



**THE PROSPECTING RIGHT APPLICATION COMBINED  
WITH A WASTE LICENCE APPLICATION OF AAA  
MINING CC FOR THE PROSPECTING OF DIAMONDS  
ALLUVIAL, DIAMONDS IN KIMBERLITE,  
DIAMONDS GENERAL & DIAMONDS ON THE  
REMAINING EXTENT OF THE FARM KAMEELDRIFT  
285, REGISTRATION DIVISION: HOPETOWN,  
NORTHERN CAPE PROVINCE.  
(NC30/5/1/1/2/12632PR)**

**CaseID: 16014**

**Compiled for:**

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Prepared by

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March 2021

## **Declaration of Independence**

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favorable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realize that a false declaration is an offense in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

## **Disclosure of Vested Interest**

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations.

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**SIGNATURE:**

A handwritten signature in black ink that reads "Elize Butler." The signature is written in a cursive style with a large initial "E" and a period at the end.

This Palaeontological Impact Assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

*Table 1: - NEMA Table*

<b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>	<b>Relevant section in report</b>	<b>Comment where not applicable.</b>
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to <b>Appendix A</b>	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 9	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Desktop Assessment	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1 and 10	
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 10	
(k) Any mitigation measures for inclusion in the EMPr	Section 1 and 10	
(l) Any conditions for inclusion in the environmental authorisation	N/A	None required
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1 and 11	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 11	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 10	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process will be conducted as part of the EIA and EMPr process.
(p) A summary and copies if any comments that were received during any consultation process	N/A	

<b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>	<b>Relevant section in report</b>	<b>Comment where not applicable.</b>
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	

## EXECUTIVE SUMMARY

Banzai Environmental was appointed by Milnex CC to conduct the Palaeontological Desktop Assessment assessing the proposed Prospecting Right Application and Waste License Application of AAA Mining CC for the Prospecting of Diamonds Alluvial, Diamonds in Kimberlite, Diamonds General & Diamonds on the Remaining Extent of the Farm Kameeldrift 285, Registration Division: Hopetown, Northern Cape Province. In agreement with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), a Palaeontological Assessment (PA) is necessary to determine if fossil material is present within the planned development. This study is therefore necessary to evaluate the effect of prospecting on the palaeontological finds.

The proposed development footprint is largely mantled by superficial sediments of Late Caenozoic age. The Late Tertiary to Quaternary calcretes covers the largest area of the development while unconsolidated aeolian (*i.e.* wind-blown) sands of the Kalahari Group (Gordonia Formation) is present in the far south. In the east Dwyka sediments are present and is locally overlain, in the Douglas area, by fossiliferous mudrocks of the Prince Albert Formation (Ecca Group) as well as inliers of the Allanridge Formation (Ventersdorp Supergroup).

The fossil assemblages of the Quaternary are generally Low in diversity, occur over a wide range and mostly has a Low Paleontologically Sensitivity but locally High. The Permo-Carboniferous Dwyka sediments and Kalahari Group (Gordonia) Formation has a Moderate Palaeontological Sensitivity. The Prince Albert Formation (Ecca Group) is fossiliferous and has a High palaeontological sensitivity but is not represented on the SAHRIS map as the scale of the map is most probably too high. Sediments of the Allanridge Formation within the Ventersdorp Supergroup is unfossiliferous and thus has a zero Palaeontological Sensitivity.

A low Palaeontological significance has been allocated to the proposed development. From a Palaeontological point of view the prospecting development may be authorised, but if fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that mitigation can be carry out by a paleontologist.

Preceding any collection of fossil material, the palaeontologist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies required by SAHRA.

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## 1 INTRODUCTION

Milnex CC Environmental Consultants was appointed by AAA Mining CC as the independent environmental consultant to commence with the Scoping and EIA process for a Diamonds Alluvial (DA), Diamonds in Kimberlite (DK), Diamonds General (D) & Diamonds (DIA) Prospecting Right Application, combined with a Waste license Application, with associated infrastructure, structures and earthworks on the remaining extent of the farm Kameeldrift 285, Registration Division: Hopetown; Northern Cape Province.

The Northern Cape is the largest province in South Africa, with a surface area of 360 000 km<sup>2</sup>. Diamond mining in the province forms a significant portion of the economy. Almond and Pether (2009) noted that mining impends on palaeontological heritage in the province (along ancient river systems; and on and off- shore along the coast).

## 2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-five years. She has experience in locating, collecting, and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

## 3 LEGISLATION

### 3.1 National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include **“all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens”**.

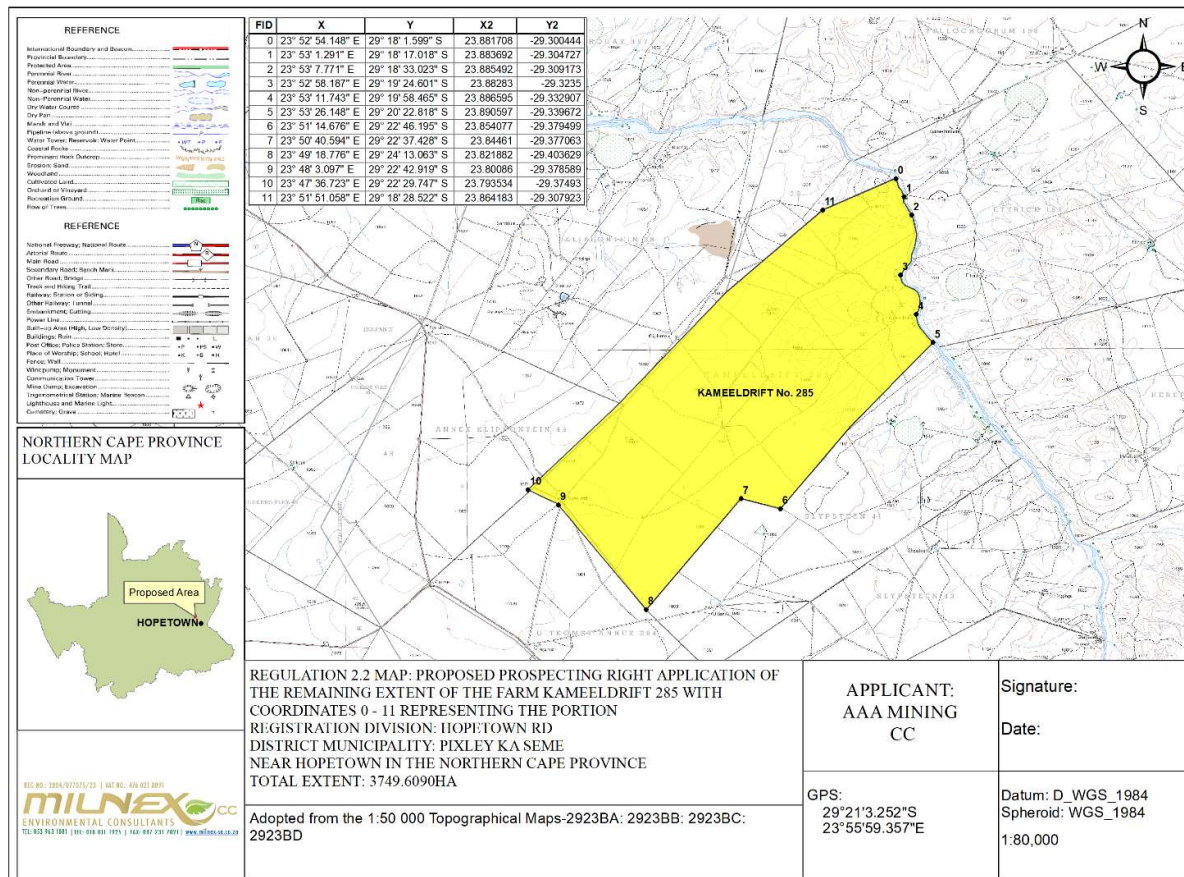
Palaeontological heritage is unique and non-renewable and is protected by the NHRA. Palaeontological resources may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Impact Assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
- the construction of a bridge or similar structure exceeding 50m in length;
- any development or other activity which will change the character of a site—
  - a. (exceeding 5 000 m<sup>2</sup> in extent; or
  - b. involving three or more existing erven or subdivisions thereof; or
  - c. involving three or more erven or divisions thereof which have been consolidated within the past five years; or
  - d. the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
  - e. the re-zoning of a site exceeding 10 000m<sup>2</sup> in extent;
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.



**Figure 1:** Google Earth Image (2020) indicating the locality (in yellow) of the proposed Prospecting Right Application and Waste License Application of AAA Mining CC for the Prospecting of Diamonds Alluvial, Diamonds in Kimberlite, Diamonds General & Diamonds on the Remaining Extent of the Farm Kameeldrift 285, Registration Division: Hopetown, Northern Cape Province.



**Figure 2:** Locality of the proposed Prospecting Right Application and Waste License Application of AAA Mining CC for the Prospecting of Diamonds Alluvial, Diamonds in Kimberlite, Diamonds General & Diamonds on the Remaining Extent of the Farm Kameeldrift 285, Registration Division: Hopetown, Northern Cape Province

## 4 OBJECTIVE

The objective of a Palaeontological Impact Assessment (PIA) is to determine the impact of the development on potential palaeontological material at the site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the aims of the PIA are: 1) to **identify** the palaeontological status of the exposed as well as rock formations just below the surface in the development footprint 2) to estimate the **palaeontological importance** of the formations 3) to determine the **impact** on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

The terms of reference of a PIA are as follows:

### General Requirements:

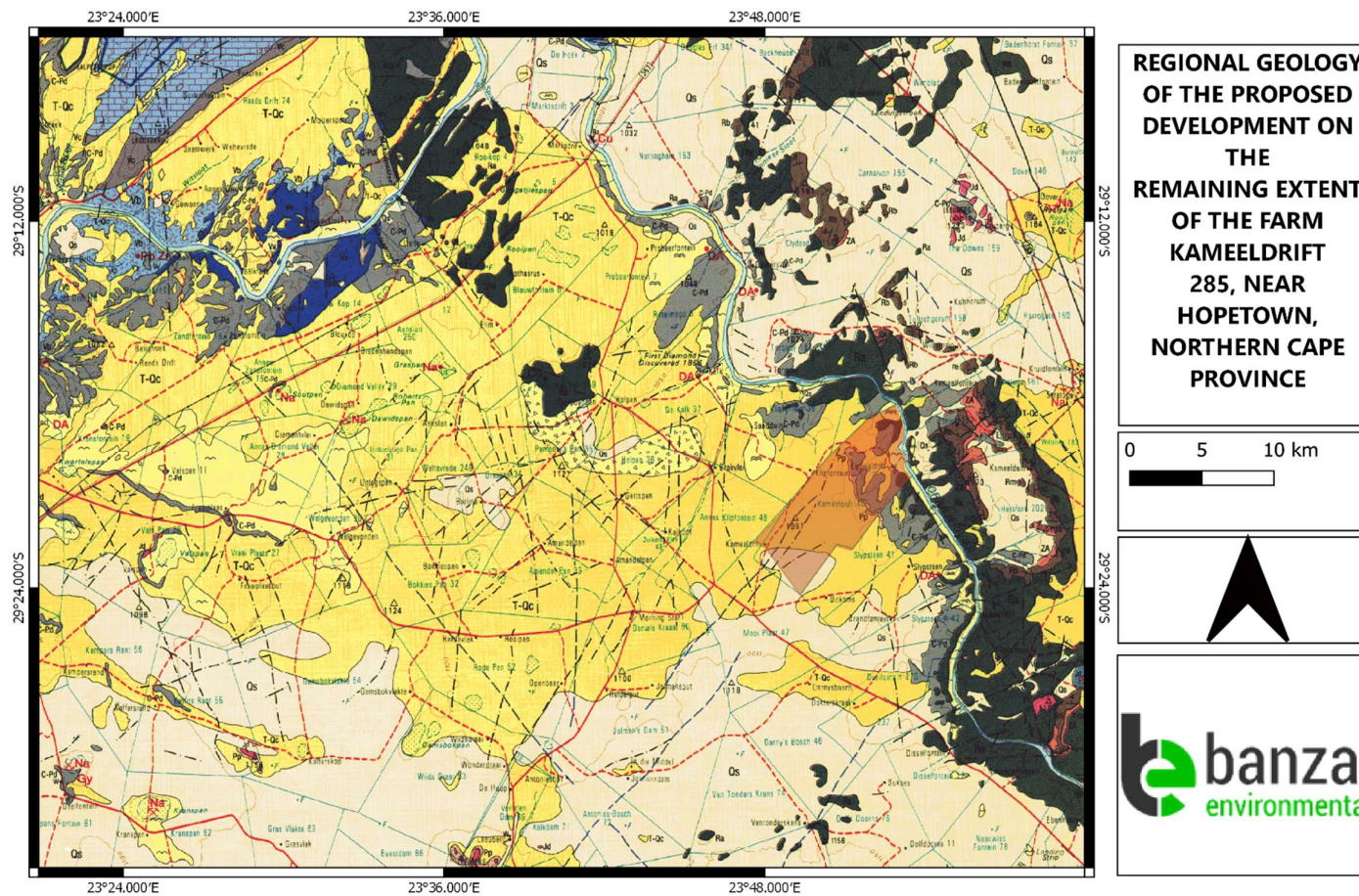
- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;
- Submit a comprehensive overview of all appropriate legislation, guidelines;
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study;
- Description and location of the proposed development and provide geological and topographical maps;
- Provide Palaeontological and geological history of the affected area;
- Identification sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
  - a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
  - b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
  - c. **Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided);
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

## 5 GEOLOGICAL AND PALAEOONTOLOGICAL HISTORY

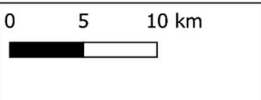
The proposed Prospecting Right Application and Waste License Application of AAA Mining CC for the Prospecting of Diamonds Alluvial, Diamonds in Kimberlite, Diamonds General & Diamonds on the Remaining Extent of the Farm Kameeldrift 285 in the Northern Cape Province is depicted on the 1:250 000 2922 Prieska Geological Map (Council of Geoscience) (Figure 3). The 2922 Prieska Geological Map indicates that the development footprint is largely mantled by superficial sediments of Late Caenozoic age. The Late Tertiary to Quaternary calcretes (dark yellow; T-Qc; *i.e.* carbonate-cemented surface deposits) covers the largest area of the development while unconsolidated aeolian (*i.e.* wind-blown) sands (Qs) of the Kalahari Group (Gordonia Formation) is present in the far south. In the east Dwyka sediments are present and is locally overlain, in the Douglas, area by fossiliferous mudrocks of the Prince Albert Formation (Ecca Group) as well as inliers of the Allanridge Formation (Ventersdorp Supergroup) (Figure 3).

The fossil assemblages of the Quaternary are generally Low in diversity, occur over a wide range and mostly has a Low Paleontologically Sensitivity but locally High. The Permo-Carboniferous Dwyka sediments and Kalahari Group (Gordonia) Formation has a Moderate Palaeontological Sensitivity. The Prince Albert Formation (Ecca Group) is fossiliferous and has a High palaeontological sensitivity but is not represented on the SAHRIS map (Figure 4) as the scale of the map is most probably too high. Sediments of the Allanridge Formation within the Ventersdorp Supergroup is unfossiliferous and thus has a zero Palaeontological Sensitivity.

Superficial deposits in the Douglas area consists of alluvial gravels, aeolian sands, calcretes of the Quaternary and overlies the older sediments. Quaternary deposits are the most widespread body of terrestrial sediments in southern Africa. The sands and calcretes range in thickness from a few metres to more than 180m (Partridge *et al.*, 2006). The pan sediments of the area contain white to brown fine-grained silts, sands and clays. Some of the pans consist of clayey material mixed with evaporates that shows seasonal effects of shallow saline groundwaters. Quaternary alluvial gravels also known as high level gravels is mapped along both the Vaal and Orange River and is associated with diamond mining (De Wit *et al.*, 2000). Windsorton is located northeast of Douglas and is known to have heavily calcretized "Older Gravels". These gravels have been allocated to the Windsorton Formation and are supposed to be Miocene-Pliocene in age (Partridge & Brink 1967, De Wit *et al.*, 2000, Partridge *et al.* 2006). The "Younger gravels" of the Vaal River System comprise of the Rietputs Formation.



**REGIONAL GEOLOGY  
OF THE PROPOSED  
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**Figure 3:** Extract of the 1:250 000 2922 Prieska Geological map (Council of Geoscience) indicating the proposed development in orange. Surface geology indicates that the development footprint is underlain by the Late Tertiary to Quaternary calcrete (T-Qc), isolated inliers of the Allanridge Formation (Ra) as well as sediments of the Dwyka Group (C-Pd); Prince Albert (Pp; Ecca Group) and the Kalahari Group (Gordonia Formation, Qs).





The Quaternary Gordonia Formation (Kalahari Group) are dated as Late Pliocene/Early Pleistocene to Recent times by the Middle to Later Stone Age stone tools recovered from them (Dingle et al (1983). The fossil assemblages of the Quaternary are generally Low in diversity and occur over a wide range and mostly has a Low Paleontologically Sensitivity but locally High. These fossils represent terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods and trace fossils. The palaeontology of the Quaternary superficial deposits has been relatively neglected in the past. Late Cenozoic calcrete may comprise of bones, horn cores as well as mammalian teeth. Tortoise remains have also been uncovered as well as trace fossils which includes termite and insect's burrows and mammalian trackways. Amphibian and crocodile skeletons have been uncovered where the depositional settings in the past were wetter.

The Dwyka Group is Late Carboniferous to Early Permian in age (300-290 Million years ago (Ma) and overlies glaciated Precambrian bedrock faces along the northern margin of the basin. In the south the Dwyka overlies the Cape Supergroup unconformably/paraconformably and in the east it unconformably overlies the Natal Group and Msikaba Formation. Underlying rocks, especially in the north, is well-developed striated glacial pavements that formed in places. Visser (1986) identified several types of lithofacies which he perceived to be deposited in a marine basin.

The Dwyka Group is divided into northern and southern facies (Visser, 1981) due to the distinctive lithological variations over the basin. Visser *et al.* (1990) and Von Brunn and Visser (1999) found that the Dwyka rocks in the Douglas-Prieska area (close to the northern edge of the Main Karoo Basin) belong to the Mbizane Formation which can be up to 190 m thick. The Mbizane Formation of the Dwyka Group consists mainly of the northern inlet facies which is characterised by thickness changes, extremely varying lithology and low massive diamictite (~20 %) and high mudrock (~40%) content. The Elandsvlei Formation is the southern platform and are depicted by a high massive diamictite (~70%) and low mudrock (~8%) content, while there is a gradual southernly increase in thickness (100 m to 800 m). Debris eroded, from the highlands and was deposited by a ground ice sheet but in the west fluctuations in the ice front caused bedded diamictons and subaqueous and subglacial outwash sediments (Visser *et al* 1987). The key Reference Stratotype C section for the Mbizane Formation is situated a few km west of Douglas on the northern side of the Vaal River (Von Brunn & Visser, 1999)

The Permo-Carboniferous Dwyka sediments are of moderate palaeontological sensitivity and known for its track ways (Ichnofacies) formed by fish and arthropods. Fossilized faeces or coprolites have also been recovered. Body fossils consists of gastropods, invertebrates, and marine fish, as well as fossil plants. A rich diversity of conifers, cordaitaleans, glossopterids, ginkgoaleans, pollens and spores have been described from this Group while ferns, horsetails and lycopods, are also found.

The Prince Albert Formation (Ecca Group) consists of marine to hyposaline basin plain mudrocks that occur with minor volcanic ashes, iron stones and phosphates. Post-glacial mudrocks is present at the base of the Prince Albert Formation. The fossil assemblage of the Prince Albert Formation is known for its plant fossils known as the *Glossopteris* flora and includes palynomorphs (spores and acritarchs), petrified wood, and roots. Moderately diverse trace fossil assemblages can be present and include fish or non-marine arthropod groups like crustaceans, king crabs and predatory water scorpions which could have reached lengths of two meters or more. This trace fossil assemblage of the non-marine *Mermia* Ichnofacies, is dominated by the ichnogenera *Umfolozia* (arthropod trackways) and *Undichna* (fish swimming trails). Fish coprolites have also been described from this formation. A low diversity marine invertebrate (bivalves, brachiopods and nautiloids), as well as palaeoniscoid fish, sharks and protozoans have been uncovered. There is also a possibility that stromatolites and oolites are preserved. Well-preserved skeletons of the well-known aquatic mesosaurids have been uncovered while amphibians are also recorded from the uppermost Ecca beds.

Microbial stromatolites in the upper Vryburg Formation were described by Smith (1991). The stromatolitic carbonates are interpreted to be intertidal (Altermann and Wotherspoon, 1995). South African Archaean stromatolites have been discussed in detail (Altermann, 2001; Buick, 2001; and Schopf, 2006). Columnar stromatolites from the Schmidtsdrif Subgroup of the Northern Cape have been described by Bertrand-Sarfati and Eriksson (1977).

An area north-east of the development is underlain by the Allanridge Formation (Ventersdorp Supergroup) (Figure 3). The best exposures of the Ventersdorp Supergroup are in the Northern Cape and North West Province as well as Gauteng and southern Botswana. This Supergroup consists of (from oldest to youngest) the Kliprivierberg Group, which is overlain by the Platberg Group, followed by the sedimentary Bothaville Formation and the volcanic Allanridge Formation (uppermost Ventersdorp unit and youngest Formation).

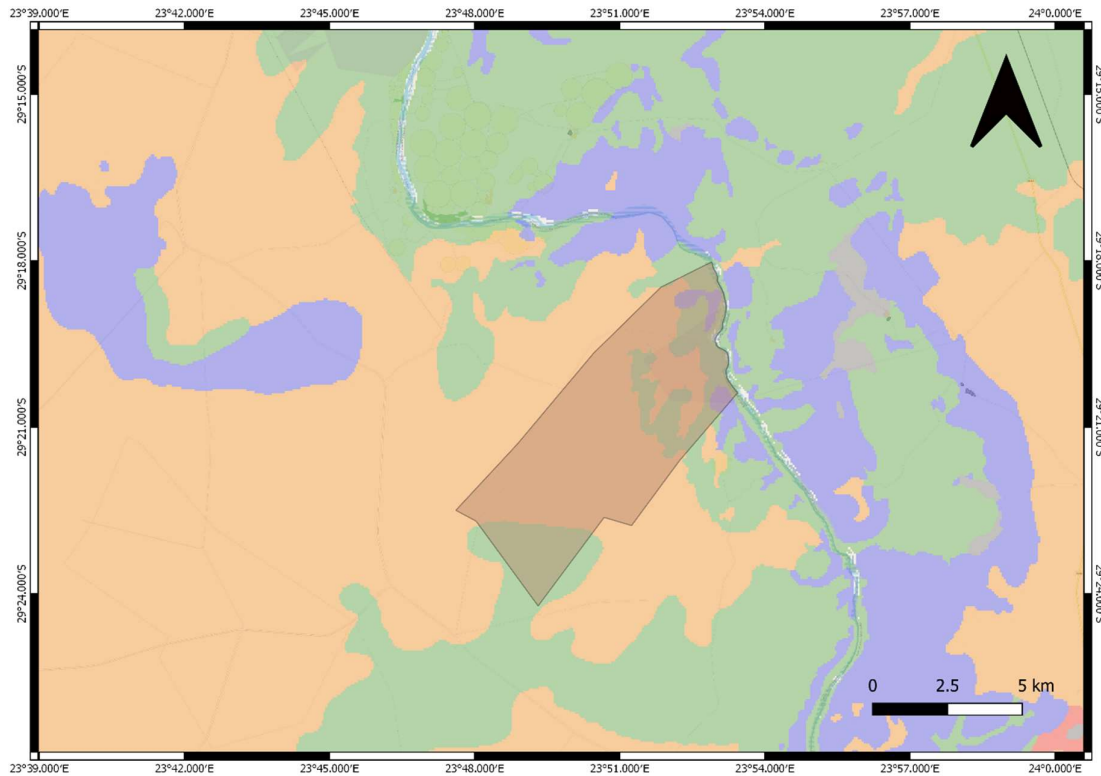
The Platberg Group is subdivided in four formations namely the Kameeldoorns-, Goedgenoeg-, Makwassie-, and Rietgat Formations. These formations consist of heterogenous rock varying from chemical and classic sediments, to felsic and mafic volcanics (Visser et al, 1975-1976, Buck, 1980).

The Allanridge Formation comprise mostly of light-greenish grey porphyritic lava, dark-green amygdaloidal lava, and pyroclastic rocks (Keyser, 1992). The lavas are approximately 2700 million years old and comprise of basaltic andesites. The Vryburg Formation overlies the Ventersdorp Supergroup and is interpreted as a fluvial to marginal marine deposit that comprise of basal transgressive conglomerate and quartzites, subordinate stromatolitic carbonates and shales (Eriksson et al., 2006).

Table 2: Fossil heritage of rocks represented in the proposed Diamond drilling Project (taken from Almond and Pether, 2008)

Geological Unit	Rock Types & Age	Fossil Heritage	Palaeontological Sensitivity
Other Caenozoic Fluvial, Lacustrine & Terrestrial Deposits of Interior (Most too small to be indicated on 1: 250 000 geological maps) <i>eg</i> Kwaggaskop, Dasdap, Vaalputs, Arries Drift, Windsorton, Rietputs, Riverton Fms	Fluvial, pan, lake and terrestrial sediments, including diatomite (diatom deposits), pedocretes, spring tufa / travertine, cave deposits, peats, colluvium Late Cretaceous /Palaeocene to Holocene	Bones and teeth of wide range of mammals, including mammals ( <i>eg</i> teeth & bones of mastodont proboscideans, rhinos, bovids, horses, micromammals), reptiles (crocodiles, tortoises), ostrich egg shells, fish, freshwater and terrestrial molluscs (unionid bivalves, gastropods), crabs, trace fossils ( <i>eg</i> termitaria, horizontal invertebrate burrows, stone artefacts), petrified wood, leaves, rhizoliths, diatom floras, peats and palynomorphs. Calcareous tufas at edge of Ghaap Escarpment might be highly fossiliferous ( <i>cf</i> Taung in NW Province – abundant Makapanian Mammal Age vertebrate remains, including	High
14. KALAHARI GROUP	Fluvial gravels, sands, lacustrine and pan mudrocks, evaporites, aeolian sands, pedocretes (especially calcrete) Late Cretaceous to Recent <90 Ma → 0 Ma	Palynomorphs, root casts (rhizomorphs) and burrows ( <i>eg</i> termitaria), rare vertebrate remains (mammals, fish, ostrich egg shell <i>etc</i> ), diatom-rich limestones, freshwater stromatolites, freshwater and terrestrial shells	Moderate

			(gastropods, bivalves), ostracods, charophytes	
12. DWYKA GROUP (C-Pd) Late Carboniferous – Early Permian c. 320-290 Ma	12c. Mbizane Fm Early Permian	Varied glacially-related sediments, including valley glacier deposits (tillites, conglomerates, sandstones mudrocks)	Low diversity non-marine trace fossil assemblages (predominantly fish, arthropod traces, <i>Rhizocorallium</i> ) scattered vascular plant remains (eg <i>Glossopteris</i> leaves, petrified wood)	Moderate
	12b. Elandsvlei Fm Late Carboniferous – Early Permian	Predominantly massive tillites, with interglacial mudrocks at intervals	Interglacial mudrocks occasionally with low diversity marine fauna of invertebrates (molluscs, starfish, brachiopods, coprolites etc), palaeoniscoid fish, petrified wood, leaves (rare) and palynomorphs of <i>Glossopteris</i> Flora. Well-preserved nonmarine ichnofauna (traces of fish, arthropods) in laminated mudrocks. Possible stromatolites, oolites	Moderate
9-11. KAROO SUPERGROUP	10. ECCA GROUP (Ppr, Ppw, Pw, Pt, Ps, Pk, Pwa)	Offshore basin plain (predominantly non-marine) to coastal deltaic sediments, minor volcanic ashes (tuffs) Early – Mid Permian 290 – 266 Ma	9b. Ecca Group: non-marine trace fossils, vascular plants (including petrified wood) and palynomorphs of <i>Glossopteris</i> flora,	Diverse non-marine trace fossil assemblages from Gondwana



**Figure 4:** Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences).  
Approximate location of the proposed development is indicated in brown.

Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required

WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.
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According to the SAHRIS Palaeosensitivity map (Figure 4) there is a high chance (orange), and a moderate chance (green) and a low chance (blue) of finding fossils in this area. The orange area (T-Qc) triggers a desktop study in order to determine whether a field assessment is required.

## 6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development is located on the Remaining Extent of the Farm Kameeldrift 285, Registration Division: Hopetown, Northern Cape Province. The property is situated about 30km from Douglas, towards Hopetown in the Northern Cape Province. The Orange River is flowing north and east of the area. The proposed development is 3749.6090 ha in extent.

*Table 3: Farms Co-ordinates*

Farms		Longitude	Latitude
Remaining Extent of the farm Kameeldrift 285	0	23° 52' 54.148" E	29° 18' 1.599" S
	1	23° 53' 1.291" E	29° 18' 17.018" S
	2	23° 53' 7.771" E	29° 18' 33.023" S
	3	23° 52' 58.187" E	29° 19' 24.601" S
	4	23° 53' 11.743" E	29° 19' 58.465" S
	5	23° 53' 26.148" E	29° 20' 22.818" S
	6	23° 51' 14.676" E	29° 22' 46.195" S
	7	23° 50' 40.594" E	29° 22' 37.428" S
	8	23° 49' 18.776" E	29° 24' 13.063" S
	9	23° 48' 3.097" E	29° 22' 42.919" S
	10	23° 47' 36.723" E	29° 22' 29.747" S
11	23° 51' 51.058" E	29° 18' 28.522" S	

## 7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This include all trace fossils and fossils. All available information is consulted to compile a desktop study and includes: Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

## 7.1 Assumptions and Limitations

The focal point of geological maps is the geology of the area and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have never been reviewed by palaeontologists and data is generally based on aerial photographs alone. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is sourced to provide information on the existence of fossils in an area which was not documented in the past. When using similar Assemblage Zones and geological formations for Desktop studies it is generally **assumed** that exposed fossil heritage is present within the footprint. **A field-assessment will thus improve the accuracy of the desktop assessment.**

## 8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984);
- 1: 250 000 2922 Prieska Geological map (Council of Geoscience);
- A Google Earth map with polygons of the proposed development was obtained from Milnex CC.;
- 1:50 000 Topographical Maps 2923 BA, 2923 BB; 2923BC, 2923BD
- Palaeontological Impact Assessments in the Douglas area include Almond 2010a, 2010b, 2010c, 2010d (see references)

*Table 4: Solar developments present within a radius of 30km from the proposed development.*

No	EIA Ref number	Classification	Status	Distance from study area (km)
	12/12/20/2682	Solar PV	Approved	11.8
	2/12/20/2512	Solar PV	Approved	24.4
	14/12/16/3/3/2/283	Solar PV	Approved	25.3
	14/12/16/3/3/1/825	Solar PV	Approved	29



## 9 IMPACT ASSESSMENT METHODOLOGY

### 9.1 Impact Rating System

Impact assessment must take account of the nature, scale and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the following project phases:

- Construction
- Operation
- Decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact the following criteria is used:

*Table 5: The rating system*

<b>NATURE</b>		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
<b>GEOGRAPHICAL EXTENT</b>		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
<b>PROBABILITY</b>		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).

<b>DURATION</b>		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
<b>INTENSITY/ MAGNITUDE</b>		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

<b>REVERSIBILITY</b>		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
<b>IRREPLACEABLE LOSS OF RESOURCES</b>		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
<b>CUMULATIVE EFFECT</b>		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects

<b>SIGNIFICANCE</b>
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: <b>(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.</b>

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive

### 9.1.1 Summary of Impacts

Only the site will be affected (1). It is probable that the impact will occur (3). The expected duration of the impact is assessed as potentially permanent to long term (4). The impact on fossil heritage will be irreversible and a complete loss of fossil heritage will take place (4). The cumulative effect of the impact will be Low (1). The magnitude of the impact happening will be low (1)

Significance = (Extent (1) + probability (3) + reversibility (4) + irreplaceability (4) + duration (4) + cumulative effect) (2) x magnitude/intensity (1) =18.

The Impact significance will therefore be a negative low Impact.

## 10 FINDINGS AND RECOMMENDATIONS

The proposed development footprint is largely mantled by superficial sediments of Late Caenozoic age. The Late Tertiary to Quaternary calcretes covers the largest area of the development while unconsolidated aeolian (*i.e.* wind-blown) sands of the Kalahari Group (Gordonia Formation) is present in the far south. In the east Dwyka sediments are present and is locally overlain in the Douglas area by fossiliferous mudrocks of the Prince Albert Formation (Ecca Group) as well as inliers of the Allanridge Formation (Ventersdorp Supergroup).

The fossil assemblages of the Quaternary are generally Low in diversity, occur over a wide range and mostly has a Low Paleontological Sensitivity but locally High. The Permo-Carboniferous Dwyka sediments and Kalahari Group (Gordonia) Formation has a Moderate Palaeontological Sensitivity. The Prince Albert Formation (Ecca Group) is fossiliferous and has a High palaeontological sensitivity but is not represented on the SAHRIS map (Figure 4) as the scale of the map is most probably too high. Sediments of the Allanridge Formation within the Ventersdorp Supergroup is unfossiliferous and thus has a zero Palaeontological Sensitivity.

A low Palaeontological significance has been allocated to the proposed development. From a Palaeontological point of view the prospecting development may be authorised, but if fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that mitigation can be carry out by a paleontologist.

Preceding any collection of fossil material, the palaeontologist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies required by SAHRA.

## 11 CHANCE FINDS PROTOCOL

A following procedure will only be followed if fossils are uncovered during excavation.

### 11.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 25 of 1999) (NHRA)**. According to Section 3 of the Act, all Heritage resources include “**all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**”.

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

### 11.2 Background

A fossil is the naturally preserved remains (or traces) of plants or animals embedded in rock. These plants and animals lived in the geologic past millions of years ago. Fossils are extremely rare and irreplaceable. By studying fossils, it is possible to determine the environmental conditions that existed in a specific geographical area millions of years ago.

### 11.3 Introduction

This informational document is intended for workmen and foremen on construction sites. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

It is the responsibility of the Environmental Site Officer (ESO) or site manager of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the absence of the ESO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

### 11.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town.

PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.

- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO (site manager). Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

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## Appendix A – Elize Butler CV

### CURRICULUM VITAE

#### ELIZE BUTLER

**PROFESSION:** Palaeontologist

**YEARS' EXPERIENCE:** 26 years in Palaeontology

**EDUCATION:** B.Sc Botany and Zoology, 1988  
University of the Orange Free State

B.Sc (Hons) Zoology, 1991  
University of the Orange Free State

Management Course, 1991  
University of the Orange Free State

M. Sc. *Cum laude* (Zoology), 2009  
University of the Free State

**Dissertation title:** The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

Registered as a PhD fellow at the Zoology Department of the UFS

2013 to current

**Dissertation title:** A new gorgonopsian from the uppermost *Daptocephalus Assemblage Zone*, in the Karoo Basin of South Africa

#### MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

#### EMPLOYMENT HISTORY

Part-time Laboratory assistant Department of Zoology & Entomology  
University of the Free State Zoology 1989-1992

Part-time laboratory assistant Department of Virology  
University of the Free State Zoology 1992

Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

## TECHNICAL REPORTS

**Butler, E. 2014.** Palaeontological Impact Assessment of the proposed development of private dwellings on portion 5 of farm 304 Matjesfontein Keurboomstrand, Knysna District, Western Cape Province. Bloemfontein.

**Butler, E. 2014.** Palaeontological Impact Assessment for the proposed upgrade of existing water supply infrastructure at Noupoort, Northern Cape Province. 2014. Bloemfontein.

**Butler, E. 2015.** Palaeontological impact assessment of the proposed consolidation, re-division and development of 250 serviced erven in Nieu-Bethesda, Camdeboo local municipality, Eastern Cape. Bloemfontein.

**Butler, E. 2015.** Palaeontological impact assessment of the proposed mixed land developments at Rooikraal 454, Vrede, Free State. Bloemfontein.

**Butler, E. 2015.** Palaeontological exemption report of the proposed truck stop development at Palmiet 585, Vrede, Free State. Bloemfontein.

**Butler, E. 2015.** Palaeontological impact assessment of the proposed Orange Grove 3500 residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Gonubie residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Ficksburg raw water pipeline. Bloemfontein.

**Butler, E. 2015.** Palaeontological Heritage Impact Assessment report on the establishment of the 65 mw Majuba Solar Photovoltaic facility and associated infrastructure on portion 1, 2 and 6 of the farm Witkoppies 81 HS, Mpumalanga Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed township establishment on the remainder of portion 6 and 7 of the farm Sunnyside 2620, Bloemfontein, Mangaung metropolitan municipality, Free State, Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Woodhouse 1 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse729, near Vryburg, North West Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Woodhouse 2 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Orkney solar energy farm and associated infrastructure on the remaining extent of Portions 7 and 21 of the farm Wolvehuis 114, near Orkney, North West Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Spectra foods broiler houses and abattoir on the farm Maiden Manor 170 and Ashby Manor 171, Lukhanji Municipality, Queenstown, Eastern Cape Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoot concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoot, Northern Cape. Prepared for Savannah Environmental. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Woodhouse 1 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Woodhouse 2 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.

**Butler, E. 2016.** Proposed 132kV overhead power line and switchyard station for the authorised Solis Power 1 CSP project near Upington, Northern Cape. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Senqu Pedestrian Bridges in Ward 5 of Senqu Local Municipality, Eastern Cape Province. Bloemfontein.

**Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Modderfontein Filling Station on Erf 28 Portion 30, Founders Hill, City Of Johannesburg, Gauteng Province. Bloemfontein.

**Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Modikwa Filling Station on a Portion of Portion 2 of Mooihoek 255 Kt, Greater Tubatse Local Municipality, Limpopo Province. Bloemfontein.

**Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Heidedal filling station on Erf 16603, Heidedal Extension 24, Mangaung Local Municipality, Bloemfontein, Free State Province. Bloemfontein.

**Butler, E. 2016.** Recommended Exemption from further Palaeontological studies: Proposed Construction of the Gunstfontein Switching Station, 132kv Overhead Power Line (Single Or Double Circuit) and ancillary infrastructure for the Gunstfontein Wind Farm Near Sutherland, Northern Cape Province. Savannah South Africa. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.

**Butler, E. 2016.** Chris Hani District Municipality Cluster 9 water backlog project phases 3a and 3b: Palaeontology inspection at Tsomo WTW. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoot concentrated solar power facility and associated infrastructure on portion 1 and 4 of the

farm Carolus Poort 167 and the remainder of Farm 207, near Noupoot, Northern Cape. Savannah South Africa. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed upgrading of the main road MR450 (R335) from the Motherwell to Addo within the Nelson Mandela Bay Municipality and Sunday's river valley Local Municipality, Eastern Cape Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment construction of the proposed Metals Industrial Cluster and associated infrastructure near Kuruman, Northern Cape Province. Savannah South Africa. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment for the proposed construction of up to a 132kv power line and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces. PGS Heritage. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed development of two burrow pits (DR02625 and DR02614) in the Enoch Mgijima Municipality, Chris Hani District, Eastern Cape.

**Butler, E. 2016.** Ezibeleni waste Buy-Back Centre (near Queenstown), Enoch Mgijima Local Municipality, Eastern Cape. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment for the proposed construction of two 5 Mw Solar Photovoltaic Power Plants on Farm Wildebeestkuil 59 and Farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment for the proposed development of four Leeuwberg Wind farms and basic assessments for the associated grid connection near Loeriesfontein, Northern Cape Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological impact assessment for the proposed Aggeneys south prospecting right project, Northern Cape Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological impact assessment of the proposed Motuoane Ladysmith Exploration right application, Kwazulu Natal. Bloemfontein.

**Butler, E. 2016.** Palaeontological impact assessment for the proposed construction of two 5 MW solar photovoltaic power plants on farm Wildebeestkuil 59 and farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.

**Butler, E. 2016:** Palaeontological desktop assessment of the establishment of the proposed residential and mixed use development on the remainder of portion 7 and portion 898 of the farm Knopjeslaagte 385 Ir, located near Centurion within the Tshwane Metropolitan Municipality of Gauteng Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological impact assessment for the proposed development of a new cemetery, near Kathu, Gamagara local municipality and John Taolo Gaetsewe district municipality, Northern Cape. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment Of The Proposed Development Of The New Open Cast Mining Operations On The Remaining Portions Of 6, 7, 8 And 10 Of The Farm Kwaggafontein 8 In The Carolina Magisterial District, Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the Proposed Development of a Wastewater Treatment Works at Lanseria, Gauteng Province. Bloemfontein.



**Butler, E. 2017.** Palaeontological Scoping Report for the Proposed Construction of a Warehouse and Associated Infrastructure at Perseverance in Port Elizabeth, Eastern Cape Province.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the Proposed Establishment of a Diesel Farm and a Haul Road for the Tshipi Borwa mine Near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the Proposed Changes to Operations at the UMK Mine near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment for the Development of the Proposed Ventersburg Project-An Underground Mining Operation near Ventersburg and Henneman, Free State Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological desktop assessment of the proposed development of a 3000 MW combined cycle gas turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment for the Development of the Proposed Revalidation of the lapsed General Plans for Elliotdale, Mbhashe Local Municipality. Bloemfontein.

**Butler, E. 2017.** Palaeontological assessment of the proposed development of a 3000 MW Combined Cycle Gas Turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed development of the new open cast mining operations on the remaining portions of 6, 7, 8 and 10 of the farm Kwaggafontein 8 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed mining of the farm Zandvoort 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed Lanseria outfall sewer pipeline in Johannesburg, Gauteng Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of open pit mining at Pit 36W (New Pit) and 62E (Dishaba) Amandelbult Mine Complex, Thabazimbi, Limpopo Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological impact assessment of the proposed development of the sport precinct and associated infrastructure at Merrifield Preparatory school and college, Amathole Municipality, East London. PGS Heritage. Bloemfontein.

**Butler, E. 2017.** Palaeontological impact assessment of the proposed construction of the Lehae training and fire station, Lenasia, Gauteng Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of the new open cast mining operations of the Impunzi mine in the Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the construction of the proposed Viljoenskroon Munic 132 KV line, Vierfontein substation and related projects. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed rehabilitation of 5 ownerless asbestos mines. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of the Lephhalale coal and power project, Lephhalale, Limpopo Province, Republic of South Africa. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed construction of a 132KV powerline from the Tweespruit distribution substation (in the Mantsopa local municipality) to the Driedorp rural substation (within the Naledi local municipality), Free State province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of the new coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed construction of a Photovoltaic Solar Power station near Collett substation, Middelburg, Eastern Cape. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment for the proposed township establishment of 2000 residential sites with supporting amenities on a portion of farm 826 in Botshabelo West, Mangaung Metro, Free State Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed prospecting right project without bulk sampling, in the Koa Valley, Northern Cape Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed Aroams prospecting right project, without bulk sampling, near Aggeneys, Northern Cape Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed Belvior aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.

**Butler, E. 2017.** PIA site visit and report of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed construction of Tina Falls Hydropower and associated power lines near Cumbu, Mthlontlo Local Municipality, Eastern Cape. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed construction of the Mangaung Gariiep Water Augmentation Project. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed Belvoir aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed construction of the Melkspruit-Rouxville 132KV Power line. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of a railway siding on a portion of portion 41 of the farm Rustfontein 109 is, Govan Mbeki local municipality, Gert Sibande district municipality, Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed consolidation of the proposed Ilima Colliery in the Albert Luthuli local municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed extension of the Kareerand Tailings Storage Facility, associated borrow pits as well as a storm water drainage channel in the Vaal River near Stilfontein, North West Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed construction of a filling station and associated facilities on the Erf 6279, district municipality of John Taolo Gaetsewe District, Ga-Segonyana Local Municipality Northern Cape. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed of the Lephalale Coal and Power Project, Lephalale, Limpopo Province, Republic of South Africa. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed Overvaal Trust PV Facility, Buffelspoort, North West Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed development of the H2 Energy Power Station and associated infrastructure on Portions 21; 22 And 23 of the farm Hartebeestspruit in the Thembisile Hani Local Municipality, Nkangala District near Kwamhlanga, Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed upgrade of the Sandriver Canal and Klippan Pump station in Welkom, Free State Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed upgrade of the 132kv and 11kv power line into a dual circuit above ground power line feeding into the Urania substation in Welkom, Free State Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed diamonds alluvial & diamonds general prospecting right application near Christiana on the remaining extent of portion 1 of the farm Kaffraria 314, registration division HO, North West Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Hartebeesfontein, near Panbult, Mpumalanga. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Rustplaas near Piet Retief, Mpumalanga. Bloemfontein.

**Butler, E. 2018.** Palaeontological Impact Assessment for the Proposed Landfill Site in Luckhoff, Letsemeng Local Municipality, Xhariep District, Free State. Bloemfontein.

**Butler, E. 2018.** Palaeontological Impact Assessment of the proposed development of the new Mutsho coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Impact Assessment of the authorisation and amendment processes for Manangu mine near Delmas, Victor Khanye local municipality, Mpumalanga. Bloemfontein.

**Butler, E. 2018.** Palaeontological Desktop Assessment for the proposed Mashishing township establishment in Mashishing (Lydenburg), Mpumalanga Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Desktop Assessment for the Proposed Mlonzi Estate Development near Lusikisiki, Ngquza Hill Local Municipality, Eastern Cape. Bloemfontein.

**Butler, E. 2018.** Palaeontological Phase 1 Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.

**Butler, E. 2018.** Palaeontological Desktop Assessment for the proposed electricity expansion project and Sekgame Switching Station at the Sishen Mine, Northern Cape Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological field assessment of the proposed construction of the Zonnebloem Switching Station (132/22kV) and two loop-in loop-out power lines (132kV) in the Mpumalanga Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Field Assessment for the proposed re-alignment and decommissioning of the Firham-Platrand 88kv Powerline, near Standerton, Lekwa Local Municipality, Mpumalanga province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Desktop Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.

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- E. Butler. 2019.** Palaeontological Impact Assessment for the proposed Umsobomvu Solar PV Energy Facilities, Northern and Eastern Cape
- E. Butler. 2019.** Palaeontological Desktop Assessment for six proposed Black Mountain Mining Prospecting Right Applications, without Bulk Sampling, in the Northern Cape.

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- E. Butler. 2019.** Palaeontological Desktop Assessment Of The Proposed Upgrade Of The Vaal Gamagara Regional Water Supply Scheme: Phase 2 And Groundwater Abstraction
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## **CONFERENCE CONTRIBUTIONS**

### **NATIONAL**

### **PRESENTATION**

Butler, E., Botha-Brink, J., and F. Abdala. A new gorgonopsian from the uppermost *Dicynodon Assemblage Zone*, Karoo Basin of South Africa. 18<sup>th</sup> Biennial conference of the PSSA 2014. Wits, Johannesburg, South Africa.

#### **INTERNATIONAL**

Attended the Society of Vertebrate Palaeontology 73<sup>th</sup> Conference in Los Angeles, America.  
October 2012.

#### **CONFERENCES: POSTER PRESENTATION**

##### **NATIONAL**

Butler, E., and J. Botha-Brink. Cranial skeleton of *Galesaurus planiceps*, implications for biology and lifestyle. University of the Free State Seminar Day, Bloemfontein. South Africa. November 2007.

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#### **INTERNATIONAL VISITS**

Natural History Museum, London

July 2008

Paleontological Institute, Russian Academy of Science, Moscow

November 2014