral impact on local fossil heritage resources. Providing that the construction phase mitigation recommendations outlined below are followed through, there are no objections on palaeontological heritage grounds to authorisation of the proposed development.

The following mitigation measures to safeguard any fossils exposed on site during the construction phase of the development are proposed (See also tabulated Fossil Finds Procedure appended to this report):

- The ECO responsible for the development must remain aware that all sedimentary deposits have the potential to contain fossils and he/she should thus monitor all deeper (> 1 m) excavations into sedimentary bedrock for fossil remains on an on-going basis. If any substantial fossil remains (*e.g.* vertebrate bones, teeth, stromatolites, petrified wood, shells) are found during construction SAHRA should be notified immediately (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web : www.sahra.org.za). This is in order that that appropriate mitigation (*i.e.* recording, sampling or collection) by a palaeontological specialist can be considered and implemented, at the developer's expense.

- A chance-find procedure should be implemented so that, in the event of fossils being uncovered, the ECO/Site Engineer will take the appropriate action, which includes:
    - Stopping work in the immediate vicinity and fencing off the area with tape to prevent further access;
    - Reporting the discovery to the provincial heritage agency and/or SAHRA;
    - Appointing a palaeontological specialist to inspect, record and (if warranted) sample or collect the fossil remains;
    - Implementing further mitigation measures proposed by the palaeontologist; and
    - Allowing work to resume only once clearance is given in writing by the relevant authorities.

- During maintenance and servicing of infrastructure, if excavation is required, it shall be limited to the disturbed footprint as far as practicable. Should bulk works exceed the existing disturbed footprint, SAHRA shall be notified.

If the mitigation measures outlined above are adhered to, the residual impact significance of any construction phase impacts on local palaeontological resources is considered to be very low.

The mitigation measures proposed here should be incorporated into the Environmental Management Plan (EMP) for the Olyvenkolk 187 (Portions 6 & 3) PV solar facility project.

The palaeontologist concerned with mitigation work will need a valid collection permit from SAHRA. All work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere to the minimum standards for Phase 2 palaeontological studies recently published by SAHRA (2013).

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7. 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, Kwa-Zulu Natal, Mpumalanga and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has previously 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**

<table>
<tr><td colspan="3">CHANCE FOSSIL FINDS PROCEDURE: 300 MW PV SOLAR FACILITY ON PORTIONS 6 AND 3 OF FARM 187 OLYVENKOLK NEAR KENHARDT</td></tr>
<tr><td>Province & region:</td><td colspan="2">KENHARDT DISTRICT, NORTHERN CAPE</td></tr>
<tr><td>Responsible Heritage Management Authority</td><td colspan="2">SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000,South Africa. Phone : +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web : www.sahra.org.za</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Dwyka Group (Mbizane Formation), Gordonia and Mokolanen Formations (Kalahari Group)</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Calcretised rhizoliths & termitaria, ostrich egg shells, land snail shells, rare mammalian and reptile (e.g. tortoise) bones, teeth</td></tr>
<tr><td rowspan="5">ECO protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
• Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
• Context – describe position of fossils within stratigraphy (rock layering), depth below surface
• Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
• Alert Heritage Management Authority and project palaeontologist (if any) who will advise on any necessary mitigation
• Ensure fossil site remains safeguarded until clearance is given by the Heritage Management Authority for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
• Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
• Photograph fossils against a plain, level background, with scale
• Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
• Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
• Alert Heritage Management Authority and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Management Authority, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Management Authority</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Authority. Adhere to best international practice for palaeontological fieldwork and Heritage Management Authority minimum standards.</td></tr>
</table>