

Proposed development of Amandelbult Open Cast Mine near Thabazimbi, Limpopo

DESKTOP STUDY REPORT PALAEOLOGY

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Table of Contents:

1. Introduction.....	3
2. Terms of reference for the report.....	4
3. Details of study area and the type of assessment.....	7
4. Geological setting of the study area	8
5. Palaeontological overview of the study area	9
6. Conclusion and Recommendations.....	10

List of Figures:

Figure 1: Google Earth photo indicating the study areas. The yellow shaded polygon indicates the area earmarked for the opencast mine and the pink polygon west of it indicates the area earmarked for the crushing plant.....7

Figure 2: Geological Map of the study area and surroundings (adapted from the 2426 THABAZIMBI 1:250 000 Geology Map, Council for Geoscience, 1978).....8

1. Introduction

The palaeontological heritage of South Africa is unsurpassed and can only be described in superlatives. The South African palaeontological record gives us insight in *i.a.* the origin of life, dinosaurs and humans. Fossils are also used to identify rock strata and determine the geological context of the geological formations and the chronostratigraphy of Southern Africa.

The first evidence of tectonic plate movement was discovered after studying the distribution of Karoo-age fossils in South Africa and other continents and subcontinents such as India, Antarctica, South America and Australia. Fossils are also used to study evolutionary relationships, sedimentary processes and palaeoenvironments.

The Heritage Act of South Africa stipulates that fossils and fossil sites may not be altered or destroyed. The purpose of this document is to detail the probability of finding fossils in the study area which may be impacted by the proposed development.

2. Terms of reference for the report

According to the South African Heritage Resources Act (Act 25 of 1999) (Republic of South Africa, 1999), certain clauses are relevant to palaeontological aspects for a terrain suitability assessment.

- **Subsection 35(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 with the detection or recovery of metals or archaeological material or objects, or use such equipment for the recovery of meteorites.
- **Subsection 35(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 procedures 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.

South Africa's unique and non-renewable palaeontological heritage is protected in terms of the NHRA. According to this act, heritage resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

As areas are developed and landscapes are modified, heritage resources, including palaeontological resources, are threatened. As such, both the environmental and heritage legislation require that development activities must be preceded by an assessment of the impact undertaken by qualified professionals. Palaeontological Impact Assessments (PIAs) are specialist reports that form part of the wider heritage component of:

- Heritage Impact Assessments (HIAs) called for in terms of Section 38 of the National Heritage Resources Act, Act No. 25, 1999 by a heritage resources authority.
- Environmental Impact Assessment process as required in terms of other legislation listed in s. 38(8) of NHRA;
- Environmental Management Plans (EMPs) required by the Department of Mineral Resources.

HIAs are intended to ensure that all heritage resources are protected, and where it is not possible to preserve them in situ, appropriate mitigation measures are applied. An HIA is a comprehensive study that comprises a palaeontological, archaeological, built environment, living heritage, etc specialist studies. Palaeontologists must acknowledge this and ensure that they collaborate with other heritage practitioners. Where palaeontologists are engaged for the entire HIA, they must refer heritage components for which they do not have expertise on to appropriate specialists. Where they are engaged specifically for the palaeontology, they must draw the attention of environmental consultants and developers to the need for assessment of other aspects of heritage. In this sense, Palaeontological Impact Assessments that are part of Heritage Impact Assessments are similar to specialist reports that form part of the EIA reports. The standards and procedures discussed here are therefore meant to guide the conduct of PIAs and specialists undertaking such studies must adhere to them. The process of assessment for the palaeontological (PIA) specialist components of heritage impact assessments, involves:

Scoping stage in line with regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment. This involves an **initial assessment** where the specialist evaluates the scope of the project (based, for example, on NID/BIDs) and advises on the form and extent of the assessment process. At this stage the palaeontologist may also decide to compile a **Letter of Recommendation for Exemption from further Palaeontological Studies**. This letter will state that there is little or no likelihood that any significant fossil resources will be impacted by the development. This letter should present a reasoned case for exemption, supported by consultation of the relevant geological maps and key literature.

A Palaeontological Desktop Study – the palaeontologist will investigate available resources (geological maps, scientific literature, previous impact assessment reports, institutional fossil collections, satellite images or aerial

photos , etc) to inform an assessment of fossil heritage and/or exposure of potentially fossiliferous rocks within the study area. A Desktop studies will conclude whether a further field assessment is warranted or not. Where further studies are required, the desktop study would normally be an integral part of a field assessment of relevant palaeontological resources.

A Phase 1 Palaeontological Impact Assessment is generally warranted where rock units of high palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large-scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed project area is unknown. In the recommendations of Phase 1, the specialist will inform whether further monitoring and mitigation are necessary. The Phase 1 should identify the rock units and significant fossil heritage resources present, or by inference likely to be present, within the study area, assess the palaeontological significance of these rock units, fossil sites or other fossil heritage, comment on the impact of the development on palaeontological heritage resources and make recommendations for their mitigation or conservation, or for any further specialist studies that are required in order to adequately assess the nature, distribution and conservation value of palaeontological resources within the study area.

A Phase 2 Palaeontological Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or the recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before Phase 2 may be implemented.

A 'Phase 3' Palaeontological Site Conservation and Management Plan may be required in cases where the site is so important that development will not be allowed, or where development is to co-exist with the resource. Developers may be required to enhance the value of the sites retained on their properties with appropriate interpretive material or displays as a way of promoting access of such resources to the public.

The assessment reports will be assessed by the relevant heritage resources authority, and depending on which piece of legislation triggered the study, a response will be given in the form of a Review Comment or Record of Decision (ROD). In the case of PIAs that are part of EIAs or EMPs, the heritage resources authority will issue a comment or a record of decision that may be forwarded to the consultant or developer, relevant government department or heritage practitioner and where feasible to all three.

3. Details of study area and the type of assessment:



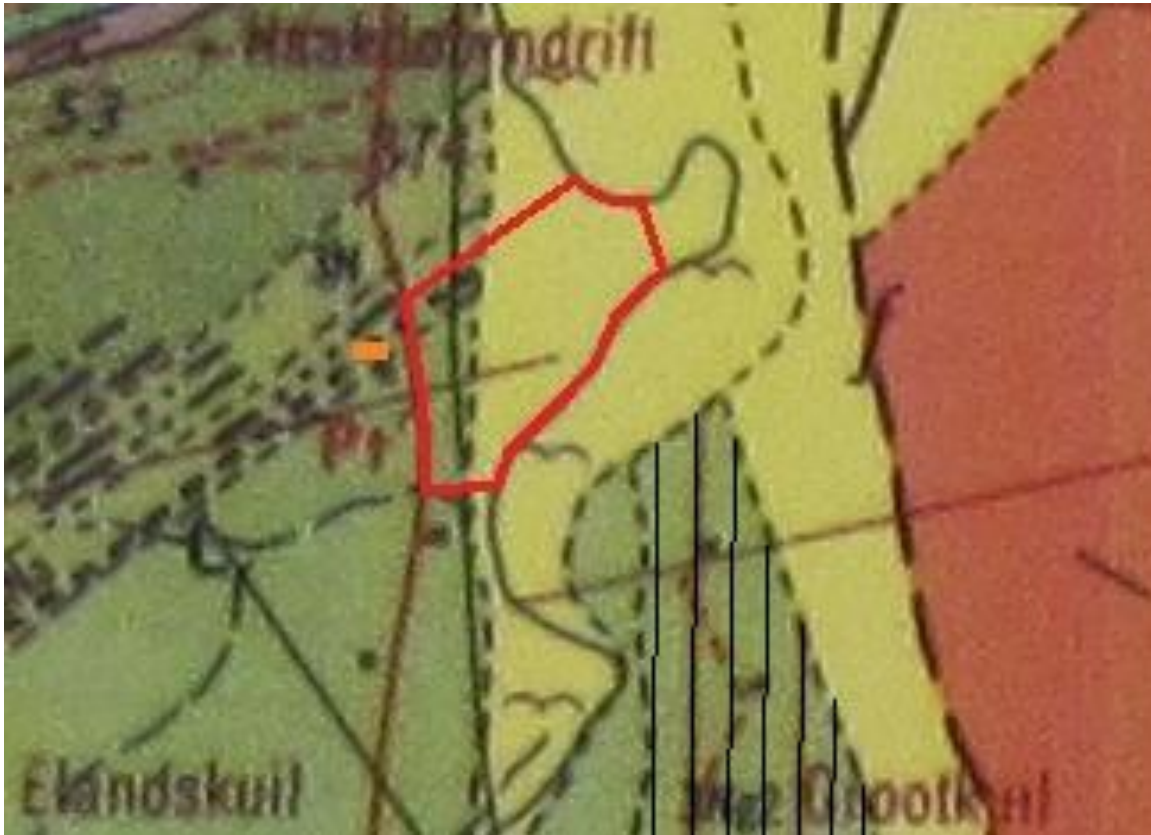
Figure 1: Google Earth photo indicating the study areas. The yellow shaded polygon indicates the area earmarked for the open cast mine and the pink polygon west of it indicates the area earmarked for the crushing plant.

The study area lies approximately 14km south of Thabazimbi in the Limpopo Province.

Geomorphologically the study area lies on a gentle slope adjacent to the Crocodile River which forms much of the eastern boundary of the study area. The study area and the adjacent farms are under cultivation (see Fig.1). The area is characterised by deep red and black soils.

The relevant literature and geological maps for the study area in which the development is proposed to take place, have been studied for a desktop study.







4. Geological setting of the study area



[The study areas are indicated by the red polygon and the orange rectangle]

Figure 2: Geological Map of the study area and surroundings (adapted from the 2426 THABAZIMBI 1:250 000 Geology Map, Council for Geoscience, 1978)

GEOLOGICAL LEGEND

	Lithology	Geological Units		Age
	Alluvium			Tertiary to Quaternary
	Black soil, red soil, ferricrete, calcrete			
	"Main granite", granophyric, porphyritic, pegmatitic or aplitic in places	Lebowa Granite Suite	Bushveld Igneous Complex	Vaalian
	Ferrogabbro with magnetite bands: 	Rustenburg Layered Suite (mafic rocks)		
	Gabbro. Noritic at base and locally anorthositic			
3Up	Pyroxenite			

The study site is largely situated on alluvium deposited on Bushveld Igneous Complex rocks (Fig.2). The alluvium consists mainly of Aeolian sand which has been deposited from the Tertiary to Quaternary along the Crocodile River and may be correlated with the Kalahari beds. Black and red soil and calcrete also cover the underlying Bushveld Igneous Complex rocks adjacent to the Crocodile River in areas that are poorly drained. Leached red soil tends to form on sand-yielding formations resistant to erosion. The black unleached soil formed on formations which are easily eroded and do not yield sand. Residual and alluvial clays occur along poorly defined watercourses in broad shallow depressions (Jansen, 1978).

The underlying rocks form part of the western limb of the Bushveld Igneous Complex. The Rustenburg Layered Suite comprises rock types ranging from dunite and pyroxenite through norite, gabbro and anorthosite to magnetite- and apatite-rich diorite, and so demonstrates a complete differentiation sequence for a basic magma. The granites of the Lebowa Granite Suite are differentiated, and variations in mineralogy and trace- and major-element chemistry are evident from the bottom to the top of the Nebo Granite sheet and through the Bobbejaankop and Klipkloof Granites. The mafic mineralogy of the Nebo Granite changes upwards from 14% hornblende to 1-25 biotite at the top (Cawthorn *et al.*, 2009)

5. Palaeontological overview of the study area

The rocks of the Bushveld Igneous Complex are non-fossiliferous and are of no palaeontological concern.

No fossils have been reported from the study area and the probability of fossils occurring in the Tertiary to Quaternary aeolian sand and soils in the study area is very low. These sediments are correlated with the Kalahari Group sediments. The fossils reported from Kalahari Group sediments are very sparse, occur sporadically and are low in diversity. Although no fossils have been reported for the study area, fossils such as root casts, burrows, termitaria, ostrich egg shells, mollusc shells and isolated bones have been discovered in the Kalahari Group elsewhere (Almond & Pether 2008).

References:

- Almond, J.E. & Pether, J. (2008) Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.
- Cawthorn, R.G.; Eales, H.V.; Walraven, F.; Uken, R. & Watkeys, M.K. (2009) The Bushveld Complex. *In*: Johnson, M.R.; Anhaeusser, C.R. & Thomas, R.J. (2009) *The geology of South Africa*. Council for Geoscience.

Geological Survey (1978) Thabazimbi 2426 1: 250 000 Geology Map.

Jansen, H. (1978) Map description of the Thabazimbi 2426 1: 250 000 Geology Map.

6. Conclusion and recommendations:

In the unlikely event of fossils being discovered in the sands and the soils in the study area, the CEO should document the fossils photographically, note the locality and contact a palaeontologist for advice. No attempt should be made to remove such fossils. In this event a palaeontologist should be appointed to rescue the fossils with a permit from SAHRA and to take it to an acknowledged palaeontological repository such as the Ditsong Museum in Pretoria.



Palaeontological specialist:

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BSc Botany & Zoology (RAU), BSc Zoology (WITS), Museology Dipl. (UP),
Higher Education Diploma (RAU), PhD Palaeontology (WITS)

Experience:

Palaeontological assessments:

- Urban development in Cradle of Humankind World Heritage Site (Gauteng): Letamo, Honingklip, Windgat, Sundowners, Ekutheni
- Urban development at Goose Bay, Vereeniging, Gauteng
- Urban development on Portions 98, 99, 179, 236, 284 and 364 of the farm Waterkloof 306 JQ, Rustenburg, North West Province
- Upgrade of R21 between N12 and Hans Strydom Drive, Gauteng
- Vele Colliery, Limpopo Province
- De Wildt 50 MW Solar Power Station, Gauteng
- 10 MW PV Plant Potchefstroom, North West Province
- Omega 342 50MW Solar Power Station, Viljoenskroon, Free State
- Springfontein wind and solar energy facility, Free State
- Solar power plant, Bethal, Mpumalanga
- Diamond mine on Endora, Limpopo Province
- Development at Tubatse Ext.15, Limpopo Province
- Manganese mine south of Hotazel, Northern Cape
- Wind energy facility at Cookhouse, Eastern Cape
- Energy facility at Noupoot, Northern Cape
- Fluorspar mine near Wallmannsthal, Gauteng
- ESKOM power line, Dumo, KwaZulu-Natal
- ESKOM Gamma-Omega 765KV transmission line, Western Cape
- ESKOM 44KV power line at Elandspruit near Middelburg, Mpumalanga
- ESKOM Makopane Substation, Limpopo Province
- ESKOM Platreef Substation and power lines to Borutho MTS Substation, Limpopo Province
- Solar energy facility at Prieska, Northern Cape.
- Marang B - a 3 x 500MVA 400/132kV Main Transmission Substation east of Rustenburg, North West Province
- Upgrading of storm water infrastructure in Valencia, Addo, Eastern Cape
- Development of a 10 MW Solar Energy facility on the Farm Liverpool 543 KQ Portion 2 at Koedoeskop, Limpopo Province
- Development of a fluorspar mine at Wallmannsthal, North of Pretoria
- Extension of limestone mine on the farms Buffelskraal 554 KQ Portion1 and Krokodilkraal 545 KQ, Limpopo Province
- Lesego Platinum Mine, Sekhukhune Area, Steelpoort, Limpopo Province
- Mine at Hotazel, Northern Cape
- Pollution control dams at Transalloys in Clewer, Emalahleni, Mpumalanga
- Erection of spill points on the Farm Kwikstaart 431 KQ Portion 2, Thabazimbi, Limpopo Province
- Construction of dam at Ethemba, Swaziland
- Construction of bridge at Busingatha, KwaZulu Natal
- Water Reticulation System - Kei Road and Berlin General, Eastern Cape

- Construction of Nhlezi Bridge, KwaZulu Natal
- Erection of spill point and dam on the Farm Faure 72 KQ Portion 8, Makoppa near Thabazimbi, Limpopo Province
- Colliery on the Farm Goedehoop near Piet Retief, Mpumalanga
- Erection of spill points on the Farm Diepwater 302 KQ Portions 4 -8 near Thabazimbi, Limpopo Province
- Construction of 2 MW photovoltaic power plant on the farm De Hoek 32, Pixley ka Seme District Municipality, Northern Cape Province
- Road upgrade near Magogo, KwaZulu/Natal
- Construction of haul road & waste dump at Lylyveld, Sishen Mine, Northern Cape
- Construction of 4 weirs and a road culvert on Portion 3 of the Farm Roodekrans 133JT, Dullstroom Area, Mpumalanga
- Construction of a solar energy facility on Blaubospan near Groblershoop, Northern Cape
- Construction of road from Macengeni to Macijo, KwaZulu/Natal
- Construction of the John Taole Gaetsewe school and hostels in Dithakgong, Northern Cape
- Development at Duduza Township, Gauteng
- Construction of roads near Ndanyana KwaZulu/Natal
- Development of colliery on the farm Goedehoop near Piet Retief, Mpumalanga
- Construction of Tiger Solar power plant near Windsorton, Northern Cape

Palaeontological research:

- Gauteng: Wonder Cave
- KwaZulu/Natal: Newcastle, Mooi River, Rosetta, Impendle, Himeville Underberg, Polela & Howick Districts, Sani Pass
- Eastern Cape: Cradock District, Algoa Basin
- Western Cape: Clanwilliam District
- Free State: Memel & Warden Districts
- Limpopo Province: Nyalaland (KNP), Vhembe Reserve, Pont Drift
- Zimbabwe: Sentinel Ranch, Nottingham