Development of farmland on Farm Skutwater 115 MS, Musina Local Municipality, Vhembe District

PALAEONTOLOGICAL IMPACT ASSESSMENT

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For:

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1. Executive Summary

Parts of the study site are situated in an area that is considered to be of Very High Palaeontological Sensitivity.

An overview of the literature on the palaeontology and associated geology of the area is given. Although no publications exist of palaeontological studies that were done in the study area, several palaeontological studies were done in the areas to the north, east and west of the study area.

No fossils were found at the study site during the site visit. The geology of the study area is covered to a great extent by a thick layer of sandy soil and only limited outcrops of rock are exposed in gullies.

The study site is underlain by the Red Rocks Member of the Clarens Formation. Agricultural development is planned at the study site. There is a possibility that ex situ dinosaur fossils may be found in the soil covering the bedrock in the study site during development.

It is imperative that a palaeontologist be consulted if fossils are exposed during the development process. The ECO should take responsibility for supervising the development and should follow the Chance Find Procedure (p. 17-18) if a significant fossil discovery is made.

2. Introduction

This is a Palaeontological Impact Assessment that was prepared in line with Regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment. This involved an overview of the literature on the palaeontology and associated geology of the area and a site visit.

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 that may be impacted by the proposed development.

The palaeontological heritage of South Africa is unsurpassed and can only be described in superlatives. The South African palaeontological record gives us insight in inter alia the origin of dinosaurs, mammals and humans. Fossils are also used to identify rock strata and determine the geological context of the subregion with other continents and played a crucial role in the discovery of Gondwanaland and the formulation of the theory of plate tectonics. Fossils are also used to study evolutionary relationships, sedimentary processes and palaeoenvironments.

South Africa has the longest record of palaeontological endeavour in Africa. South Africa was even one of the first countries in the world in which museums displayed fossils and palaeontologists studied earth history. South African palaeontological institutions and their vast fossil collections are world-renowned and befittingly the South African Heritage Act is one of the most sophisticated and best considered in the world.

Fossils and palaeontological sites are protected by law in South Africa. Construction in fossiliferous areas may be mitigated in exceptional cases but there is a protocol to be followed.

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 form 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.

4. Details of study area and type of assessment:

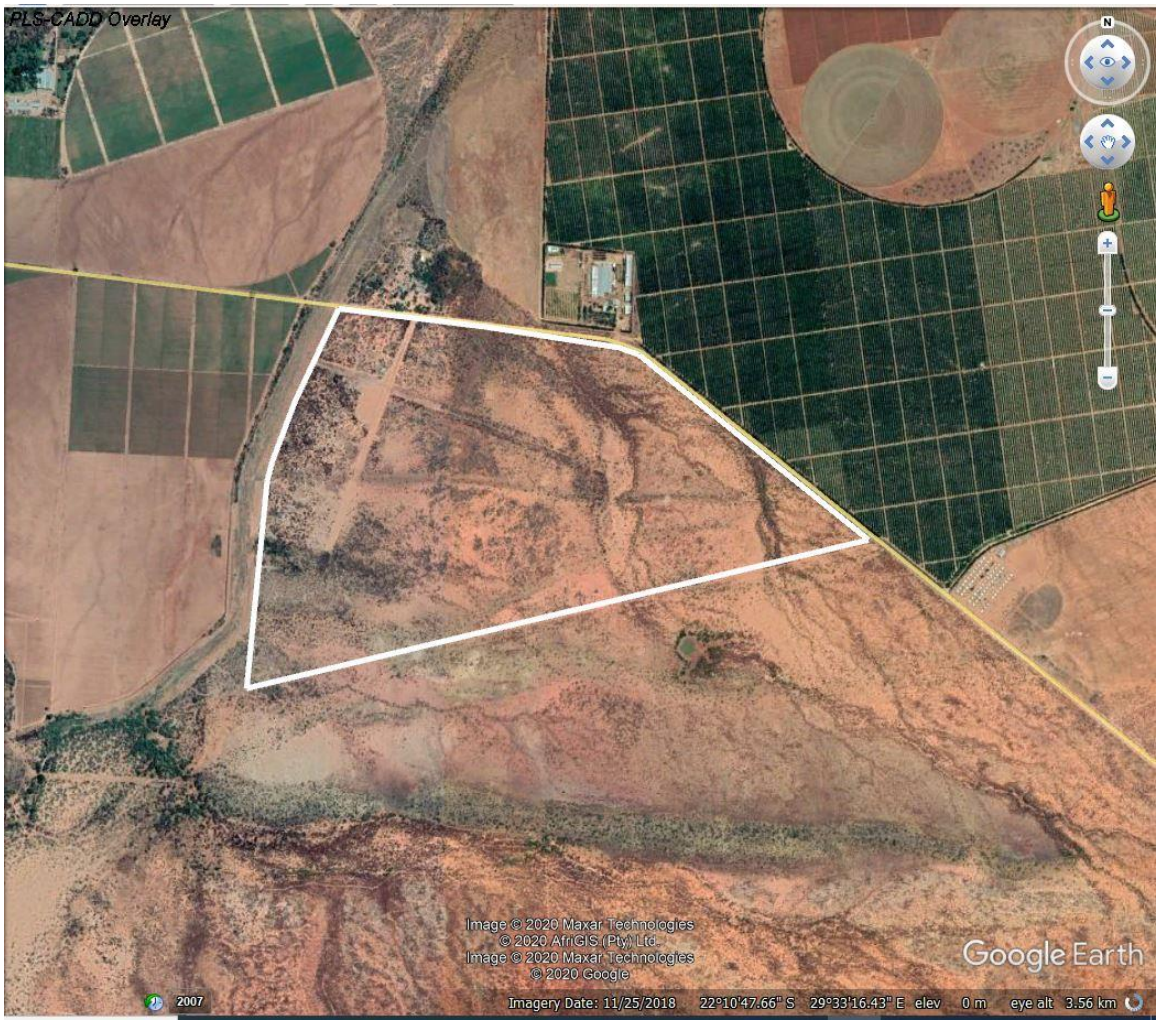
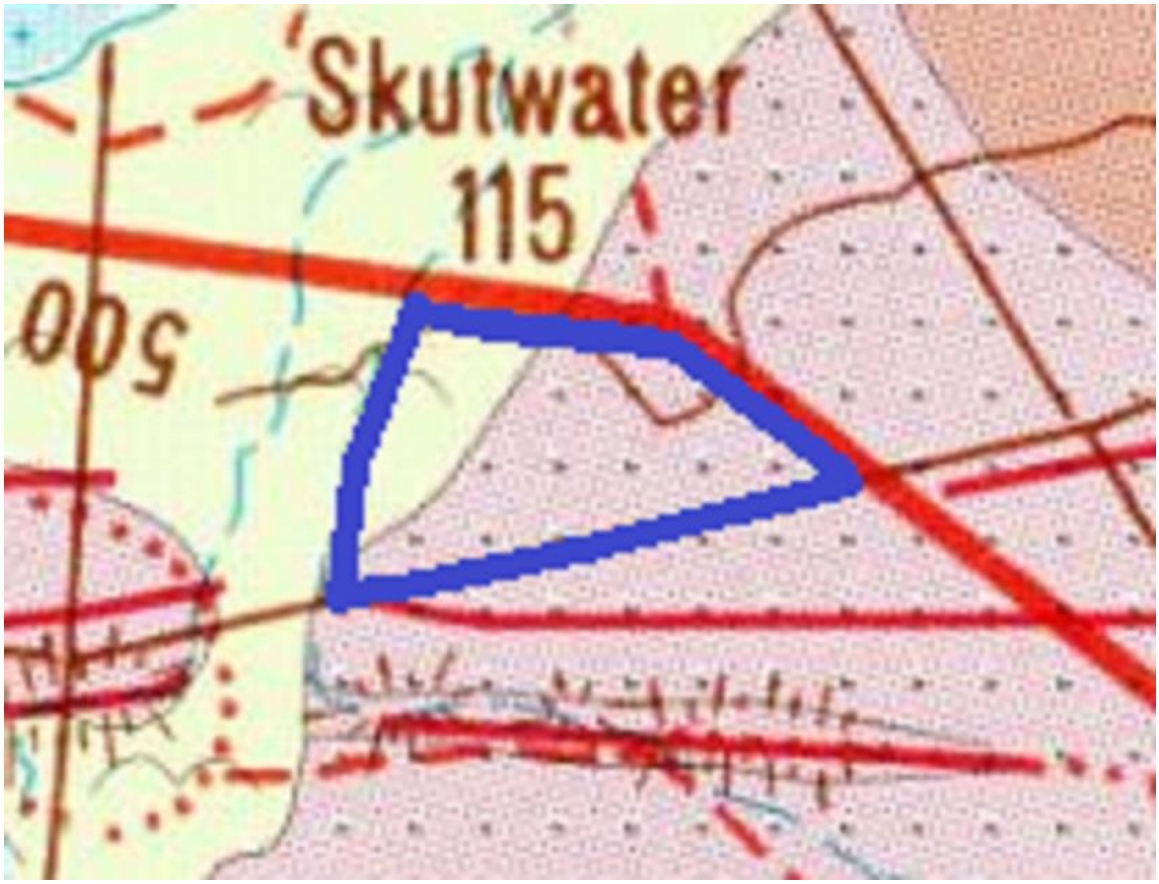


Figure 1: Google Earth photo indicating study site (white polygon)

The relevant literature and geological maps have been studied for a Desktop Study in preparation for a Palaeontological Impact Assessment.

The study site lies between farms that are used for agriculture south of the Limpopo River and approximately 8.5 km east of Mapungubwe (Fig. 1). The study site itself is situated in mopane veld that has been cleared for agriculture. The study site slopes towards the north and non-perennial streams and gullies run through it. Red sandy soil covers the study site.

5. Geological setting



The study sites are indicated by the blue polygon

Figure 2: Geological map of the study area and surroundings (adapted from the 2228 Alldays 1:250 000 geology map, Council for Geoscience, 2000)

GEOLOGICAL MAP LEGEND

	Lithology	Stratigraphy			Age
	Alluvium				Quarter-nary
Trct	Fine-grained whitish to pink sandstone	Karoo Supergroup	Clarens Formation	Tshipise Member	Triassic
Trcr	Fine-grained white and red mottled argillaceous sandstone			Red Rocks Member	
Trb	Brick-red to purplish mudstone and siltstone		Bosbokpoort Formation		

The largest portion of the study site is underlain by rocks of the Red Rocks Member of the Clarens Formation of the Karoo Supergroup while the north-western portion is covered in alluvium (see Fig. 2).

The Main Karoo Basin, which covers more than 50 % of the surface of South Africa, can be subdivided into the Dwyka, Ecca and Beaufort Groups. The layers overlying the Beaufort Group can be subdivided into the Molteno, Elliot and Clarens Formations which are in turn overlain by the Drakensberg Basalts (Johnson *et al*., 1996).

In the northern part of the Limpopo Province and in Mpumalanga the Karoo Supergroup is much attenuated and incomplete compared to the Main Karoo Basin to the south. The Karoo-aged rocks occur mainly in two areas in the Limpopo Province named the Tuli and Tshipise Blocks with minor outliers between them. The study area lies on the eastern limit of the Tuli Block. The geology of this region is dominated by sedimentary rock with some occurrences of igneous rocks in the form of basalt and dolerite.

The sedimentary sequences of the Tuli Block were set down on top of the Beit Bridge gneisses in a small intercratonic graben-type depression before the break up of Gondwanaland. This depression formed part of an east-west trending aulacogen that formed the third arm of the triple junction with the Lebombo Basin which in turn is the southern extent of the African Rift Valley. The basalts were set down on top of the sedimentary sequence during the break up of Gondwanaland (Brandl, 2002).

The Clarens Formation overlies the Bosbokpoort Formation in the northern part of the Limpopo Province. The Clarens Formation in this region has been subdivided into the lower Red Rocks Member and the upper Tshipise Member (McCourt & Brandl, 1980; Johnson *et al*., 2009).

The Red Rocks Member, which is up to 60 m thick in places, comprises very fine- to fine-grained pinkish to red argillaceous sandstones. Irregular patches of white sandstone gives this formation a mottled appearance. This unit was deposited in distal flood-plain overbank and natural levees environments that are associated with mature meandering streams.

A 5 m thick mudstone layer in the Red Rocks Member that is identical to the mudstones in the Bosbokpoort Formation has yielded prosauropod dinosaur bones. This fossiliferous layer, that was set down during a localised return to subaerial floodplain conditions, occurs 2-3 m beneath the top of this sequence. A 1-3 m thick calcareous layer containing fossil bone fragments underlies the Tshipise Member in places (Brandl, 2002; Johnson *et al*., 2009).

6. Site visit

Figure 3: Northwestern corner facing southeast (22°11'17.12"S 29°32'33.98"E)

Figure 4: Northeastern corner facing southwest (22°11'20.0"S 29°33'09.1"E)

Figure 5: End of landing strip facing southwest 22°11'35.4"S 29°32'36.4"E

Figure 6: Southeastern corner facing northwest 22°11'42.42"S 29°33'37.2"E

The study site is covered in red sandy soil that obscures the geology (see Figs. 3-6). Vegetation is limited to sparsely growing grass that covers the area that has been cleared for development (Figs. 3 & 4) with a fringe of natural vegetation along the southern fringe of the study site (Figs. 5 & 6).

No fossils were discovered during the field assessment.

7. Palaeontological assessment of the study site

(The study site is indicated with the white polygon)

Figure 7: Palaeontological sensitivity of the region (SAHRA, 2020)

Colour	Palaeontological Significance	Action
RED	VERY HIGH	Field assessment and protocol for finds are required.
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.

Although there are no published records of fossils from the study site, the Clarens Formation is known to be fossiliferous and fossils have been found in this formation at Mapungubwe west of the study site and at Sentinel Ranch in Zimbabwe north of the study site. Several palaeontological sites have been reported from the Tuli Block in South Africa and Zimbabwe and from the Tshipise

Block in South Africa (Van Eeden & Keyser, 1971; Durand, 2005; Brandl, 2002; Johnson *et al*., 2009).

The Late Triassic to Early Jurassic strata of the Tuli and Tshipise Blocks contain dinosaur (Figure 8) and thecodont fossils and scarce palaeosurfaces with trackways. The fossils in these layers are scientifically very important and need to be excavated and collected for research purposes or preserved *in situ*.

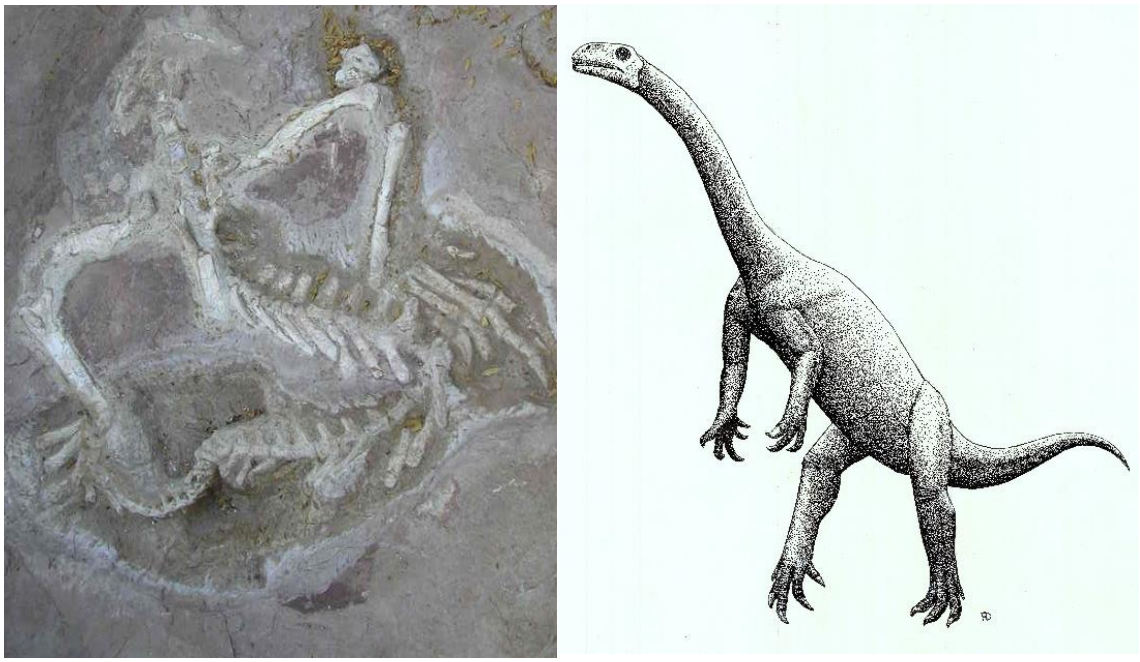


Figure 8: *Massospondylus* skeleton *in situ* in the Clarens Formation at Sentinel Ranch, north of the study site (left), reconstruction of *Massospondylus* (right)

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8. Conclusion and recommendations:

No fossils have been found during the site visit.

The rocks of the Clarens Formation is covered by a thick layer of red sandy soil at the study site. Agricultural development is planned in the study site.

In the rare event that a significant fossil find is made in the soil, sand, alluvium in the dry stream beds or in the underlying sandstone during development, the ECO should take the following steps:

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 any fossil material be unearthed the excavation must be halted.

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.

9. 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.

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