

**Phase 1 Palaeontological Impact Assessment of two
borrow pit sites on Farm 506IN near Vryburg, Northwest
Province.**



Report prepared by
Paleo Field Services
PO Box 38806
Langenhovenpark
9330

Executive Summary

A Phase 1 Palaeontological Impact Assessment was carried out for two borrow pit sites on Farm 506IN outside Vryburg, Northwest Province. The proposed Sand Quarry A and B locality (designated Site 1) and the proposed new borrow pit area (designated Site 2) are located on municipal land, currently used for off-road activities and cattle farming. The field assessment has shown that Site 1 is entirely capped by a thick mantle of red-brown Quaternary wind-blown sand. **The removal of sand will not adversely affect potential fossil heritage at Sand Quarries A and B and the area is assigned a site rating of Generally Protected C.** The exposures at the southeastern portion of Site 2, indicate that the South Area and the Existing Biesiesvlakte Borrow Pit are underlain by well-developed calcrete formations, mantled by a coarse gravel veneer. **Excavations for the removal of road building material will not adversely affect potential fossil heritage in the South Area and Biesiesvlakte Existing Quarry. They are each assigned a site rating of Generally Protected C.** The flat northwestern portion of the study area, covering West Area 1, West Area 2 and the Apex Area at Site 2, is covered by gravelly soils that hampered bedrock visibility during the pedestrian survey, but carbonate rocks of the Boomplaas Formation are occasionally visible. Well-preserved stromatolite assemblages have been recorded within the carbonate rocks of the Boomplaas Formation in the region, so there is a **moderate to high likelihood that excavations for the removal of road building material may adversely affect potential fossil heritage within the capped dolomites underlying West Area 1, West Area 2 and Apex Area.** Stromatolites can be preserved both as isolated occurrences or as laterally distributed horizons, so it will be difficult to determine the potentially adverse effect of excavations into potentially fossil-bearing dolomites underlying the area other than to emphasize that impacts on fossil heritage are generally irreversible. It is advised that **West Area 1, West Area 2 and Apex Area are assigned a site rating of Generally Protected A** with the recommendation that mitigation of expected damage and destruction of fossil stromatolites within the proposed development area will require the recording and sampling of fossil occurrences by a professional palaeontologist after the topsoil / residual overburden has been removed, but before any excavations into fresh dolomite bedrock is conducted.

Table of Contents

Executive Summary.....	2
Introduction.....	4
Terms of Reference.....	5
Methodology.....	5
Field Rating.....	5
Locality data.....	5
Site Information.....	5
Background.....	6
Impact Statement and Recommendations.....	6
References.....	8
Tables and Figures.....	9

Introduction

A Phase 1 Palaeontological Impact Assessment was carried out for two borrow pit areas on municipal land on Farm 506IN outside Vryburg, Northwest Province (**Fig.1**). The assessment is required as a prerequisite for new development in terms of the National Environmental Management Act and is also called for in terms of the National Heritage Resources Act (NHRA) 25 of 1999. The region's unique and non-renewable archaeological heritage sites are 'Generally' protected in terms of the National Heritage Resources Act (Act No 25 of 1999, section 35) and may not be disturbed at all without a permit from the relevant heritage resources authority. As many such heritage sites are threatened daily by development, both the environmental and heritage legislation require impact assessment reports that identify all heritage resources including palaeontological sites in the area to be developed, and that make recommendations for protection or mitigation of the impact of such sites.

The NHRA identifies what is defined as a heritage resource, the criteria for establishing its significance and lists specific activities for which a heritage specialist study may be required. **In this regard, categories of development relevant to the proposed development listed in Section 38 (1) of the NHR Act are as follows:**

38 (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as—

- The construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
- The construction of a bridge or similar structure exceeding 50m in length;
- Any development or other activity which will change the character of the site
 - a) exceeding 5000 m² in extent; or
 - b) involving three or more existing erven or subdivisions thereof; or
 - c) involving three or more subdivisions thereof which have been consolidated within the past five years;
- The rezoning of a site exceeding 10 000 m²; or
- Any other category of development provided for in regulations by the South African Heritage Resources Agency (SAHRA).

Terms of Reference

- Identify and map possible heritage sites and occurrences using available resources.
- Determine and assess the potential impacts of the proposed development on potential heritage resources;
- Recommend mitigation measures to minimize potential impacts associated with the proposed development.

Methodology

The heritage significance of the affected area was evaluated through a desktop study and carried out on the basis of existing field data, database information and published literature. This was followed by a field assessment by means of a pedestrian survey. A Garmin Etrex Vista GPS hand model (set to the WGS 84 map datum) and a digital camera were used for recording purposes. Relevant publications, aerial photographs (incl. Google Earth) and site records were consulted and integrated with data acquired during the on-site inspection. A site visit and subsequent assessment took place in July 2016.

Field Rating

Site significance classification standards prescribed by SAHRA (2005) were used to indicate overall significance and mitigation procedures where relevant (**Table 1**).

Locality data

Site Information

1 : 50 000 scale topographic map: 2624DC Vryburg

1:250 000 scale geological map 2624 Vryburg

The proposed sand quarry (Site 1) and borrow pit (Site 2) localities are located on Farm 506 IN on generally flat-lying municipal land currently used for off-road activities and cattle farming (**Fig 2**). Site 1 is demarcated Sand Quarry A and Sand Quarry B and covers approximately 35 ha of a largely degraded terrain (old excavations), situated east of the R378 provincial road, about 5.5 km north of Vryburg. Presently divided into 5 camps, Site 2 covers about 360 ha and is situated adjacent to the Leon Taljaard Nature Reserve next to the N14 national road between Vryburg and Kuruman (**Fig. 2**).

Site coordinates (Fig. 2):

Sand Quarry Area Farm 506 IN

- A) 26°53'54.13"S 24°41'55.28"E
- B) 26°53'50.56"S 24°42'1.90"E
- C) 26°54'34.57"S 24°42'9.03"E
- D) 26°54'39.66"S 24°41'58.99"E

Borrow Pit Area Farm 506 IN

- A) 26°56'58.86"S 24°40'28.05"E
- B) 26°58'41.11"S 24°41'32.31"E
- C) 26°58'4.67"S 24°42'36.43"E

Geology

The geology of the study area is shown on the 1: 250 000 geology map 2624 Vryburg (Council for Geoscience, Pretoria) and has been described by Keyser & Du Plessis (1993). According to the map sheet both sites are underlain by Late Archaean sedimentary rocks of the Schmidtsdrif Subgroup (Ghaap Group, Transvaal Supergroup) that are capped in places by more recent Kalahari Group deposits (**Fig. 3**). The bedrock at Site 1 is represented by Vryburg Formation quartzites (*Vv*) while the northwestern portions of Site 2 are shown to be underlain by shallow marine carbonates (oolitic and stromatolitic dolomites) and subordinate siliclastic sediments of the overlying Boomplaas Formation (*Vb*). The southeastern portion of Site 2 is underlain by Quaternary Kalahari Group calcretes (*T-Qc*) and river terrace gravels (*Qa*).

Background

Studies on the stratigraphy and sedimentology of the Ghaap Group, which includes the carbonate rocks of the Boomplaas Formation, also provided a comprehensive account of Neoproterozoic stromatolites as a record of early microbial-dominated life in shallow seas and lakes on earth (Beukes 1978; Eriksson and Altermann 1998; Moore 2001).

Younger fossil repositories in the region include Cenozoic dolines and cave breccia associated with the karst topography such as at Kathu Pan and Taung. The Norlim

tufas at Taung contain solution cavities that produced the first type specimen of *Australopithecus africanus* (Dart 1925). Subsequent excavations have produced fossil vertebrate material attributed to over 20 different animal species. Another important locality at Norlim is Equus Cave, a Late Pleistocene fossil locality that has produced over 40 mammalian species, including the extinct taxa *Equus capensis*, *Megalotragus priscus* and *Antidorcas bondi*. Superficial sediments around Vryburg are made up of Kalahari Group (Tertiary to Quaternary) surface limestones and thick deposits of unconsolidated aeolian sands. These deposits can be fossiliferous, but then also very localized, and particularly those that are directly related to fluvial environments along major river courses or associated with pan dunes. There are currently no records of Quaternary fossil localities within the vicinity of Vryburg.

Field Assessment

Site 1

The study area is entirely capped by a thick mantle of red-brown Quaternary wind-blown sand (**Fig. 4**). A foot survey of old excavations in both quarry areas (A & B) indicate that these deposits are represented by a fairly homogenous profile consisting of a light-brown sandy topsoil and a substantial layer of reddish-brown aeolian sand, reaching depths of up to 4m (**Fig. 5**).

Site 2

The exposures at the southeastern portion of the site, indicate that the South Area and the Existing Borrow Pit Area (see **Fig. 2**), are underlain by well-developed calcrete formations mantled by a coarse gravel veneer (**Fig. 6 & 7**). The flat northwestern portion of the study area, covering West Area 1, West Area 2 and the Apex Area, is covered by gravelly soils that hampered bedrock visibility during the pedestrian survey, but carbonate rocks of the Boomplaas Formation are occasionally exposed (**Fig. 8**).

Impact Statement and Recommendations

Site 1

The Quaternary sand overburden capping the site is not considered to be palaeontologically sensitive and the removal of sand will not adversely affect

potential fossil heritage within the study area. Proposed Sand Quarries A and B are assigned a site rating of Generally Protected C (**Table 1**).

Site 2

South Area and Biesiesvlakte Existing Quarry

The calcrete deposits within these zones are not considered to be palaeontologically sensitive and excavations for the removal of road building material will not adversely affect potential fossil heritage. The South Area and Biesiesvlakte Existing Quarry are assigned a site rating of Generally Protected C (**Table 1**).

West Area 1, West Area 2 and Apex Area

Stromatolite assemblages have been recorded within the carbonate rocks of the Boomplaas Formation in the region, so there is a moderate to high likelihood that excavations for the removal of road building material may adversely affect potential fossil heritage within the capped dolomites underlying West Area 1, West Area 2 and Apex Area. Stromatolites can be preserved both as isolated occurrences or as laterally distributed horizons, so it will be difficult to determine the potentially adverse effect of excavations into potentially fossil-bearing dolomites underlying the area other than to emphasize that impacts on fossil heritage are generally irreversible. Conversely, the recovery of new fossils as a result of industrial excavation activities can also be considered a positive impact, but only if the process is accompanied by appropriate scientific recording and retrieval methods. It is advised that West Area 1, West Area 2 and Apex Area are assigned a site rating of Generally Protected A (**Table 1**) with the recommendation that mitigation of expected damage and destruction of fossil stromatolites within the proposed development area will require the recording and sampling of well-preserved fossil occurrences by a professional palaeontologist after the topsoil / residual overburden has been removed, but before any excavations into fresh bedrock is conducted.

References

Beukes N.J. 1978 *Die Karbonaatgesteentes en Ysterformasies van die Ghaap Groep van die Transvaal Supergroep in Noord-Kaapland*. Unpublished PhD – thesis. Rand Afrikaans University, Johannesburg, pp 580

Eriksson, P.G. & Altermann, W. 1998. An overview of the geology of the Transvaal Supergroup dolomites (South Africa). *Environmental Geology* 36, 179-188.

Keyser, N. & Du Plessis, C.P. 1993. *The geology of the Vryburg area*. Explanation to 1: 250 000 geology sheet 2624 Vryburg. Council for Geoscience, Pretoria.

Moore, J.M., Tsikos, H. & Polteau, S. 2001. Deconstructing the Transvaal Supergroup, South Africa: implications for Palaeoproterozoic palaeoclimate models. *African Earth Sciences* 33, 437-444.

Schopf et al. 2007. Evidence of Archean life: Stromatolites and microfossils. *Precambrian Research* 158: 141 – 155.

Tables and Figures

Table 1. Field rating categories for heritage sites as prescribed by SAHRA.

Field Rating	Grade	Significance	Mitigation
National Significance (NS)	Grade 1	-	Conservation; national site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; provincial site nomination
Local Significance (LS)	Grade 3A	High significance	Conservation; mitigation not advised
Local Significance (LS)	Grade 3B	High significance	Mitigation (part of site should be retained)
Generally Protected A (GP.A)	-	High/medium significance	Mitigation before destruction
Generally Protected B (GP.B)	-	Medium significance	Recording before destruction
Generally Protected C (GP.C)	-	Low significance	Destruction

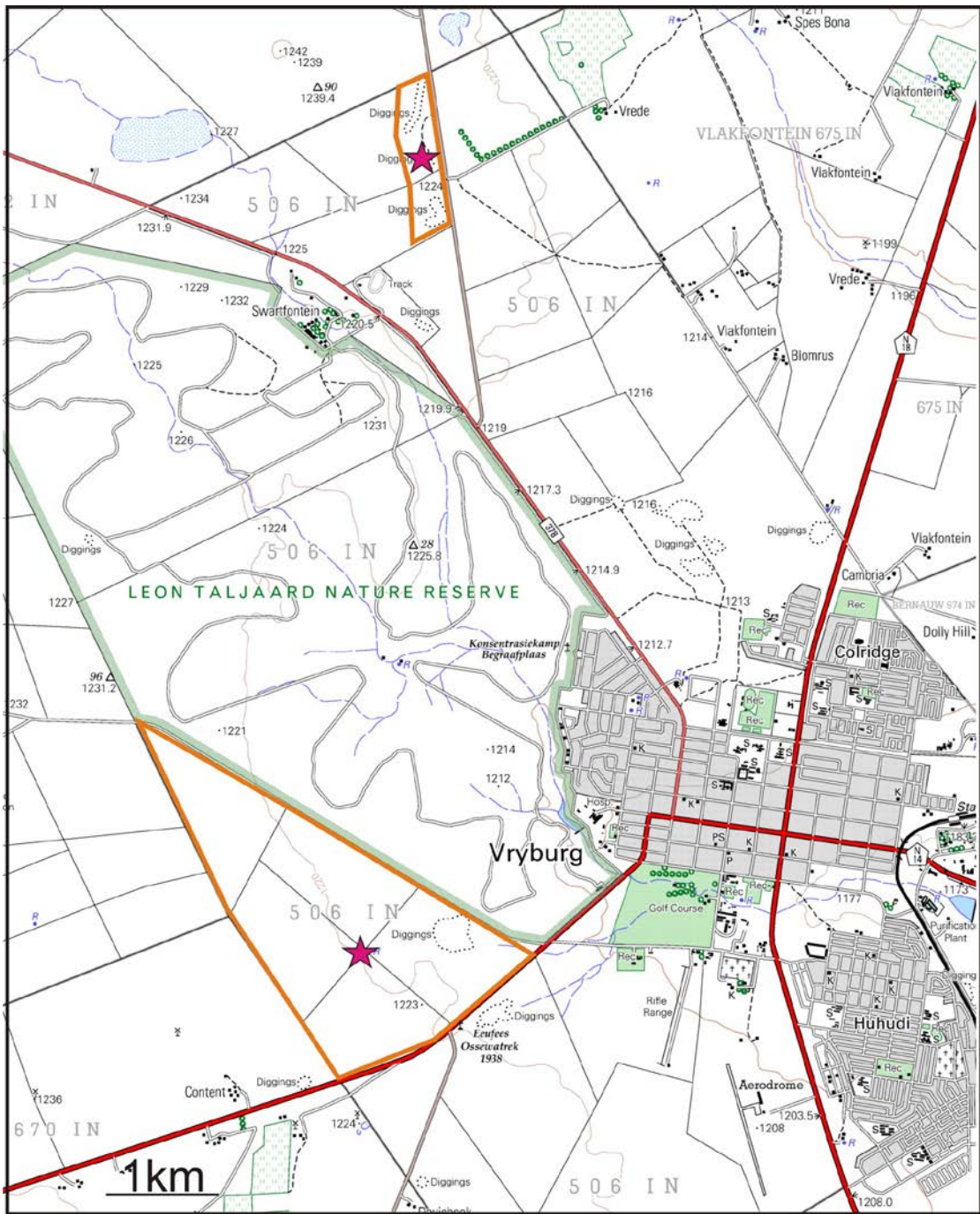


Figure 1. Portion of 1:50 000 scale topographic map 2624DC Vryburg showing the localities of the proposed development areas (star).

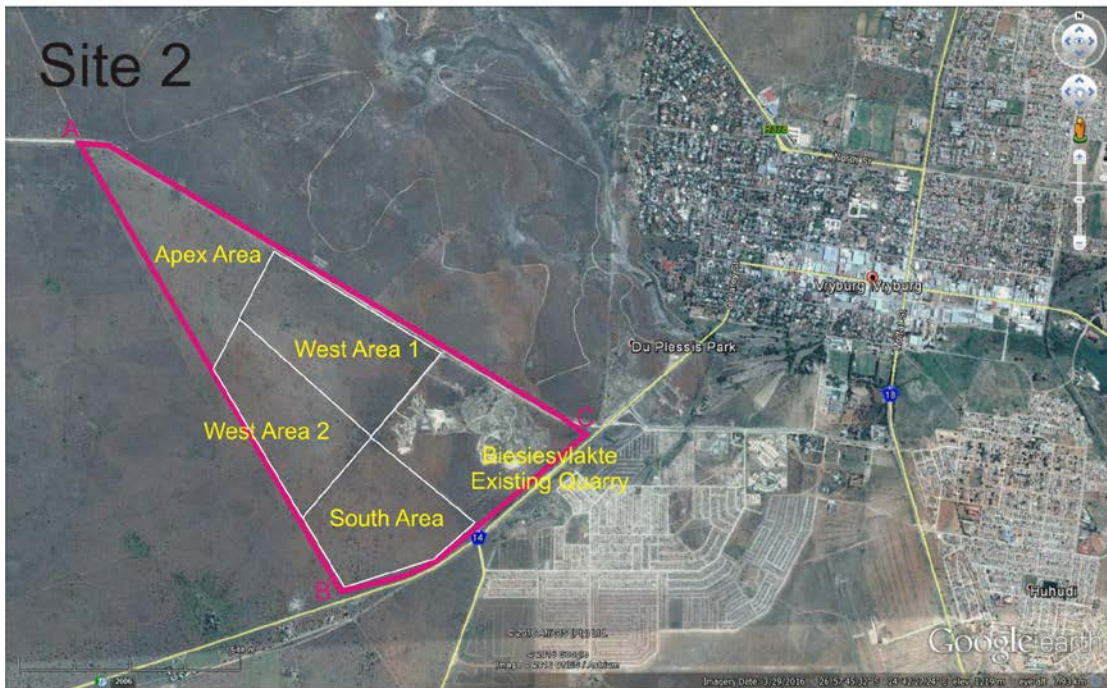
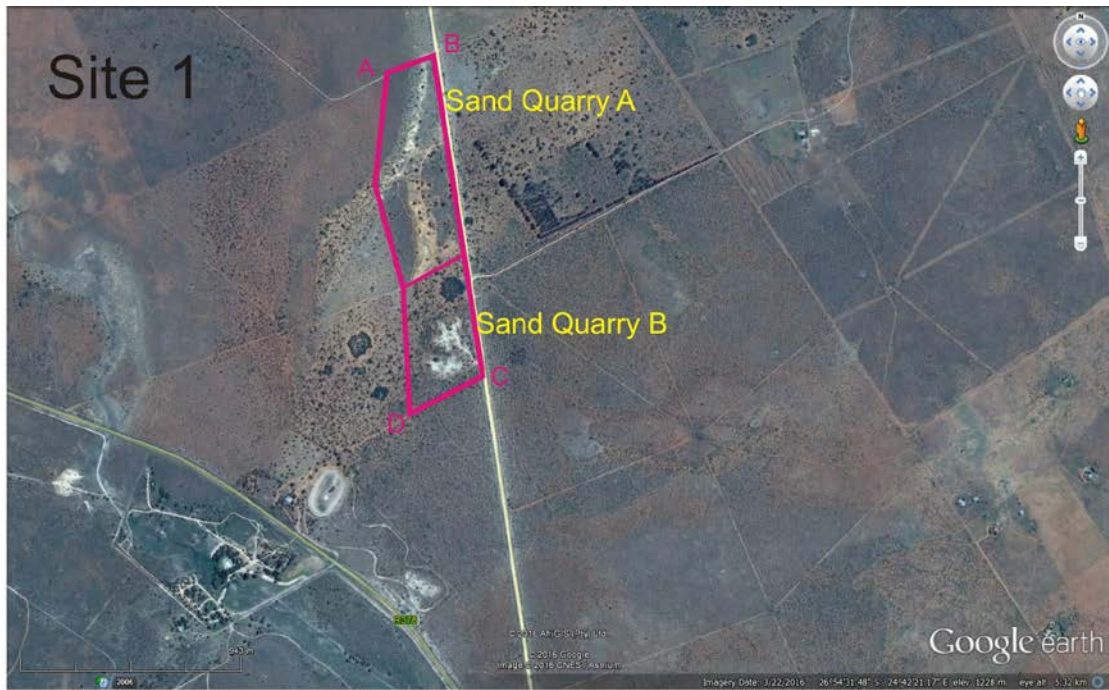


Figure 2. Aerial view and layout of the study areas.

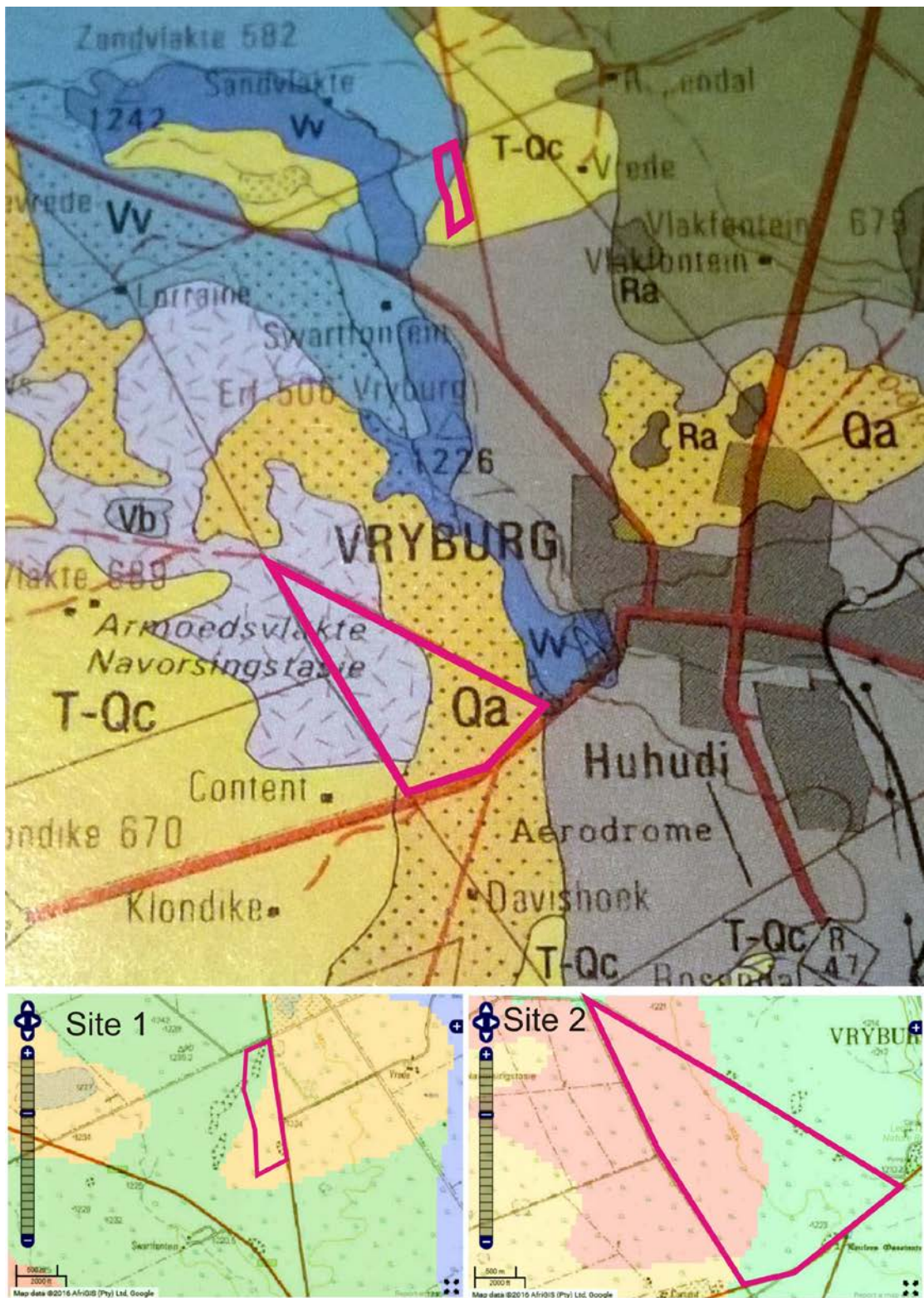


Fig. 3. Portion of the 1: 250 000 geological map 2624 Vryburg showing the position of Site 1 and Site 2 on Farm 506 IN to the north and west of Vryburg (top). Site 1 is designated moderately sensitive (green to yellow areas) and part of Site 2 highly sensitive (red area) in terms of palaeontological heritage according to the SAHRIS Palaeosensitivity Map of SA (bottom left and right).



Figure 4. General view of the aeolian sand deposits at Sand Quarries A & B (Site 1).



Figure 5. A soil profile from Site 1: light-brown sandy topsoils covering thick deposits of reddish-brown aeolian sand. Scale 1 = 10 cm.



Figure 6. Hardpan calcrete and calcrete gravel deposits exposed at the Biesiesvlakte Quarry, looking south.



Figure 7. Well-developed calcrete formations (top left &right), mantled by a coarse gravel veneer (below) in the South Area and the Biesiesvlakte Borrow Pit.



Figure 8. The flat landscape at West Area 1, West Area 2 and the Apex Area is covered by gravelly soils (top). Carbonate rocks of the Boomplaas Formation are occasionally exposed (below).
Scale 1 = 10 cm.