Development on Erf 185 Olifantsnek, south of Rustenburg, Northwest Province

DESKTOP STUDY
PALAEONTOLOGY

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1. Executive Summary

The area that will be impacted by the development is underlain by Vaalian aged (2.65 – 2.05 Ga) sedimentary rocks of the Silverton Formation of the Pretoria Group of the Transvaal Supergroup. The Silverton Formation rocks may contain fossilised bacteria and bacterial mats.

However, the site is close to the igneous rocks of the Rustenburg Layered Suite of the Bushveld Igneous Complex that intruded into the older Transvaal Supergroup rocks. Due to contact thermal metamorphosis caused by the Bushveld Igneous Complex intrusions in the vicinity, the chances of finding intact fossils of bacteria and microbial mats in these sedimentary rocks are small.

The ECO should take responsibility of monitoring the excavations and development onsite. In the unlikely event of a significant palaeontological find being made, the procedure stipulated under Procedure for Chance Palaeontological Finds (p.14 & 15) should be followed which includes the safeguarding of the exposed fossils and the contacting of a palaeontologist for further advice.

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2. 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.

Some of the oldest evidence of life on Earth came from the rocks at Barberton which contain fossilized bacteria. Stromatolites in the dolomitic regions in South Africa were formed by shallow marine mats of cyanobacteria. The cyanobacteria, which were some of the first photosynthesising organisms, provided most of the oxygen in our atmosphere.

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.

South Africa is probably best known palaeontologically for having more than half of all the hominin specimens in the world, the greatest variety of hominins in a country and the longest record of continuous hominin occupation in the world.

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.

3. 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. A 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 study 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.

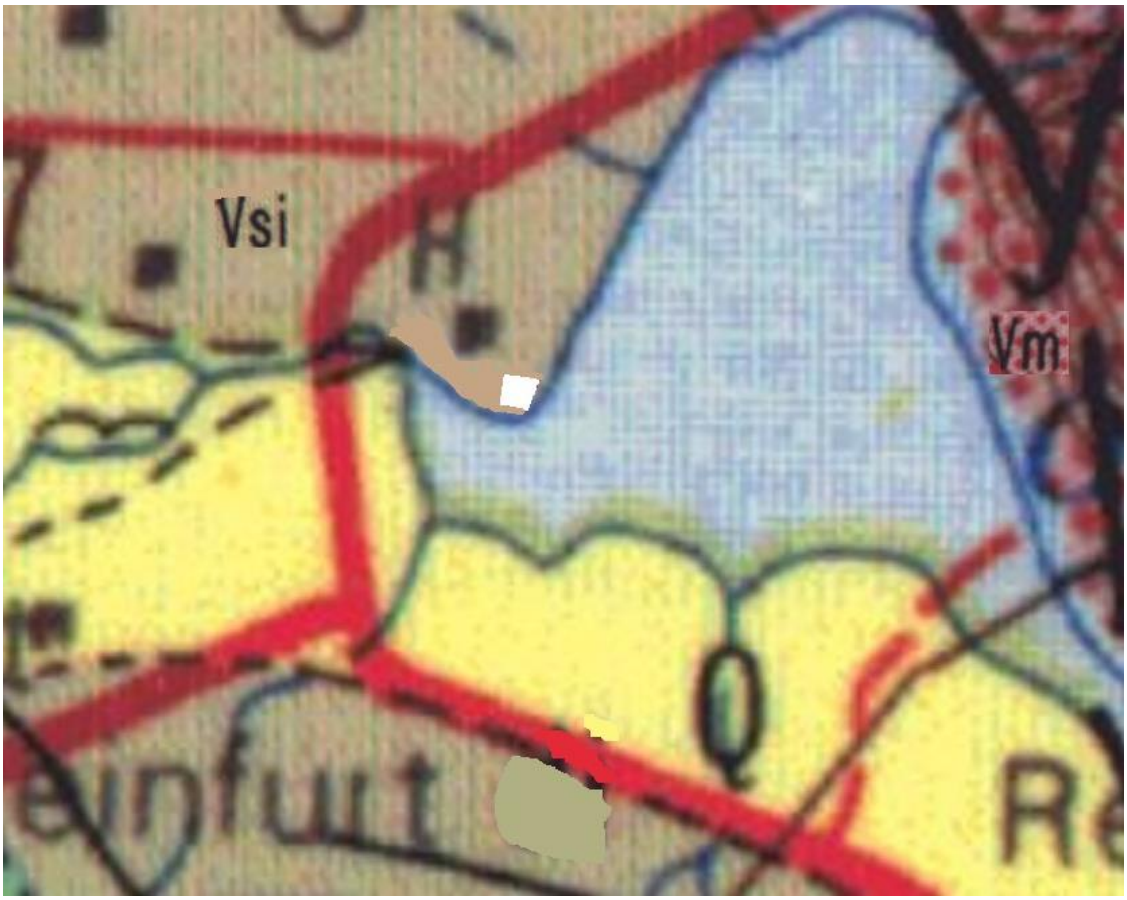
4. Details of study area and the type of assessment:

Figure 1: Google Earth photo indicating the study site (red polygon)

The study area is surrounded by urban development and smallholdings and the Olifantsnek Dam (see Fig 1).

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 Report.

5. Geological setting of the study area



The study area is indicated by the white rectangle.
Figure 2: Geological Map of the study area and surroundings (adapted from the Rustenburg 2526 1:250 000 Geology Map)

GEOLOGICAL LEGEND

	Lithology	Stratigraphy		Age
Q	Undifferentiated surface deposits			Quaternary
	Alluvium			
Vsi	Slate, shale, hornfels	Silverton Formation	Pretoria Group of the Transvaal Supergroup	Vaalian
Vm	Quartzite	Magaliesberg Formation		

The Pretoria Group is a 6-7km thick succession of mostly mudrocks alternating with quartzitic sandstones, basaltic-andesite lavas, subordinate conglomerates diamicites and carbonate rocks (Eriksson *et al*., 2009).

The characteristic high-alumina shale, slate and hornfels of the Silverton Formation overlie the Daspoort Formation of the Pretoria Group (Fig. 2). The

Silverton Formation sediments are indicative of a high-stand facies tract that would suggest the advance of an epeiric sea onto the lowstand facies tract represented by the Daspoort Formation sediments (Eriksson *et al*., 2009).

The Magaliesberg Formation was set down over the Silverton Formation during a period of sea level regression. Sediments – mostly sand, but also mud and silt - were set down in terrestrial to shallow water environments in the form of fluvial and deltaic deposits (Eriksson *et al*., 2009).

The quartzite-dominated Magaliesburg Formation is more resistant to weathering than the mudstone and shale dominated underlying Silverton Formation which contributes greatly to the mountainous landscape of the study area.

6. Palaeontological potential of the study site

Figure 3: Palaeontological sensitivity map of the study site (red polygon) and surroundings (SAHRA, 2022)

Colour	Palaeontological Significance	Action
Orange	HIGH	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely.
Green	MODERATE	Desktop study is required.

The study site is underlain by the Silverton Formation of the Pretoria Group of the Transvaal Supergroup that is considered to be of High Palaeontological Sensitivity (see Fig. 3). Although there are no reports of fossil discoveries from the study area, fossils of microbial mats have been described from fossil localities in the Pretoria Group sediments elsewhere (Groenewald & Groenewald, 2014; Parizot *et al*., 2005; Bosch & Eriksson, 2008; Eriksson *et al*., 2012).

These microbial mats, that were related to those forming stromatolite domes, covered the shallow sea floor in areas where there was sufficient sunlight to support photosynthesis. The microbial mats bound sediment particles together to form firm surfaces that resisted reworking when gentle currents swept across them. Ripple marks were preserved in areas where they were covered by the microbial mats. Wrinkle structures and sinuous cracks named *Manchuriophycus* occur in places between the ripple marks (see Fig. 4) (Bosch & Eriksson, 2008)

while very thin rolled-up carbon-rich fragments of presumably broken-up microbial mats could also be found in these sediments (see Fig, 5) (Eriksson *et al*., 2007, 2012).

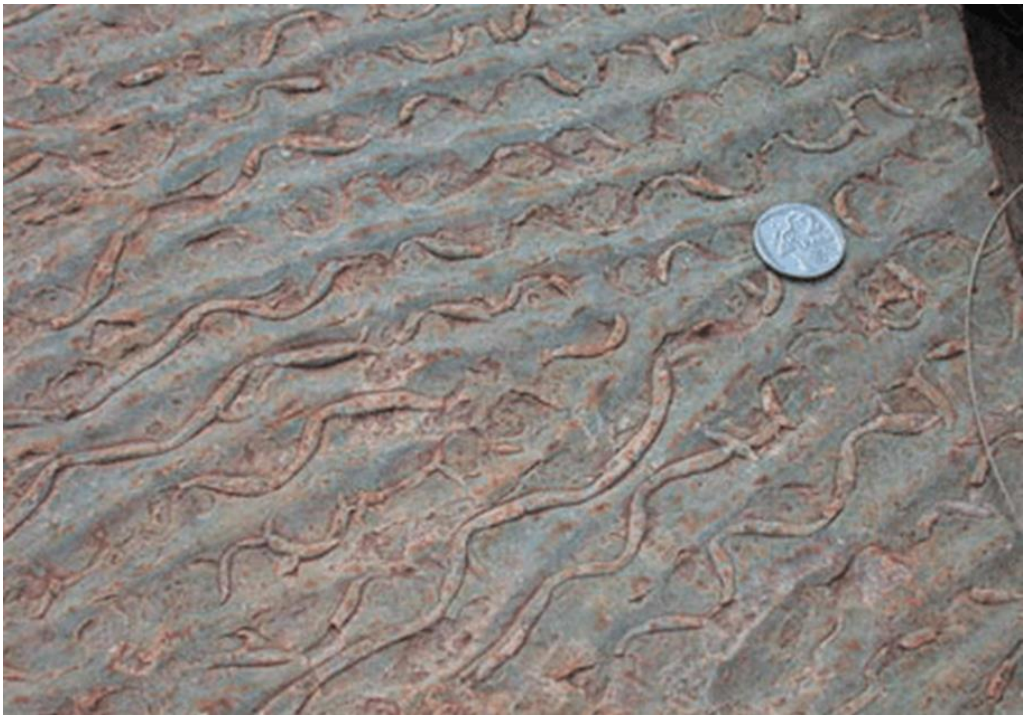


Figure 4: *Manchuriophyscus* (from: Bosch & Eriksson (2008). Picture by Pieter Bosch) https://www.researchgate.net/publication/304076637_Synaeresis_Crack_Polygons/figures?lo=1

Figure 5: Rolled-up microbial mat fragments (from: Eriksson *et al*., 2007). https://www.researchgate.net/publication/259343767_Mat-destruction_features/figures?lo=1)

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SAHRA (2022) Palaeosensitivity Map http://www.sahra.org.za/sahris/map/palaeo

7. Conclusion and recommendations:

The Silverton Formation of the Pretoria Group underlies the study site. Stromatolites, cyanobacterial mats and microfossils have been reported in the Pretoria Group rocks elsewhere. However, the sedimentary rocks of the region have been subjected to thermal metamorphosis from the intrusion of diabase and the Bushveld Igneous Complex into the Transvaal Supergroup. This process probably destroyed these delicate fossils in the region.

In the rare event of a significant fossil find during excavations or other development at the study site, the ECO should follow the following Chance Find Procedure:

PROCEDURE FOR CHANCE PALAEONTOLOGICAL FINDS
(Extracted and adapted from the National Heritage Resources Act, 1999 Regulations Reg No. 6820, GN: 548)

The following procedure must be considered in the event that previously unknown fossils or fossil sites are exposed or found during the life of the project:

1. Surface excavations should continuously be monitored by the ECO and the excavation must be halted should any fossil material be unearthed.

2. If fossiliferous material has been disturbed during the excavation process it should be put aside to prevent it from being destroyed.

3. The ECO then has to take a GPS reading of the site and take digital pictures of the fossil material and the site from which it came.

4. The ECO then should contact a palaeontologist and supply the palaeontologist with the information (locality and pictures) so that the palaeontologist can assess the importance of the find and make recommendations.

5. If the palaeontologist is convinced that this is a major find an inspection of the site must be scheduled as soon as possible in order to minimise delays to the development.

From the photographs and/or the site visit the palaeontologist will make one of the following recommendations:

a. The material is of no value so development can proceed, or:

b. Fossil material is of some interest and a representative sample should be collected and put aside for further study and to be incorporated into a recognised

fossil repository after a permit was obtained from SAHRA for the removal of the fossils, after which the development may proceed, or:

c. The fossils are scientifically important and the palaeontologist must obtain a SAHRA permit to excavate the fossils and take them to a recognised fossil repository, after which the development may proceed.

7. If any fossils are found then a schedule of monitoring will be set up between the developer and palaeontologist in case of further discoveries.

8. Declaration of Independence:

I. Jacobus Francois Durand declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development, 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.

Palaeontological specialist:
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