The Proposed Project Fifty-Eight Development on Portion 58 of the Farm Kromdraai 520-JQ

Mogale City Local Municipality, West Rand District Municipality, Gauteng Province

Farm: Portion 58 Kromdraai 520-JQ

Fourie, H. Dr heidicindy@yahoo.com

012 322 7632/079 940 6048

Palaeontological Impact Assessment: Phase 1: Field Study

Commissioned by: Environmental Consultants International

Mooikloof Office Park West, Building 8, Ground Floor,

Pretoria,

0040

012 942 9666

Ref: Pending

2021/06/11

Irrigasie Formasie – Plant fossil (H. Fourie)

B. Executive summary

Outline of the development project: Environmental Consultants International has facilitated the appointment of Dr H. Fourie, a palaeontologist, to undertake a Palaeontological Impact Assessment (PIA), Phase 1: Field Study of The Proposed Project Fifty-Eight Development on Portion 58 of the Farm Kromdraai 520-JQ in Mogale City Local Municipality, West Rand District Municipality, Gauteng Province on the Farm Portion 58 Kromdraai 520-JQ.

The applicant, Anderbridge Investments (Pty) Ltd. proposes to construct a retreat in the Cradle of Humankind World Heritage Site as a tourism facility as a place to restore conscious appreciation for life.

The Project includes one locality Option (Figure 2):
Option 1: A polygon outlined in blue with the R374 Road to the north, the R540 Road to the west, the R114 Road to the east, and a farm to the south. The area is approximately 163.3 hectares in size, but the extent of the proposed development will be 8.16 ha.

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.

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) (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 m² in extent; (e) or any other category of development provided for in regulations by SAHRA or a PHRA authority.

This report (**1c)** aims to provide comment and recommendations on the potential impacts that the proposed development project 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); 1:250 000, 2526 Rustenburg (Walraven 1981) and 1:250 000, 2626 West Rand (Keyser 1986).

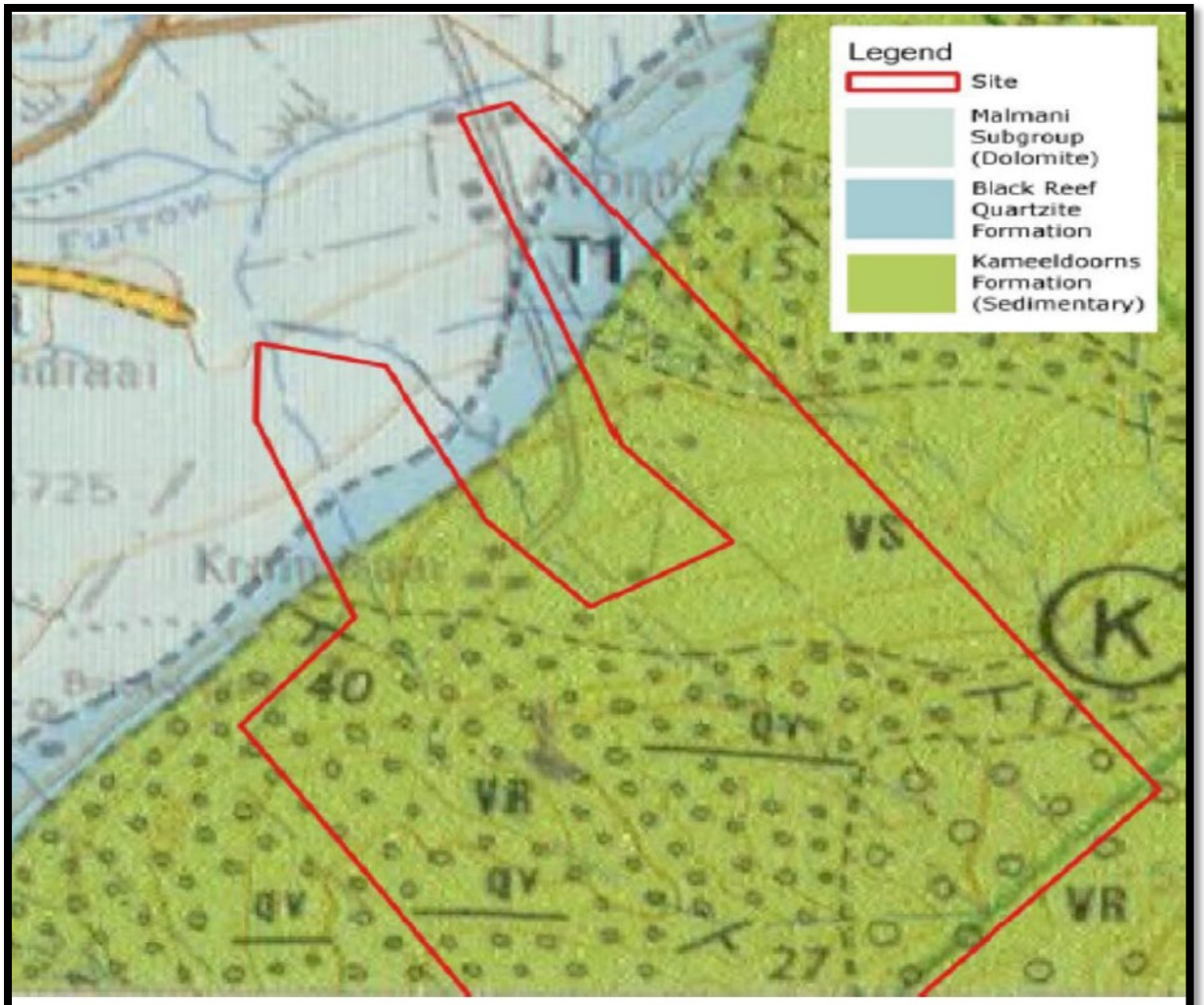


Figure 12: Geological Map

Figure: The geology of the development area. (ECI).

Legend to Figure and short explanation.

Vmm – Chert-rich dolomite; oolitic (blue). Monte Christo, Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup. Vaalian.

Vmo – Dark chert-free dolomite (blue ˚˚). Oaktree Formation, Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup. Vaalian.

Vbr – Quartzite, conglomerate, shale (dark blue). Black Reef Formation. Vaalian.

V-Rk – Shaley sandstone, sandy shale; conglomerate, grit, quartzite (::), boulder conglomerate (○˚○), breccia, greywacke, limestone, tuff (green). Kameeldoorns Formation, Platberg Group, Ventersdorp Suergroup. Vaalian.
------ – (black) Lineament (Landsat, aeromagnetic).
------ - Concealed geological boundary.
⊥40˚ – Strike and dip of bed.
□– Proposed development (blocked in redblack).

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 (Vmd) is the Duitschland Formation underlain by the Penge and Monte Christo Formations. Sandstone is mostly absent. 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 Black Reef Formation of the Transvaal Supergroup consists of quartzite with lenses of grit and conglomerate. Shale is always present, particularly near the top close to the contact with the overlying dolomite (Kent 1980). It is Vaalian in age and not very thick, only up to 500m in the north-east. It contains a fair amount of gold and the limestone is mined (Snyman 1996).

Several formations make up the Platberg Group, the basal Kameeldoorns, Makwassie, and upper Rietgat Formations, the Bothaville and Allanridge Formations are grouped seperately (Kent 1980). The Platberg Group consists predominantly of Randian age and Vaalian age rocks. The sedimentary Kameeldoorns Formation crops out in the Northern Cape at T'Kuip and in the North West Provine near Hartswater, west of Jan Kempsdorp, as well as in areas northwest and north of Vryburg and in the Mafikeng and Lichtenburg areas. It unconformably overlies the Klipriviersberg Group and in some places the basement granite (V.d. Westhuizen *et al.* 2006).

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 sedimentary strata the palaeontological sensitivity can generally be **LOW** to **VERY HIGH**, and here in the development area **HIGH** for the Malmani Subgroup, Chuniespoort Group, **MODERATE** for the Black Reef Formation, and **LOW** for the Kameeldoorns Formation (SG 2.2 SAHRA APMHOB, 2012).

In addition to the mammalian fossils such as hominids that may be present in caves, 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). These can range in size from 3.5 - 17 mm in height and up to 10 mm in diameter and can be present in the development area.

Stromatolites may also be present in the Black Reef Formation and the Kameeldoorns Formation.

Summary of findings (**1d**): The Phase 1: Field Palaeontological Impact Assessment was undertaken in June 2021 in winter in mild and dry conditions (**1c)** during the official adjusted Level 2 of the Covid-19 lockdown, and the following is reported:

This report is supplemental to the Heritage Impact Assessment commented upon by SAHRA with CaseID 16380.

Field Observation – The property is large and mostly covered with vegetation such as grass, trees, bushes, and crops. Several rocky ridges are present with non-perennial streams. Buildings with agricultural fields are also present, these are walled. Dolomite rocks were only observed at the stream present at the house and crop area. No fossils were found.

The Project includes one locality Option (Figure 2) in the Cradle of Humankind, most of the property is situated on an area with a **LOW** palaeontological sensitivity:
Option 1: A polygon outlined in blue with the R374 Road to the north, the R540 Road to the west, the R114 Road to the east, and a farm to the south. The area is approximately 163.3 hectares in size, but the extent of the proposed development will be 8.16 ha.

The only locality Option presented is situated on the Chuniespoort Group, Black Reef and Kameeldoorns Formations. Farming and most of the infrastructure will be built here as well as on the Black Reef Formation.

Recommendation:
The potential impact of the development on fossil heritage is **HIGH** in the north and therefore a Phase 1: Field Survey was necessary for this development. A Phase 2: Mitigation is only recommended if fossils are found during construction activities (according to SAHRA protocol). For a Chance Fossil Find, the Protocol is attached.

Concerns/threats (**1g**) to be added to the EMPr:

1. Threats to the National Heritage are earth moving equipment/machinery (for example haul trucks, front end loaders, excavators, graders, dozers) during construction, the sealing-in 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. An appropriate Protocol and Management plan is attached for the Environmental Control Officer (Appendix 2).

The recommendations are (**1ni, 1niA,1nii)**:

1. Mitigation may be needed (Appendix 2) if fossils are found.
2. No consultation with parties was necessary. The Environmental Control Officer must familiarise him- or herself with the formations present and its fossils and receive pre-construction training.
3. The development may go ahead, but the ECO must survey for fossils before and or after clearing, blasting, drilling or excavating.
4. 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.
5. It is recommended that a professional plio-pleistocene palaeoanthropoligist monitors the site during excavations.
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 – this was done showing a very low density allowing for low-level structures as planned.

Stakeholders: Developer – Anderbridge Investments (Pty) Ltd. Mr N. Max Liebmann, P.O. Box 1973, Paulshof, Gauteng, 2193. Tel: 011 483 1182.

Environmental – Environmental Consultants International. Mooikloof Office Park West, Building 8, Ground Floor, 0040, Tel: 012 942 9666.
Landowner – Anderbridge Investments (Pty) Ltd. Mr N. Max Liebmann, P.O. Box 1973, Paulshof, Gauteng, 2193. Tel: 011 483 1182.

C. Table of Contents

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 (May 2019) of the Environmental Impact Assessment Regulations (see Appendix 2). It is also in compliance with The Minimum Standards for Palaeontological Components of Heritage Impact Assessment Reports (**2**), SAHRA, APMHOB, Guidelines 2012, Pp 1-15.

Outline of development

This report discusses and aims to provide the applicant with information regarding the location of palaeontological material that will be impacted by the development. In the construction phase, it may be necessary for the applicant to apply for the relevant permit from the South African Heritage Resources Agency (SAHRA / PHRA) if a fossil is unearthed.

The applicant, Anderbridge Investments (Pty) Ltd. proposes to construct a retreat in the Cradle of Humankind World Heritage Site as a tourism facility as a place to restore conscious appreciation for life. The facility will be able to accommodate 150 guests with 22 residential villas, 18 residential suites, 19 residential rooms, six residential pods, wellbeing facility, 23 room residency, lounge/event space, central facilities, and restaurant.

The Project includes the following related infrastructure (**1f**):

- Hotel.
- Ashram sanctuary.
- Healing centre.
- Storm water channels for drainage.

- Waste management.
- Sewer reticulation.
- Farming component.

Local benefits of the proposed development include benefits to the local economy through possible job creation, poverty alleviation, food security, and local supplier procurement during the construction phase as well as during the operational phase of the development.

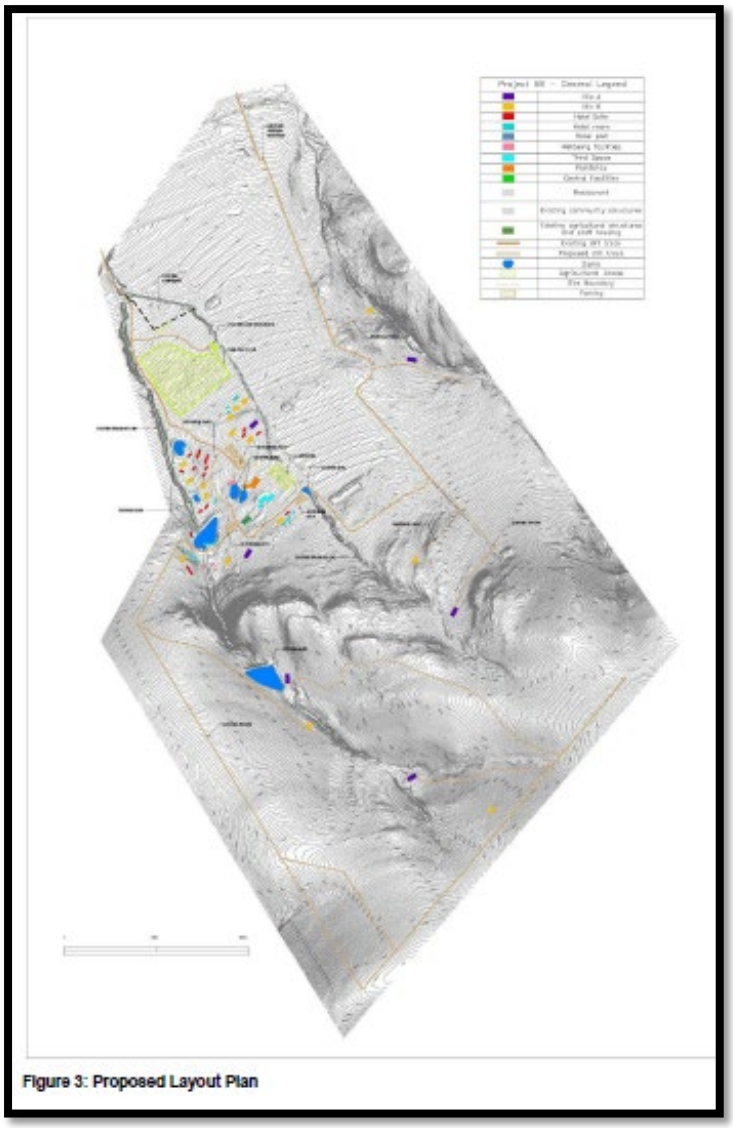


Figure 1: Proposed lay-out plan (ECI)

The Project includes one locality Option (Figure 2) with lay-out as shown above:
Option 1: A polygon outlined in blue with the R374 Road to the north, the R540 Road to the west, the R114 Road to the east, and a farm to the south. The area is approximately 163.3 hectares in size, but the extent of the proposed development will be 8.16 ha.

Rezoning/ and or subdivision of land: Presently Agriculture.
Name of developer and Environmental consultant: Anderbridge Investments (Pty) Ltd and Environmental Consultants International.

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.
Curriculum vitae – short (**1aii, 1aii)**: 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. She is currently employed by Ditsong: National Museum of Natural History as Curator of the fossil plant, invertebrate, amphibian, fish, reptile, dinosaur and Therapsid collections. For the past 14 years she carried out field work in the Eastern Cape, Western Cape, North West, Northern Cape, Free State, Gauteng, Limpopo, KwaZulu Natal, and Mpumalanga Provinces. Dr Fourie has been employed at the Ditsong: National Museum of Natural History in Pretoria (formerly Transvaal Museum) for 26 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 Proposed Project Fifty-Eight Development on Portion 58 of the Farm Kromdraai 520-JQ will be situated in Mogale City Local Municipality, West Rand District Municipality, Gauteng Province.

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 and is determined by the depth of the building construction. The Malmani Subgroup reaches a thickness of 1500 m.

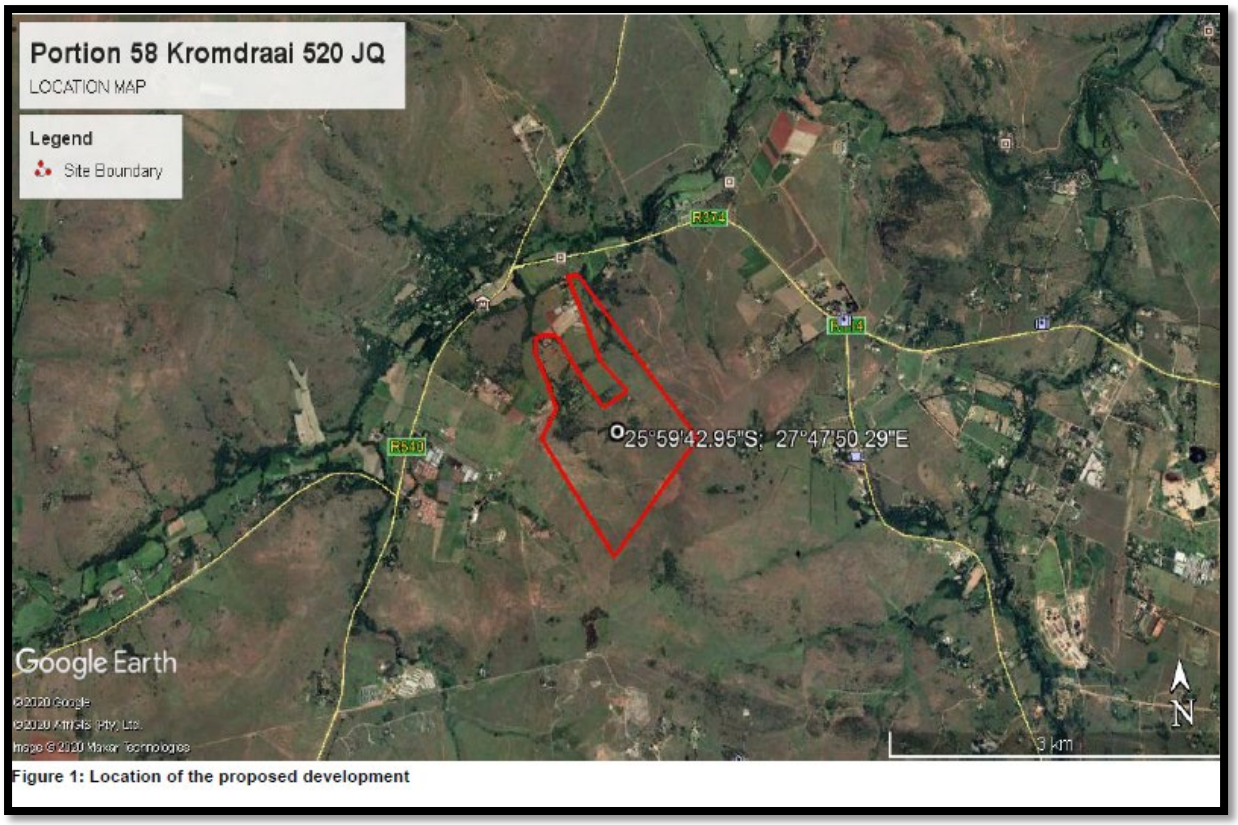


Figure 2: Google Earth location map (ECI).

The Project includes one locality Option (Figure 2) near Krugersdorp in the Cradle of Humankind:

Option 1: A polygon outlined in blue with the R374 Road to the north, the R540 Road to the west, the R114 Road to the east, and a farm to the south. The area is approximately 163.3 hectares in size, but the extent of the proposed development will be 8.16 ha.

F. Description of the Geological Setting

Description of the rock units:

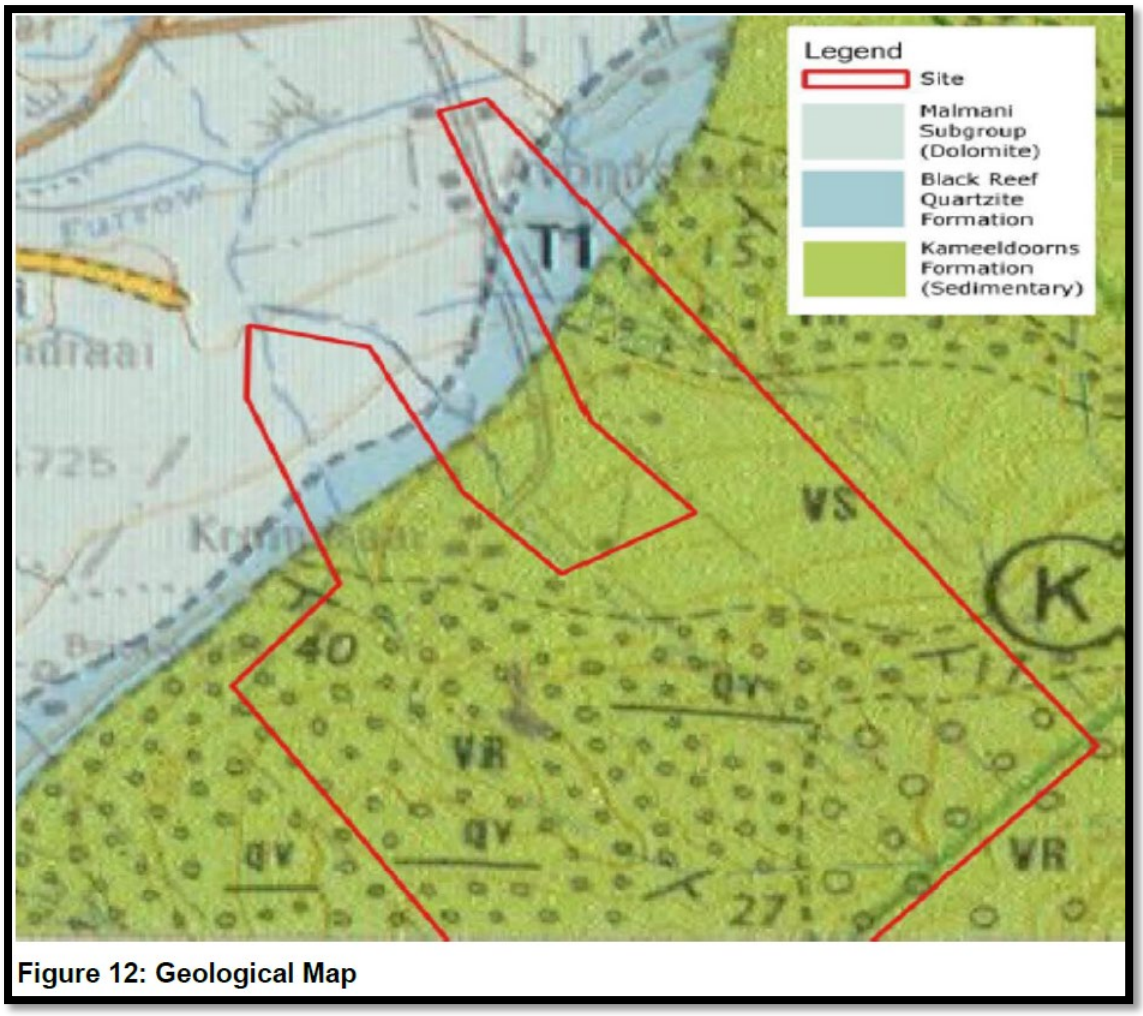


Figure 3: Excerpt of 1:250 000 Geological Maps (**1h)**.

Legend to Figure and short explanation.

Vmm – Chert-rich dolomite; oolitic (blue). Monte Christo, Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup. Vaalian.

Vmo – Dark chert-free dolomite (blue ˚˚). Oaktree Formation, Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup. Vaalian.

Vbr – Quartzite, conglomerate, shale (dark blue). Black Reef Formation. Vaalian.

V-Rk – Shaley sandstone, sandy shale; conglomerate, grit, quartzite (::), boulder conglomerate (○˚○), breccia, greywacke, limestone, tuff (green). Kameeldoorns Formation, Platberg Group, Ventersdorp Suergroup. Vaalian.

------ – (black) Lineament (Landsat, aeromagnetic).

------ - Concealed geological boundary.

⊥40˚ – Strike and dip of bed.

□ – Proposed development (blocked in red).

Mining Activities on Figure 3:

None in the development site. But lime was mined in this area, hence some of the caves.

The mining past and present has no influence on the development.

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 (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).

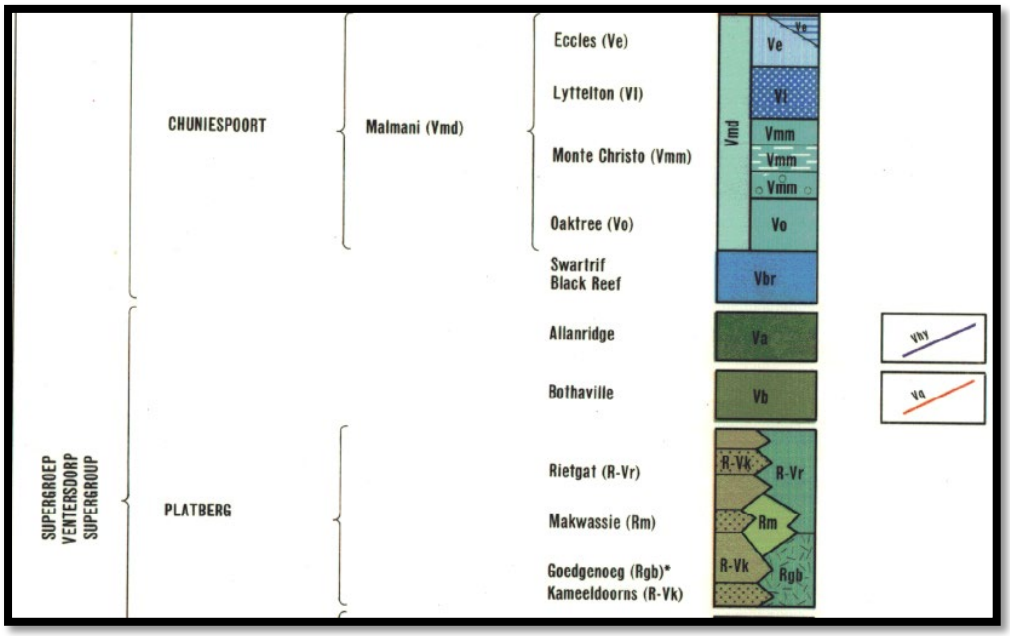


Figure 4: Lithostratigraphy (Keyser 1986).

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 Duitschland 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 Black Reef Formation is known for stromatolite carbonates and fossiliferous Late Cenozoic cave breccias similar to the Malmani dolomite.

The Black Reef Formation of the Transvaal Supergroup consists of quartzite with lenses of grit and conglomerate. Shale is always present, particularly near the top close to the contact with the overlying dolomite (Kent 1980). It is Vaalian in age and not very thick, only up to 500m in the north-east. It contains a fair amount of gold and the limestone is mined (Snyman 1996).

The Ventersdorp Supergroup consists mainly of andesitic lava, tuff and agglomerate. The Klipriviersberg Group and the Platberg Group are Randian in age, where the Rietgat Formation is Vaalian in age (Sheet information 2626 Wes Rand). The Ventersdorp Supergroup sits disconformably on the Witwatersrand Supergroup and is made up of the lower Klipriviersberg Group, the middle Platberg Group, and two formations (Bothaville and Allanridge). Together it can reach a maximum thickness of 4,260 m in some areas. It is described as an elliptical

basin named after the town of Ventersdorp. Sediments accumulated in fault-bounded troughs or grabens and gold can be present (Norman and Whitfield 2006).

Several formations make up the Platberg Group, the basal Kameeldoorns, Makwassie, and upper Rietgat Formations, the Bothaville and Allanridge Formations are grouped seperately (Kent 1980). The Platberg Group consists predominantly of Randian age and Vaalian age rocks (Kent 1980). Soils forming can be divided into three groups with the solid lavas creating excellent conditions for foundations, the residual soils and the tuffs are not ideal for foundations (Snyman 1996). The sedimentary Kameeldoorns Formation crops out in the Northern Cape at T'Kuip and in the North West Provine near Hartswater, west of Jan Kempsdorp, as well as in areas northwest and north of Vryburg and in the Mafikeng and Lichtenburg areas. It unconformably overlies the Klipriviersberg Group and in some places the basement granite (V.d Westhuizen *et al.* 2006).

Field Observation – The property is large and mostly covered with vegetation such as grass, trees, bushes, and crops. Several rocky ridges are present with non-perennial streams. Buildings with agricultural fields are also present, these are walled. Dolomite rocks were only observed at the stream present at the house and crop area. No fossils were found (Figures 5 -11).

Figure 5: View of rocky outcrop in river bed, Black Reef Formation.

Figure 6: Area with streams were surveyed to check for caves as two villas (A, B) will be constructed in this area.

Figure 7: Rocks are piled, either from an excavation or clearing of a field. Present near middle section where two villas will be constructed, Kameeldoorns Formation.

Figure 8: View of hill with loose rocks.

Figure 9: Dolomite boulders present in the stream at the farmyard. Most of the structures will be constructed at the existing farm yard, Malmani Subgroup. Farming and most of the infrastructure will be built here as well as on the Black Reef Formation.

Figure 10: Close-up of loose rocks present on site. This is in the south where four of the villas will be constructed, Kameeldoorns Formation.

Figure 11: Rocky outcrop in river.

G. Background to Palaeontology of the area (1j)

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).

One of the formations (Black Reef) in the development area may contain fossils. Nixon *et al*. (1988) described the black shales south-west of Potchefstroom as consisting of overlapping laminated basal mounds which are stromatolitic as well as spheroidal possible planktonic fossil algae. These can range in size from 3.5 - 17 mm in height and up to 10 mm in diameter and can be present in the development area.

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.

Figure 12: Photograph of a stromatolite (E. Butler).

Stromatolites are significant indicators of palaeoenvironments and provide evidence of algal growth between 2640 and 2432 million years ago (Groenewald and Groenewald 2014). Caves in the Malmani dolomite (Vmd) of the Transvaal Supergroup provided a refuge for man's distant ancestors (Norman and Whitfield 2006). These caves are also home to Middle and Late Stone Age cultures. The cave breccia in the Cradle of Humankind, near Johannesburg, yielded internationally renowned hominins such as *Australopithecus africanus and robustus* and extinct mammals and other fauna. The caves are actively being researched and excavated and this has led to many international collaborations (refer to Heritage Impact assessment). The caves are filled with sediments from the Kalahari Group.

Figure 13: Examples of mammalian fossils that may occur in caves.

The Black Reef Formation is known for stromatolite carbonates and fossiliferous Late Cenozoic cave breccias similar to the Malmani dolomite. Algal microfossils are reported from shales and are probably from diagenetic origin. Stromatolites are preserved in the subordinate carbonate rocks.

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

CHUNIESPOORT		Duitschland (Vd)		Conglomerate	No fossils recorded	Good examples of stromatolites in Cradle of Humankind region ALERT FOR POTENTIALLY FOSSILIFEROUS LATE CAENOZOIC CAVE BRECCIAS WITHIN "TRANSVAAL DOLOMITE" OUTCROP AREA (breccias not individually mapped)
		Penge (Vp)		Iron-rich shale	Stromatolites	
	Malmani (Vm; Vmd; Vma)			Stromatolitic carbonates (limestones / dolomites), minor secondary cherts, mudrocks including carbonaceous shales	Range of shallow marine to intertidal stromatolites (domes, columns etc), organic-walled microfossils	
		Black Reef (Vbr)		Siliciclastic sediments (mature sandstones plus minor mudrocks, conglomerates) deposited during a fluvial to shallow marine transition	Possible equivalent of Black Reef Fm in N. Cape (Vryburg Formation) contains stromatolitic carbonates	
PLATBERG (R-Vp)		Ra; Rb; Rm; Rma; Rgb; Rka; Rkm; Rka1; Rka2		Basic and acid volcanics with subordinate siliciclastic sediments (breccias, conglomerates, sandstones, mudrocks), with minor limestones and cherts in upper part of succession Late Archaean Randian 2.7-2.5	Lacustrine stromatolites and possible microfossils.	Fossils recorded from sediments of Platberg Group elsewhere (Northern Free State) and therefore might also be present in Gauteng
		Rietgat (Rr; Rrg; Rrg2)		Predominantly lavas with minor metasediments (fluvial and lacustrine conglomerates, breccias, minor shales, stromatolitic carbonates, cherts)	Lacustrine stromatolites reported in carbonates,of Rietgat Formation (Platberg Group); possible organic-walled microfossils in cherts. LIP (Large Igneous Province) with voluminous eruptions of basaltic and other lavas.	Stromatolites recorded from borehole cores. Any surface occurrences would be of considerable interest.
		Rm; Rgb; Rkm			Possible stromatolites	

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

Rock Unit	Significance/vulnerability	Recommended Action
Malmani Subgroup	High	Desktop Study and Phase 1: Field Assessment
Black Reef F	Moderate	Desktop Study and Field Assessment likely
Kameeldoorns F.	Low	Desktop Study

Databases and collections: Ditsong: National Museum of Natural History. Evolutionary Studies Institute, University of the Witwatersrand (ESI).
Impact: **HIGH, MODERATE, LOW** There may be significant fossil resources that may be impacted by the development (shale/dolomite).

The project includes one locality Option (Figure 2) with the above impact.
Option 1: A polygon outlined in blue with the R374 Road to the north, the R540 Road to the west, the R114 Road to the east, and a farm to the south. The area is approximately 163.3 hectares in size, but the extent of the proposed development will be 8.16 ha.

H. Description of the Methodology (1e)

The palaeontological impact assessment was undertaken in June 2021 during the official Covid-19 lockdown. A Phase 1: Field Study includes a walk through and drive through of the affected portion and photographs (in 20 mega pixels) taken of the site with a digital camera (Canon PowerShot SX620HS). It may be necessary to use a Global Positioning System (GPS) (Garmin eTrex 10) to record outcrops if fossils are present and if not covered with topsoil, subsoil, overburden, and vegetation. A literature survey is included and the study relied on literature, geological maps, google maps, and google earth images.

SAHRA Document 7/6/9/2/1 requires track records/logs from archaeologists not palaeontologists as palaeontologists concentrate on outcrops which may be recorded on 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. An archaeozoologist can be called upon to survey for more recent fossils in the Quaternary and Tertiary deposits, as present here.

Assumptions and Limitations (**1e)**:-
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.
7. Insufficient data from developer and exact lay-out plan for all structures (for this report all required data/information was provided).

A Phase 1 Palaeontological Impact Assessment: Field Study will include:

1. Recommendations for the future of the site.
2. Background information on the project.
3. Description of the property of affected environment with details of the study area.
4. Description of the geological setting and field observations.
5. Background to palaeontology of the area.
6. Heritage rating.
7. Stating of significance (Heritage Value).

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.
The National Estate as: 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 used: (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

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.

The Black Reef Formation is known for stromatolite carbonates and fossiliferous Late Cenozoic cave breccias similar to the Malmani dolomite. Algal microfossils are reported from shales and are probably from diagenetic origin. Stromatolites are preserved in the subordinate carbonate rocks.

Stromatolites may also be present in the Kameeldoorns Formation.

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 to the National Palaeontological Heritage are:

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

J. Recommendation (1o,1p, 1q)

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 is **HIGH** in the north. A Phase 2 Palaeontological Mitigation is only required if a Phase 1 Palaeontological Assessment identified a fossiliferous formation or surface fossils or if fossils are found during clearing, construction excavations, drilling and blasting. The Protocol for Chance Finds and Management Plan is attached (Appendix 2) for the ECO.
b. It is recommended that a professional plio-pleistocene palaeoanthropoligist monitors the site during excavations.
c. This project will benefit the economy (tourism) and social development of the community.
d. Preferred choice: One locality Option is presented and possible (see Executive Summary).
e. The following should be conserved: if any palaeontological material is exposed during clearing, digging, excavating, drilling or blasting SAHRA must be notified. All construction activities must be stopped, a 30 m no-go barrier constructed, and a palaeontologist should be called in to determine proper mitigation measures.
f. Consultation with parties was not necessary.
g. This report must be submitted to SAHRA together with the Heritage Impact Assessment.

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: Only if a fossil is unearthed.
d. Permits for mitigation: **SAHRA/PHRA**.

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 scope was provided by the Consultant. All technical information was provided by Environmental Consultants International.
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 digging, excavating, drilling or blasting, SAHRA must be notified. All development activities must be stopped, a 30 m no-go barrier constructed and a palaeontologist should be called in to determine proper mitigation measures, especially for shallow caves.
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.

L. Bibliography

ALMOND, J., PETHER, J, and GROENEWALD, G. 2013. South African National Fossil Sensitivity Map. SAHRA and Council for Geosciences.

DE ZANCHE, V. and MIETTO, P. 1977. *The World of Fossils.* Sampson Low Guides, Berkshire, Printed in Italy, Pp 256.

ECI, 2021. The Proposed Project Fifty-Eight Development on Portion 58 of the Farm Kromdraai 520-JQ. Draft Basic Assessment Report Pp 103.

GROENEWALD, G and GROENEWALD, D. 2014. SAHRA Palaeotechnical Report. Palaeontological Heritage of the Gauteng Province, Pp 20.

KENT, L. E., 1980. Part 1: Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia and the Republics of Bophuthatswana, Transkei and Venda. SACS, Council for Geosciences, *Stratigraphy of South Africa. 1980. South African Committee for Stratigraphy.* Handbook 8, Part 1, pp 690.

KEYSER, N., BOTHA, G.A. and GROENEWALD, G.H. 1986. 1:250 000 Geological Map of East Rand, 2628. South African Committee for Stratigraphy, Council for Geoscience, Pretoria.

MACRAE, C. 1999.*Life Etched in Stone: Fossils of South Africa.* Geological Society of south Africa, Johannesburg. Pp 305.

MCCARTHY, T and RUBIDGE, B. 2005. *The Story of Earth Life: A southern African perspective on a 4.6-billion-year journey.* Struik. Pp 333.

NIXON, N., ERIKSSON, P.G., JACOBS, R. and SNYMAN, C.P. 1988. Early Proterozoic micro-algal structures in carbonaceous shales of the Pretoria Group, south-west of Potchefstroom. *South African Journal of Science,* **84:** 592-595.

NORMAN, N. and WHITFIELD, G., 2006. *Geological Journeys.* De Beers, Struik, P 1-320.

RUBIDGE, B. S. (ed.), 1995. Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Biostratigraphy, Biostratigraphic Series No. 1, 46pp. Council for Geoscience, Pretoria.

SG 2.2 SAHRA APMHOB Guidelines, 2012. Minimum standards for palaeontological components of Heritage Impact Assessment Reports, Pp 1-15.

SNYMAN, C. P., 1996. *Geologie vir Suid-Afrika*. Departement Geologie, Universiteit van Pretoria, Pretoria, Volume 1, Pp. 513.

VAN DER WALT, M., DAY, M., RUBIDGE, B. S., COOPER, A. K. & NETTERBERG, I., 2010. Utilising GIS technology to create a biozone map for the Beaufort Group (Karoo Supergroup) of South Africa. *Palaeontologia Africana,* **45:** 1-5.

VAN DER WESTHUIZEN, W.A., BRUIYN, H. and MEINTJES, P.G. 2006. *Geology of South Africa: 8. The Ventersdorp Supergroup*, Pp 22.

VISSER, D.J.L. 1984 (ed). Geological Map of South Africa 1:100 000. South African Committee for Stratigraphy. Council for Geoscience, Pretoria.
VISSER, D.J.L. 1989 (ed). *Toeligting: Geologiese kaart (1:100 000). Die Geologie van die Republieke van Suid Afrika, Transkei, Bophuthatswana, Venda, Ciskei en die Koningkryke van Lesotho en Swaziland*. South African Committee for Stratigraphy. Council for Geoscience, Pretoria.
WALRAVEN, F. 1981. 1:250 000 Geological Map of Rustenburg, 2526. South African Committee for Stratigraphy, Council for Geoscience, Pretoria.

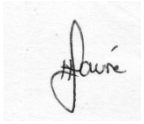
Declaration (disclaimer) (1b)

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 Palaeontolgical Impact Assessment may have missed palaeontological resources in the project area as outcrops are not always present or visible due to vegetation 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.



_____

Heidi Fourie
2021/06/11

Appendix 1 (**1k,1l,1m**): **Protocol for Chance Finds and Management plan for EMP'r**

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) so that when a fossil is unearthed they can notify the relevant department and specialist to further investigate. Therefore, the EMPr must be updated to include the involvement of a palaeontologist during the digging and excavation (ground breaking) phase of the development.

The EMPr already covers the conservation of heritage and palaeontological material that may be exposed during construction activities.

- The protocol is to immediately cease all construction activities if a fossil is unearthed and contact SAHRA for further investigation.
- The area must be fenced-off with a 30 m barrier and the construction workers must be informed that this is a no-go area.
- If fossils were found, they must be placed in a safe area for further investigation.
- The ECO should familiarise him- or herself with the fossiliferous formations and its fossils.
- A site visit is recommended after drilling, excavations and blasting and the keeping of a photographic record. A regular monitoring presence over the period during which excavations are made, by a palaeontologist, is generally not practical, but can be done during ground breaking or predetermined.
- Most Museums and Universities has good examples of Pliocene Fossils.
- The developer may be asked to survey the areas affected by the development and indicate on plan where the construction / development 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 (if present). 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 fossil 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.

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 (if applicable)/ construction/ development operations and dig representative trenches and if possible supply geological borehole data.
2. When clearing topsoil, subsoil or overburden and hard rock (outcrop) is found, the contractor / developer 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 a 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. Use 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.

SAHRA Documents:
Guidelines to Palaeontological Permitting Policy.
Minimum Standards: Palaeontological Component of Heritage Impact Assessment reports.
Guidelines for Field Reports.
Palaeotechnical Reports for all the Provinces.

Appendix 2: Table of Appendix 6 requirements (bold and bracketed in text).

Section in Report	**Point in Act**	**Requirement**
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
B	1(ni)(niA)	Authorisation
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
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 the Malmani Subgroup 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 probability of the impact occurring is medium. The expected duration of the impact is assessed as potentially permanent. Only the site will be affected. 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 low/minor possibility. The significance of the impact occurring will be medium before Mitigation.

Probability: 3
Duration: 5
Scale: 1

Magnitude: 6
SP=54 31≥60 Medium