PALAEONTOLOGICAL HERITAGE ASSESSMENT: DESKTOP STUDY:

PROPOSED ESKOM GROBLERSHOOP 132/22 KV SUBSTATION AND THE GARONA – GROBLERSHOOP 132 KV KINGBIRD LINE, GROBLERSHOOP, NORTHERN CAPE

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1. SUMMARY

The proposed 132 kV Kingbird powerline (*c*. 20 km long) and new 132/22 kV electrical substation near Groblershoop are underlain, at or below the surface, by highly metamorphosed Precambrian basement rocks (schists, quartzites, gneisses) of the Namaqua-Natal Province that are entirely unfossiliferous. These are locally mantled by Late Caenozoic superficial sediments including Quaternary aeolian sands of the Gordonia Formation (Kalahari Group), calcrete pedocretes and alluvium of the Orange River and its tributaries. These younger superficial sediments are generally of low palaeontological sensitivity. Potentially fossiliferous older alluvial gravels are not mapped along the banks of the Orange River close to Groblershoop.

The overall impact significance of the proposed powerline and substation developments for local fossil heritage is considered to be LOW and, pending the discovery of substantial new fossils during construction, further palaeontological studies or specialist mitigation for this project is not considered necessary.

Should substantial fossil remains be exposed during construction, however, such as well-preserved fossil bones, teeth, shells or petrified wood, the ECO should safeguard these, preferably *in situ*, and alert SAHRA as soon as possible so that appropriate mitigation can be undertaken by a professional palaeontologist (SAHRA Contact details: South African Heritage Resources Agency, 111 Harrington Street, PO Box 4637, Cape Town 8000, South Africa. Email: ksmuts@sahra.org.za. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509 Web: www.sahra.org.za).

2. INTRODUCTION & BRIEF

Eskom Holdings SOC Limited, Western Operating Unit: Distribution Division is proposing to construct a new 132/22 kV electrical substation at Groblershoop and a 132 kV Kingbird powerline from the existing Garona substation to a proposed new substation close to Groblershoop, Northern Cape (Fig. 1). The powerline will be approximately 20 km long. The servitude will be a minimum of 31 meters and maximum of 40 meters in certain places along the route.

The proposed developments overlie potentially fossiliferous superficial sediments along the Orange River (*e.g.* Kalahari Group). Fossils preserved within the superficial deposits may be disturbed, damaged or destroyed during the construction phase of the proposed project. The extent of the proposed development (over 5000 m^2) falls within the requirements for a Heritage Impact Assessment (HIA) as required by Section 38 (Heritage Resources Management) of the South African Heritage Resources Act (Act No. 25 of 1999).

This desktop palaeontological study has accordingly been commissioned on behalf of Eskom by Landscape Dynamics Environmental Consultants (6 La Hey Close, Steynsrust, Somerset West, 7130. Contact: Susanna Nel. Tel: +27 (0)21 855 0912. Fax: +27 (0)86 561 7744. Cell: +27 (0)82 888 4060. Email: susanna@landscapedynamics.co.za).

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

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

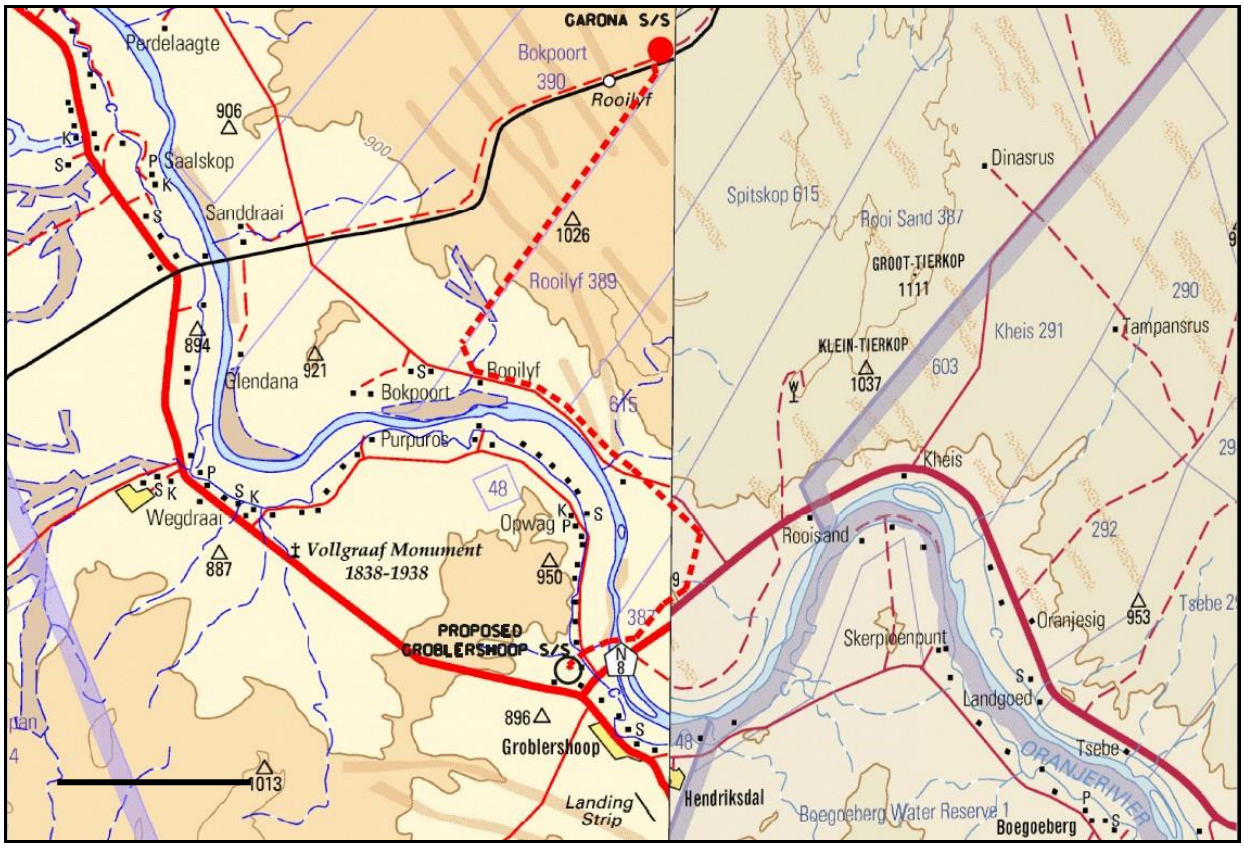

Fig. 1. Map of the Groblershoop area, Northern Cape, showing the route of the proposed 132 kV Kingbird powerline (red dashed line) and the location of the proposed new Groblershoop substation (black circle). Scale bar is *c*. 5 km. Modified from an image kindly provided by Landscape Dynamics Environmental Consultants.

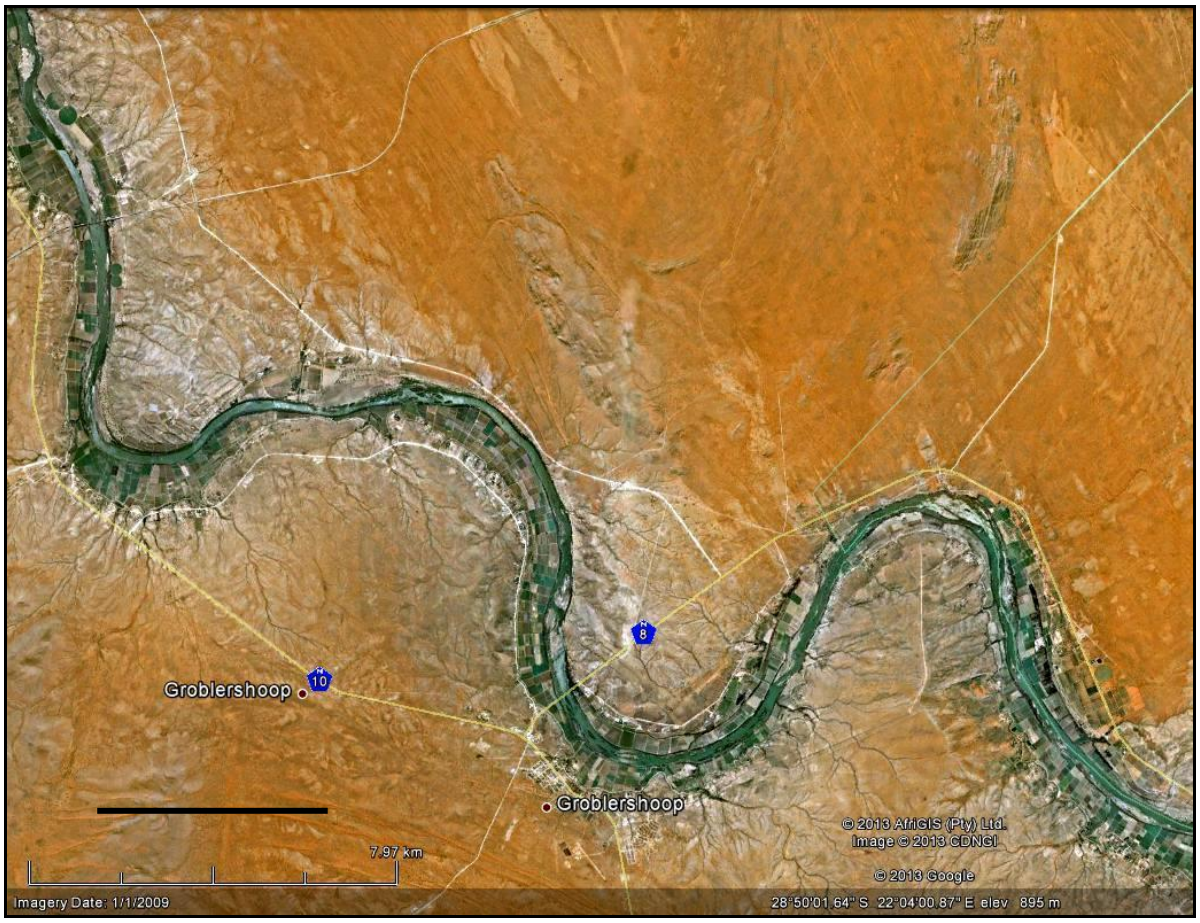

Fig. 2. Google earth© satellite image of arid terrain in the broader study region along the Orange River near Groblershoop (black scale bar = *c.* 5 km.). The orange-brown area to the northeast of the River Orange shows NW-SE trending linear sand dunes of the Gordonia Formation (Kalahari Group). Close to the river paler greyish areas with fine dendritic stream drainage reflect Precambrian bedrock exposure of the Namaqua-Natal Metamorphic Province.

2.2. General approach used for palaeontological desktop studies

The present report, based on a desktop analysis of the study region near Groblershoop, provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations for specialist palaeontological mitigation where this is considered necessary. Minimum standards for the palaeontological component of heritage impact assessment reports have been developed by SAHRA (2013).

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations *etc*) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region (*e.g.* Almond 2011b, 2012), 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 during the compilation of the final report). This data is then used to assess the palaeontological sensitivity of each rock unit to 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 of the development itself, most notably the extent of fresh bedrock excavation envisaged.

When rock units of moderate to high palaeontological sensitivity are exposed within the development footprint, a Phase 1 field-based study by a professional palaeontologist is usually warranted. Most detrimental impacts on palaeontological heritage occur during the construction phase when fossils may be disturbed, destroyed or permanently sealed-in during excavations and subsequent construction activity. Where specialist palaeontological mitigation is recommended, this may take place before construction starts or, most effectively, during the construction phase while fresh, potentially fossiliferous bedrock is still exposed for study. Mitigation usually involves the judicious sampling, collection and recording of fossils as well as of relevant contextual data concerning the surrounding sedimentary matrix. The palaeontologist concerned would need to apply beforehand for a collection permit from SAHRA (Contact details: South African Heritage Resources Agency, 111 Harrington Street, PO Box 4637, Cape Town 8000, South Africa. Email: ksmuts@sahra.org.za. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509 Web: www.sahra.org.za).

It should be emphasised that, *provided* appropriate mitigation is carried out, many developments involving bedrock excavation actually have a *positive* impact on our understanding of local palaeontological heritage. Constructive collaboration between palaeontologists and developers should therefore be the expected norm

3. GEOLOGICAL BACKGROUND

The study area comprises arid, low relief terrain on the north-eastern side of the Orange River near Groblershoop, some 85 km southeast of Upington, Northern Cape. The terrain slopes broadly down to the river, from *c*. 960 m amsl near the Garona Substation to *c*. 860 m at the Orange. As clearly seen in satellite images (Fig. 2) bedrock exposure is good close to the river and along some sectors of the river bank, while away from the river the bedrocks are largely mantled with Kalahari sands. NW to SE trending linear sand dunes here surround occasional emergent rocky Inselberge rising to heights of 1024 m amsl. Bedrock exposures in the vicinity are dissected by the dendritic drainage courses of small, imtermittently-flowing streams.

The geology of the study area near Groblershoop is shown on the adjoining 1: 250 000 geological maps 2820 Upington and 2822 Postmasburg (Council for Geoscience, Pretoria; Fig. 3 herein). A comprehensive sheet explanation for the Upington map has been published by Moen (2007) while a very brief explanation for the Postmasburg area is printed on the map itself. The entire study area is underlain at depth by ancient Precambrian igneous and metamorphic rocks that belong to the **Namaqua-Natal Province** of Mid Proterozoic (Mokolian) age (Cornell *et al.* 2006, Moen 2007). These metamorphosed basement rocks are approximately two to one billion years old and are entirely unfossiliferous (Almond & Pether 2008). They include a range of schistose and quartzitic units assigned to the **Brulpan Group** (*e.g.* Groblershoop and Prynnsburg Formation), details of which are given by Moen (2007) as well as Cornell *et al.* (2006). Locally the Brulpan rocks are intruded by the **Kalkwerf Granite-gniess**, likewise unfossiliferous. The proposed new substation site near Groblershoop is underlain by metasediments of the Groblershoop Formation (Brulpan Group).

The Precambrian basement rocks within the study area are mantled with a spectrum of other coarse to fine-grained **superficial deposits** such as rocky soils, downwasted surface gravels, colluvium (slope deposits), sheet wash, calcrete hardpans, aeolian sands and

alluvium of intermittently flowing streams. These younger deposits are generally young (Quaternary to Recent) and are largely unfossiliferous.

Small patches of Late Tertiary to Quaternary **calcretes** or pedogenic limestones (T, darker yellow in Fig. 3) occur to the southwest of Garona Substation as well as on both sides of the river near Groblershoop. Some of these may be correlated with the Pleistocene or Late Pliocene **Mokalanen Formation** of the **Kalahari Group**, while others may be of younger age (Partridge *et al.* 2006, Moen 2007). They include horizons of layered to structureless or nodular calcretes overlying basement rocks that are usually less than 3 m thick and often partially covered by wind-blown sands.

Most of the remainder of the study area, including the Garona Substation site, is covered by fine-grained aeolian (wind-blown) sands of the **Gordonia Formation** (**Qg**, pale yellow in Fig. 3), the youngest, Pleistocene to Recent, subunit of the Kalahari Group. Prominent NW-SE trending linear dunes of orange-hued sands are clearly visible on satellite images of the study area (Fig. 2). The geology of the Late Cretaceous to Recent Kalahari Group is reviewed by Thomas (1981), Dingle *et al.* (1983), 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 1.8Ma back to 2.588 Ma would place the Gordonia Formation almost entirely within the Pleistocene Epoch.

According to Moen (2007) **older river terrace gravels** of possible Late Tertiary to Pleistocene age occur “all along the river” within 2 km of the present banks and at elevations of up to 45 m (rarely as high as 85m) above the present flood plain. These older river gravels are frequently calcretised. Small patches of older terrace gravels are mapped along the eastern banks of the River Orange some 25 km north of Groblershoop but they are not indicated in the present study area. They may either be completely absent here or too small to map at 1: 250 000 scale.

4. PALAEONTOLOGICAL HERITAGE

The Precambrian metamorphic and igneous basement rocks of the **Namaqua-Natal Metamorphic Province** in the study area are entirely unfossiliferous.

Late Caenozoic calcretes may 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 occasionally expected within Kalahari Group sediments and calcretes, notably those associated with ancient alluvial gravels and pans (*cf* Almond 2008a). However, these fossil assemblages are generally sparse, low in diversity, and occur over a wide geographic area, so the palaeontological sensitivity of the calcretes within the study region is rated as low. This applies equally to the thin veneer of other surface deposits (rocky scree, stream alluvium *etc*) within this highly arid region.

Alluvial gravels of the Orange River of Miocene and younger age are locally highly fossiliferous (*e.g.* Hendy 1984, Schneider & Marias 2004, Almond 2008a, 2009 and extensive references therein) but, as argued above, these are *not* mapped within the study area. Younger silty alluvial deposits may contain a range of terrestrial and freshwater fossils and subfossils. Freshwater snails are mentioned in particular by Moen (2007, p. 150). Stream gravels close to the west bank of the Orange River in the Groblershoop area were examined without success for palaeontological remains by Almond (2012).

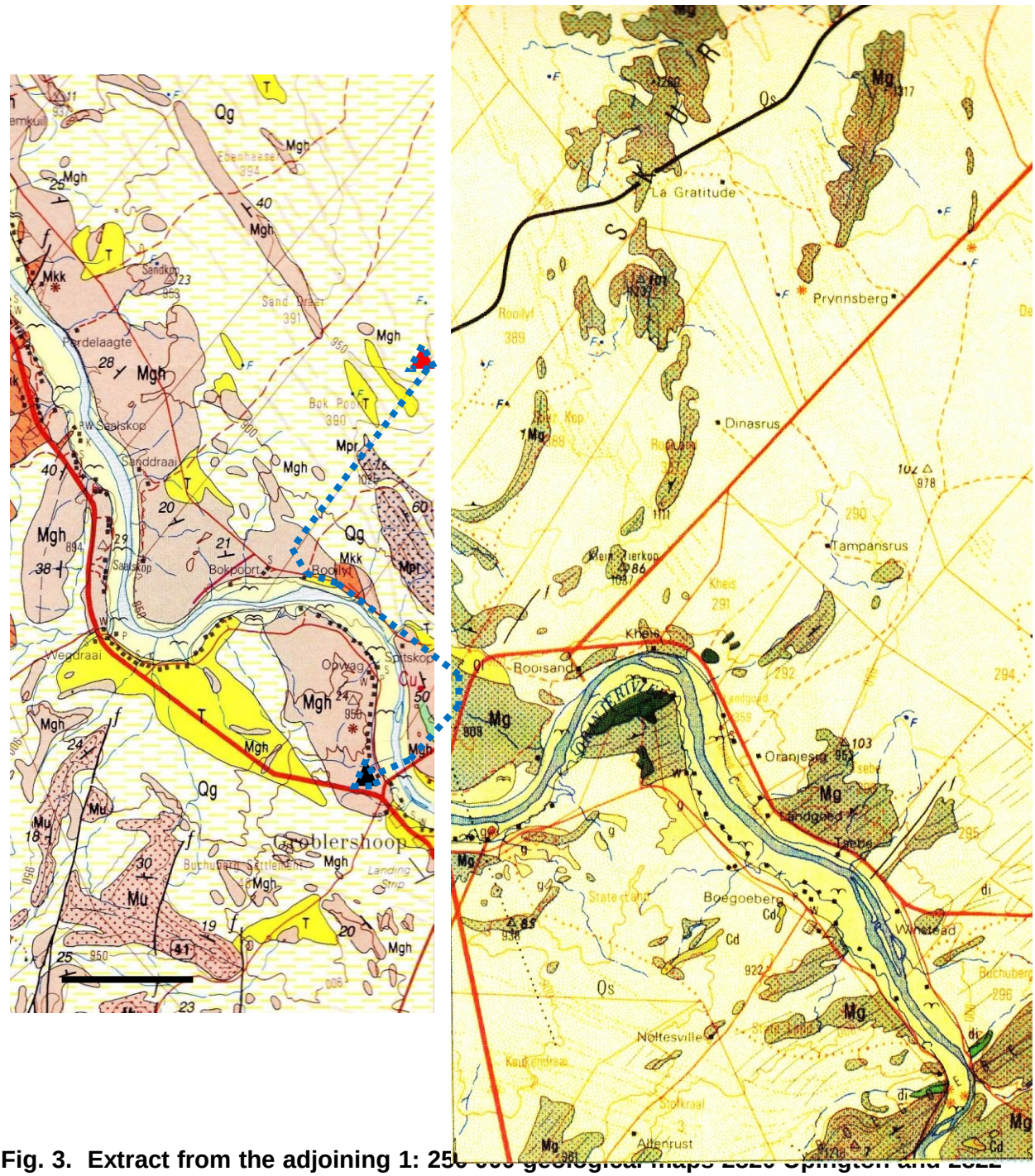

Fig. 3. Extract from the adjoining 1: 250 000 geological maps 2820 Springbok and 2822 Postmasburg (Council for Geoscience, Pretoria) showing the location of the existing Garona Substation (red triangle), the proposed new Groblershoop Substation (black triangle) as well as the proposed new 132 kV Kingbird powerline connecting the two (blue dotted line). Scale bar = *c*. 5 km.

The study area is underlain at depth by unfossiliferous Precambrian (Middle Proterozoic / Mokolian) basement rocks of the Namaqua-Natal Metamorphic Province (Mgh, Mg, Mpr *etc*) that are assigned to the Brulpan Group and are intruded by granite gneisses (Mkk, orange = Kalkwerf Gneiss). Superficial sediments of Late Caenozoic age include calcretes (T, bright yellow), reddish aeolian sands of the Gordonia Formation, Kalahari Group (Qg, pale yellow), and alluvium of the Orange River (pale yellow). Small patches of older (Tertiary) terrace gravels are mapped on the eastern bank of the Orange River *c*. 25 km NW of Groblershoop, but not in the study area.

5. CONCLUSIONS & RECOMMENDATIONS

The proposed new powerline and substation developments near Groblershoop are underlain, at or below the surface, by highly metamorphosed Precambrian basement rocks (schists, quartzites, gneisses) of the Namaqua-Natal Province that are entirely unfossiliferous. These are locally mantled by Late Caenozoic superficial sediments including Quaternary aeolian sands of the Gordonia Formation (Kalahari Group), calcrete pedocretes and alluvium of the Orange River and its tributaries. These younger superficial sediments are generally of low palaeontological sensitivity. Potentially fossiliferous older alluvial gravels are not mapped along the banks of the Orange River close to Groblershoop.

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6. ACKNOWLEDGEMENTS

Ms Susanna Nel of Landscape Dynamics Environmental Consultants, Somerset West, is thanked for commissioning this study and for kindly providing all the necessary background information.

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8. 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 under the aegis of his Cape Town-based company *Natura Viva* cc. He is 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 APHAP (Association of Professional Heritage Assessment 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.

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