PALAEONTOLOGICAL HERITAGE ASSESSMENT: COMBINED DESKTOP & FIELD-BASED STUDY

Proposed Alpha Solar Power Plant on Portion 3 of Farm Middel Pan 605 near Vryburg, Naledi Local Municipality, North-West Province

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EXECUTIVE SUMMARY

The company Alpha Solar Power Plant (RF) (Pty) Ltd is proposing to develop up to 115 MW photovoltaic solar facility, known as the Alpha Solar Power Plant, on Portion 3 of the Farm Middel Pan 605, IN Registration Division, Province of the North-West.

The Alpha Solar Power Plant study area is entirely underlain by late Archaean (*c*. 2.6 billion year-old) sedimentary rocks of the Schmidtsdrif Subgroup (Ghaap Group, Transvaal Supergroup). These mainly comprise shallow marine siliciclastic sediments of the Vryburg Formation that are mostly mantled by thin downwasted gravels and sandy soils.

Field assessment suggests that stromatolite-bearing carbonate rocks are not present within the Vryburg Formation succession in the study area. It is concluded that, with or without mitigation, the overall impact of the proposed Alpha Solar Power Plant on Farm Middel Pan 605 is of **NEGATIVE LOW SIGNIFICANCE** in palaeontological heritage terms.

Should significant fossil remains - such as well-preserved stromatolites - be exposed during construction, the responsible Environmental Control Officer should safeguard these, preferably *in situ*. The South African Heritage Resources Authority (SAHRA) should be alerted as soon as possible (Contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000, Tel: 021 462 4502, Email: cscheermeyer@sahra.org.za), 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. The palaeontologist concerned with mitigation work will need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). These recommendations should be included within the EMPr for the proposed solar power plant development.

There are no fatal flaws in the proposed solar power plant development, nor are there objections to its authorisation as far as fossil heritage conservation is concerned, *provided* that the mitigation recommendations outlined above are fully complied with. The no-go option (no solar development) will have a neutral impact on local palaeontological heritage resources.

1. INTRODUCTION & BRIEF

The company Alpha Solar Power Plant (RF) (Pty) Ltd is proposing to develop up to 115MW photovoltaic solar facility, known as the Alpha Solar Power Plant, on Portion 3 of the Farm Middel Pan 605, IN Registration Division, Province of the North-West. The land parcel measures 664,8825 hectares in area and is situated approximately 30 km west of the town of Vryburg, Naledi Local Municipality, North-West Province. The footprint of the proposed alternative energy project will be approximately 285 hectares (including supporting infrastructure).

The study site is situated on flat lying terrain in the north-eastern portion of the Farm Middel Pan 605, *c.* 8.5 km north of the R14 tar road between Vryburg and Upington. The location of the study area is shown on the map Fig. 1 and a satellite image of the area is shown in Fig. 2.

The proposed solar energy facility overlies potentially fossiliferous sediments of the Ghaap Group (Transvaal Supergroup) of Precambrian age. Fossils preserved within the bedrock or 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).

The present combined desktop and field-based palaeontological study has accordingly been commissioned on behalf of the client by Alpha Solar Power Plant (RF) (Pty) Ltd (Contact details: Mr D.P.S. Berlijn**,** Managing Director. Phone: +27 10 500 3680. Mobile: +27742 488 488. Fax: +27 862 731 614. Address: 2nd Floor West Tower, Nelson Mandela Square, Maude Street, Sandown. PO Box 785553, Sandton, 2146, RSA).

The Terms of Reference for this palaeontological study, as defined by Alpha Solar Power Plant (RF) (Pty) Ltd, are as follows:

- A desktop investigation of the area, in which all geological maps, published scientific literature, previous paleontological impact studies in the same region and the author's field of experience (consultation with professional colleagues as well as examination of institutional fossil collections and data) should be studied and used.

- Based on the outcome of the desktop study and the comments obtained from SAHRA, the need for a field assessment must be determined. The desktop investigation must be supplemented with a field assessment if required.

- Assess the potential impacts, based on a supplied methodology.

- Describe mitigation measures to address impacts during the construction, operation and decommissioning stages.

- Develop a protocol for any paleontological finds.

- Describe cumulative impacts of the project on paleontological resources in both the local study area, regional study area and the proponent's plans to manage those effects.

- Supply the client with geo-referenced GIS shape files of any sensitive areas.

1.1. Legislative context of this palaeontological study

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

2. APPROACH TO THE PALAEONTOLOGICAL HERITAGE ASSESSMENT

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

1. A short project outline and maps provided by Alpha Solar Power Plant (RF) (Pty) Ltd;

2. A review of the relevant scientific literature, including published geological maps, satellite images, and previous fossil heritage assessments in the region (*e.g.* Almond 2013a, 2013b, 2013c);

3. A short site visit by the author and one assistant on 14 January 2016.

4. The author's database on the formations concerned and their palaeontological heritage.

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 development. The potential 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, *i.e.* The South African Heritage Resources Authority (SAHRA) (Contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000, Tel: 021 462 4502, Email: cscheermeyer@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.

2.1. 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 case of the present project area near Vryburg the main limitation for fossil heritage assessment is the generally low level of Precambrian and Palaeozoic bedrock exposure due to extensive cover by largely unfossiliferous superficial sediments as well as the limited access to much of the study area because of the sparse road network. However, confidence levels regarding the conclusions drawn following palaeontological field assessment are moderately good.

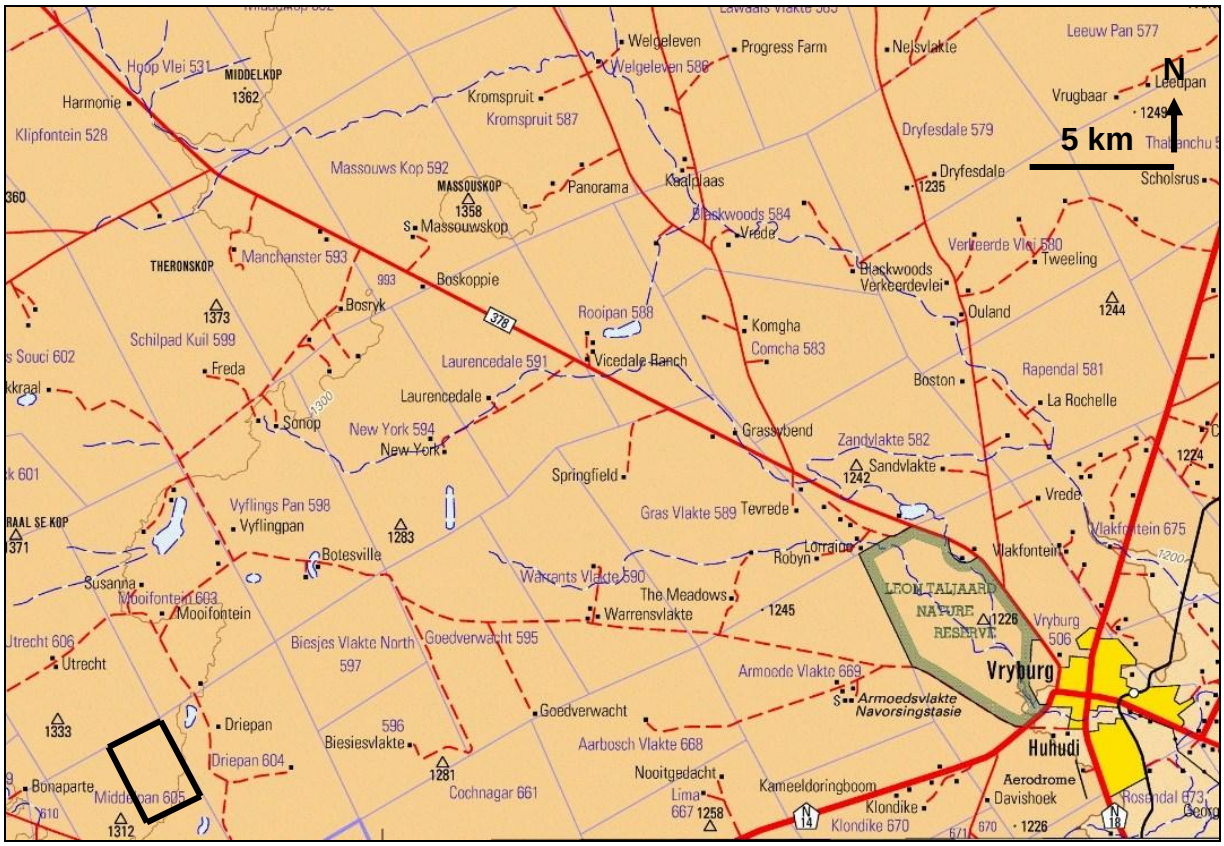

Fig. 1. Extracts from the 1: 250 000 topographical map 2624 Vryburg (Courtesy of the Chief Directorate National Geo-spatial Information, Mowbray) showing the location of the proposed Alpha Solar Power Plant study area on Portion 3 of Farm Middel Pan 605, some 30 km west of Vryburg, North-West Province (black polygon).

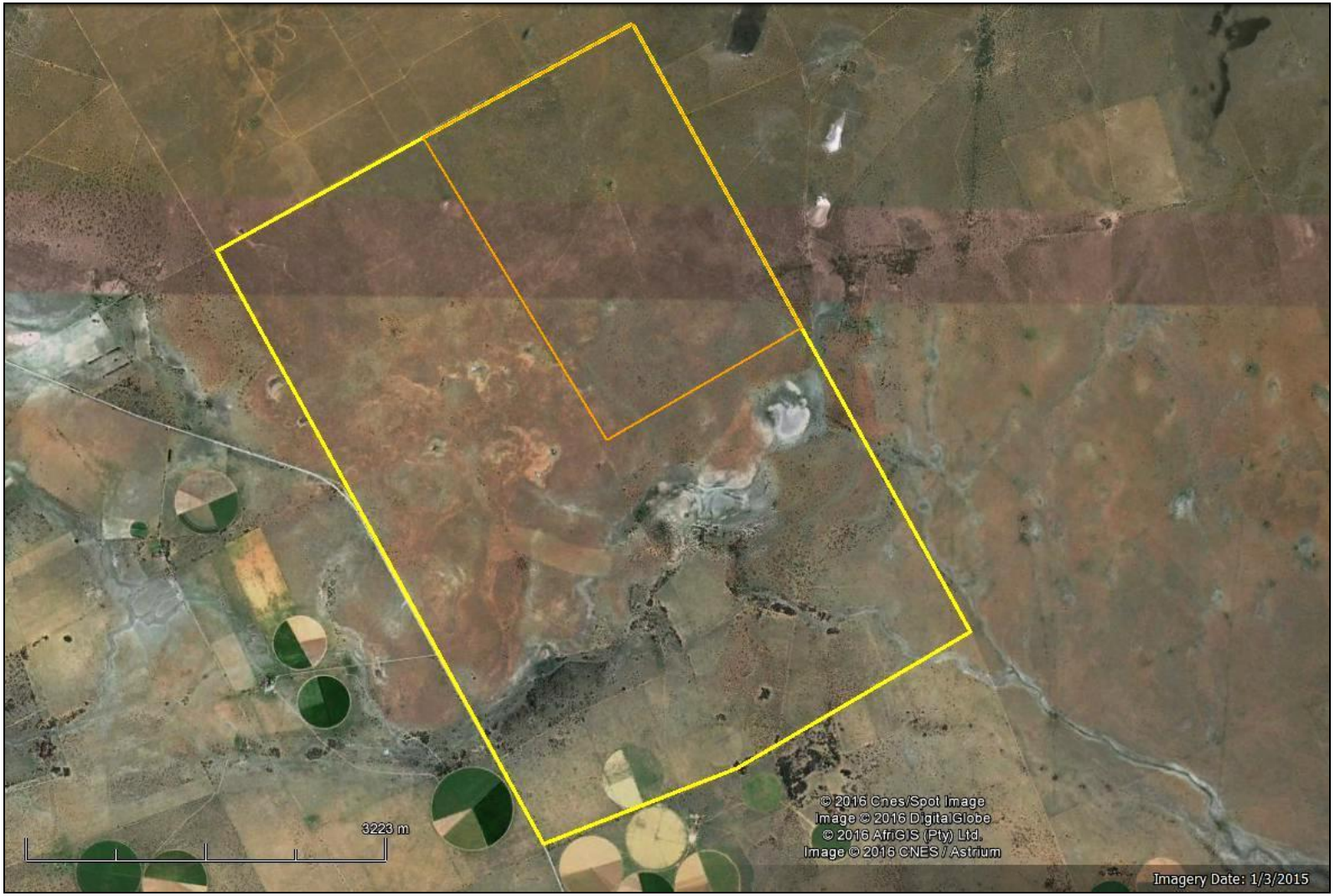

Fig. 2. Google earth© satellite image of the Alpha Solar Power Plant study area on Portion 3 of Farm Middel Pan 605 to the west of Vryburg, North-West Province (orange polygon). The outline of Middel Pan 605 is shown in yellow.

3. GEOLOGICAL & PALAEONTOLOGICAL BACKGROUND

The Alpha Solar Power Plant study area on the north-eastern sector of Farm Middle Pan 605 near Vryburg consists of typical flat-lying terrain of the Ghaap Plateau region at an elevation of *c*. 1300 – 1300 m amsl that is currently used for agricultural purposes (principally cattle farming). The climate is semi-arid and the dense vegetation cover of grassy thornveld is mapped as Ghaap Plateau Vaalbosveld (Fig. 3). There are several small pans within or just outside the study area, several of the later associated with the Wildealsleegte that runs through Middel Pan 605 further to the south. Numerous small depressions to the east of the area are probably sinkholes associated with the carbonate bedrocks of the Boomplaas Formation. Bedrock exposure within the study area is generally very poor.

Fig. 3. Typical grassy Kalahari thornveld vegetation and flat-lying terrain of the Alpha study area on Middel Pan 605. Note absence of bedrock exposure here.

The geology of the study area west of Vryburg is shown on the 1: 250 000 geology map 2624 Vryburg (Council for Geoscience, Pretoria; Fig. 4 herein). An explanation for the Vryburg geological map has been published by Keyser & Du Plessis (1993) and that for the adjoining Christiana sheet 2724 to the south is also very relevant (Schutte 1994). The entire study area is underlain by ancient sedimentary rocks of the **Schmidtsdrif Subgroup** that are almost flat-lying in this area. This is the basal subdivision of the Late Archaean to Early Proterozoic **Ghaap Group** (**Transvaal Supergroup**) in the Griqualand West Basin, Ghaap Plateau Subbasin (Fig. 5). Useful reviews of the stratigraphy and sedimentology of these Transvaal Supergroup rocks have been given by Moore *et al.* (2001), Eriksson and Altermann (1998) as well as Eriksson *et al.* (1993, 1995, 2006). The Ghaap Group represents some 200 Ma of chemical sedimentation - notably iron and manganese ores, cherts and carbonates with subordinate siliclastic rocks - within the Griqualand West Basin that was situated towards the western edge of the Kaapvaal Craton (See fig. 4.19 in McCarthy & Rubidge 2005).

The study area on Farm Middel Pan 605 is underlain by the **Vryburg Formation** (**Vv**) that comprises siliclastic fluvial and shallow marine / lagoonal sediments as well as volcanic rocks in the Vryburg area itself. The Vryburg Formation is approximately 140 m thick in this region and unconformably overlies lavas of the Venterdorp Supergroup (Allanridge Formation). An important reference section (Stratotype G), including good examples of the two major volcanic packages known as the Rosendal and Waterloo Members, is located on Waterloo Farm 992 just to the southeast of Vryburg (Smit *et al.* 1991). These last authors give a useful summary of the geology and sedimentology of the Vryburg succession, together with a detailed stratigraphic column for Waterloo Farm largely based on exposures along or close to the Droë Harts River (See also Almond 2013a). The lower portion of the Vryburg succession there comprises a basal conglomerate followed by a 20 m-thick, prominent-weathering package of cross-bedded feldspathic quartzites known as the Kobaga beds. This is overlain by *c*. 20 m of andesitic or basaltic lavas (the Rosendal Member) and pyroclastic sediments and then another 20 m package of varied siliciclastic rocks including conglomerates, quartzites, grits, flaggy sandstones (often ripple marked) and shales. These last are often pitch black and calcitic. The overlying Waterloo Member consists of c. 20-50 m of amydaloidal and non-amydaloidal basaltic / andesitic lavas and is overlain by 14 m of interbedded pyroclastic sediments and thin lenticular limestones. These last form the top of the Vryburg Formation and are followed by the carbonate-dominated beds of the Boomplaas Formation. According to Schutte (1994), however, the uppermost Vryburg beds, especially well exposed on Waterloo 992, comprise thin-bedded flaggy sandstones, pale quartzites and interbedded dolomite.

Minor carbonate interbeds within the upper Vryburg Formation in its southern, more distal outcrop area (*e.g.* near Douglas) contain microbial stromatolites, and these are also recorded from the holostratotype section some 40 km south of Vryburg (Smit *et al.* 1991). The stromatolitic carbonates within the Vryburg succession interfinger with and pass up into siliclastic sediments and are interpreted as intertidal in setting (Altermann & Wotherspoon 1995). To the author's knowledge, a detailed description of the Vryburg stromatolite occurrences has not yet been published. Useful reviews of Archaean stromatolites and associated organic-walled microfossils from southern Africa and elsewhere are provided by Altermann (2001), Buick (2001), Brasier *et al.* (2006) and Schopf (2006). Bertrand-Sarfarti and Eriksson (1977) describe columnar stromatolites from the Schmidtsdrift Subgroup of the Northern Cape.

The Vryburg Formation is treated as the basal unit of the Schmidtsdrif Subgroup by several recent authors (*e.g.* Altermann & Wotherspoon 1995, Sumner & Beukes 2006) but was previously placed below the base of the Ghaap Group succession (See stratigraphic column in Fig. 5). The Vryburg siliciclastics and overlying carbonate-rich Boomplaas Formation of the Griqualand West Basin have classically been correlated with the Black Reef Formation and overlying basal Malmani dolomites of the Transvaal Basin (*e.g.* Eriksson *et al.* 1995, 2006). However, recent sequence stratigraphic studies of the Transvaal Supergroup have demonstrated that the Vryburg / Boomplaas / Clearwater sequence is in fact older than the Black Reef Formation (Sumner & Beukes 2006). Lavas from the Vryburg Formation have been radiometrically dated to 2.64 Ga (billion years old), *i.e.* Late Archaean in age (Eriksson *et al.* 2006), and the overlying Boomplaas stromatolitic carbonates are likewise assigned a Neoarchaean age (Fig. 5).

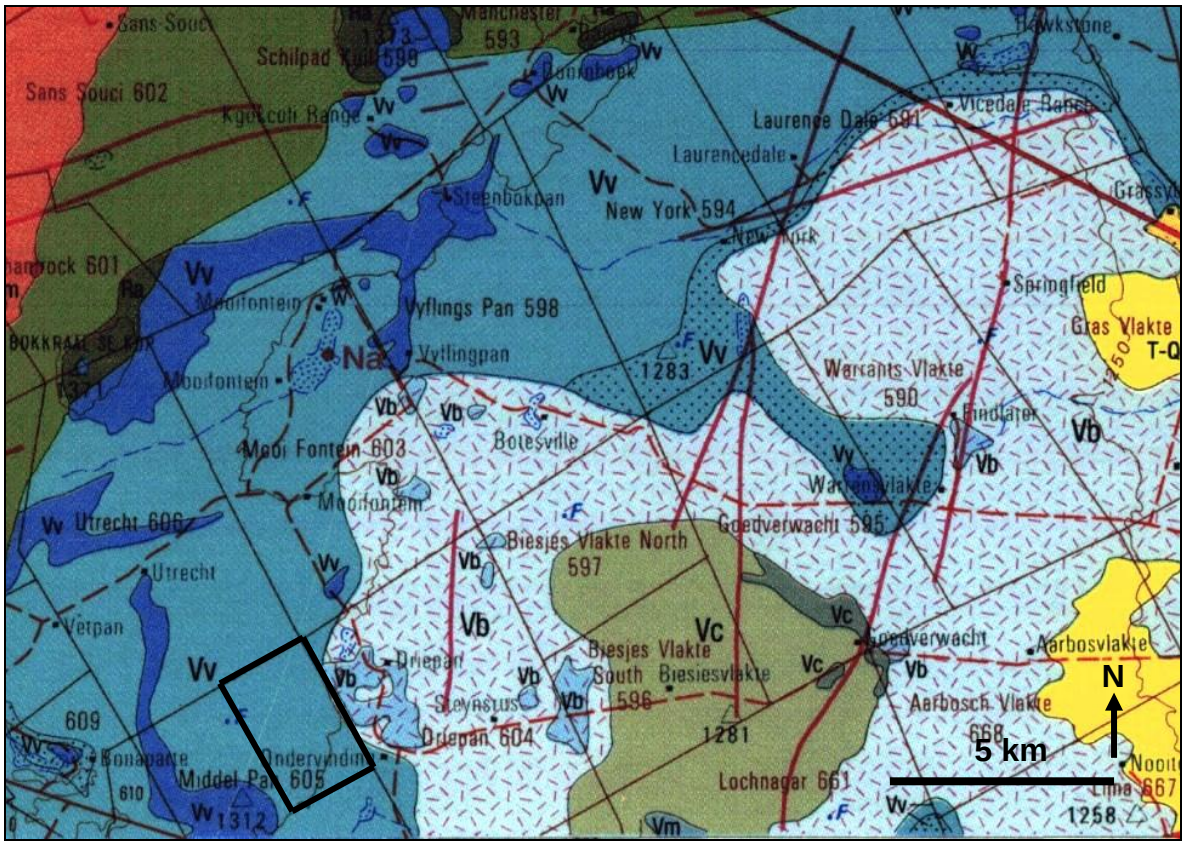

Fig. 4. Extract from the 1: 250 000 geological map 2624 Vryburg (Council for Geoscience, Pretoria) showing the outline of the study area for the proposed Alpha Solar Power Plant study area on Portion 3 of Farm Middel Pan 606, some 30 km west of Vryburg (black polygon). The main geological units represented mapped the broader study region include:

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

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

Clearwater Formation (Vc, dark grey) – late Archaean mudrocks with interbedded dolomites, flagstones, tuffites, cherts.

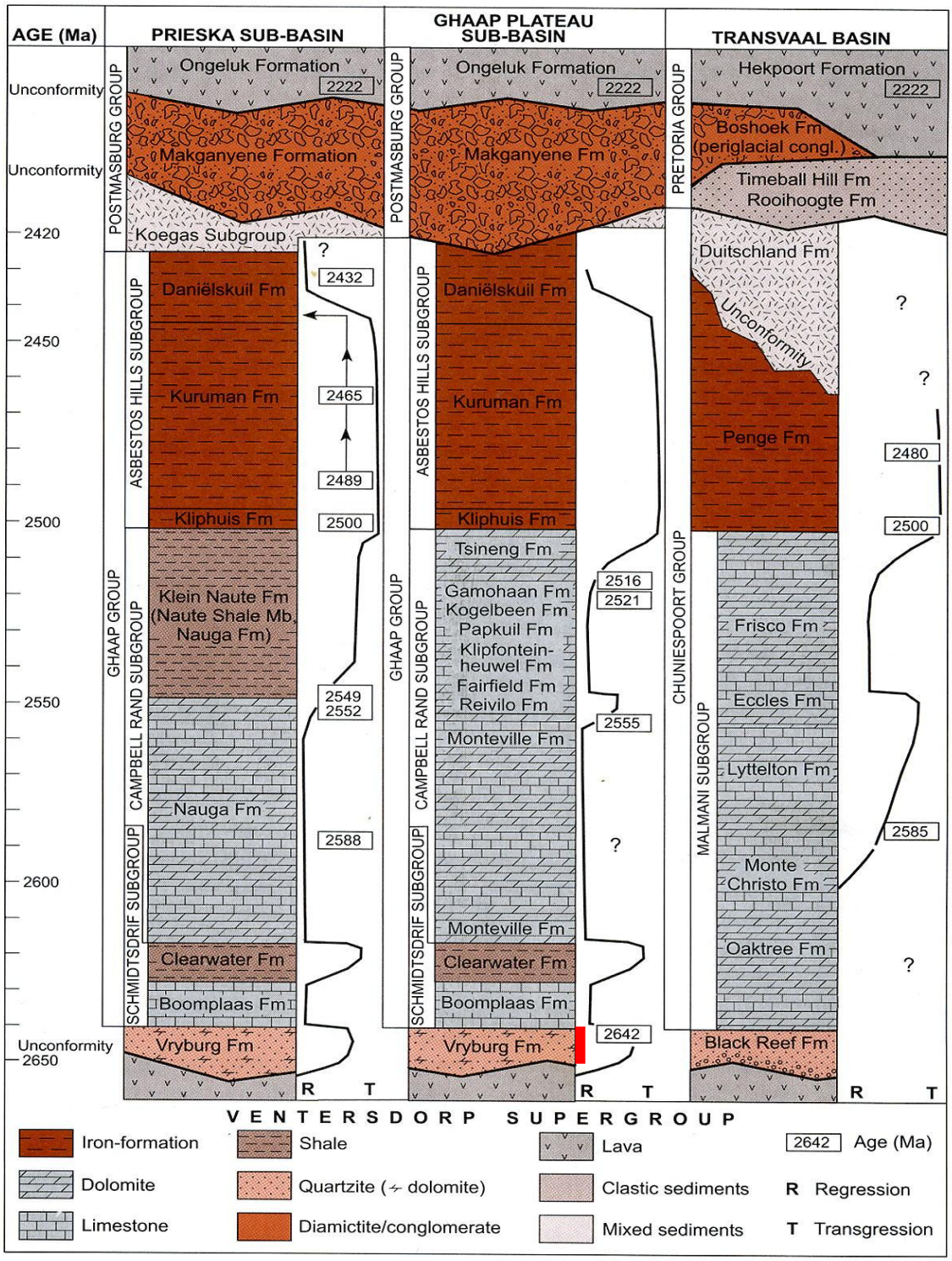

Fig. 5. Stratigraphy of the Transvaal Supergroup of the Ghaap Plateau Basin (central column) showing the position of the Vryburg Formation that is represented in the study area (red line) (From Eriksson *et al.* 2006). Note that the is incorporated within the base of the Schmidtsdrif Subgroup by some recent authors and is no longer correlated with the Black Reef Formation of the Transvaal Basin as shown here (*e.g.* Altermann & Wotherspoon 1995, Sumner & Beukes 2006).

4. FIELD OBSERVATIONS ON FARM MIDDEL PAN 605

Since Neoarchaean stromatolites have been reported from the Vryburg Formation to the south of Vryburg, the field assessment of Farm Middel Pan 605 concentrated on this stratigraphic unit. As mentioned earlier, superficial deposits such as river alluvium, colluvial rubble and downwasted surface gravels are generally unfossiliferous, or at most sparsely fossiliferous, in this region. GPS locations of sites mentioned by number in the text are listed in the Appendix.

4.1. Vryburg Formation

The limited surface exposures of the Vryburg Formation bedrocks in the broader study region are associated with small pans within and on the outskirts of the study area itself. Here are seen pale brown-weathering, grey-green, tough, well-jointed, medium-grained to gritty, coarse-grained quartzites (Figs. 6 & 7). The sediments are medium-bedded, sometimes flaggy, with occasional darker flasers and thin horizons of mudflake intraclasts (Figs. 8 & 9). Sparse white specks within the well-sorted quartzites are weathered (kaolinitised) grains of feldspar. Some bedding planes show small scale wave ripples. No volcanic or carbonate bedrocks were observed, nor were any fossil stromatolites seen.

4.2. Superficial sediments

Most of the bedrocks in the study area are mantled by shallow orange-brown, sandy soils (possibly of Kalahari provenance) with sparse downwasted surface gravels of quartzite (Figs. 3 & 11). Fluvially emplaced gravels of resistant lithologies such as quartzite, chalcedony and chert (some flaked) occur on the periphery of pans associated with shallow drainage lines. The contact between the bedrock and sandy soils is marked by subsurface gravels of fine to coarse sandstone / quartzite as well as abundant dark grey or pale buff chert (including flaked ESA and MSA artefacts) (Fig. 10). Occasional blocks of siliceous breccia and ferricrete are downwasted relicts of pedocrete horizons.

Fig. 6. Well-jointed, brown-weathering quartzites of the Vryburg Formation exposed in a shallow pan just west of the study area. Note also coarse downwasted quartitic gravels.

Fig. 7. Flat-lying, wave-rippled Vryburg quartzites in a small pan on Portion 3 of Farm Middel Pan 605 (Hammer = 30 cm).

Fig. 8. Flaggy Vryburg Formation quartzites and downwasted gravels exposed in a farm track.

Fig. 9. Block of tough, greyish Vryburg Formation quartzite showing faint cros-lamination and occasional dark heavy mineral laminations or flasers (Hammer = 30 cm).

Fig. 10. Accumulation of angular gravels between the Vryburg Formation bedrocks and overlying sandy soils (Hammer = 30 cm). Note the abundance of angular chert clasts.

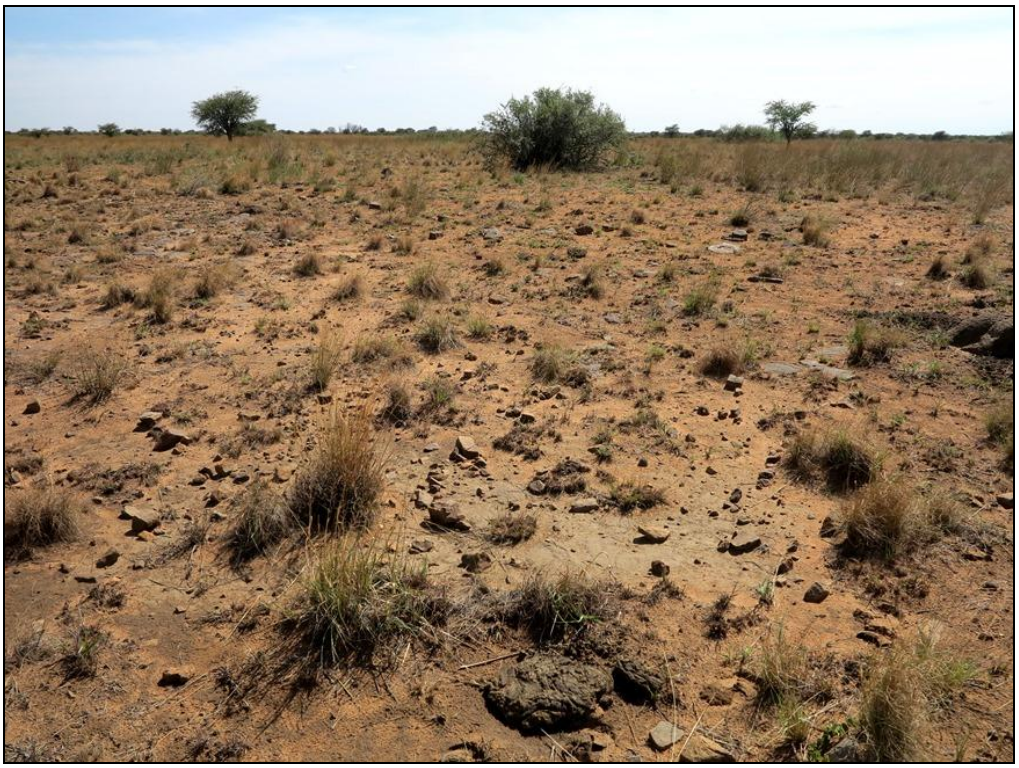

Fig. 11. Quartzitic and cherty gravels, in part of alluvial origin, and orange-brown sandy soils on the periphery of a shallow pan.

5. SIGNIFICANCE OF POTENTIAL IMPACTS ON PALAEONTOLOGICAL HERITAGE

A brief assessment of the impact significance of the construction phase of the proposed Alpha Solar Power Plant on local fossil heritage resources on Farm Middel Pan 605 is presented here. Please note that further impacts are not anticipated during the operational and decommissioning phase of the development.

- **Nature of the impact**

Bedrock excavations and site clearance for the proposed PV panels, control building, any buried cables, the electrical substation as well as the internal site roads and powerline infrastructure may adversely affect potential fossil heritage within the study area by damaging, destroying, disturbing or permanently sealing-in fossils at or below the ground surface that are then no longer available for scientific research or other public good.

- **Geographical extent and duration of the impact**

Any significant impacts on fossil heritage are limited to the development site and to the construction phase when site clearance and excavations into fresh, potentially fossiliferous bedrock may take place. No further significant impacts are anticipated during the operational or decommissioning phases of the solar facility. Impacts on fossil heritage are generally permanent.

- **Probability of the impact occurring**

Following field assessment, the bedrocks in the study area are inferred to comprise non-fossiliferous quartzites. No evidence was found for stromatolitic carbonate bedrocks here. The probability of significant impacts on palaeontological heritage during the construction phase is therefore very low.

- **Intensity / magnitude of impact**

Given the apparent absence of fossil-rich bedrocks in the study area, the magnitude of impacts on palaeontlogical heritage is rated as very low.

- **Degree to which the impact can be reversed**

Impacts on fossil heritage are generally irreversible. Well-documented new records and further palaeontological studies of any fossils revealed during construction would represent a positive impact from a scientific viewpoint.

- **Degree to which the impact may cause irreplaceable loss of resources**

Irreplaceable loss of fossil heritage resources is not anticipated here.

- **Degree to which the impact can be mitigated**

Given the lack of evidence for vulnerable fossils on site, there are no recommendations for specialist monitoring or mitigation for the Alpha Solar Power Plant project on Farm Middel Pan 603.

Should significant fossil remains - such as well-preserved stromatolites - be exposed during construction, the responsible Environmental Control Officer should safeguard these, preferably *in situ*. The South African Heritage Resources Authority (SAHRA) should be alerted as soon as possible (Contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000, Tel: 021 462 4502, Email: cscheermeyer@sahra.org.za), 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. The palaeontologist concerned with mitigation work will need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). These recommendations should be included within the EMPr for the proposed solar power plant development.

- **Cumulative impacts**

Cumulative impacts could arise as other similar projects are constructed in the area. According to the Energy Blog's database only one other solar PV plant has been granted preferred bidders status within close proximity to the proposed Alpha PV plant:

Waterloo Solar Park with a capacity of 75MW near Vryburg, North West Province (Approvals, planning and financing phase)

According to the Department's database numerous other solar plants have been proposed in relative close proximity to the proposed activity, namely:

- The proposed Carocraft Solar Park near Vryburg, North West Province (14/12/16/3/3/2/374);
- Construction of the 75MW Photovoltaic facility and associated infrastructure in Naledi (14/12/16/3/3/2/390).
- The proposed Tiger Kloof Solar Photovoltaic energy facility near Vryburg, North West Province (14/12/16/3/3/2/535).
- The proposed Keren Energy Bosh Pan Solar Plant, Northern Cape Province (14/12/16/3/3/1/563);
- The proposed renewable energy generation project. Carocraft Solar Park in North West Province (14/12/16/3/3/2/699);
- The proposed Renewable Energy Genertion Project rem farm Elda, North West (14/12/16/3/3/2/750);
- The proposed Renewable Energy Project on Farm Doornbult 29 and Doornbult 33, North West (14/12/16/3/3/2/751);

Environamics and other environmental consultants are also in the process of applying for Environmental Authorisation for other PV projects in the area, namely:

- The proposed Protea Solar Power Plant near Vryburg, North West Province.
- The proposed Gamma Solar Power Plant near Vryburg, North West Province.
- The proposed Alpha Solar Power Plant near Vryburg, North West Province.
- The proposed Meerkat Solar Power Plant near Vryburg, North West Province.

- The proposed Sonbesie Solar Power Plant near Vryburg, North West Province.
- Three PV Solar Energy facilities on the farm Klondike - AMDA Developments.

The potential for cumulative impacts may therefore exist. The Environmental Impact Assessment (EIA) Report will include a detailed assessment of the potential cumulative impacts associated with the proposed development.

6. CONCLUSIONS & RECOMMENDATIONS

The Alpha Solar Power Plant study area is entirely underlain by late Archaean (*c*. 2.6 billion year-old) sedimentary rocks of the Schmidtsdrif Subgroup (Ghaap Group, Transvaal Supergroup). These mainly comprise shallow marine siliciclastic sediments of the Vryburg Formation.

Field assessment suggests that stromatolite-bearing carbonate rocks are not present within the Vryburg Formation succession in the study area. It is concluded that, with or without mitigation, the overall impact of the proposed Alpha Solar Power Plant on Farm Middel Pan 605 is of **NEGATIVE LOW SIGNIFICANCE** in palaeontological heritage terms.

7. ACKNOWLEDGEMENTS

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

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

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APPENDIX: GPS LOCALITY DATA FOR NUMBERED SITES LISTED IN TEXT

All GPS readings were taken in the field using a hand-held Garmin GPSmap 60CSx instrument. The datum used is WGS 84.

Loc number	GPS data	Comments
206	S26° 59' 49.0" E24° 25' 24.5"	Float blocks and small bedrock exposure of brown-weathering Vryburg Fm quartzites, SW corner of study area.
207	S26° 59' 20.6" E24° 26' 24.9"	Small exposure of flaggy Vryburg Fm quartzites overlain by quartzite and chert-rich gravels with occasional stone artefacts (ESA, MSA).
208	S26° 58' 56.4" E24° 25' 50.8"	Shallow pan area with surface exposure of Vryburg quartiztes, fluvial gravels.
209	S26° 59' 20.5" E24° 25' 01.7"	Shallow pan area just west of study area with good exposure of well-jointed Vryburg quartzites, downwasted gravels.