

The Upgrade of the N11 Section 13 National Route between Mokopane (Km 1.3) and the Grootssandsloot River  
(Km 24.0)

Mogalakwena Local Municipality, Waterberg District Municipality, Limpopo Province.

Farm: Linear Project for 24 km

Fourie, H. Dr

***Palaeontological Impact Assessment: Phase 1 Field Study***

Facilitated by: Chameleon Environmental Consultants

P.O. Box 11788, Silver Lakes,

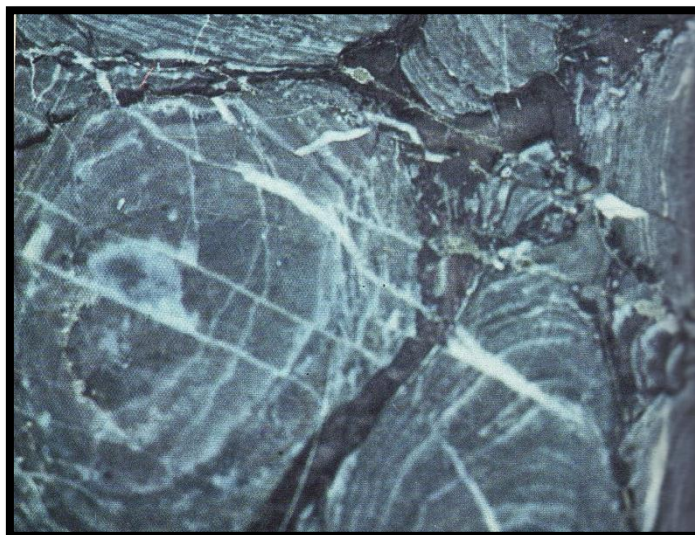
Pretoria, 0054

Tel: 082 452 1928

2023/01/30

Ref: Pending

*Stromatolite thin section (De Znahe et al)*



## B. Executive summary

Outline of the development project: Chameleon Environmental Consultants has facilitated the appointment of Dr H. Fourie, a palaeontologist, to undertake a Palaeontological Impact Assessment (PIA), Phase 1: Field Study of the suitability of The Upgrade of the N11 Section 13 National Route between Mokopane (Km 1.3) and the Grootssandsloot River (Km 24.0) in the Mogalakwena Local Municipality, Waterberg District Municipality, Limpopo Province on Farm: Linear Project for 24 km.

The applicant, SANRAL (Pty) Ltd intends to upgrade the road surface, culverts, shoulder and bridges of the N11 National Road north of Mokopane.

The Project includes one locality Option (see Figure 2):

Option 1: A line in blue drawn on the existing N11 National Road north-west of Mokopane. The approximate length of the upgrade is 24 km.

### Legal requirements:-

The **National Heritage Resources Act (Act No. 25 of 1999) (NHRA)** requires that all heritage resources, that is, all places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance are protected. The Republic of South Africa (RSA) has a remarkably rich fossil record that stretches back in time for some 3.5 billion years and must be protected for its scientific value. Fossil heritage of national and international significance is found within all provinces of the RSA. South Africa's unique and non-renewable palaeontological heritage is protected in terms of the National Heritage Resources Act. According to this act, palaeontological 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.

The main aim of the assessment process is to document resources in the development area and identify both the negative and positive impacts that the development brings to the receiving environment. The PIA therefore identifies palaeontological resources in the area to be developed and makes recommendations for protection or mitigation of these resources.

“palaeontological” means any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or traces.

For this study, resources such as geological maps, scientific literature, institutional fossil collections, satellite images, aerial maps and topographical maps were used. It provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations (if any) for further specialist palaeontological input where this is considered necessary.

A Palaeontological Impact Assessment is generally warranted where rock units of **LOW** to **VERY 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 area is unknown. The specialist will inform whether further monitoring and mitigation are necessary.

Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act No.25 of 1999):

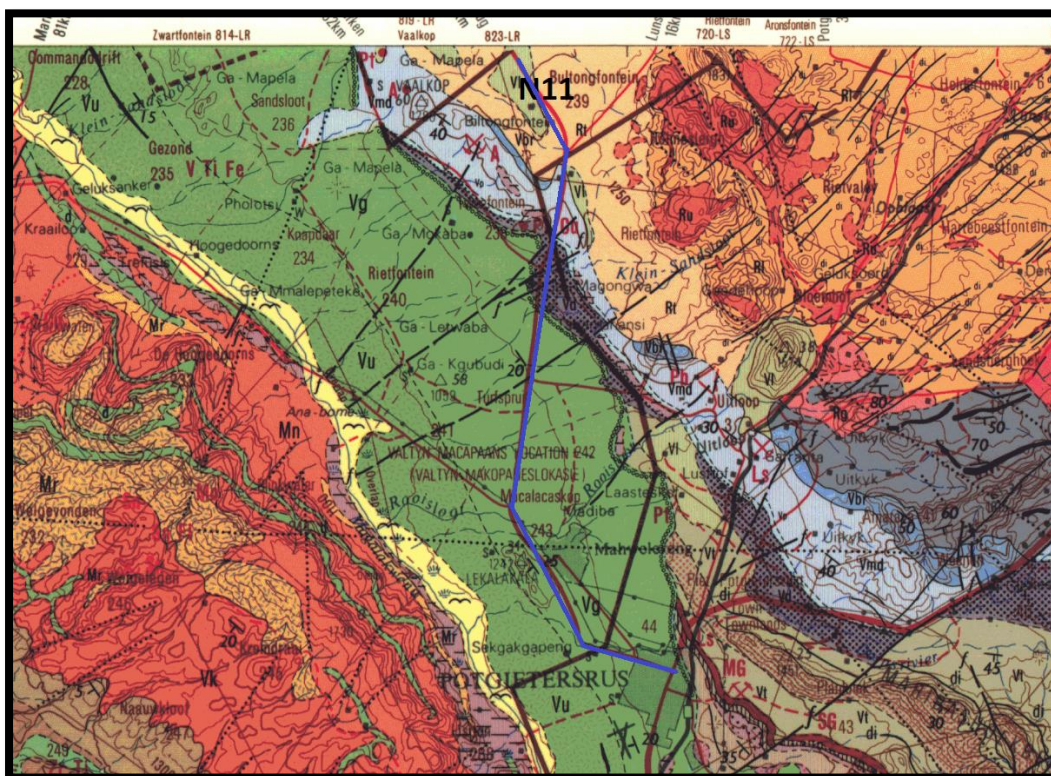
(i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens.

This report adheres to the guidelines of Section 38 (1) of the National Heritage Resources Act (Act No. 25 of 1999). Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as (a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length; (b) the construction of a bridge or similar structure exceeding 50 m in length; (c) any development or other activity which will change the character of a site (see Section 38); (d) the re-zoning of a site exceeding 10 000 m<sup>2</sup> (1 ha) in extent; (e) or any other category of development provided for in regulations by SAHRA or a PHRA authority.

This report (Appendix 6, 1c) aims to provide comment and recommendations on the potential impacts that the proposed development could have on the fossil heritage of the area and to state if any mitigation or conservation measures are necessary.

Outline of the geology and the palaeontology:

The geology was obtained from map 1:100 000, Geology of the Republic of South Africa (Visser 1984), 2428 Nylstroom (du Plessis 1978) 1:250 000 geological maps.



**Figure:** The geology of the development area.

*Legend to Figure and short explanation.*

- Vg – Gabbro, norite, anorthosite (green). Main Zone, Rustenburg Layered Suite, Bushveld Complex. Vaalian.
- VI – Melanorite, pyroxenite, serpentized hartzburgite, chromatite layer (---) (light green). Lower Zone, Rustenburg Layered Suite, Bushveld Complex.
- Vd – Limestone, dolomite, chert, shale, quartzite, diamictite, hornfels, and conglomerate (:: purple). Duitschland Formation, Chuniespoort Group, Transvaal Supergroup. Vaalian.
- Vmd – Dolomite, chert, limestone, chert breccia with interbedded shale, sandstone and quartzite (blue). Chuniespoort Group, Transvaal Supergroup. Vaalian.

Rt – Fine to medium-grained grey and pink biotite granite with relics of migmatite and banded biotite granite-gneiss, sometimes porphyritic and pegmatitic (orange). Turfloop granite. Randian.

---- - Concealed geological boundary.

..... – (black) Lineament (Possible dyke).

--f— Fault.

└20° - Strike and dip.

□ – Approximate position of N11 (blue line).

The Rustenburg Layered Suite is so termed as it is intrusive in origin and the term is to be equivalent to a 'group'. It consists of mafic and ultramafic rocks and is rich in platinum, chrome and vanadium. It is here that iron ore and the Merensky Reef are found. Magnesite mines provide magnesium carbonate for making heat-resistant bricks (Norman and Whitfield 2006). The Rustenburg Layered Suite can be divided into five zones, namely – Marginal, Lower, Lower Critical, and Upper Critical. The Rustenburg Layered Suite of the Bushveld Complex is Vaalian in age (2,100 – 1,920 Ma) and consists of an igneous intrusion with anorthosite, hybrid gabbro, gabbro, diabase, epidiorite, pyroxenite, and norite rocks.

The Chuniespoort Group is made up of chemical and biochemical sediments such as dolomite, chert, limestone and banded iron formation, carbonaceous shale is also present. At the top of the Malmani Subgroup is the Deutschland Formation underlain by the Penge and Monte Christo Formations. Sandstone is mostly absent. It is this formation that has great economic value for its lead, zinc, dolomite, and manganese (Kent 1980, Snyman 1996). Fluorspar, concrete aggregate, iron ore and manganese are also mined from this formation. Cave formation in the dolomite is a major concern in developing areas, especially in the 1500m thick dolomite of the Malmani Subgroup. Chemical sediments such as fine-grained limestone and dolomite is made up of deposits of organically derived carbonate shells, particles or precipitate. Dolomite is magnesium-rich limestone formed from algal beds and stromatolites.

The Turfloop Granite is a batholith on the edge of the Pietersburg Group with an age of between 2 566 ±65 and 2 660 ±60 my. (Visser 1989).

*Palaeontology* – Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity can generally be **LOW** to **VERY HIGH**, and here locally in the development area **VERY LOW** for the Bushveld Complex and **HIGH** for the Chuniespoort Group (SG 2.2 SAHRA APMHOB, 2012).

Chemical sediments such as fine-grained limestone and dolomite of the Malmani Subgroup is made up of deposits of organically derived carbonate shells, particles or precipitate. Dolomite is magnesium-rich limestone formed from algal beds and stromatolites. These Early Proterozoic Transvaal stromatolitic dolomites formed and released free oxygen at around 2900 – 2400 Ma. Stromatolites are common in the Malmani dolomites, accepted to be the fossil remnants of the simplest single-celled organisms. They are finely layered, concentric, mound-like structures formed by microscopic algal organisms (Norman and Whitfield 2006). Chert may contain fossils such as echinoids or sponges if nodular, although not common and is rated unlikely.

Summary of findings (1d): The Phase 1: Field Study was undertaken in January 2023 in the summer in dry and hot conditions, the season and time has an influence, and the following is reported:

*Field Observation*: The area is not large. Vegetation next to the road on the shoulder is lush, mostly grassland, trees and bushes; buildings are present in the townships. All areas were accessible, but very few outcrops are

present on the shoulder of the road, mostly isolated rocks of granite and dolomite. The topography is undulating. Fossils were not located (Figures 5-19).

The Project includes one locality Option present on the **Chuniespoort Group** and Bushveld Complex:

Option 1: A line in blue drawn on the existing N11 National Road north-west of Mokopane. The approximate length of the upgrade is 24 km.

Recommendation:

The potential impact of the development on fossil heritage is **HIGH** and therefore a field survey was necessary for this development (according to SAHRA protocol). A Phase 1 Palaeontological Impact Assessment: Field Study was done. A Phase 2: Mitigation will be recommended if the Phase 1: Field Study finds fossils (not found) or if fossils are found during the development.

Concerns/threats (**1k,l,m**) to be added to EMPr:

1. Threats are earth moving equipment/machinery (for example haul trucks, front end loaders, excavators, graders, dozers) during construction, the sealing-in, disturbance, damage or destruction of the fossils by development, vehicle traffic, and human disturbance.
2. Special care must be taken during the digging, drilling, blasting and excavating of foundations, trenches, channels and footings and removal of overburden not to intrude fossiliferous layers.

The recommendations are (**1g**):

1. Mitigation will be needed if fossils are found during the development.
2. No consultation with parties was necessary. The Environmental Control Officer must familiarise him- or herself with the formations present and its fossils and follow protocol.
3. The development may go ahead with caution due to the possible presence of dolomites.
4. The ECO must survey for fossils before and or after clearing, digging, drilling or excavating.
5. The EMPr already covers the conservation of heritage and palaeontological material that may be exposed during construction activities. For a chance fossil find, the protocol is to immediately cease all construction activities, construct a 30 m no-go barrier, and contact SAHRA for further investigation.
6. Care must be taken during the dolomite risk assessment as stromatolites may be present (according SANS 1936-1 (2012)) not to destroy any stromatolites.

Stakeholders: Developer – SANRAL. 38 Ida Street, Menlo Park.

Environmental – Chameleon Environmental Consulting. P.O. Box 11788, Silver Lakes, Pretoria, 0054. Tel: 082 571 6920.

Landowner – SANRAL.

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#### **D. Background information on the project**

##### Report

This report is part of the environmental impact assessment process under the National Environmental Management Act, as amended (Act No. 107 of 1998) (NEMA) and includes Appendix 6 (GN R326 of 7 April 2017) of the Environmental Impact Assessment Regulations (see Appendix 2). It also is in compliance with The Minimum Standards for Palaeontological Components of Heritage Impact Assessment Reports, SAHRA, APMHOB, Guidelines 2012, Pg 1-15 (2).

##### Outline of development

This report discusses and aims to provide the developer with information regarding the location of palaeontological material that will be impacted by the development. In the pre-construction phase it may be necessary for the developer to apply for the relevant permit from the South African Heritage Resources Agency depending on the presence of fossils (SAHRA / PHRA).

The applicant, SANRAL (Pty) Ltd intends to upgrade the road surface, culverts, shoulder and bridges of the N11 National Road Section 13 north-west of Mokopane.

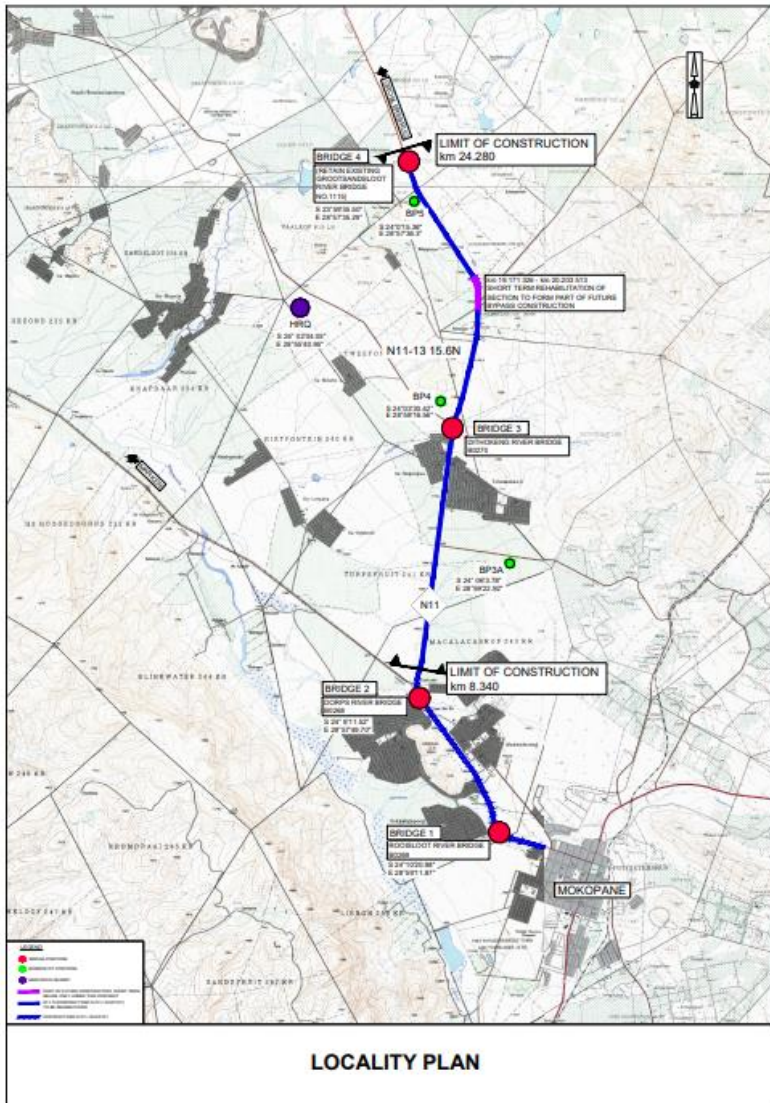


Figure 1: Lay-out plan of development (Chameleon).

Related Infrastructure:

1. Bridges
2. New intersections
3. Drainage channels
4. Temporary buildings and chemical ablation
5. Potable water
6. Temporary storage facility.

Present N11 National Road has a deteriorating road surface and inadequate capacity to carry traffic load

**Road rehabilitation will include:**

- The rehabilitation of the existing road surface by upgrading sections of the single carriageway and expanding sections of the road as dual carriageway
- Replacing the existing bridges spanning the Dorps, Roosloot and Dithokeng rivers.
- Construction of drainage channels and the replacement of major and minor drainage culverts
- Erection of security fencing and street lighting in identified areas

- Upgrading of existing major intersections and community access roads providing safe access to the N11
- Construction of paved sidewalks in identified areas.
- Erosion protection and landscaping

**Bridge rehabilitation – Dorps, Rooisloot and Dithokeng rivers will include:**

- Demolishing of the existing bridges and construction of new bridges to address hydraulic inadequacies.
- Backfilling and implementation of embankment protection measures of the river embankments.
- Re-alignment of bridge infrastructure to improve the natural flow of the watercourses.

The Project includes one locality Option (see Figure 2):

Option 1: A line in blue drawn on the existing N11 National Road north-west of Mokopane. The approximate length of the upgrade is 24 km.

Rezoning/ and or subdivision of land: No.

Name of Developer and Consultant: SANRAL and Chameleon Environmental Consultants.

Terms of reference: Dr H. Fourie is a palaeontologist commissioned to do a palaeontological impact assessment: field study to ascertain if any palaeontological sensitive material is present in the development area. This study will advise on the impact on fossil heritage mitigation or conservation necessary, if any.

Short Curriculum vitae (1ai,aii): Dr Fourie obtained a Ph.D from the Bernard Price Institute for Palaeontological Research (now ESI), University of the Witwatersrand. Her undergraduate degree is in Geology and Zoology. She specialises in vertebrate morphology and function concentrating on the Therapsid Therocephalia. At present she is curator of a large fossil invertebrate collection, Therapsids, dinosaurs, amphibia, fish, reptiles, and plants at Ditsong: National Museum of Natural History. For the past 16 years she carried out field work in the North West, Western Cape, Northern Cape, Eastern Cape, Limpopo, Mpumalanga, Gauteng and Free State Provinces. Dr Fourie has been employed at the Ditsong: National Museum of Natural History in Pretoria (formerly Transvaal Museum) for 28 years.

Legislative requirements: South African Heritage Resources Agency (SAHRA) for issue of permits if necessary. National Heritage Resources Act (Act No. 25 of 1999). An electronic copy of this report must be supplied to SAHRA.

**E. Description of property or affected environment**

Location and depth:

The suitability of The Upgrade of the N11 Section 13 National Route between Mokopane (Km 1.3) and the Grootsandsloot River (Km 24.0) will be situated in the Mogalakwena Local Municipality, Waterberg District Municipality, Limpopo Province on Farm: Linear Project for 24 km.

Depth is determined by the related infrastructure to be developed and the thickness of the formation in the development area as well as depth of the foundations, footings and channels to be developed. Details of the location and distribution of all significant fossil sites or key fossiliferous rock units are often difficult to determine due to thick topsoil, subsoil, overburden and alluvium. Depth of the overburden may vary a lot. Geological maps do not provide depth or superficial cover, it only provides mappable surface outcrops. The depth can be verified with test pit results or drill cores. The depth of the Formations is described below in Section F.



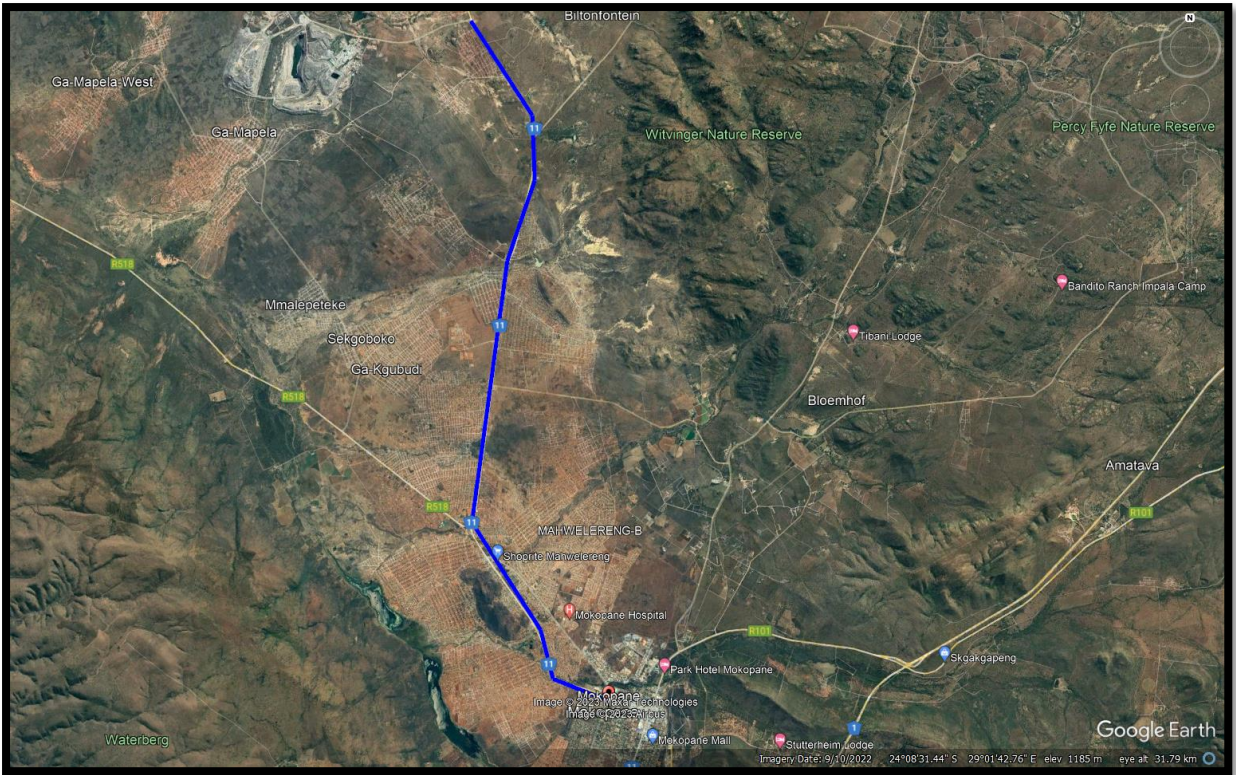
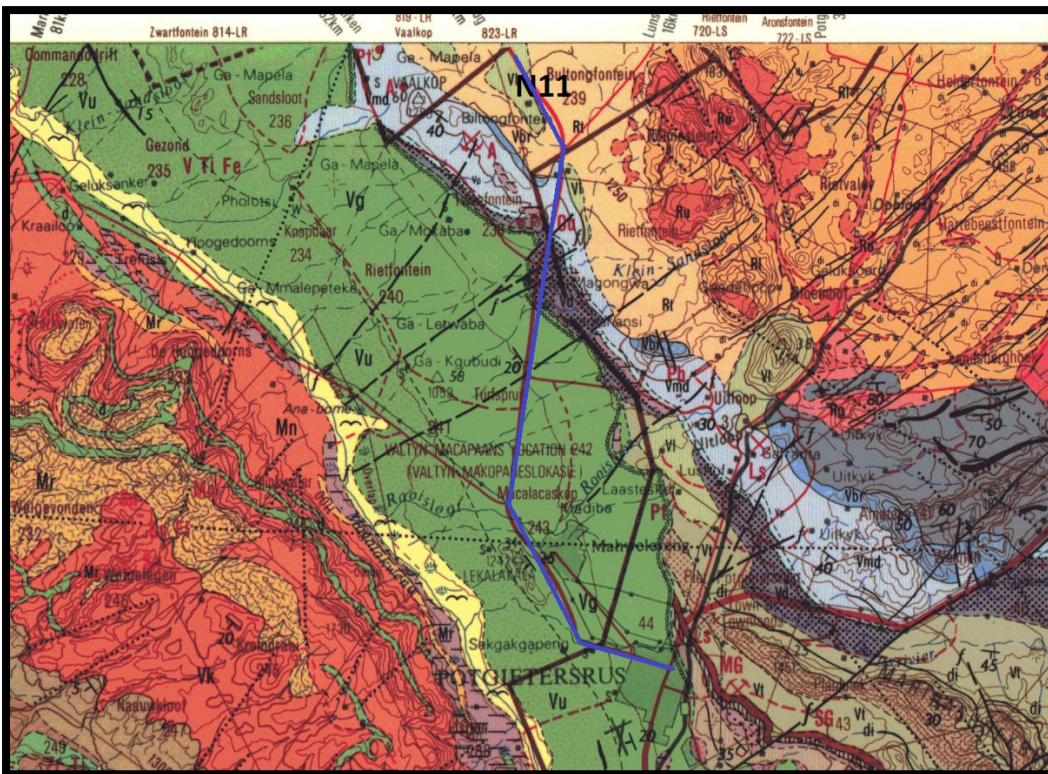


Figure 2: Google Earth image showing prospecting area (Chameleon).

The site is underlain by the Bushveld Complex and Transvaal Supergroup Formations.

## F. Description of the Geological Setting

Description of the rock units:



**Figure 3: Geology of the development area (1h).**

*Legend to Figure and short explanation.*

Vg – Gabbro, norite, anorthosite (green). Main Zone, Rustenburg Layered Suite, Bushveld Complex. Vaalian.

VI – Melanorite, pyroxenite, serpentized hartzburgite, chromitite layer (---) (light green). Lower Zone, Rustenburg Layered Suite, Bushveld Complex.

Vd – Limestone, dolomite, chert, shale, quartzite, diamictite, hornfels, and conglomerate (:: purple). Duitschland Formation, Chuniespoort Group, Transvaal Supergroup. Vaalian.

Vmd – Dolomite, chert, limestone, chert breccia with interbedded shale, sandstone and quartzite (blue). Chuniespoort Group, Transvaal Supergroup. Vaalian.

Rt – Fine to medium-grained grey and pink biotite granite with relics of migmatite and banded biotite granite-gneiss, sometimes porphyritic and pegmatitic (orange). Turfloop granite. Randian.

---- - Concealed geological boundary.

..... – (black) Lineament (Possible dyke).

--f-- Fault.

⊥20° - Strike and dip.

□ – Approximate position of road (blue line).

Mining Activities on Figure:

Cu – Copper.

Mining past and present has no influence on the project.

The Bushveld Complex (surrounding area) is a massive body of igneous origin and it is intrusive in the Transvaal Supergroup (Kent, 1980). The Bushveld Complex extends over 440 km east-west, from Burgersfort to Nietverdiend; and for nearly 350 km north-south from Villa Nora to Bethal. It covers an area of 65 000 km<sup>2</sup> and is chrome and platinum rich (Visser, 1989). The age is Vaalian (2,100 – 1,920 Ma). The layered rocks of the Bushveld Complex are generally believed to be the result of crystals settling out of magma during slow cooling. The magmatic events petrogenetically related to and generally considered part of the whole magmatic evolution of the Complex are, the diabase sills and the Rooiberg Group. The Complex consists of three main units or suites of which the Rustenburg Layered Suite is one (Kent, 1980), the other two are the Rashedoop Granophyre Suite (Mr) and Lebowa Granite Suite (Visser, 1989). The region will be covered by 'Bushveld' vegetation. The weathering product is known as 'black turf' (Kent, 1980; Visser, 1989). There is a presence of mining past and present with iron ore and the Merensky Reef. Magnesite mines provide magnesium carbonate for making heat-resistant bricks (Norman and Whitfield 2006). The Layered Suite, the source of an immense wealth of platinum, chrome and vanadium, comprises six quite distinct zones.

The Rustenburg Layered Suite is so termed as it is intrusive in origin and the term is to be equivalent to a 'group'. It consists of mafic and ultramafic rocks and is rich in platinum, chrome and vanadium. It is here that iron ore and the Merensky Reef are found. Magnesite mines provide magnesium carbonate for making heat-resistant bricks (Norman and Whitfield 2006). The Rustenburg Layered Suite can be divided into five zones, namely – Marginal, Lower, Lower Critical, and Upper Critical. The Rustenburg Layered Suite of the Bushveld Complex is Vaalian in age (2,100 – 1,920 Ma) and consists of an igneous intrusion with anorthosite, hybrid gabbro, gabbro, diabase, epidiorite, pyroxenite, and norite rocks.

The Transvaal Supergroup fills an east-west elongated basin in the south-central part of the old Transvaal (now North – West, Gauteng and Mpumalanga) as far south as Potchefstroom. It is Vaalian in age, approximately 2600 Ma to 2100 Ma. A maximum thickness of the Transvaal Supergroup reaches 2000 m in the north-eastern section. The east-west elongated basin is filled with clastic, volcanic and chemical sedimentary rocks. Three groups based

on lithological differences have been established: they are the Rooiberg, Pretoria and Chuniespoort Groups as well as other smaller groups such as the Groblersdal Group, Buffelsfontein Group, Wolkberg Group and the Black Reef Formation (Kent 1980, Snyman 1996). It is the Bushveld Complex that is responsible for the tilting of the Transvaal sediments and the heat of its intrusion having created andalusite crystals (Norman and Whitfield 2006). This Supergroup is underlain by the Ventersdorp, Witwatersrand and Pongola Supergroups, and the Dominion Group. Three prominent ridges are present from the oldest to the youngest, the Time Ball Hill, Daspoort and Magaliesberg Formations (Norman and Whitfield 2006).

The Chuniespoort Group is made up of chemical and biochemical sediments such as dolomite, chert, limestone and banded iron formation, carbonaceous shale is also present. At the top of the Malmani Subgroup is the Deutschland Formation underlain by the Penge and Monte Christo Formations. Sandstone is mostly absent. It is this formation that has great economic value for its lead, zinc, dolomite, and manganese (Kent 1980, Snyman 1996). Fluorspar, concrete aggregate, iron ore and manganese are also mined from this formation. Cave formation in the dolomite is a major concern in developing areas, especially in the 1500m thick dolomite of the Malmani Subgroup. Chemical sediments such as fine-grained limestone and dolomite is made up of deposits of organically derived carbonate shells, particles or precipitate. Dolomite is magnesium-rich limestone formed from algal beds and stromatolites.

The Turfloop Granite is a batholith on the edge of the Pietersburg Group with an age of between 2 566 ±65 and 2 660 ±60 my. (Visser 1989).

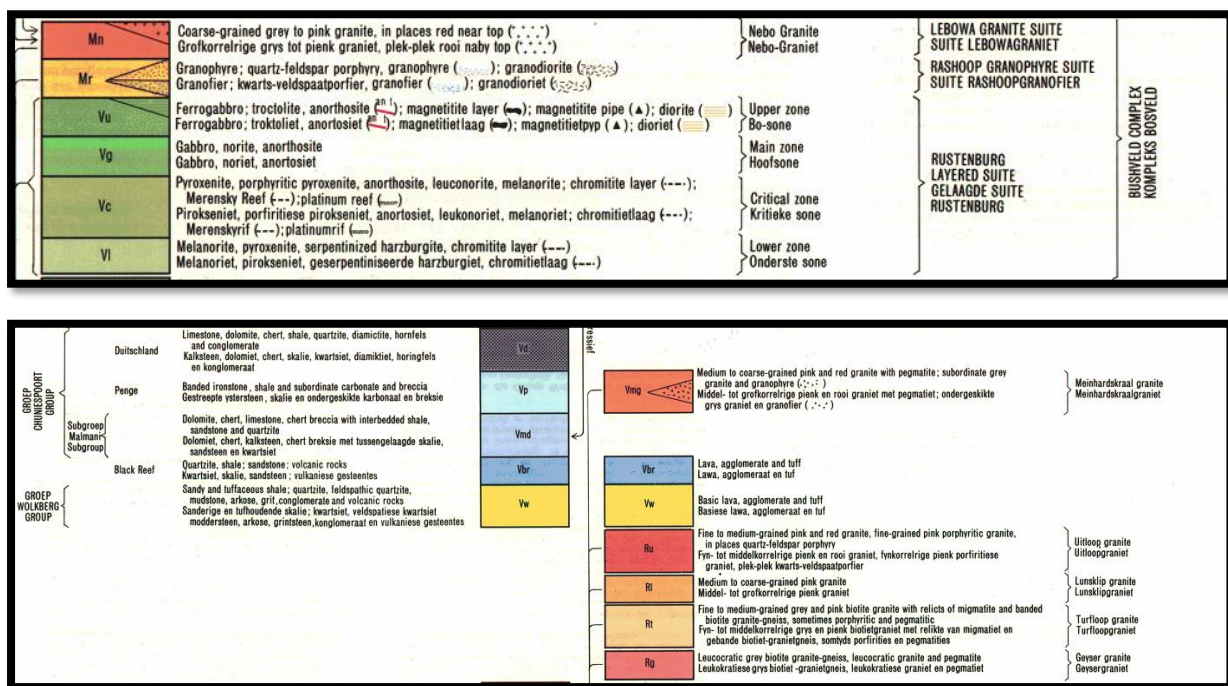


Figure 4: Lithostratigraphic column of the development area (Nylstroom).

*Field Observation:* The area is not large. Vegetation next to the road on the shoulder is lush, mostly grassland, trees and bushes; buildings are present in the townships. All areas were accessible, but very few outcrops are present on the shoulder of the road, mostly isolated rocks of granite and dolomite. The topography is undulating. Fossils were not located (Figures 5-19).



Figure 5: View of road looking back at Mokopane.



Figure 6: View of road directly outside Mokopane, note bad road surface.



Figure 7: View at second bridge.



Figure 8: View of road and shoulder with lush grass.



**Figure 9:** View in south moving towards end of upgrade.



**Figure 10:** View of road with wide shoulder, lush grass and deteriorating surface.



Figure 11: Dolomite rocks start appearing in the north.



Figure 12: Shallow dolomite outcrop on shoulder of road.



**Figure 13:** Very bad road surface and shallow dolomite outcrop.



**Figure 14:** View of Turfloop Granite in distance.





Figure 15: Townships are present all along the road.



Figure 16: Granite boulders are present in the south.



Figure 17: Another bridge to be upgraded.



Figure 18: Bridge close to Mokopane.



Figure 19: The bridge above has a weir present with a wetland.

It is recommended to wait for the response from SAHRA on the Phase 1: Field Study (this report). SAHRA protocol must be followed.

### **G. Background to Palaeontology of the area**

Summary: When rock units of moderate to very high palaeontological sensitivity are present within the development footprint, a desk top and or field scoping (survey) study by a professional palaeontologist is usually warranted. The main purpose of a field scoping (survey) study would be to identify any areas within the development footprint where specialist palaeontological mitigation during the construction phase may be required (SG 2.2 SAHRA AMPHOB, 2012).

Chemical sediments such as fine-grained limestone and dolomite of the Malmani Subgroup is made up of deposits of organically derived carbonate shells, particles or precipitate. Dolomite is magnesium-rich limestone formed from algal beds and stromatolites. These Early Proterozoic Transvaal stromatolitic dolomites formed and released free oxygen at around 2900 – 2400 Ma. Stromatolites are common in the Malmani dolomites, accepted to be the fossil remnants of the simplest single-celled organisms. They are finely layered, concentric, mound-like structures formed by microscopic algal organisms (Norman and Whitfield 2006). Chert may contain fossils such as echinoids or sponges if nodular, although not common and is rated unlikely.

Both the Bushveld Complex and Turfloop Granite are devoid of fossils.



**Figure 20:** Stromatolite (E. Butler).

Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity is generally **LOW** to **VERY HIGH**.

**Table 1:** Taken from Palaeotechnical Report (Groenewald and Groenewald 2014) (**1cA**).

CHUNIESPOORT	Makapani (Vm; Vma; Vma1; Vma2; Vma3)	Duitsland (Vt)	Conglomerate	No fossils recorded	
		Penge (Vp; Vpe)	Iron-rich shale	Stromatolites	
		Lyttelton (Vly)	Stromatolitic carbonates (limestones / dolomites), minor secondary cherts, mudrocks including carbonaceous shales	Range of shallow marine to intertidal stromatolites (domes, columns etc), organic-walled microfossils	Stromatolites in Makapansgat Valley ALERT FOR POTENTIALLY FOSSILIFEROUS LATE CAENZOZOIC CAVE BRECCIAS WITHIN "TRANSVAAL DOLOMITE" OUTCROP AREA (breccias not individually mapped)

**Table 2:** Criteria used (Fossil Heritage Layer Browser/SAHRA) (**1cB**):

Rock Unit	Significance/vulnerability	Recommended Action
Bushveld	Very Low	No action required
Chuniespoort Group	High	Desktop and Field Assessment likely

Databases and collections: Ditsong: National Museum of Natural History. Evolutionary Studies Institute, University of the Witwatersrand (ESI).

Impact: **HIGH** There are significant fossil resources that may be impacted by the development (mudstone, shale) and if destroyed are no longer available for scientific research or other public good (Almond, *et al.* 2009).

The Project includes one locality Option (see Figure 2) (**1f,j**) The palaeontological sensitivity is as stated above. Option 1: A line in blue drawn on the existing N11 National Road north-west of Mokopane. The approximate length of the upgrade is 24 km.

All the land involved in the development was assessed (**ni,nii**) and none of the property is unsuitable for development (see Recommendation B).

#### **H. Description of the Methodology (1e)**

The palaeontological impact assessment field study was undertaken in January 2023. A Phase 1: Field Survey of the affected portion includes photographs (in 7.1 mega pixels) taken of the site with a digital camera (Canon PowerShot A470). Additionally, Google Maps will be accessed on a cellular phone/tablet for navigation. A Global Positioning System (GPS) (Garmin eTrex 10) is used to record fossiliferous finds and outcrops (bedrock) when the area is not covered with topsoil, subsoil, overburden, vegetation, grassland, trees or waste. The survey did identify the Karoo Supergroup. A literature survey is included and the study relied heavily on geological maps.

SAHRA document 7/6/9/2/1 (SAHRA 2012) requires track records/logs from archaeologists not palaeontologists as palaeontologists concentrate on outcrops which may be recorded with a GPS. Isolated occurrences of rocks usually do not constitute an outcrop. Fossils can occur in dongas, as nodules, in fresh rock exposures, and in riverbeds. Finding fossils require the experience and technical knowledge of the professional palaeontologist, but that does not mean that an amateur can't find fossils. The geology of the region is used to predict what type of fossil and zone will be found in any particular region. Archaeozoologists concentrate on more recent fossils in the quaternary and tertiary deposits.

#### **Assumptions and Limitations (1i):-**

The accuracy and reliability of the report **may be** limited by the following constraints:

1. Most development areas have never been surveyed by a palaeontologist or geophysicist.
2. Variable accuracy of geological maps and associated information.
3. Poor locality information on sheet explanations for geological maps.
4. Lack of published data.
5. Lack of rocky outcrops.
6. Inaccessibility of site – was accessible.
7. Insufficient data from developer and exact lay-out plan for all structures - sufficient.

#### **A Phase 2 Palaeontological Impact Assessment: Mitigation will include:**

1. Recommendations for the future of the site.
2. Description of work done (including number of people and their responsibilities).
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan.
6. Possible declaration as a heritage site or Site Management Plan.

The National Heritage Resources Act No. 25 of 1999 further prescribes.

#### Act No. 25 of 1999. National Heritage Resources Act, 1999.

National Estate: 3 (2) (f) archaeological and palaeontological sites,

(i)(1) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens,

Heritage assessment criteria and grading: (a) Grade 1: Heritage resources with qualities so exceptional that they are of special national significance;

(b) Grade 2: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and (c) Grade 3: Other heritage resources worthy of conservation.

SAHRA is responsible for the identification and management of Grade 1 heritage resources.  
Provincial Heritage Resources Authority (PHRA) identifies and manages Grade 2 heritage resources.  
Local authorities identify and manage Grade 3 heritage resources.

No person may damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of a provincially protected place or object without a permit issued by a heritage resources authority or local authority responsible for the provincial protection.

Archaeology, palaeontology and meteorites: Section 35.

(2) Subject to the provisions of subsection (8) (a), 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.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, 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 a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (e. g. during bedrock excavations), this must be safeguarded, where feasible *in situ*, and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (e. g. Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

### **I. Description of significant fossil occurrences**

All Karoo Supergroup geological formations are ranked as **LOW** to **VERY HIGH**, and here the impact is potentially **HIGH** for the Chuniespoort Group.

Chemical sediments such as fine-grained limestone and dolomite of the Malmani Subgroup is made up of deposits of organically derived carbonate shells, particles or precipitate. Dolomite is magnesium-rich limestone formed from algal beds and stromatolites. These Early Proterozoic Transvaal stromatolitic dolomites formed and released free oxygen at around 2900 – 2400 Ma. Stromatolites are common in the Malmani dolomites, accepted to be the fossil remnants of the simplest single-celled organisms. They are finely layered, concentric, mound-like structures formed by microscopic algal organisms (Norman and Whitfield 2006). Chert may contain fossils such as echinoids or sponges if nodular, although not common and is rated unlikely.

Details of the location and distribution of all significant fossil sites or key fossiliferous rock units are often difficult to be determined due to thick topsoil, subsoil, overburden and alluvium. Depth of the overburden may vary a lot.

The threats are:-

- Earth moving equipment/machinery (front end loaders, excavators, graders, dozers) during construction,
- The sealing-in or destruction of fossils by development, vehicle traffic and human disturbance. See Description of the Geological Setting (F) above.

## J. Recommendation

- a. There is no objection (see Recommendation B) to the development, it was necessary to request a Phase 1 Palaeontological Impact Assessment: Field Study to determine whether the development will affect fossiliferous outcrops as the palaeontological sensitivity of the area is **HIGH**. A Phase 2 Palaeontological Mitigation is only required if the Phase 1 Palaeontological Assessment identified a fossiliferous formation and fossils or if fossils are found during construction. Protocol is attached (Appendix 2).
- b. This project may benefit the community, will create short- and long-term employment, the life expectancy of the community, the growth of the community, and social development in general.
- c. Preferred choice: Locality Option 1 is preferred and possible.
- d. The following should be conserved: if any palaeontological material is exposed during clearing, digging, excavating, or drilling SAHRA must be notified. All prospecting activities must be stopped, a 30 m no-go barrier constructed and a palaeontologist should be called in to determine proper mitigation measures.
- e. Consultation with parties was not necessary **(1o,p,q)**.
- f. This report must be submitted to SAHRA/PHRA together with the Heritage Impact Assessment Report.

### Sampling and collecting:

Wherefore a permit is needed from the South African Heritage Resources Agency (SAHRA / PHRA).

- a. Objections: Cautious. See heritage value and recommendation.
- b. Conditions of development: See Recommendation.
- c. Areas that may need a permit: Yes.
- d. Permits for mitigation: **Needed from SAHRA/PHRA prior to Mitigation.**

## K. Conclusions

- a. All the land involved in the development was assessed and none of the property is unsuitable for development (see Recommendation B).
- b. All information needed for the Phase 1 Palaeontological Impact Assessment and Field Study was provided by the Consultant. All technical information was provided by Chameleon Environmental Consultants.
- c. Areas that would involve mitigation and may need a permit from the South African Heritage Resources Agency are discussed.

- d. The following should be conserved: if any palaeontological material is exposed during clearing, digging, excavating, drilling or blasting, SAHRA must be notified. All development activities must be stopped, a 30 m barrier constructed, and a palaeontologist should be called in to determine proper mitigation measures.
- e. Condition in which development may proceed: It is further suggested that a Section 37(2) agreement of the Occupational, Health and Safety Act 85 of 1993 is signed with the relevant contractors to protect the environment (fossils) and adjacent areas as well as for safety and security reasons.

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### **Declaration (1b)**

I, Heidi Fourie, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project for which I was appointed to do a palaeontological assessment. There are no circumstances that compromise the objectivity of me performing such work.

I accept no liability, and the client, by receiving this document, indemnifies me against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the use of the information contained in this document.

It may be possible that the Phase 1: Field Study may have missed palaeontological resources in the project area as outcrops are not always present or visible while others may lie below the overburden of earth and may only be present once development commences.

This report may not be altered in any way and any parts drawn from this report must make reference to this report.

### POPI Act 2013 Statement

It provides that everyone has the right to privacy and includes a right to protection against the unlawful collection, retention dissemination and use of personal information contained in this document and pertains to the phone and contact details, signature and contents.

As per the Declaration Section none of the information may be shared without the permission of the author.

*The report will be signed as soon as comments have been included.*

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Heidi Fourie  
2023/01/30

### **Appendix 1: Protocol for Chance Finds and Management Plan (1k,l,m)**

This section covers the recommended protocol for a Phase 2 Mitigation process as well as for reports where the Palaeontological Sensitivity is **LOW**; this process guides the palaeontologist / palaeobotanist on site and should not be attempted by the layman / developer. As part of the Environmental Authorisation conditions, an Environmental Control Officer (ECO) will be appointed to oversee the construction activities in line with the legally binding Environmental Management Programme (EMPr).

- The EMPr already covers the conservation of heritage and palaeontological material that may be exposed during construction activities.
- For a chance find, the protocol is to immediately cease all construction activities, construct a 30 m no-go barrier, and contact SAHRA for further investigation. Construction workers must be informed that this is a no-go area.
- It is recommended that the EMPr be updated to include the involvement of a palaeontologist for pre-construction training of the ECO or during the digging and excavation phase of the development.
- The ECO must visit the site after clearing, drilling, excavations and blasting and keep a photographic record.
- The developer may be required to survey the areas affected by the development and indicate on plan where the construction / development / mining will take place. Trenches may have to be dug to ascertain how deep the sediments are above the bedrock (can be a few hundred metres). This will give an indication of the depth of the topsoil, subsoil, and overburden, if need be trenches should be dug deeper to expose the interburden.

Mitigation will involve recording, rescue and judicious sampling of the fossil material present in the layers sandwiched between the geological / coal layers. It must include information on number of taxa, fossil abundance, preservational style, and taphonomy. This can only be done during mining or excavations. In order for this to happen, in case of coal mining operations, the process will have to be closely scrutinised by a professional palaeontologist / palaeobotanist to ensure that only the coal layers are mined and the interlayers (siltstone and mudstone) are surveyed for fossils or representative sampling of fossils are taking place.

The palaeontological impact assessment process presents an opportunity for identification, access and possibly salvage of fossils and add to the few good plant localities. Mitigation can provide valuable onsite research that can benefit both the community and the palaeontological fraternity.

A Phase 2 study is very often the last opportunity we will ever have to record the fossil heritage within the development area. Fossils excavated will be stored at a National Repository.

#### **A Phase 2 Palaeontological Impact Assessment: Mitigation will include (SAHRA) -**

1. Recommendations for the future of the site.
2. Description and purpose of work done (including number of people and their responsibilities).
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan and map.
6. Possible declaration as a heritage site or Site Management Plan.
7. Stakeholders.
8. Detailed report including the Desktop and Phase 1 study information.
9. Annual interim or progress Phase 2 permit reports as well as the final report.
10. Methodology used.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, 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 a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (e. g. during bedrock excavations), this must be safeguarded, where feasible *in situ*, and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (e. g. Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

The Palaeontological Society of South Africa (PSSA) does not have guidelines on excavating or collecting, but the following is suggested:

1. The developer needs to clearly stake or peg-out (survey) the areas affected by the mining/ construction/ development operations and dig representative trenches and if possible supply geological borehole data. When the route is better defined, it is recommended that a specialist undertake a 'walk through' of the entire road as well as construction areas, including camps and access roads, prior to the start of any construction activities, this may be done in sections.
2. When clearing vegetation, topsoil, subsoil or overburden, hard rock (outcrop) is found, the contractor needs to stop all work.
3. A Palaeobotanist / palaeontologist (contact SAHRIS for list) must then inspect the affected areas and trenches for fossiliferous outcrops / layers. The contractor / developer may be asked to move structures, and put the development on hold.
4. If the palaeontologist / palaeobotanist is satisfied that no fossils will be destroyed or have removed the fossils, development and removing of the topsoil can continue.
5. After this process the same palaeontologist / palaeobotanist will have to inspect and offer advice through the Phase 2 Mitigation Process. Bedrock excavations for footings may expose, damage or destroy previously buried fossil material and must be inspected.

6. When permission for the development is granted, the next layer can be removed, if this is part of a fossiliferous layer, then with the removal of each layer of sediment, the palaeontologist / palaeobotanist must do an investigation (a minimum of once every week).
7. At this stage the palaeontologist / palaeobotanist in consultation with the developer / mining company must ensure that a further working protocol and schedule is in place. Onsite training should take place, followed by an annual visit by the palaeontologist / palaeobotanist.

**Fossil excavation if necessary, during Phase 2:**

1. Photography of fossil / fossil layer and surrounding strata.
2. Once a fossil has been identified as such, the task of extraction begins.
3. It usually entails the taking of a GPS reading and recording lithostratigraphic, biostratigraphic, date, collector and locality information.
4. Using Paraloid (B-72) as an adhesive and protective glue, parts of the fossil can be kept together (not necessarily applicable to plant fossils).
5. Slowly chipping away of matrix surrounding the fossil using a geological pick, brushes and chisels.
6. Once the full extent of the fossil / fossils is visible, it can be covered with a plaster jacket (not necessarily applicable to plant fossils).
7. Chipping away sides to loosen underside.
8. Splitting of the rock containing palaeobotanical material should reveal any fossils sandwiched between the layers.

**This document forms part of the Environmental Monitoring Programme.** For practical reasons a palaeontologist/palaeobotanist may be required to be on site as predetermined. If any fossil material is discovered then a Phase 2 rescue operation may be necessary, and a permit will be required.

**The South African Heritage Resources Agency has the following documents in place:**

Guidelines to Palaeontological Permitting policy.

Minimum Standards: Palaeontological Component of Heritage Impact Assessment reports.

Guidelines for Field Reports.

Palaeotechnical Reports (Eastern Cape, North West, Northern Cape, Mpumalanga, Gauteng, Western Cape, Free State, Kwazulu Natal, and Limpopo)

**Appendix 2: Table 2:** Listing points in Appendix 6 of the Act and position in Report (bold in text).

<b>Section in Report</b>	<b>Point in Act</b>	<b>Requirement</b>
B	1(c)	Scope and purpose of report
B	1(d)	Duration, date and season
B	1(g)	Areas to be avoided
D	1(ai)	Specialist who prepared report
D	1(aii)	Expertise of the specialist
F Figure 3	1(h)	Map
F, B	1(ni)(iA)	Authorisation
F, B	1(nii)	Avoidance, management, mitigation and closure plan
G Table 1	1(cA)	Quality and age of base data
G Table 2	1(cB)	Existing and cumulative impacts
G, D	1(f)	Details or activities of assessment
G	1(j)	Description of findings
H	1(e)	Description of methodology
H	1(i)	Assumptions

J	1(o)	Consultation
J	1(p)	Copies of comments during consultation
J	1(q)	Information requested by authority
Declaration	1(b)	Independent declaration
Appendix 2	1(k)	Mitigation included in EMPr
Appendix 2	1(l)	Conditions included in EMPr
Appendix 2	1(m)	Monitoring included in EMPr
D	2	Protocol or minimum standard

### Appendix 3: Impact Statement

The development footprint is situated on a geological layer with a **HIGH** palaeontological sensitivity. The nature of the impact is the destruction of Fossil Heritage. Loss of fossil heritage will have a negative impact. The extent of the impact only extends in the region of the development activity footprint and may include transport routes. The expected duration of the impact is assessed as potentially permanent. The intensity/magnitude of the impact is moderate as it may continue in a modified way. The probability of the impact occurring will be high.

In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent. The loss of resources occurs but natural cultural and social processes continue, albeit in a modified manner. With Mitigation the impact will be low and the cumulative impact is low. Impacts on palaeontological heritage during the construction and preconstruction phase could potentially occur but are regarded as having a moderate possibility. The significance of the impact occurring will be  $S = (2+5+8)4$

$S = 60$  Medium (30-60).