Excelsior Abattoir Extension - Kuruman

Ga-Segonyana Local Municipality, John Taolo Gaetsewe District Municipality, Northern Cape Province

Farm: Erf 4051, 4052 Kuruman RD

Fourie, H. Dr

Palaeontological Impact Assessment: Desktop Study

Facilitated by: EARTHnSKY Environmental

P.O. Box 5419, Rietvalleirand,

Pretoria

0174

Tel: 061 524 2211

2022/12/03

Ref: Pending

Regisaurs (ESI)

B. Executive summary

Outline of the development project: EARTHnSKY has facilitated the appointment of Dr H. Fourie, a palaeontologist, to undertake a Palaeontological Impact Assessment (PIA), Desktop Study of the Excelsior Abattoir Extension in the Ga-Segonyana Local Municipality, John Taolo Gaetsewe District Municipality, Northern Cape Province on Farm: Erf 4051, 4052 Kuruman RD.

The applicant, Excelsior Abattoir CC proposes to expand the existing facility in order to increase capacity.

The Project includes one locality Option (see Figure 2):
Option 1: An area indicated in red with the towns of Kuruman and Rensville to the north, the R31 Road to the west and the N14 National Road north. The approximate size of the site is 8293 m^2 (< 1 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.

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

This report aims (**1c)** 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) and the 1:250 000 geological map of Kuruman 2722 (Moen 1979).

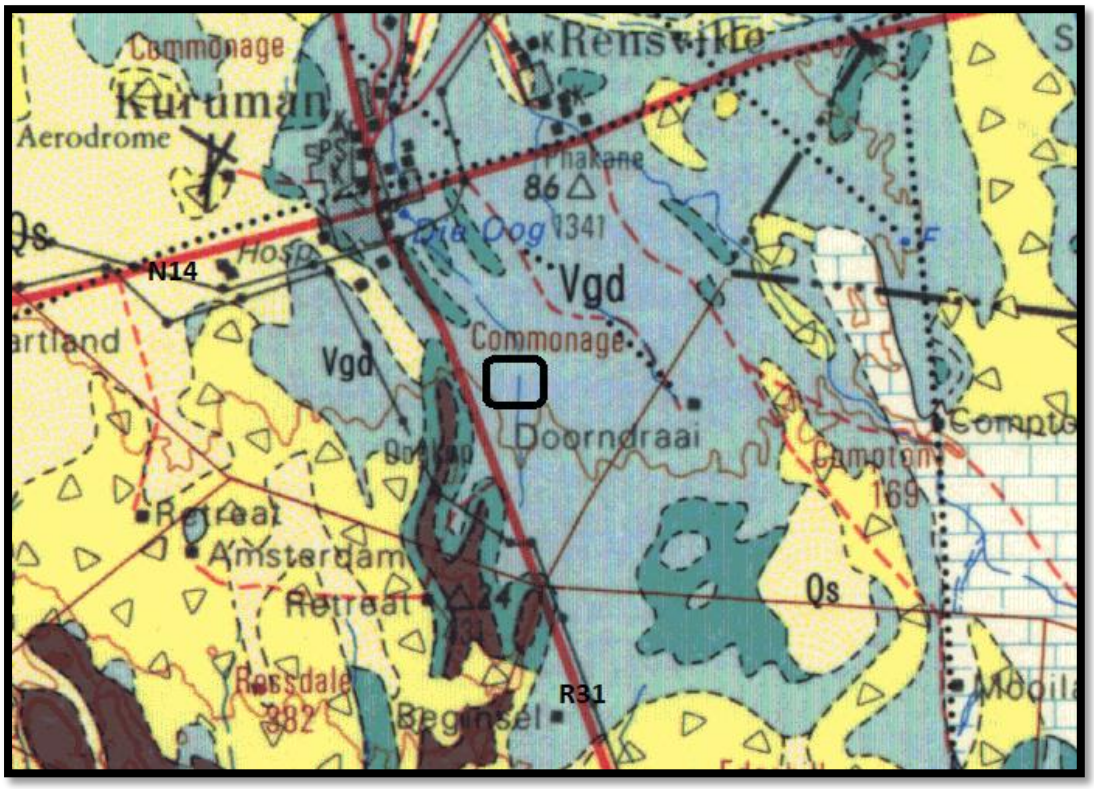

Figure: The geology of the development area.
Legend to Figure and short explanation.
Vgd – Dolomite, limestone (blue). Kogelbeen Formation, Campbell Rand Subgroup, Transvaal Supergroup. Vaalian.
---f--- – (black) Fault.
……. – Undifferentiated linear structure.
------- - Concealed geological boundary.
⊥10º - Strike and dip.
□ – Approximate position of expansion (blocked in black on figure).

Summary of findings: The Palaeontological Impact Assessment: Desktop Study was undertaken in November 2022 in summer in dry and hot conditions (Appendix 6 of Act, **1(d)**), as this is a Desktop Study, the season has no influence on the outcome. The following is reported:

The development is taking place on the Kogelbeen Formation.

Almond and Pether (2009) referred to this as the Griqualand Basin within the Transvaal Supergroup. The most recent classification was done in 2006 (Eriksson *et al.*) with the Ghaap Group (Schmidtsdrif Subgroup, Campbell Rand Subgroup, Koegas and Asbestos Hills Subgroups) at the bottom underlain by the Vryburg Formation; overlain by the Postmasburg Group (Makganyene, Ongeluk, Hotazel, Mooidraai Formations). The Kogelbeen Formation, Campbell Rand Subgroup is at least 445 m thick with the Lyme Acers Member at the top containing economically important limestone deposits (Eriksson *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, the palaeontological sensitivity can generally be **LOW** to **VERY HIGH**, and here in the development is shown below (SG 2.2 SAHRA APMHOB, 2012) (Almond and Pether 2009).

Fossils are listed below:

Range of shallow marine and lacustrine stromatolites (some very large), oolites, pisolites in carbonates, filamentous and coccoid organic walled microfossils (eg cyanobacteria) in siliciclastics / carbonates as well as cherts of banded iron formations (BIF): Schmidtsdrift, Campbell Rand Asbestos Hills Subgroups	Formations with carbonate rocks (eg Vb, Vc, Vgd, Vu, Vf, Vh, Vsb, Vsm, Vgu, Vgf) are most palaeontologically sensitive. Classic Early Proterozoic stromatolitic successions and cyanobacterial microfossils (Ghaap Postmasburg Groups of Griqualand West Basin). Early continental shelf environments (margins of Kaapvaal Craton).
Stromatolites	

These are also present in the Kogelbeen Formation (Eriksson *et al.* 2006).

Recommendation:
The impact of the prospecting on the fossil heritage is **HIGH**. A Phase 1 Palaeontological Impact Assessment: Field Study is recommended if fossils are found during excavating, drilling, clearing or digging (according to SAHRA protocol).

The Project includes one locality Option (see Figure 2):
Option 1: An area indicated in red with the towns of Kuruman and Rensville to the north, the R31 Road to the west and the N14 National Road north. The approximate size of the site is 8293 m^2 (< 1 ha).

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

1. The overburden and inter-burden must always be surveyed for fossils. Special care must be taken during the clearing, digging, drilling, blasting, trenching, and removal of overburden not to intrude fossiliferous layers.

2. Threats are earth moving equipment/machinery (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.

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

1. Mitigation is needed if fossils are found. Permission needed from SAHRA.
2. No consultation with parties was necessary.
3. The development may go ahead. The ECO must survey the excavations for fossils and follow SAHRA protocol.
4. The EMPr will cover 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, construct a 30 m no-go barrier, and contact SAHRA for further investigation.

Stakeholders: Applicant – Excelsior Abattoir CC. Kuruman.
Environmental – EARTHnSKY Environmental. P.O. Box 5419, Rietvalleirand, Pretoria, 0174, Tel: 061 524 2211.
Landowner – Excelsior Abattoir CC.

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 (GN R38282 of 4 December 2014) of the Environmental Impact Assessment Regulations (see Appendix 1). It is also in compliance with SG 2.2 SAHRA APMHOB Guidelines, 2012. Minimum standards for palaeontological components of Heritage Impact Assessment Reports, Pp 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 if fossils are present (SAHRA / PHRA).

The applicant, Excelsior Abattoir CC proposes to expand the existing facility in order to increase capacity.

Expansion of the Excelsior Abattoir will increase the cattle (red meat) slaughtering capacity from 50 to 200 cattle per day. The expansion will include internal changes to the abattoir as well as the expansion of the abattoir building to accommodate an additional cold storage room with three product loading bays. The main abattoir building will be extended to the north-west and the offices will be extended to the north-east.

Local benefits of the proposed development include benefits to the local communities through job creation and also boosts the municipality's economic development.

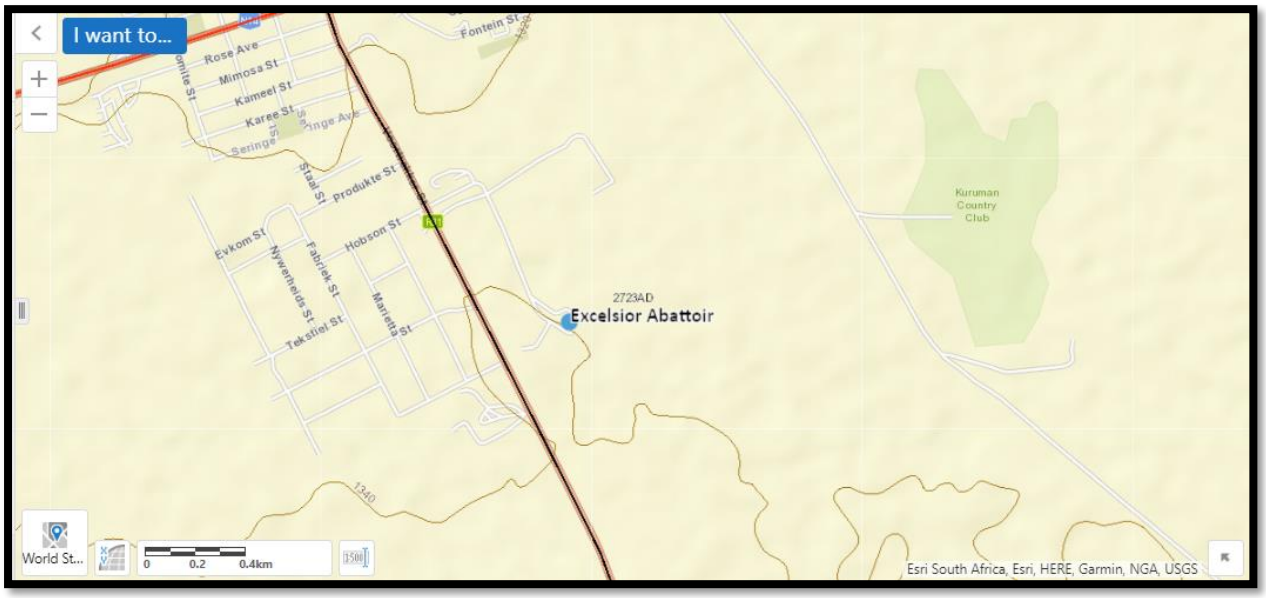

Figure 1: Map showing location of proposed expansion (EARTHnSKY).

The following infrastructure is anticipated (8293 m^2):

1. Buildings (Abattoir)
2. Manage pollution
3. Storm water management

The Project includes one locality Option (see Figure 2):
Option 1: An area indicated in red with the towns of Kuruman and Rensville to the north, the R31 Road to the west and the N14 National Road north. The approximate size of the site is 8293 m^2 (< 1 ha).

Rezoning/ and or subdivision of land: Not needed.
Name of Developer and Consultant: Excelsior Abattoir CC and EARTHnSKY Environmental.
Terms of reference: Dr H. Fourie is a palaeontologist commissioned to do a palaeontological impact assessment 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,ii**):* 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. For the past 16 years she carried out field work in the Eastern Cape, Limpopo, Mpumalanga, Gauteng, Free State and Natal 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 Excelsior Abattoir Extension will be situated in the Ga-Segonyana Local Municipality, John Taolo Gaetsewe District Municipality, Northern Cape Province on Farm: Erf 4051, 4052 Kuruman RD.

Depth is determined by the related infrastructure, such as the foundations to be developed and the thickness of the formation. 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.

Figure 2: Location map on Google Earth (EARTHnSKY).

F. Description of the Geological Setting
Description of the rock units:
Over areas totalling fully 40% of Southern Africa the 'hard rocks', from the oldest to the Quaternary, are concealed by normally unconformable deposits – principally sand, gravel, sandstone, and limestone. Inland deposits are much more extensive than marine deposits and are terrestrial and usually unfossiliferous. Some of these deposits date back well into the Tertiary, whereas others are still accumulating. Owing to the all-to-often lack of fossils and of rocks suitable for radiometric or palaeomagnetic dating, no clear-cut dividing line between the Tertiary and Quaternary successions could be established (Kent 1980). The alluvium sands were deposited by a river system and reworked by wind action (Snyman 1996). A thick cover of Kalahari reddish sand blankets most outcrops and is dominated by the typical Kalahari thornveld (Norman and Whitfield 2006).

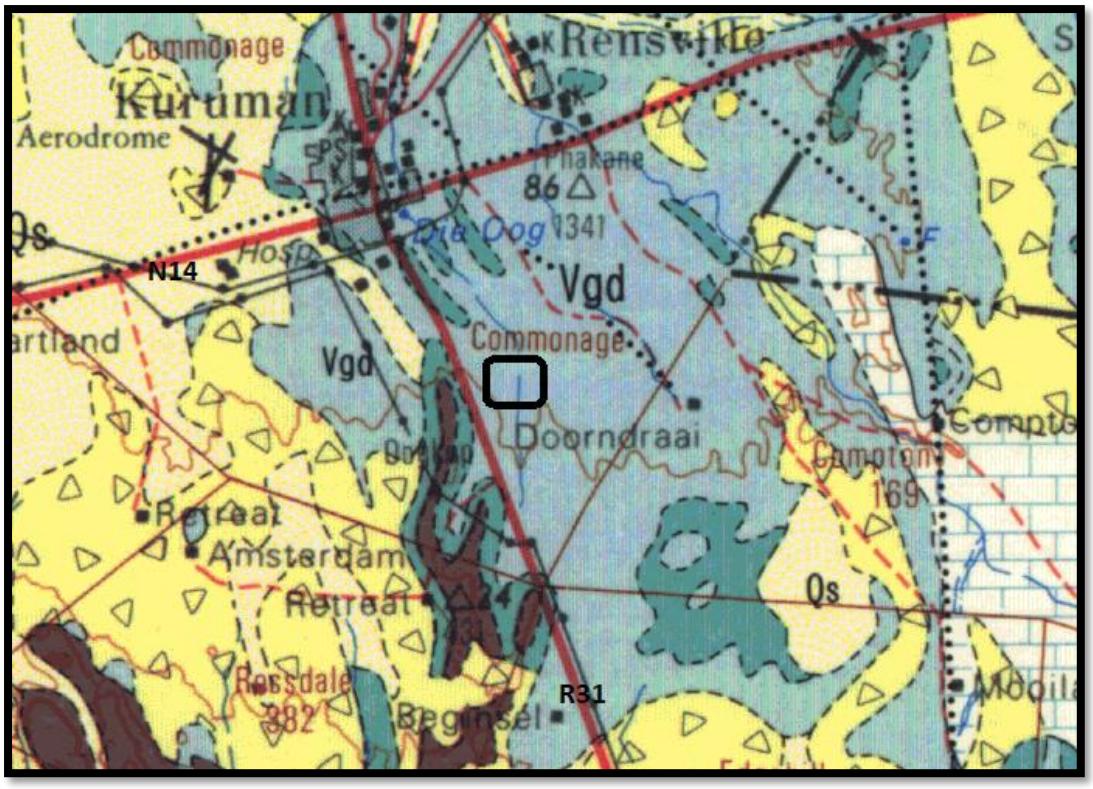

Figure 3: Geology of the area (Moen 1979) (**1h)**.
Vgd – Dolomite, limestone (blue). Kogelbeen Formation, Campbell Rand Subgroup, Transvaal Supergroup. Vaalian.
Legend to Figure and short explanation.
-- – (black) Fault.
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□ – Approximate position of expansion (in black on figure).

Mining Activities in study area on Figure above
AK – Crocidolite.
The mining past and present has no influence on this development.

The Kalahari deposits extend in age down to at least the Late and probably the Early Tertiary (65 million years ago). Fossils are scarce, and are of terrestrial plants and animals with close affinity to living forms. Included in the Kalahari Group are the Quaternary alluvium, terrace gravels, surface limestone, silcrete, and aeolian sand. Four major types of sands have been delineated (Kent 1980, Visser 1989). The alluvium sands were deposited by a river system and reworked by wind action (Snyman 1996). A thick cover of Kalahari reddish sand blankets most outcrops and is dominated by the typical Kalahari thornveld (Norman and Whitfield 2006). The Kalahari Group is underlain by the Uitenhage and Zululand Groups (McCarthy and Rubidge 2005).

The Gordonia Formation (Qg) is of Late Pliocene / Pleistocene to Recent in age (the well-known “Kalahari Sands”). It can be up to 30 m thick and form part of a vast dune sea or erg that stretches northwards to the equator and beyond (Almond and Pether 2009).

The Griqualand West Basin consists mainly of sediments of chemical origin together with lavas and subordinate clastic sediments. The basal unit, the Vryburg Formation lies unconformably on the granite and rocks of the Ventersdorp Supergroup. It is followed by the Campbell Group (Visser 1989). There are two formations in the Griquatown Group, namely, the Asbestos Hills and Koegas Formations. The Cox Group consists of the lower Ongeluk Formation and the upper Voëlwater Formation. It attains a maximum thickness of 4500 m (Kent 1980, Snyman 1996). Almond and Pether (2009) referred to this as the Griqualand Basin within the Transvaal Supergroup. The most recent classification was done in 2006 (Eriksson *et al.*) with the Ghaap Group (Schmidtsdrif Subgroup, Campbell Rand Subgroup, Koegas and Asbestos Hills Subgroups) at the bottom underlain by the Vryburg Formation; overlain by the Postmasburg Group (Makganyene, Ongeluk, Hotazel, Mooidraai Formations). The Asbestos Hills Subgroup has two Members, the Kuruman and Danielskuil. The Kogelbeen Formation, Campbell Rand Subgroup is at least 445 m thick with the Lyme Acers Member at the top containing economically important limestone deposits (Eriksson *et al.* 2006).

Groenewald and Groenewald (2014) placed the Ghaap Plateau as a Group in the Transvaal Supergroup with the Campbell Group as a Subgroup. The Ghaap Plateau was deposited as a thick layer of carbonaceous sediments in extensive shallow basins. It consists of carbonates, siliclastics and iron formations. The age is Late Archaean, Early Proterozoic. The Schmidtsdrif Formation forms the lower part of the Campbell Group and is divided into three members. The members are each approximately 10 m thick. Stromatolites are present in the upper member. Stromatolites occur in the dolomite of the Ghaap Plateau Formation. The Ghaap Plateau Formation is followed by the Asbestos Hills Formation (Sheet 2722 info). The Ghaap Plateau dolomites correlate with the Chuniespoort Group dolomites (McCarthy and Rubidge 2005).

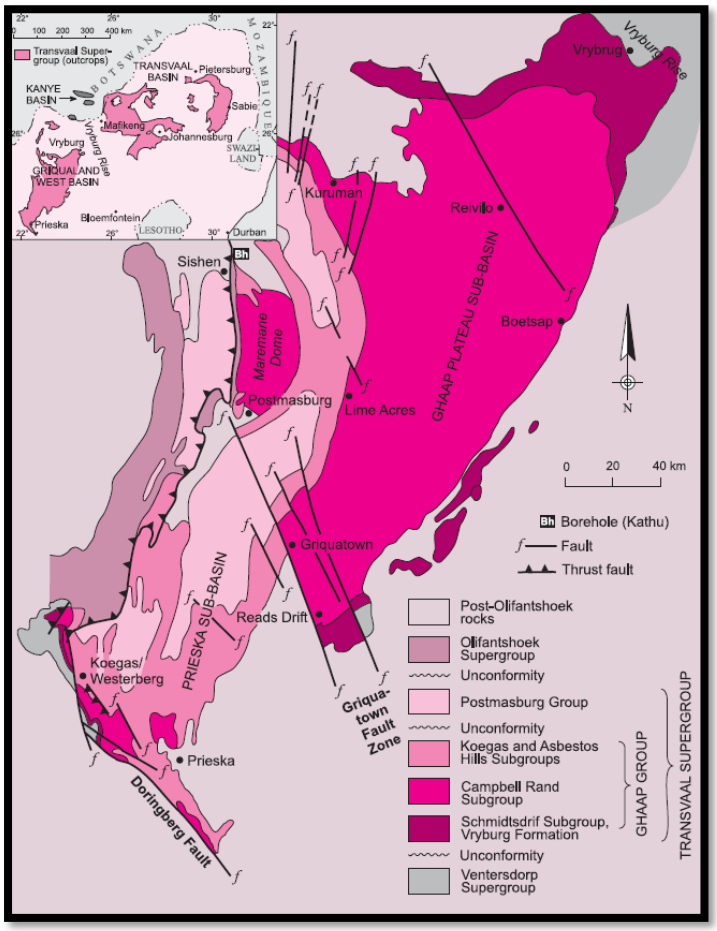

Figure 4: Geological map of the Ghaap Group (Eriksson *et al.* 2006).

Asbestos is present as blue asbestos in the Asbestos Hill Formation, together with the Gamagara Formation it is mined at Sishen (Snyman 1996). This formation forms the hills in the south and the Kuruman Hill in the north (Visser 1989). Limestone occurs as lenses in the upper portion of the Ghaap Plateau. Manganised silica breccia (the manganese marker) is at the top of the Ghaap Plateau Formation (Sheet 2722 info).

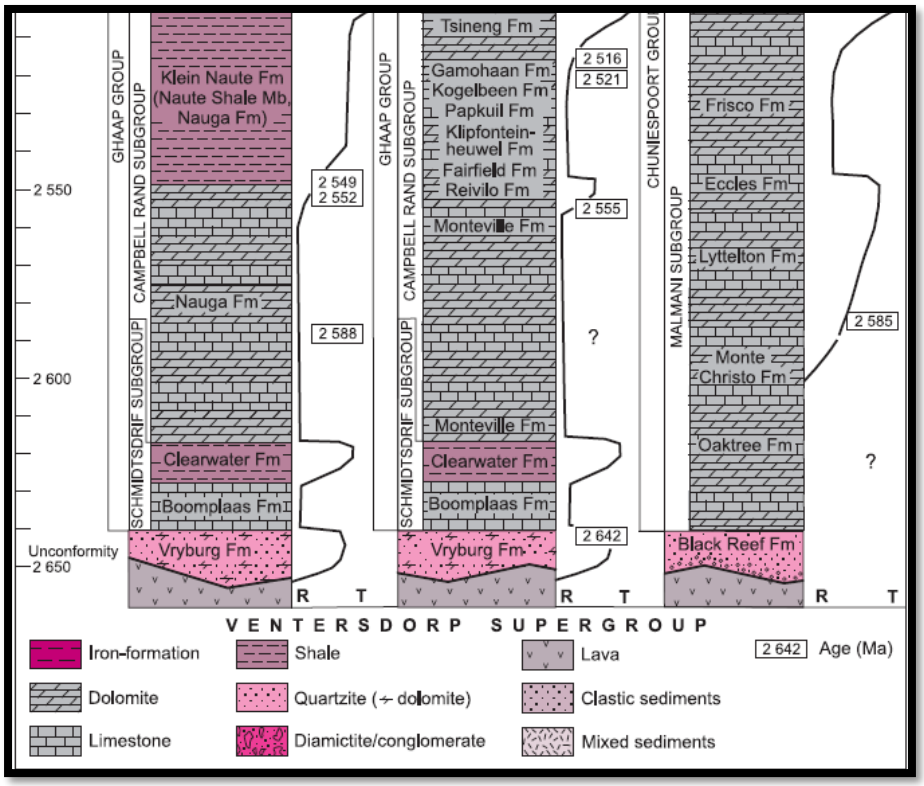

Figure 5: Lithology of the Campbell Rand Subgroup (Eriksson *et al.* 2006) (numbers indicate time).

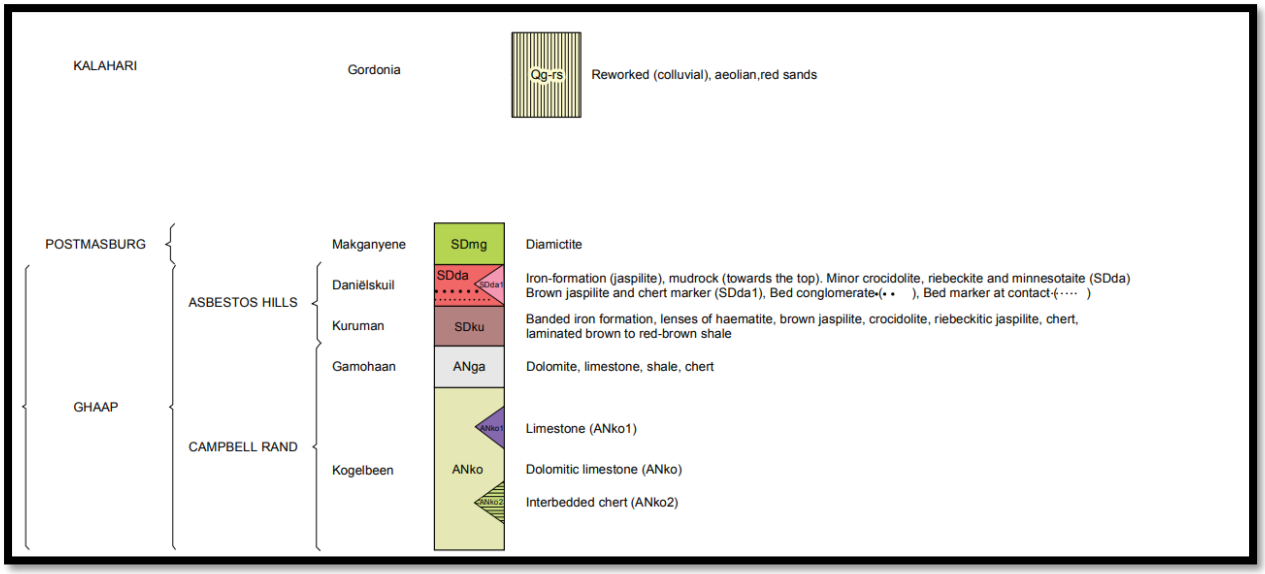

Figure 6: Lithology (Magagane 2007).

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).

'Algal microfossils' have been reported from shales and are probably of diagenetic origin (Eriksson 1999), these may be present here. Stromatolites are significant indicators of palaeoenvironments and provide evidence of algal growth between 2640 and 2432 million years ago. Significant fossil remains of Cenozoic and terrestrial organisms have been recorded from the sedimentary rocks of the Kalahari Group. These fossils are rarely found and are allocated a **HIGH** palaeontological sensitivity as they are important indicators of palaeo-environmental conditions (Groenewald and Groenewald 2014).

The Cenozoic Era, in which we are presently living, is popularly known as the 'Age of the Mammals'. Its fossils are preserved on the river gravel terraces (Cornelia), cave systems (Makapan), coastal plains (Langebaanweg), and basins. The Cenozoic Era of South Africa has been subdivided into six African Land Mammal Ages, namely, Recent, Florisian, Cornelian, Makapanian, Langebaanian, and Namibian (MacRae 1999).

Significant fossil finds in the Free State are recorded from Cenozoic aged superficial deposits at specific localities such as Florisbad, Cornelia and others. The fossils recorded include bones and teeth of mammals, reptiles, fish, freshwater molluscs, petrified wood, trace fossils, rhizoliths and diatom floras (Groenewald and Groenewald 2014).

A wide range of possible fossil remains occur in the Cenozoic, though these are often sparse, such as: mammalian bones and teeth, tortoise remains, ostrich eggshells, non-marine mollusc shells, ostracods, diatoms, and other micro fossil groups, trace fossils (e.g. calcretised termitaria, rhizoliths, burrows, vertebrate tracks), freshwater stromatolites, plant material such as peats, foliage, wood, pollens, within calc tufa. Stromatolite structures range from a centimetre to several tens of metres in size. They are the result of algal growth in shallow water, indicating a very rich growth that would have caused an enrichment in the amount of oxygen in the atmosphere. Deposits of cenozoic aged cave breccia associated with sinkholes and karst formations contain the remains of the ancestors of man (Groenewald and Groenewald 2014).

Taung is north of Kimberley closer to Vryburg and is known for the Taung child or *Australopithecus africanus.* Another well-known site is that of Florisbad near Bloemfontein which yielded archaic *Homo sapiens.* Early in the Palaeocene, mammals of all types became abundant and at the beginning of the Miocene the primates became abundant and approximately eight million years ago the first hominin lineage is seen (McCarthy and Rubidge 2005). Stromatolites are present in the Campbell Rand Subgroup of the Ghaap Group in the North West Province. They 2014).

Stromatolites are present in the Campbell Rand Subgroup of the Ghaap Group in the North West Province. They provide evidence of algal growth between 2 640 and 2 432 million years ago (Groenewald and Groenewald 2014). These are also present in the Kogelbeen Formation (Eriksson *et al.* 2006).

Figure 7: Stromatolite (Photography E. Butler).

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

GHAAP	Schmidtsdrift, Campbell Rand Asbestos Hills		Vad; Vak; Vgd; Vsm; Vsc; Vsb; Vgl; Vgf; Vgu; Vku; Vku2; Vku4; Vko1; Vko2; Vko3; Vko4; Vkl; Vkl1; Vpa; Vpa1; Vcl; Vcl1; Vcl2; Vcl3; Vbp; Vca		Carbonates with siliciclastics, iron formations Late Archaean / Early Proterozoic c. 2.56 Ga	Range of shallow marine and lacustrine stromatolites (some very large), oolites, pisolites in carbonates, filamentous and coccoid organic walled microfossils (eg cyanobacteria) in siliciclastics / carbonates as well as cherts of banded iron formations (BIF): Schmidtsdrift, Campbell Rand Asbestos Hills Subgroups	Formations with carbonate rocks (eg Vb, Vc, Vgd, Vu, Vf, Vh, Vsb, Vsm, Vgu, Vgf) are most palaeontologically sensitive. Classic Early Proterozoic stromatolitic successions and cyanobacterial microfossils (Ghaap Postmasburg Groups of Griqualand West Basin). Early continental shelf environments (margins of Kaapvaal Craton).
			Gamohaan (Vga; Vga1)			Stromatolites	
			Reivilo (Vrv; Vrv2; Vrv3)				
			Fairfield (Vfa; Vfa1; Vfa2)				
			Klipfonteinheuwel (Vkf; Vkf1)				
			Papkuil (Vpa; Vpa1				

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):

Rock Unit	Significance/vulnerability	Recommended Action
Gordonia Formation	**Moderate**	Desktop Study is required
Kogelbeen Formation	**High**	Desktop Study is required, field assessment likely

Databases and collections: Ditsong: National Museum of Natural History.
Impact: **HIGH** for the Ghaap Group. There may be significant fossil resources that may be impacted by the development and if destroyed are no longer available for scientific research or other public good.

The Project includes one locality Option (Figure 2) (**1f,j)** with a **HIGH** palaeontological sensitivity.
Option 1: An area indicated in red with the towns of Kuruman and Rensville to the north, the R31 Road to the west and the N14 National Road north. The approximate size of the site is 8293 m^2 (< 1 ha).

Figure 8: Two views of site (EARTHnSKY).

Figure 9: View at back of buildings (EARTHnSKY).

Figures above show existing buildings and expansion area. Foundations are not going to be excavated for this project as they are building on hard rock.

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 study was undertaken in November 2022. A Phase 1: Field Study will entail a walkthrough of the affected portion with photographs (in 20 mega pixels) taken of the site with a digital camera (Canon PowerShot SX620HS). A Global Positioning System (GPS (Garmin eTrex 10) can be used to record the outcrops. 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 (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 **1(i)**:-

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 – no site visit required.
7. Insufficient data from developer and exact lay-out plan for all structures - sufficient.

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. Field 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.
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 11: 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 111: 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 11 heritage resources.
Local authorities identify and manage Grade 111 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

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.

'Algal microfossils' have been reported from shales and are probably of diagenetic origin (Eriksson 1999), these may be present here. Stromatolites are significant indicators of palaeoenvironments and provide evidence of algal growth between 2640 and 2432 million years ago. Significant fossil remains of Cenozoic and terrestrial organisms have been recorded from the sedimentary rocks of the Kalahari Group. These fossils are rarely found and are allocated a **HIGH** palaeontological sensitivity as they are important indicators of palaeo-environmental conditions (Groenewald and Groenewald 2014). These are also present in the Kogelbeen Formation (Eriksson *et al.* 2006).

Figure 10: Thin section of a stromatolite (De Zanche and Mietto 1977)

Stromatolites are present in the Campbell Rand Subgroup of the Ghaap Group in the North West Province. They provide evidence of algal growth between 2 640 and 2 432 million years ago (Groenewald and Groenewald 2014). These are also present in the Kogelbeen Formation (Eriksson *et al.* 2006).

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, clearing, and human disturbance. See Description of the Geological Setting (F) above.

J. Recommendation (1o,p,q)

a. There is no objection (see Recommendation B) to the development, it may be necessary to request a Phase 1: Palaeontological Impact Assessment: Field Study if fossils are found during excavating, clearing, drilling, or digging. The palaeontological sensitivity is **HIGH** (stromatolites).
b. This project may benefit the economy, the growth of the community and social development in general.
c. Preferred choice: Only one locality Option is presented and possible.
d. Care must be taken during the grading of roads, digging and removing topsoil, subsoil and overburden (see Executive Summary) or blasting of bedrock (not done here). The following should be conserved: if any palaeontological material is exposed during 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.
e. No consultation with parties was necessary (**1o,p,q).**
f. This report must be submitted to SAHRA together with the HIA.

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 if fossils are found.

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 Palaeontological Impact Assessment Study was provided by the Consultant. All technical information was provided by EARTHnSKY Environmental.
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 clearing, 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, for example, 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.

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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.

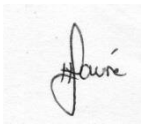
It may be possible that the Desktop Study may have missed palaeontological resources in the project area as the presence of outcrops are not known or visible due to vegetation while others may lie below the overburden of earth and may only be found once development commences.

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

<u>POPI Act 2013 Statement</u>

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.



Heidi Fourie
2022/12/03

Appendix 1: Examples of Quaternary age fossils (MacRae 1999).

Silhouette representation of the larger vertebrates whose remains are represented in Members 1-3 of the Swartkrans site on the outskirts of the town of Krugersdorp. Numbers after each taxon comprise minimum numbers of individuals represented in the remains of the lower bank (Member 1), hanging remnant (Member 1), Member 2 and Member 3 respectively.
Courtesy of Dr C.K. Brain.
Museum of Natural History, Pretoria

FAUNA FROM MEMBERS 1 - 3, SWARTKRANS (Makapanian Mammal Age)
Courtesy Dr B. Brain, - Museum of Natural History, Pretoria

1: *Homo erectus* (man) 1,3,2,0. **2**: *Australopithecus robustus* (robust apeman) 13,87,17,9. **3**: *Parapapio jonesi* 0,8,0,0. **4**: *Cercopithecoides* sp. 1,0,0,0. **5**: *Papio hamadryas robinsoni* 6,38,8,11. **6**: *Theropithecus oswaldi danieli* 1,17,1,14. **7**: *Dinopithecus ingens* 1,26,0,0. **8**: *Panthera pardus* (leopard) 4,12,2,5. **9**: *Dinofelis* sp. (false sabre-toothed cat) 0,1,0,0. **10**: *Megantereon* sp. (dirk-toothed cat) 0,1,0,1. **11**: *Acinonyx jubatus* (cheetah) 0,1,0,1. **12**: *Felis caracal* (caracal) 1,0,0,0. **13**: *Felis lybica* (African wild cat) 0,0,0,1. **14**: *Felis serval* (serval) 1,0,0,0. **15**: *Panthera leo* (lion) 1,1,0,0. **16**: *Hyaena brunnea* (brown hyaena) 1,4,2,3. **17**: *Chasmaporthetes nitidula* (hunting hyaena) 2,8,1,2. **18**:*Crocuta crocuta* (spotted hyaena) 0,2,1,1. **19**: *Proteles* sp. (large fossil aardwolf) 1,1,0,1. **20**: *Vulpes* sp. (fox) 0,2,0,3. **21**: *Canis mesomelas* (black-backed jackal) 3,4,4,5. **22**: Large canid gen. and sp. indet. 0,0,1,1. **23**: *Aonyx capensis* (Cape clawless otter) 2,0,1,2. **24**: *Atilax* sp. (water mongoose) 0,0,1,1. **25**: *Cynictis penicillata* (yellow mongoose) 0,0,1,1. **26**: *Herpestes ichneumon* (large grey mongoose) 1,0,0,0. **27**: *Suricata suricatta* (suricate) 0,0,2,1. **28**: *Genetta tigrina* (large-spotted genet) 0,0,0,1. **29**: *Manis* sp. (pangolin) 0,0,0,1. **30**: *Orycteropus afer* (antbear) 1,0,1,1. **31**: cf. *Elphas* sp. 2,0,0,1. **32**: *Procavia transvaalensis* (large fossil dassie) 3,8,3,5. **33**: *Procavia antiqua* (fossil dassie) 17,16,10,11. **34**: *Hipparion lybicum steytleri* (three-toed horse) 1,1,1,1. **35**: *Equus capensis* (giant Cape horse) 2,6,3,5. **36**: *Equus burchelli* (Burchell's zebra) 0,0,0,1. **37**: *Phacochoerus* sp. (warthog) 1,0,3,1. **38**: cf. *Tapinochoerus meadowsi* (large fossil pig) 1,7,1,1. **39**: *Hippopotamus* sp. (hippopotamus) 1,0,0,1. **40**: Giraffid 0,1,1,1. **41**: *Megalotragus* sp. (giant hartebeest) 0,3,1,3. **42**: *Connochaetes* sp. (wildebeest) 7,19,7,7. **43**: Medium alcelaphine: *Alcelaphus* sp. or *Beatragus* sp. (hartebeest) 3,22,3,6. **44**: *Rabaticerus porrocornutus* 0,2,0,0. **45**: *Damaliscus* sp. (blesbok) 2,4,6,6. **46**: *Antidorcas marsupialis australis* (springbok) 11,0,10,18. **47**: *Antidorcas recki* 0,6,2,1. **48**: cf. *Gazella* sp. (gazelle) 5,6,5,14. **49**: *Oreotragus oreotragus* (klipspringer) 1,0,0,1. **50**: *Oreotragus major* (fossil klipspringer) 0,1,0,0. **51**: *Raphicerus campestris* (steenbok) 1,0,1,3. **52**: *Makapania* sp. (musk ox) 0,3,0,0. **53**: *Syncerus* sp. (buffalo) 2,3,2,3. **54**: *Taurotragus oryx* (eland) 0,0,1,1. **55**: *Tragelaphus strepsiceros* (kudu) 0,4,0,1. **56**: *Hippotragus* cf. *niger* (sable) 0,0,1,3. **57**: *Pelea* sp. (rhebck) 0,2,0,2. **58**: *Redunca arundinum* (reedbuck) 0,1,0,0. **59**: Lagomorph gen. and sp. indet. (hare) 9,0,4,7. **60**: *Pedetes* sp. (springhare) 1,0,1,1. **61**: *Hystrix africaeaustralis* (porcupine) 2,2,1,2. **62**: *Chelonia* indet. (tortoise) 1,0,2,2.

Left: Teeth of the white rhino *Ceratotherium simum* from Makapansgat. **Right**: View from above shows the sharp cutting edges of the tooth row of this predominant grazer. Specimen 170 mm long.
In the collection of the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, Johannesburg.
Photograph C.S. MacRae

Appendix 2: **Table 3:** Listing points in Appendix 6 of the Act and position in Report (in bold).

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
F	1(ni)	Authorisation
F	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	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: Management Plan and Protocol for Chance Finds (**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) 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 will cover the conservation of heritage and palaeontological material that may be exposed during construction activities.

- When a fossil is found 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 have already been found they must be kept in a safe place for further inspection.
- The ECO should familiarise him- or herself with the formations and its fossils. A site visit after blasting, drilling, clearing or excavating is recommended and the keeping of a photographic record when feasible.
- Most museums and universities have good examples of fossils.
- The developer must survey the areas affected by the development and indicate on plan where the construction / development / mining will take place. Trenches 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, 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.

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 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 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 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 4: 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 (1). The expected duration of the impact is assessed as potentially permanent (3). The intensity/magnitude of the impact is moderate as it may continue in a modified way (1). The probability of the impact occurring will be unlikely (1).

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 an unlikely possibility. The significance of the impact occurring will be S = (1+3+1)1

S = 5 Low (1-9).

With Mitigation S = 5 Low (1-9).

Nature of the impact	This will include a qualitative description of what caused the impact and how it will affect the environment.
Extent of the impact	The size (physical/geographical) that will be affected by the impact: • Onsite impact: Weighting value **1**: The impact is confined to the project site/property • Local impact: Weighting value **2**: The impact is confined to the project site/property and a 10km radius around the project site/property • Regional impact: Weighting value **3**: The impact extends further than a 10km radius around the project site/property
Duration of the impact	The length of time over which the impact will persist: • Short term impact: Weighting value **1**: The impact will persist for up to one year • Medium term impact: Weighting value **2**: The impact will persist for longer than one year, but shorter than five years • Long term impact: Weighting value **3**: The impact will persist for longer than five years
Magnitude of the impact	The intensity of the impact on the environment: • Low impact: Weighting value **1**: Natural processes continue, albeit in an altered manner • Medium impact: Weighting value **2**: Natural processes cease temporarily • High impact: Weighting value **3**: Natural processes cease indefinitely
Probability of the impact occurring	How likely it is that the impact will happen: • Improbable: Weighting value **1**: It is unlikely that the impact will occur • Probable: Weighting value **2**: There is a chance that the impact will occur • Definite: Weighting value **3**: The impact will most certainly occur
Status of the impact	A qualitative description of the impact: • Whether the impact is **positive** or **negative** in nature • The degree to which the impact can be reversed • The degree to which the impact can be mitigated • The degree to which the impact may cause irreplaceable loss of resources

Significance of the impact	This will be calculated using the formula below: **Significance** = (Extent + Duration + Magnitude) x Probability The significance of each impact will be divided into the following ratings, according to the results of the Significance calculation given above: • Low Impact: Significance value: 1-9 • Medium Impact: Significance value: 10-18 • High Impact: Significance value: 19-27