RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES:

PROPOSED 22 kV POWERLINE IN THE MAJOMANTSHO AREA, JOE MOROLONG MUNICIPALITY, NORTHERN CAPE

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EXECUTIVE SUMMARY

It is proposed to construct new, 1.1 km-long, 22 kV powerline to supply households in the Majomantsho rural area near Ditshipeng, situated *c*. 66 km northeast of Kuruman in the Joe Morolong Municipality, Northern Cape. The granitoid igneous basement rocks underlying the Majomantsho rural area at depth are Early Precambrian in age and entirely unfossiliferous. Thin Late Caenozoic aeolian sands, calcretes, downwasted surface gravels and possible stream gravels of the Kalahari Group mantling the older bedrocks are generally of low to very palaeontological sensitivity, although occasional concentrations of fossil material (*e.g.* mammalian bones and teeth, non-marine molluscs, trace fossils) might occur here. The footprint of the short 22 kV powerline is very small. It is concluded that construction of the proposed powerline is unlikely to have significant impacts on local palaeontological heritage resources.

It is therefore recommended that, pending the discovery of significant new fossils remains before or during construction, exemption from further specialist palaeontological studies and mitigation be granted for the proposed 22 kV powerline development in the Majomantsho rural area near Kuruman, Northern Cape.

Should any substantial fossil remains (*e.g.* mammalian bones and teeth) be encountered during construction, however, these should be safeguarded, preferably *in situ*, and reported by the ECO to SAHRA, *i.e.* The South African Heritage Resources Agency, as soon as possible (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 so that appropriate 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. A Chance Fossil Finds Procedure for the Majomantsho study region is appended to this report.

1. OUTLINE OF THE PROPOSED DEVELOPMENT

Eskom Holdings SOC Ltd Distribution Northern Cape Operating Unit, Kimberley, is proposing to construct a 22 kV powerline approximately 1.1 km in length to supply households in the Majomantsho rural area near Ditshipeng which is located *c*. 66 km northeast of Kuruman and c. 90 km west of Vryburg in the Joe Morolong Municipality, Northern Cape (Fig. 1). The new powerline will run from an existing line to the households concerned (Fig. 2).

The present palaeontological heritage desktop assessment of the powerline project, which has been requested by SAHRA under their Case ID 13559 on 20 March 2019, has been commissioned on behalf of the proponent by Vhubvo Consultancy, Midrand (Contact details: Mr Rabelani Makhale,Vhubvo Consultancy,546 16th Road, Constantia Park, Building No. 2, Midrand, South Africa. Tel: 011 312 2878. Mobile: 079 918 918. E-mail: rabelani@vhubo.co.za).

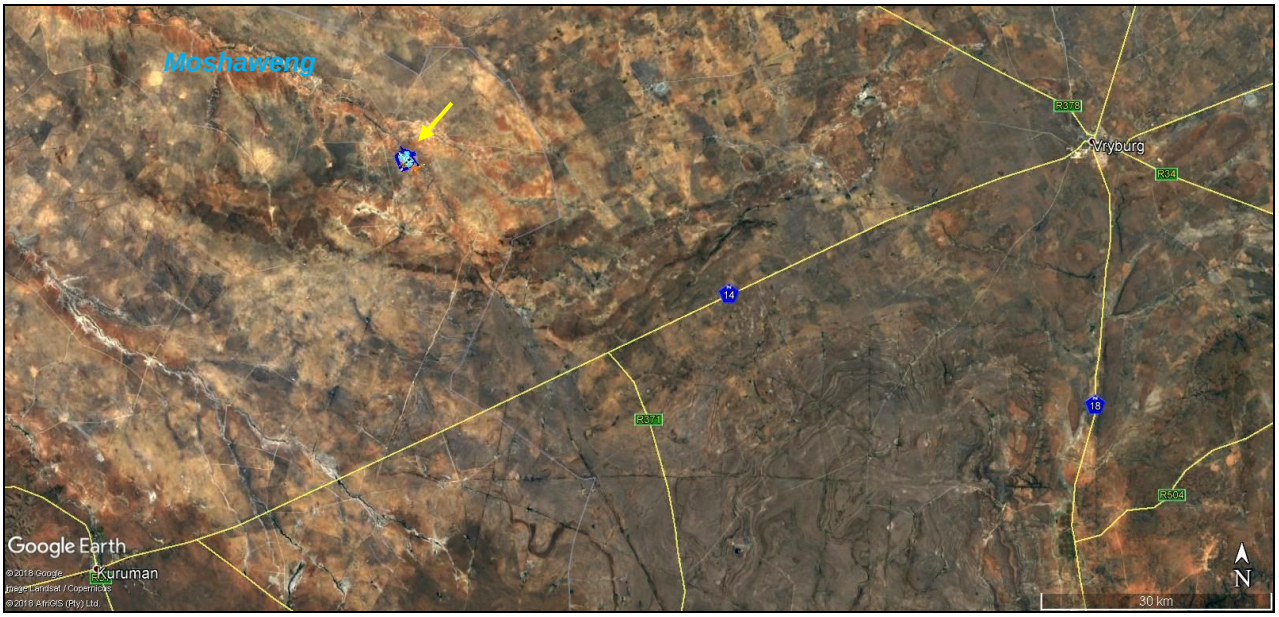

Figure 1: Google Earth© satellite image of the area between Kuruman and Vryburg indicating the location (arrow) of the electrification project to supply households in the Majomantsho rural area near Ditshipeng, Joe Morolong Municipality, Northern Cape. The Moshaweng drainage line, a tributary of the Kuruman River, is also indicated.

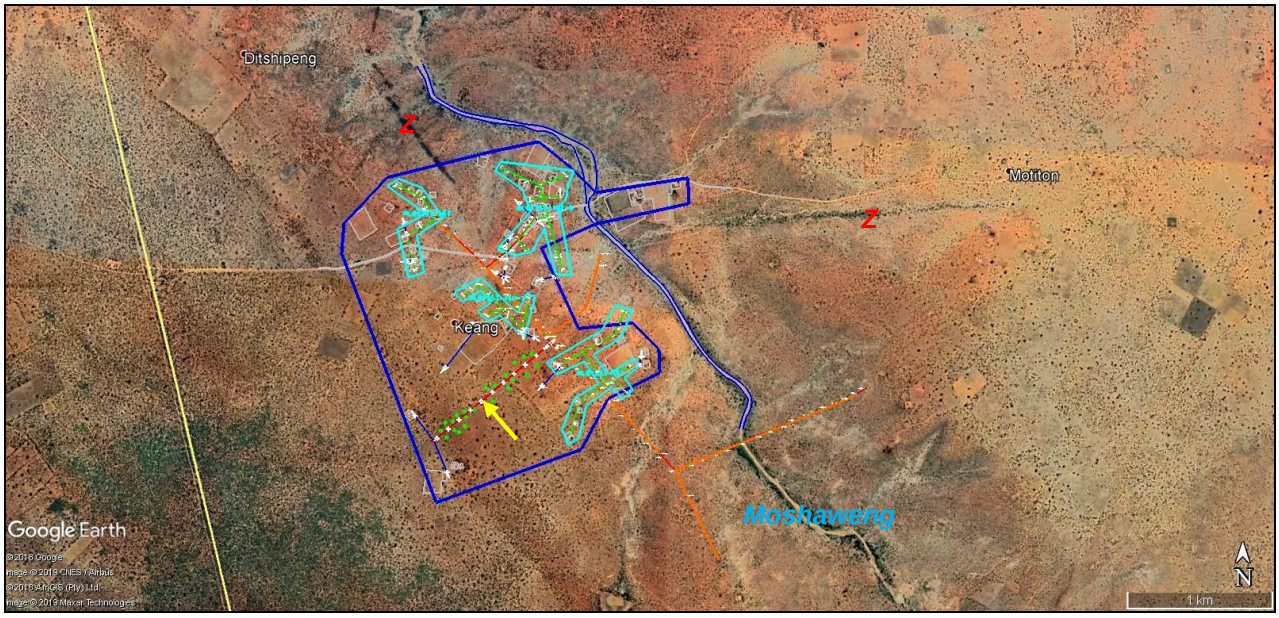

Figure 2: Google Earth© satellite image of the electrification project footprint in the Majomantsho rural area near Ditshipeng. The 1.1 km-long 22 kV powerline that is the subject of the present report (arrowed) is indicated by the red line. Quartz porphyry dykes are indicated by red Z symbols. Pale grey areas are probably underlain by Quaternary calcretes of the Mokalanen Formation while orange-hued areas feature Gordonia Formation dune sands.

1.1. Legislative context for palaeontological assessment studies

The present palaeontological heritage report falls under Sections 35 and 38 (Heritage Resources Management) of the South African Heritage Resources Act (Act No. 25 of 1999), and it will also inform the Environmental Management Programme for this project.

The proposed agricultural development is located in an area that is underlain by Precambrian basement rocks as well as Late Caenozoic superficial sediments (Sections 2 and 3). The construction phase will entail surface ground clearance as well as limited shallow excavations into the superficial sediment cover, and probably also into the older bedrocks. These developments may adversely affect known or potential fossil heritage at or beneath the surface of the ground within the study area by damaging, destroying, disturbing or sealing-in fossils that are then no longer available for scientific research or other public good.

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act 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 recently been published by SAHRA (2013).

1.2. Approach used for this specialist palaeontological study

This palaeontological report provides an assessment of the recorded or inferred palaeontological heritage within the Majomantsho rural area near Ditshipeng study area, with recommendations for specialist palaeontological mitigation where this is considered necessary. The report is based on:

(1) a review of the relevant scientific literature, published geological maps as well as satellite images;
(2) background information, field photographs, kmz files and maps supplied for this project by Vhubvo Consultancy;
(4) the author's palaeontological database and field experience of the rock units concerned (*cf* Almond & Pether 2008).

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 scoping 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 and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged. When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a field-based assessment by a professional palaeontologist is usually warranted.

On the basis of the desktop and any recommended follow-up 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. Mitigation by a professional palaeontologist – normally involving the recording and sampling of fossil material and associated geological information (*e.g.* sedimentological data) – is usually most effective during the construction phase when fresh fossiliferous bedrock has been exposed by excavations, although pre-construction recording of surface-exposed material may sometimes be more appropriate. To carry out mitigation, the palaeontologist involved will need to apply for a palaeontological collection permit from the relevant heritage management agency (*i.e* 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). It should be emphasized that, *providing appropriate mitigation is carried out*, the majority of developments involving bedrock excavation can make a *positive* contribution to our understanding of local palaeontological heritage.

1.3. 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.

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 case of palaeontological studies in the present study region, the main limitations are the absence of detailed sedimentological and palaeontological field data and the paucity of previous palaeontological impact studies in the southern Kalahari region as a whole. No relevant PIA reports could be located on the SAHRIS website. However, the explanation by Gabbrielli (2008) constitutes a very useful source of geological and palaeontological data for the Morokweng 1: 250 000 geological sheet area.

2. GEOLOGICAL BACKGROUND

The 22 kV electrification project footprint in the Majomantsho rural area near Ditshipeng comprises fairly flat-lying to at most gently hilly terrain between 1220 and 1240 m amsl on the southern margins of the Kalahari region of the Northern Cape (Figs. 1 & 2). On the basis of satellite images as well as field photographs the area comprises arid Kalahri thornveld with low shrubs and grasses as well as scattered thorn trees. The ground is sandy with downwasted granitoid surface gravels, limited bedrock exposure and evidence of disturbance in terms of tracks and local vegetation clearance. The dry course of the non-perennial Moshaweng River, a tributary of the Kuruman River, runs some 800 m to the northeast of the project footprint. Paler hues along the river courses as well as small tributary streams, none of which traverses the project area, suggest that calcretes may be exposed at or near-surface here.

The geology of the project area between Kuruman and Vryburg is shown on the 1: 250 000 geology map 2622 Morokweng (Council for Geoscience, Pretoria; Fig. 3). A comprehensive sheet explanation for this map has been published by Gabbrielli (2008). The study region is underlain at depth by ancient Precambrian basement rocks referred to the **Kraaipan Group**. These largely comprise pinkish and reddish, coarse-grained granite-gneisses with an estimated age of 2.8 Ga (billion years). Major prominent-weathering, linear quartz-feldspar porphyritic dykes intruding the basement granitoids in the region (Z in Fig. 2) are referred to the **Zoetlief Group**; they are now correlated with the extrusive Makwassie Formation of the **Ventersdorp Group** and dated to *c*. 2.7 Ga.

The basement rocks in the study area are extensively mantled by various Late Caenozoic superficial deposits that can be broadly referred to the **Kalahari Group**, the geology of which is reviewed by Thomas (1981), Dingle *et al.* (1983), Thomas & Shaw 1991, Haddon (2000) and Partridge *et al.* (2006). It is unclear on the basis of satellite images and field photos alone exactly which Kalahari Group subunits are represented within the project footprint. At a distance of 800 m or more from the banks of the Moshaweng River, it is considered unlikely that older Kalahari Group sedimentary units such as the Eden Formation are represented here; these well-consolidated sandstone beds – as well as younger lacustrine or pan sediments of the Lonely Formation - are best exposed in the Morokweng sheet area along the banks of incised water courses such as the Moshaweng River (Gabrielli 2008). Calcretised gravelly or sandy sediments mapped in the study area in Figure 3 *might* be assigned to the Pleistocene **Mokalanen Formation** but this correlation is

uncertain and the presence of these sediments within the powerline footprint is equivocal. Patches of fine-grained aeolian (wind-blown) sands in the general study region can be assigned to the **Gordonia Formation** and are of Pleistocene to Recent age, dated in part from enclosed Middle to Later Stone Age stone tools (Dingle *et al*., 1983). Additional Late Caenozoic superficial deposits present in the broader electrification project area include downwasted **surface gravels** as well as **alluvial sands and gravels**, especially along shallow ephemeral drainage lines, which are not mapped at 1: 250 000 scale.

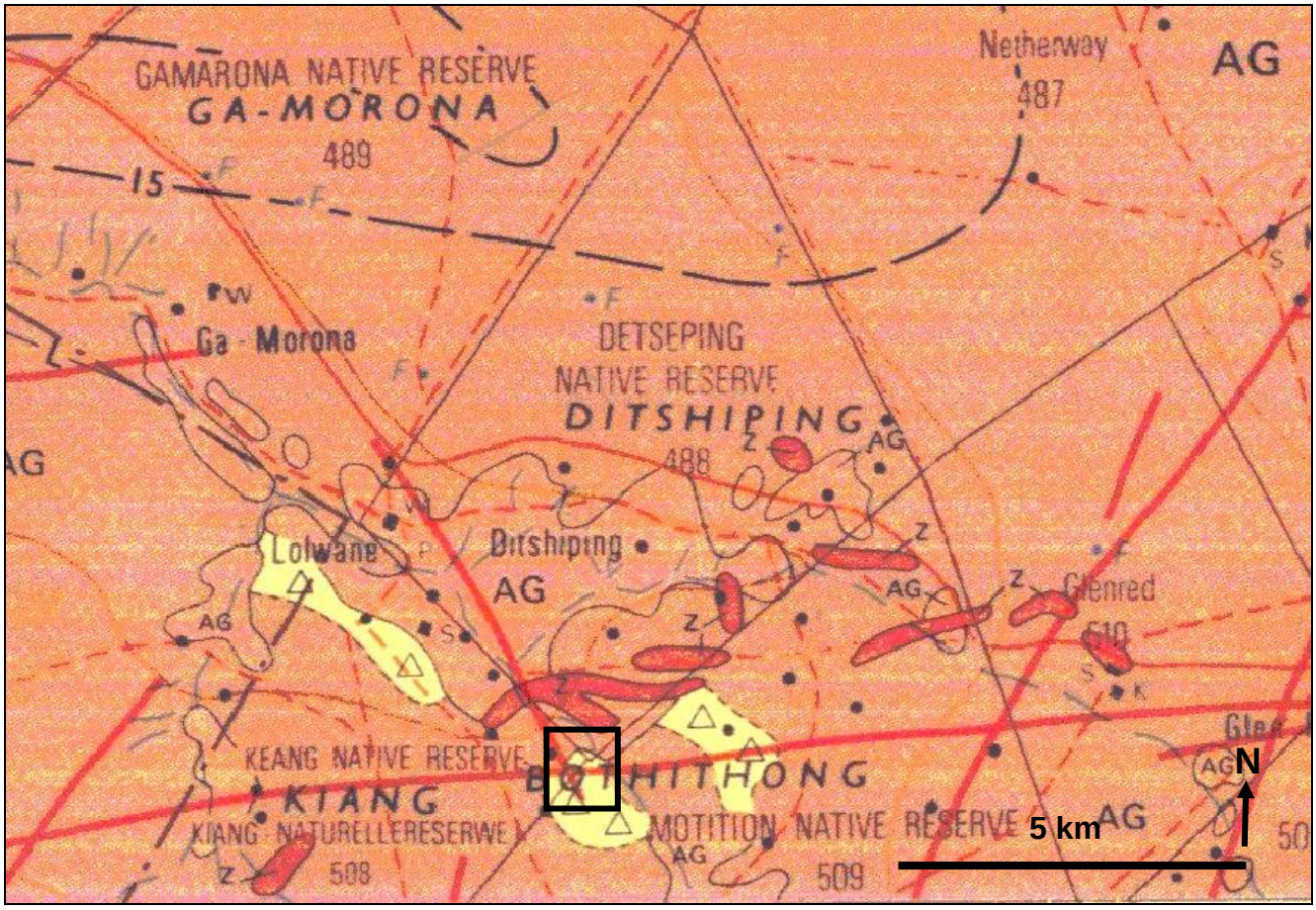

Figure 3. Extract from 1: 250 000 geological map 262 Morokweng (Council for Geoscience, Pretoria) showing the *approximate* location of the Majomantsho rural area electrification project near Ditshipeng. The main rock units mapped here include: AG (orange) = Archaean granitoid basement rocks of the Kraaipan Group; Z (red) = quartz porphyry dykes of the Zoetlief Group, now correlated with the Makwassie Formation lavas (Ventersdorp Group); Late Caenozoic calcified gravels (Pale yellow with triangle symbols). The basement rocks in the region are extensively mantled by red aeolian (wind-blown) sand of the Gordonia Formation (Kalahari Group), Late Caenozoic calcretes, downwasted surface gravels as well as alluvial sands and gravels but many of these superficial deposits are thin and not mapped at 1: 250 000 scale. The overall palaeontological sensitivity of the entire study area is rated as LOW.

3. PALAEONTOLOGICAL HERITAGE

The Precambrian igneous basement rocks of the Kraaipan Group and Zoetlief Group are approximately two to three billion years old and are entirely unfossiliferous (Almond & Pether 2008). The fossil record of the overlying **Kalahari Group** is generally sparse and low in diversity. Pleistocene calcretes of the **Mokalanen Formation** may contain a range of terrestrial trace fossils, including mammal and bird tracks, rhizoliths, stems casts of reedy plants and invertebrate burrows (*e.g.* termitaria), as well as the shells of non-marine gastropods, ostracods ("seed shrimps") and diatoms within lacustrine, fluvial, *vlei* and pan intervals (Almond & Pether 2008, Gabbrielli 2008).

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 bedrocks (including, for example, dolerite) 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), plant stem casts and termitaria (*e.g. Hodotermes*, the harvester termite), ostrich egg shells (*Struthio*) and shells of land snails (*e.g. Trigonephrus*) (Almond 2008, 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 with siliceous shells or frustules) and stromatolites (laminated microbial limestones) are associated with local watercourses and pans. Microfossils such as diatoms may be blown by wind into nearby dune sands.

These Kalahari fossils (or subfossils) can be expected to occur sporadically but widely, and the overall palaeontological sensitivity of the study area near Ditshiping is therefore considered to be low.

4. CONCLUSIONS & RECOMMENDATIONS

The granitoid igneous basement rocks underlying the Majomantsho rural area at depth are Early Precambrian in age and entirely unfossiliferous. Thin Late Caenozoic aeolian sands, calcretes, downwasted surface gravels and possible stream gravels of the Kalahari Group mantling the older bedrocks are generally of low to very palaeontological sensitivity, although occasional concentrations of fossil material (*e.g.* mammalian bones and teeth, non-marine molluscs, trace fossils) might occur here. The footprint of the short 22 kV powerline is very small. It is concluded that construction of the proposed powerline is unlikely to have significant impacts on local palaeontological heritage resources.

It is therefore recommended that, pending the discovery of significant new fossils remains before or during construction, exemption from further specialist palaeontological studies and mitigation be granted for the proposed 22 kV powerline development in the Majomantsho rural area near Kuruman, Northern Cape.

Should any substantial fossil remains (*e.g.* mammalian bones and teeth) be encountered during construction, however, these should be safeguarded, preferably *in situ*, and reported by the ECO to SAHRA, *i.e.* The South African Heritage Resources Agency, as soon as possible (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 so that appropriate 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. A Chance Fossil Finds Procedure for the Majomantsho study region is appended to this report.

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, Mpumalanga, KwaZulu-Natal 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><th colspan="3">CHANCE FOSSIL FINDS PROCEDURE: Electrical infrastructure developments in the Majomantsho rural area near Ditshipeng, Kuruman</th></tr>
<tr><td>Province & region:</td><td colspan="2">Northern Cape, Joe Morolong Municipality</td></tr>
<tr><td>Responsible Heritage Resources Agency</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">Kalahari Group: Late Caenozoic alluvium along water courses and calcrete hardpans (possibly Mokalanen Formation)</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Bones, teeth and horn cores of mammals, freshwater molluscs, calcretised termitaria and other trace fossils</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 Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation
Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Agency 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 Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Agency, 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 Resources Agency</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 Agency. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Agency minimum standards.</td></tr>
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