



# PGS HERITAGE

**PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED SOMKHELE  
ANTHRACITE OPENCAST MINING PITS WITHIN THE UMKHANYAKUDE DISTRICT  
MUNICIPALITY AND THE MTUBATUBA LOCAL MUNICIPALITY, KWAZULU NATAL**

**Issue Date:** 26 April 2020  
**Revision No.:** v1.0  
**Client:** Somkhele Coal Mining (Pty) Ltd  
**PGS Project No:** 352HIA

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## **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:**



## **ACKNOWLEDGMENT OF RECEIPT**

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Palaeontological Desktop Assessment for the 3 proposed Somkhele Colliery opencast mining pits, KwaZulu Natal

<b>Report Title</b>	<b>Palaeontological Desktop Assessment for the proposed Somkhele Anthracite Mine opencast mining pits within the Umkhanyakude District Municipality and the Mtubatuba Local Municipality, KwaZulu Natal</b>		
<b>Control</b>	<b>Name</b>	<b>Signature</b>	<b>Designation</b>
<b>Author</b>	Elize Butler		Palaeontologist
<b>Reviewed</b>	Wouter Fourie		Principal Heritage Specialist
<b>Client</b>	Jade Dafel		Environmental Officer

**CLIENT:** Tendele Coal Mining (Pty) Ltd

**CONTACT PERSON:** Jade Dafel

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.

<b>Requirements of Appendix 6 – Government Notice (GN) R326 EIA Regulations of 7 April 2017</b>	<b>Relevant section in report</b>	<b>Comment where not applicable.</b>
1.1(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 vita	Section 2 – refer to Appendix A	-
(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 Study	-
(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;	Desktop Study	-
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified
(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 11	-
(l) Any conditions for inclusion in the environmental authorisation	N/A	Non required
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 11	-
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 10	-
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		-

Requirements of Appendix 6 – Government Notice (GN) R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(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 EMP, 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 was handled as part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) process.
(p) A summary and copies if any comments that were received during any consultation process	N/A	Not applicable. To date no comments regarding heritage resources that require input from a specialist have been raised.
(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 PGS Heritage (Pty) Ltd to conduct the **Palaeontological Desktop Assessment (PDA)** to assess the Palaeontology for the 3 proposed Somkhele Anthracite Mine opencast pits (Ophondweni, Mahujini and Emalahleni), within the uMkhanyakude District Municipality and the Mtubatuba Local Municipality, KwaZulu Natal. The National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), states that a Palaeontological Impact Assessment is key to detect the presence of fossil material within the planned development footprint. This PDA of the proposed opencast mine pits is thus necessary to evaluate the effect of the construction on local palaeontological resources.

The proposed Ophondweni, Mahujini and Emalahleni opencast mining pits, is underlain by the coal-bearing Emakwezini Formations (Adelaide Subgroup, Beaufort Group, Karoo Supergroup) and Vryheid Formation (Ecca Group, Karoo Supergroup) as well as Jurassic dolerite. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Emakwezini and Vryheid Formation is Very High and that of Jurassic dolerite is insignificant as it is igneous in origin (Almond and Pether 2008, SAHRIS website).

As the Mining Right Authorizations for the Somkhele mine has already been approved in 2016 it is considered that the construction and operation of the development, is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the development may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

However, if fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations, the **Chance Find Protocol** must be implemented by the ECO or site manager in charge of these developments. Fossil discoveries should be protected, and the ECO/site manager 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 suitable mitigation can be implemented.

Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university collection), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA.

**Recommendations:**

- The EAP (Environmental Impact Assessment Practitioner) and ECO/site manager must be informed that the Emakwezini and Vryheid Formations has a Very High Palaeontological Sensitivity. There is thus a very high chance that fossils could be present in these Formations of the proposed Somkhele opencast mining pits.
- If fossil remains are discovered during any phase of construction, the **Chance Find Protocol** must be implemented by the ECO in charge of these developments. These discoveries should be secured, and the ECO/site manager must alert SAHRA so that the proper mitigation (documented and collection) can be undertaken by a palaeontologist.
- These recommendations should be included in the Heritage Management Plan and Environmental management system for the Somkhele opencast mining pits.

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## **TERMINOLOGY AND ABBREVIATIONS**

### **Cultural significance**

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

### **Development**

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influences its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- carrying out any works on or over or under a place;
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- constructing or putting up for display signs or boards;
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

### **Fossil**

Mineralized bones of animals, shellfish, plants, and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

### **Heritage**

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

### **Heritage resources**

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures, and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds; and
- sites of significance relating to the history of slavery in South Africa.

## Palaeontology

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 trace.

Table 1: Abbreviations

<b>Abbreviations</b>	<b>Description</b>
DIA	Desktop Impact Assessment
DM	District Municipality
ECO	Environmental Control Officer
EAP	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
EMP/EMPr	Environmental Management Program
GCS	Ground Water Consulting Services
GN	Government Notice
GPS	Global Positioning System
HIA	Heritage Impact Assessment
LM	Local Municipality
MR	Mining Right
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PGS	PGS Heritage
PIA	Palaeontological Impact Assessment
PSSA	Palaeontological Society of South Africa
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
WMA	Water Management Area

## 1 INTRODUCTION

The opencast anthracite mine, Somkhele, is owned and operated by Tendele Coal Mining (Pty) Ltd (Tendele) a subsidiary of Petmin Ltd. Tendele plans to develop 3 opencast pits namely Ophondweni, Mahujini and Emalahleni in Areas 4 and 5, as the existing operations are almost mined out (Figure 1-2). The Mining Right (MR) for these areas was issued in 2016 (10041MR, refer to Table 2). The Emalahleni opencast pit will be 2.5876 km<sup>2</sup> in extent and Ophondweni 5.5585 km<sup>2</sup> in extent.

### 1.1 Somkhele Mining Activities

Somkhele is an operational anthracite mine, owned and operated by Tendele, a subsidiary of Petmin Ltd. Opencast mining activities commenced in 2007 after an old order MR was granted in 2005 for Areas 2 and 3 (KZN30/5/1/2/2/216MR). The application for a MR conversion was subsequently approved on 1 February 2011 and executed on 30 March 2011 under the same license number. This converted MR is valid for 20 years. The MR for Area 8 and 9 was applied for in 2013 under Section 102 in 2013 as part of Area 2 and approved in 2014. A new order MR was granted in 2007 for Area 1 (KZN30/5/1/2/2/135MR). Area 4 and 5 received a MR in May 2016 (KZN30/5/1/2/2/10041MR). Refer to Table 2 for the MRs and corresponding Environmental Management Programs (EMPr/EMP) which have been approved.

Table 2: MRs and Corresponding EMPs

EMP Approval	Type	DMR Reference	Approval year
Area 2/3	Old order MR	KZN30/5/1/2/2/216MR	2005
Area 1	New order MR	KZN30/5/1/2/2/135MR	2007
Area 2 conversion	Conversion of old order MR to new order MR	KZN30/5/1/2/2/216MR	2011
Amendment to Area 2 EMP	Amendment to include 2 <sup>nd</sup> washing plant, calcining plant and fuel storage	KZN30/5/1/2/2/216MR	2012
Addendum to Area 2 EMP	Addendum to EMP to include 3 <sup>rd</sup> washing plant	KZN30/5/1/2/2/216MR	2013
Area 8 and 9 (Luhlanga & KwaQubuka)	Section 102 application to include in Area 2 MR	KZN30/5/1/2/2/216MR	2014
Area 4 & 5	MR application for Area 4 and 5	KZN30/5/1/2/2/10041MR	2016

Mining activities have been completed in Area 2 which includes opencast Pits A and BDE. Currently, active mining is taking place in Area 1, Area 8 (Luhlanga) and Area 9 (KwaQubuka). Mining plans to extend an existing pit in Area 8 (known as Luhlanga Box Cut Zero) as well as activities at three sites (Ophondweni, Mahujini and Emalahleni) which are planned to commence in Area 4 & 5 in 2020. This will allow the plant to run at maximum capacity 24 hours a day, seven days per week on a four-shift system<sup>1</sup>.

<sup>1</sup>Information provided by Somkhele

## **2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR**

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty-four years. She has extensive 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 for 14 years. She has been conducting PIAs since 2014.

# SOMKHELE MINE: EXTENT OF MINING RIGHT AREAS

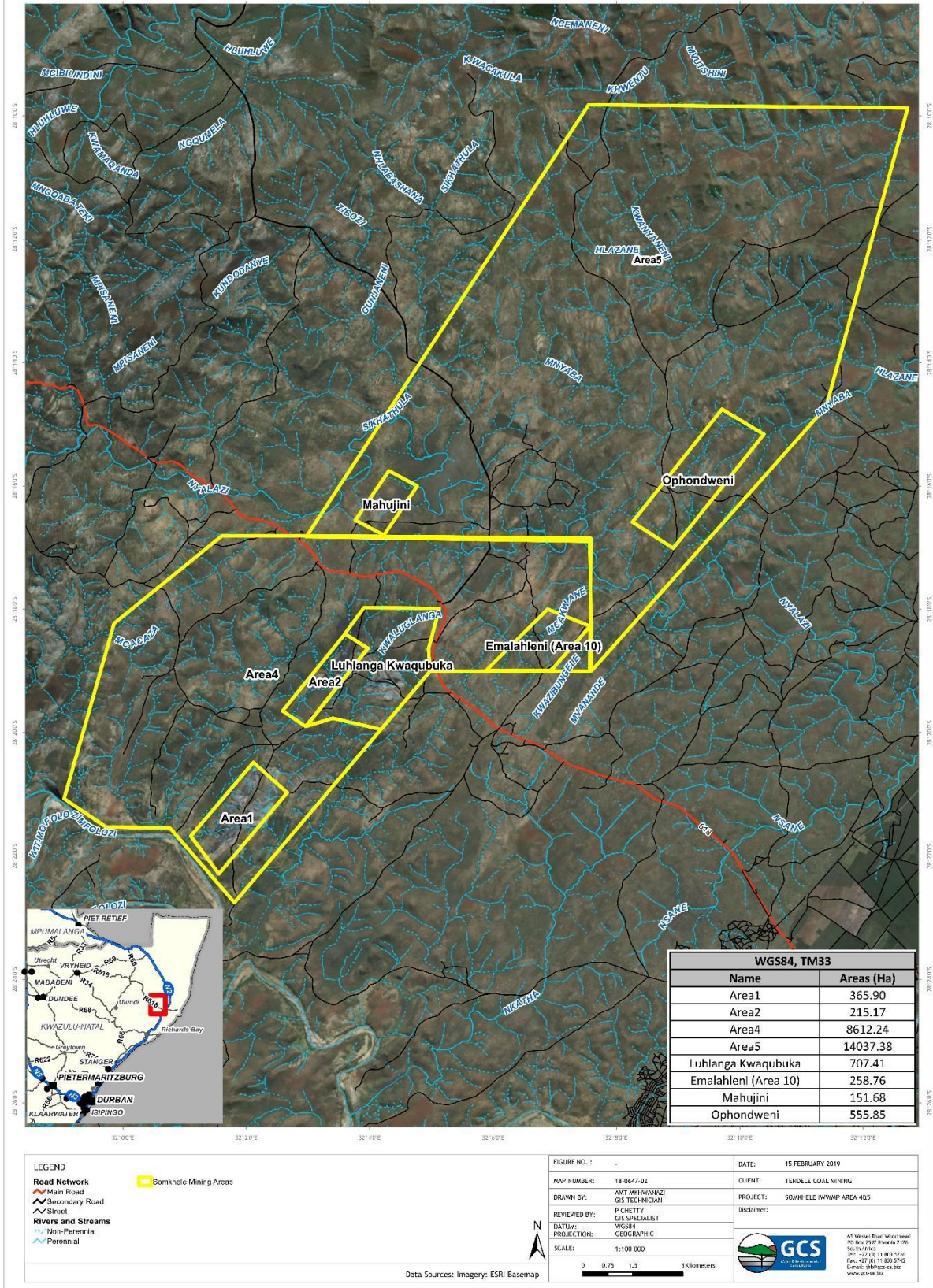


Figure 1: Somkhele mine: Extent of mining right areas (Source: Groundwater Consulting Services (GCS, 2019).

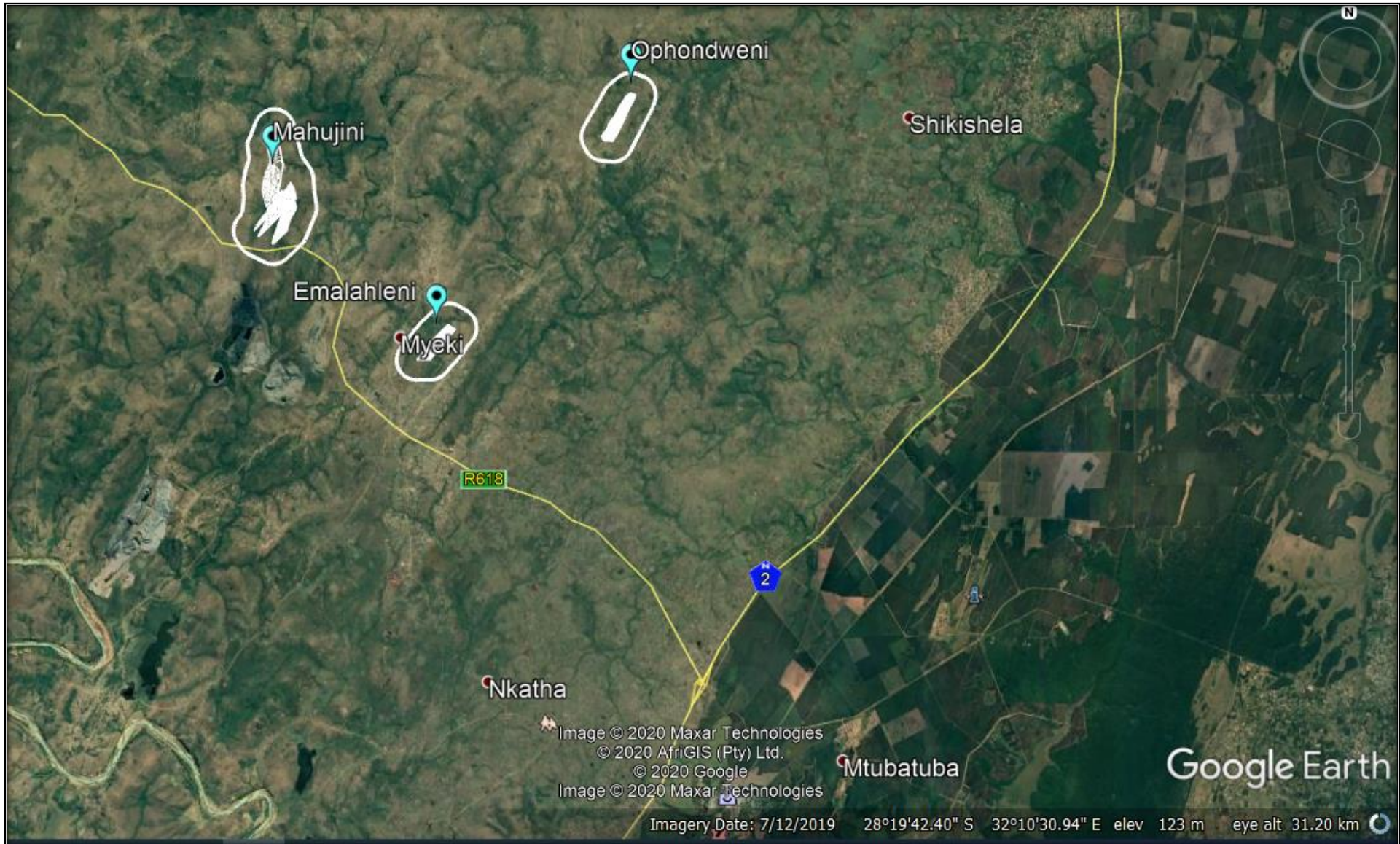


Figure 2: Google Earth Image (2020) of the proposed Emalahleni, Ophondweni and Mahujini opencast mining pits.

### 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 desktop Impact Assessment (DIA) forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an 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 300 m in length;
- the construction of a bridge or similar structure exceeding 50 m in length;
- any development or other activity which will change the character of a site—
- (exceeding 5 000 m<sup>2</sup> in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by the South African Heritage Resources Authority (SAHRA) or a provincial heritage resources authority; or
- the re-zoning of a site exceeding 10 000 m<sup>2</sup> in extent; or
- any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

### 4 OBJECTIVE

The objective of a DIA 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 DIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the Environmental Impact Assessment (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/kml's) 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, where necessary).

## 5 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The proposed Emalahleni, Ophondweni and Mahujini opencast mines, within the uMkhanyakude District Municipality and the Mtubatuba Local Municipality, KwaZulu Natal is depicted on the 1:250 000 2723 Vryheid Geological Map (Council for Geosciences, Pretoria). The proposed development is completely underlain by the coal-bearing Emakwezini Formation (Adelaide Subgroup, Beaufort Group, Karoo Supergroup) and Vryheid Formation (Ecca Group, Karoo Supergroup) as well as Jurassic dolerite (Figure 3-5, Table 3). According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Emakwezini and Vryheid Formation is Very High (Almond and Pether 2008, SAHRIS website, Table 3) while that of Jurassic dolerite is insignificant as it is igneous in origin.

The proposed opencast mining pits are situated in the **Somkhele Coalfield** (Figure 5) that was previously referred to as the Hlabisa and Lake St. Lucia Bay Coalfield (Hancox and Götz, 2014). The Somkhele and Nongoma Coalfield is more complicated than the other coalfields of KwaZulu Natal, due to its relatively limited mining history, and is thus not as well-understood (Jeffrey, 2005). The coals of the Nongoma and Somkhele Coalfield differ from those in the rest of KwaZulu Natal in that they are hosted in the Upper Permian Emakwezini Formation of the Adelaide Subgroup (Beaufort Group) (Bordy and Prevec, 2008).

Bordy and Prevec (2008) described the geology and palaeobotany of the Emakwezini Formation in detail. They found the Emakwezini Formation to be limited to a narrow, faulted, meridional subcrop and outcrop belt in the middle (Swaziland) and southern (north-eastern KwaZulu-Natal) Lebombo Basin. The Emakwezini Formation correlates with the Normandien Formation of the eastern and north-eastern and the Balfour Formation of the southern main Karoo Basin.

The Emakwezini Formation consists chiefly of fossiliferous, brown, grey and greenish-grey mudstones with coal seams, as well as subordinate yellow-white or white, primarily medium-, but locally coarsely grained, commonly feldspathic sandstones. Very rarely, discontinuous limestone lenses are present. The mudstone: sandstone ratio is about 2 to 1. Coal seams are present and varies from < 1 m to 15 m thick and is mainly associated with mudstones (Bordy and Prevec, 2008).

In the upper parts of the Emakwezini Formation their study uncovered the following plant fossils for first time: *Dictyopteridium flabellatum*, *Rigbya arberioides*, *Lidgettonia* spp., and *Trizygia speciosa*. Investigations in the lower part of the formation and in actively mined coal seams new flora includes the glossopterid fructification *Ottokaria* sp. and the sphenopsid *Schizoneura gondwanensis*. The former is known from the Lower Permian while the latter is typical of the Upper Permian in South Africa. The above-mentioned flora is atypical of South African Glossopteris flora (Bordy and Prevec, 2015) and is thus important for study and collection.

Previous work on fossil plants from borehole core and railway cuttings from this Formation include Etheridge (1902), Seward (1907) and Plumstead (1970). These authors describe various taxa namely *Glossopteris* spp., *Ottokaria* sp., *Vertebraria indica*, *Schizoneura gondwanensis*, *Phyllothea* spp. and *Dictyopteridium* in carbonaceous shales associated with coal seams. Plumstead (1970) allocated the Emakwezini Formation to the Upper Permian by the presence of *Dictyopteridium* and *Phyllothea* spp.

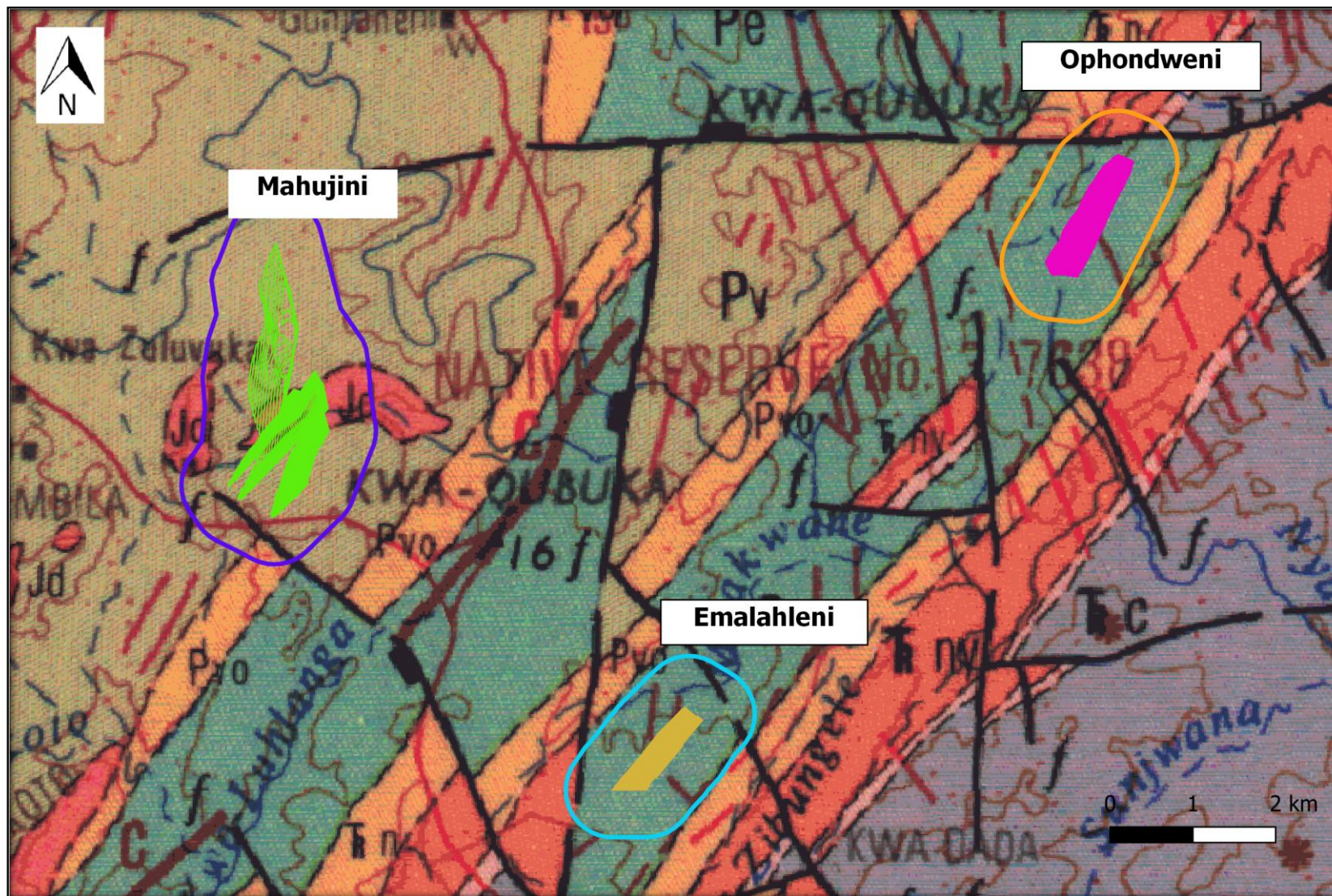


Figure 3: Extract of the 1:250 000 2723 Vryheid Geological Map (Council for Geosciences, Pretoria) indicating the location of the proposed Emalahleni, Ophondweni and Mahujini opencast mines, within the uMkhanyakude District Municipality and the Mtubatuba Local Municipality, KwaZulu Natal is underlain by the Emakwezini and Vryheid Formations of the Karoo Supergroup as well as Jurassic dolerite. Map drawn by QGIS 2.18.28.

Table 3: Explanation of symbols used in geological map

Symbol	Group/Formation	Lithology
Pv	Vryheid Formation	Shales, sandstone, and grt with coal and oil shale beds
Pe	Emakwezini Formation	Sandstone, siltstone and mudstone and thin coal seams
Trc	Ntabene	Fine grained sandstone
Jd	Jurassic	Dolerite dykes, intrusive

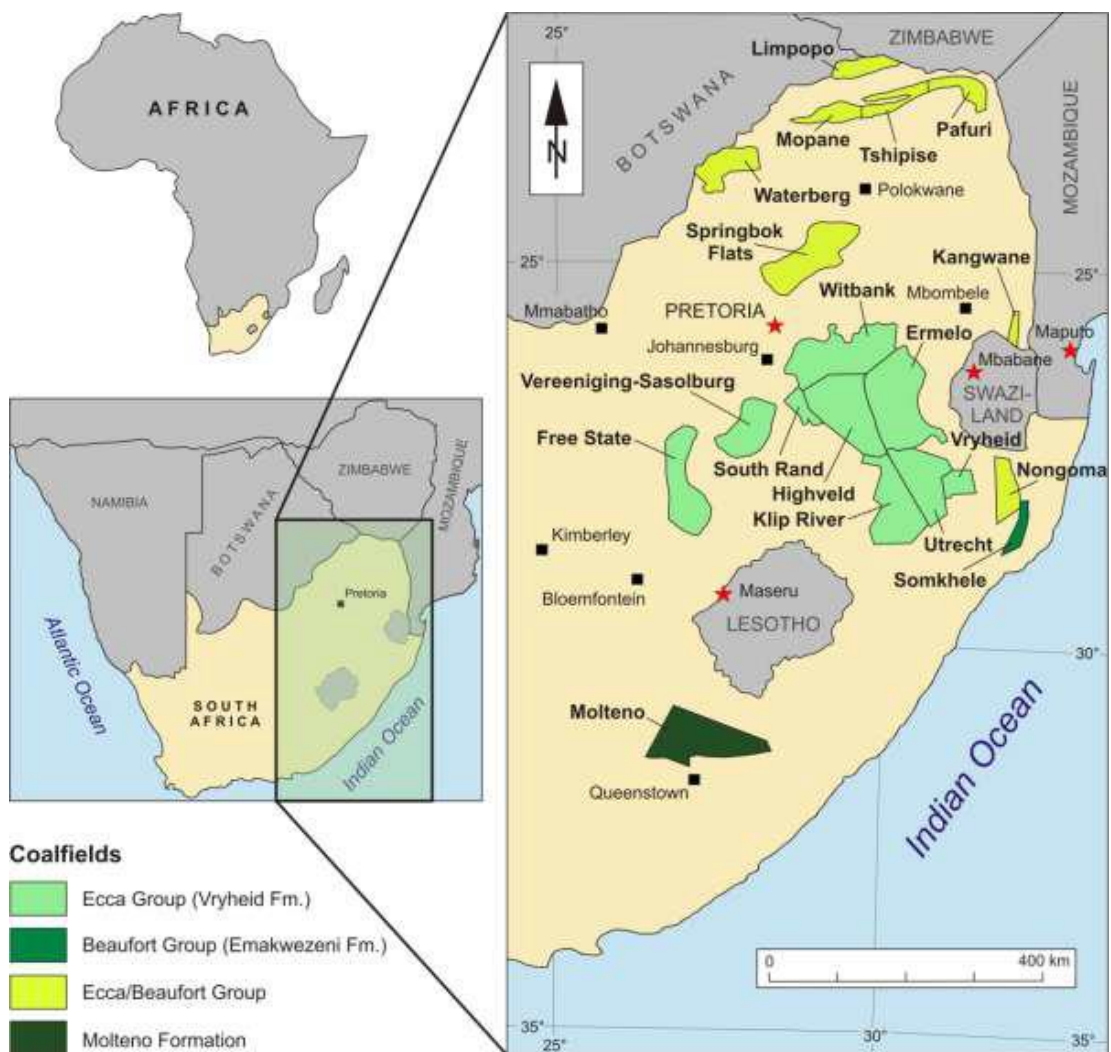


Figure 4: Coalfields of Southern Africa, taken from Hancox and Götz (2014).

Most of the coal mined in South Africa is from the Permian Vryheid Formation (Figure 4). The depth of the Vryheid Formation in the main Karoo Basin varies from 70 m to 500 m near Vryheid and New Castle in Kwazulu-Natal, where the basin was at its deepest.

The **Vryheid Formation** comprises mudrock, rhythmite, siltstone and fine- to coarse-grained sandstone (pebbly in places). The Formation contains up to five (mineable) coal seams. The different lithofacies are mainly arranged in upward-coarsening deltaic cycles (up to 80m thick in the southeast). Fining-upward fluvial cycles, of which up to six are present in the east, are typically sheet-like in geometry, although some form valley-fill deposits. They comprise coarse-grained to pebbly, immature sandstones - with an abrupt upward transition into fine-grained sediments and coal seams.

The Vryheid Formation is known to contain a rich assemblage of Glossopteris flora which is the source vegetation for the Vryheid Formation. Gymnospermous glossopterids dominated the peat and non-peat accumulating of Permian wetlands after continental deglaciation took place (Falcon, 1986c, Greb et al., 2006).

Recent paleobotanical studies in the Vryburg Formation include that of Adenforff (2005), Bordy and Prefec (2008) and Prefec et al. (2008, 2009, 2010) and Prevec, (2011). Bamford (2011) described numerous plant fossils from this formation (e.g. Azaniodendron fertile, Cyclocladon leslii, Sphenophyllum hammanskraalensis, Annularia sp., Raniganjia sp., Asterotheca spp., Liknopetalon enigmata, Hirsutum sp., Scutum sp., Ottokaria sp., Estcourtia sp., Arberia sp., Lidgetonia sp., Noeggerathiopsis sp., Podocarpidites sp as well as more than 20 Glossopteris species.

In the past palynological studies have focused on the coal bearing successions of the Vryheid Formation and include articles by Aitken (1993, 1994, 1998), and Millstead (1994, 1999), while recent studies were conducted by Götz and Ruckwied (2014).

Bamford (2011) is of the opinion that only a small amount of data have been published on these potentially fossiliferous deposits and that most likely good material are present around coal mines and in other areas the exposures are poor and of little interest. When plant fossils do occur they are usually abundant. According to Bamford it is not feasible to preserve all the sites but in the interests of science these sites ought to be well documented, researched and the collected fossils must be housed in an accredited institution.

To date no fossil vertebrates have been collected from the Vryheid formation. The occurrence of fossil insects is rare, while palynomorphs are diverse. Non-marine bivalves and fish scales have also been reported from this formation. Trace fossils are abundantly found but the diversity is low. The mesosaurid reptile, Mesosaurus has been found in the southern parts of the basin but may also be present in other areas of the Vryheid formation. Regardless of the rare and irregular occurrence of fossils in this biozone a single fossil may be of scientific importance as many fossil taxa are known from a single fossil.

The Karoo igneous province is one of the world's classic continental basalt (CFB) provinces. This province consists of intrusive and extrusive rocks that occur over a large area (Duncan et al, 2006). Generally, the flood basalts do not contribute to prominent volcanic structures, but instead are formed by successive eruptions from a set of fissures that form sub-horizontal lava flows (sills and dykes) varying in thickness. This lava caps the landscape on which they erupted. As the Karoo is an old flood basalt province it is today preserved as erosional fragments of a more extensive lava cap that covered much of southern Africa in the geological past. It is estimated that the Karoo lava outcrop currently covered at least 140 000 km<sup>2</sup> while it was larger in the past [~2 000 000 km<sup>2</sup> (Cox 1970, 1972)].

The Karoo Igneous Province contains a large volume of flood basalts as well as silicic volcanic rocks. These units are comprised of rhyodacite and rhyolitic magma and crops out along the Lebombo monocline. Individual units span up to 60 km and sometimes show massive pyroclastic structures and are thus classified as rheoignimbrites. The basal lavas lie conformable on the Clarens Formation but in specific localities sandstone erosion occurred before the volcanic eruptions took place. Lock *et al* (1974) found evidence in the Eastern Cape that in the early stages of volcanism magma interacted with ground water to produce volcaniclastic deposits as well as phreatic and phreatomagmatic diatremes. Eales *et al* (1984) also found evidence of aqueous environments during early volcanism by the existence of pillow lavas and associated hyaloclastite breccias and thin lenses of fluviatile sandstones interbedded with the lowermost magmas.

The Jurassic Dolerite is igneous in origin with a zero Palaeontological Sensitivity and is thus unfossiliferous.

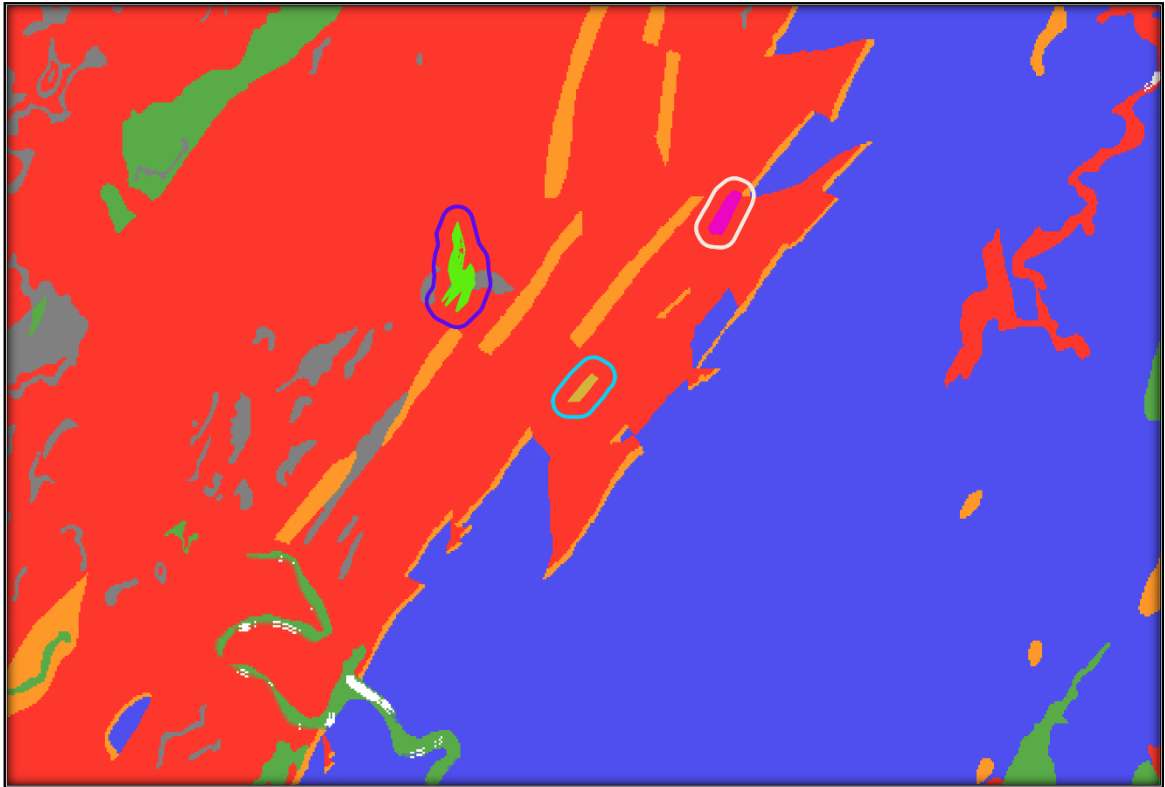


Figure 5: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the locality of the proposed opencast mines

Table 4: SAHRIS recommendations

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.

According to the SAHRIS palaeosensitivity map (Figure 5) there is very high possibility of finding fossils in this area (Table 3).

## 6 GEOGRAPHICAL LOCATION OF THE SITE

Somkhele is located within the uMkhanyakude District Municipality (DM) and the Mtubatuba Local Municipality (LM). Mtubatuba, situated 23 km south-east of Somkhele, is the closest main town to the mine, while Somkhele Village is about 3 km east of the site.



Somkhele is situated on Portion 0 of Farm No. 15822 GV Reserve No. 3 in the Mtubatuba Administrative District in the Pongola to Mtamvuna Water Management Area (WMA). The processing plants are about 7.5 km from the Mfolozi River.

The Ingonyama Trust is the landowner of Portion 0 No. 15822 Reserve No. 3, Registration Division GV (Somkhele) though Tendele is the mining right holder.

## **7 METHODS**

The aim of a Palaeontological Impact Assessment (PIA) 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: PIA reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

### **7.1 Assumptions and Limitations**

The accuracy of DIA is reduced by several factors which may include the following: the databases of institutions are not always up to date and relevant locality and geological information were not accurately documented in the past. Various remote areas of South Africa have not been assessed by palaeontologists and data is based on aerial photographs alone. Geological maps concentrate on the geology of an area and the sheet explanations were never intended to focus on palaeontological heritage.

Similar Assemblage Zones, but in different areas is used to provide information on the presence of fossil heritage in an unmapped area. Desktop studies of similar geological formations and Assemblage Zones generally **assume** that exposed fossil heritage is present within the development area. The accuracy of the Palaeontological Impact Assessment is thus improved considerably by conducting a field-assessment.

## **8 ADDITIONAL INFORMATION CONSULTED**

In compiling this report the following sources were consulted:

- The Palaeosensitivity Map from the SAHRIS website;
- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984);
- Geological Map 1: 250 000 2723 Vryheid Geological Map (Council for Geosciences, Pretoria); and
- A Google Earth map with polygons of the proposed development was obtained from PGS.

## 9 IMPACT ASSESSMENT METHODOLOGY

An assessment of the impact significance of the proposed Somkhele Anthracite Mine opencast mining pits on local fossil heritage is presented here.

### 9.1 Methodology for Impact Assessment

In order to ensure uniformity, a standard impact assessment methodology has been utilised so that a wide range of impacts can be compared. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the aforementioned assessment criteria. A summary of each of the qualitative descriptors, along with the equivalent quantitative rating scale for each of the aforementioned criteria, is given in table below.

Table 5: Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	Isolated site/ proposed corridor	<u>Incidental</u>
2	LOW	Study area	<u>Short-term</u>
3	MODERATE	Local	<u>Medium-term</u>
4	HIGH	Regional / Provincial	<u>Long-term</u>
5	VERY HIGH	Global / National	<u>Permanent</u>

A more detailed description of each of the assessment criteria is given in the following sections.

### 9.2 Significance Assessment

The Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude, but does not always clearly define these, since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of an area affected by atmospheric pollution may be extremely large (1000 km<sup>2</sup>) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would

be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed, the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common.

A more detailed description of the impact significance rating scale is given in **Table 6**: below.

Table 6: Description of the significance rating scale

RATING		DESCRIPTION
5	VERY HIGH	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	HIGH	Impact is of substantial order within the bounds of impacts which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	MODERATE	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	LOW	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	VERY LOW	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	NO IMPACT	There is no impact at all - not even a very low impact on a party or system.

### 9.3 Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in Table 7 below.

Table 7: Description of the Spatial significance rating scale

RATING		DESCRIPTION
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of possible impacts, and will be felt at a regional scale (District Municipality to Provincial Level). The impact will affect an area up to 50 km from the proposed site.
3	Local	The impact will affect an area up to 5 km from the proposed site.
2	Study Area	The impact will affect an area not exceeding the boundary of the study area.
1	Isolated Sites / proposed site	The impact will affect an area no bigger than the site.

### 9.4 Temporal/Duration Scale

In order to accurately describe the impact, it is necessary to understand the duration and persistence of an impact in the environment. The temporal or duration scale is rated according to criteria set out in **Table 8**:

Table 8: Description of the temporal rating scale

RATING		DESCRIPTION
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium-term	The environmental impact identified will operate for the duration of life of the project.
4	Long-term	The environmental impact identified will operate beyond the life of operation of the project.
5	Permanent	The environmental impact will be permanent.

## 9.5 Degree of Probability

The probability, or likelihood, of an impact occurring will be described as shown in **Table 9:** below.

Table 9: Description of the degree of probability of an impact occurring

RATING	DESCRIPTION
1	Practically impossible
2	Unlikely
3	Could happen
4	Very likely
5	It's going to happen/has occurred

## 9.6 Degree of Certainty

As with all studies, it is not possible to be 100% certain of all facts, and for this reason a standard “degree of certainty” scale is used, as discussed in **Table 10:** . The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 10: Description of the degree of certainty rating scale

RATING	DESCRIPTION
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact, or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.

## 9.7 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner, in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus, the total value of the impact is described as the function of significance, spatial and temporal scale, as described below:

$$\text{Impact Risk} = \frac{(\text{Significance (5)} + \text{Spatial (2)} + \text{Temporal (5)}) \times \text{Probability (4)}}{3 \times 5}$$

An example of how this rating scale is applied is shown below:

Table 11: Example of Rating Scale

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
	Very high	Study area	Permanent	Very likely	LOW
Impact on heritage sites	5	2	5	4	3.2

**Note:** The significance, spatial and temporal scales are added to give a total of 12, which is divided by 3 to give a criterion rating of 4. The probability (4) is divided by 5 to give a probability rating of 0.8. The criteria rating of 4 is then multiplied by the probability rating (0,8) to give the final rating of 3.2.

The impact risk is classified according to 5 classes as described in the table below.

Table 12: Impact Risk Classes

RATING	IMPACT CLASS	DESCRIPTION
0.1 – 1.0	1	Very Low
1.1 – 2.0	2	Low
2.1 – 3.0	3	Moderate
3.1 – 4.0	4	High
4.1 – 5.0	5	Very High

An impact rating of 1.6 will fall in the Impact Class 4, which will be considered to be a high impact.

## 9.8 Summary of Impact Tables

The development footprint is underlain by the Emakwezini Formation (Adelaide Subgroup, Beaufort Group, Karoo Supergroup), Vryheid Formation (Ecca Group, Karoo Supergroup) and Jurassic dolerite. The Palaeontological Sensitivity of the Emakwezini and Vryheid Formation is rated Very High while that of Jurassic dolerite is insignificant. The expected duration of the impact is assessed as potentially permanent to long term. Only the study site will be affected. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be **permanent**. Impacts on palaeontological

heritage during the construction phase could potentially occur and are regarded as having a high possibility.

## 10 FINDINGS

The proposed Emalahleni, Ophondweni and Mahujini opencast mines, within the uMkhanyakude District Municipality and the Mtubatuba Local Municipality, KwaZulu Natal is entirely underlain by the coal-bearing Emakwezini Formation (Adelaide Subgroup, Beaufort Group, Karoo Supergroup). According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Emakwezini Formation is Very High (Almond and Pether 2008, SAHRIS website).

As the Mining Right Authorizations for the Somkhele mine has already been approved in 2014 it is considered that the construction and operation of the development, is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the development may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

However, if fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations, the **Chance Find Protocol** must be implemented by the ECO or site manager in charge of these developments. Fossil discoveries should be protected, and the ECO/site manager 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 suitable mitigation (recording and collection) can be implemented.

Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university collection), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA.

### **Recommendations:**

- The EAP and ECO/site manager must be informed that the Vryheid Formation of the Ecca Group has a Very High Palaeontological Sensitivity. There is thus a very high chance that fossils could be present in the Vryheid Fm of the proposed Somkhele opencast mining pits.
- If fossil remains are discovered during any phase of construction, the **Chance Find Protocol** must be implemented by the ECO in charge of these developments. These discoveries should be secured, and the ECO/site manager must alert SAHRA so that the proper mitigation (documented and collection) can be undertaken by a palaeontologist.

- These recommendations should be included in the Heritage Management Plan and Tendele's Environmental management system for the Somkhele opencast mining pits.

## **11 CHANCE FINDS PROTOCOL**

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

### **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 Control Officer (ECO) 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 ECO, 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 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 who in turn must report the find to his/her manager and the ECO or site manager. The ECO 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 (Global Positioning System) 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 (as many as possible) 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 ECO (site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary. In the interim, until a response has been received from SAHRA, the following measures must be implemented by the ECO (site manager):

- The site must be secured to protect it from further damage. **No attempt** should be made to remove material from its environment. The exposed find/s 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.
- If the fossil cannot be stabilized in situ, the fossil may be collected with extreme care by the ECO (site manager). Fossil finds must be stored in tissue paper and in an appropriate box while special care must be taken to remove all fossil material from the rescue site.
- Once the Heritage Agency has issued the written authorization, the developer may continue with the development.

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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

#### 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 Lephalale coal and power project, Lephalale, 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 Gariep 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 Anthracite Mine 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 Lephalele Coal and Power Project, Lephalele, 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.

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

**Butler, E. 2018.** Palaeontological desktop assessment of the proposed Mookodi – Mahikeng 400kV line, North West Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Desktop Assessment for the proposed Thornhill Housing Project, Ndlambe Municipality, Port Alfred, Eastern Cape Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological desktop assessment of the proposed housing development on portion 237 of farm Hartebeestpoort 328. Bloemfontein.

**Butler, E. 2018.** Palaeontological desktop assessment of the proposed New Age Chicken layer facility located on holding 75 Endicott near Springs in Gauteng. Bloemfontein.

**Butler, E. 2018** Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.

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Palaeontological Desktop Assessment for the 3 proposed Somkhele Colliery opencast mining pits, KwaZulu Natal

**Butler, E. 2018.** Palaeontological field assessment of the proposed development of the Wildealskloof mixed use development near Bloemfontein, Free State Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Field Assessment of the proposed Megamor Extension, East London. Bloemfontein

**Butler, E. 2018.** 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. 2018.** Palaeontological Impact Assessment of the proposed construction of a new 11kV (1.3km) Power Line to supply electricity to a cell tower on farm 215 near Delportshoop in the Northern Cape. Bloemfontein.

**Butler, E. 2018.** Palaeontological Field Assessment of the proposed construction of a new 22 kV single wood pole structure power line to the proposed MTN tower, near Britstown, Northern Cape Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Exemption Letter for the proposed reclamation and reprocessing of the City Deep Dumps in Johannesburg, Gauteng Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Exemption letter for the proposed reclamation and reprocessing of the City Deep Dumps and Rooikraal Tailings Facility in Johannesburg, Gauteng Province. Bloemfontein.

**Butler, E. 2018.** Proposed Kalabasfontein Mine Extension project, near Bethal, Govan Mbeki District Municipality, Mpumalanga. Bloemfontein.

**Butler, E. 2018.** Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Desktop Assessment of the proposed Mookodi – Mahikeng 400kV Line, North West Province. Bloemfontein.

**Butler, E. 2018.** Environmental Impact Assessment (EIA) for the Proposed 325mw Rondekop Wind Energy Facility between Matjiesfontein And Sutherland In The Northern Cape Province.

**Butler, E. 2018.** Palaeontological Impact Assessment of the proposed construction of the Tooverberg Wind Energy Facility, and associated grid connection near Touws River in the Western Cape Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological impact assessment of the proposed Kalabasfontein Mining Right Application, near Bethal, Mpumalanga.

**E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed Westrand Strengthening Project Phase II.

**E. Butler. 2019.** Palaeontological Field Assessment for the proposed Sirius 3 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province

**E. Butler. 2019.** Palaeontological Field Assessment for the proposed Sirius 4 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province

**E. Butler. 2019.** Palaeontological Field Assessment for Heuningspruit PV 1 Solar Energy Facility near Koppies, Ngwathe Local Municipality, Free State Province.

- E. Butler.** 2019. Palaeontological Field Assessment for the Moeding Solar Grid Connection, North West Province.
- E. Butler.** 2019. Recommended Exemption from further Palaeontological studies for the Proposed Agricultural Development on Farms 1763, 2372 And 2363, Kakamas South Settlement, Kai! Garib Municipality, Mgcawu District Municipality, Northern Cape Province.
- E. Butler. 2019.** Recommended Exemption from further Palaeontological studies: of Proposed Agricultural Development, Plot 1178, Kakamas South Settlement, Kai! Garib Municipality
- E. Butler. 2019.** Palaeontological Desktop Assessment for the Proposed Waste Rock Dump Project at Tshipi Borwa Mine, near Hotazel, Northern Cape Province:
- E. Butler. 2019.** Palaeontological Exemption Letter for the proposed DMS Upgrade Project at the Sishen Mine, Gamagara Local Municipality, Northern Cape Province
- E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed Integrated Environmental Authorisation process for the proposed Der Brochen Amendment project, near Groblershoop, Limpopo
- E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed updated Environmental Management Programme (EMPr) for the Assmang (Pty) Ltd Black Rock Mining Operations, Hotazel, Northern Cape
- E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed Kriel Power Station Lime Plant Upgrade, Mpumalanga Province
- E. Butler.** 2019. Palaeontological Impact Assessment for the proposed Kangala Extension Project Near Delmas, Mpumalanga Province.
- E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed construction of an iron/steel smelter at the Botshabelo Industrial area within the Mangaung Metropolitan Municipality, Free State Province.
- E. Butler. 2019.** Recommended Exemption from further Palaeontological studies for the proposed agricultural development on farms 1763, 2372 and 2363, Kakamas South settlement, Kai! Garib Municipality, Mgcawu District Municipality, Northern Cape Province.
- E. Butler. 2019.** Recommended Exemption from further Palaeontological Studies for Proposed formalisation of Gamakor and Noodkamp low cost Housing Development, Keimoes, Gordonia Rd, Kai !Garib Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.
- E. Butler. 2019.** Recommended Exemption from further Palaeontological Studies for proposed formalisation of Blaauwskop Low Cost Housing Development, Kenhardt Road, Kai !Garib Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.
- E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed mining permit application for the removal of diamonds alluvial and diamonds kimberlite near Windsorton on a certain portion of Farm Zoelen's Laagte 158, Registration Division: Barkly Wes, Northern Cape Province.
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- E. Butler. 2019.** Palaeontological Desktop Assessment for The Proposed 920 Kwp Groenheuwel Solar Plant Near Augrabies, Northern Cape Province
- E. Butler. 2019.** Palaeontological Desktop Assessment for the establishment of a Super Fines Storage Facility at Amandelbult Mine, Near Thabazimbi, Limpopo Province
- E. Butler. 2019.** Palaeontological Impact Assessment for the proposed Sace Lifex Project, Near Emalahleni, Mpumalanga Province
- E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed Rehau Fort Jackson Warehouse Extension, East London
- E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed Environmental Authorisation Amendment for moving 3 Km Of the Merensky-Kameni 132KV Powerline
- 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.
- E. Butler. 2019.** Palaeontological field Assessment of the Filling Station (Rietvlei Extension 6) on the Remaining Portion of Portion 1 of the Farm Witkoppies 393JR east of the Rietvleidam Nature Reserve, City of Tshwane, Gauteng
- E. Butler. 2019.** Palaeontological Desktop Assessment Of The Proposed Upgrade Of The Vaal Gamagara Regional Water Supply Scheme: Phase 2 And Groundwater Abstraction
- E. Butler. 2019.** Palaeontological Desktop Assessment Of The Expansion Of The Jan Kempdorp Cemetry On Portion 43 Of Farm Guldenskat 36-Hn, Northern Cape Province
- E. Butler. 2019.** Palaeontological Desktop Assessment of the Proposed Residential Development On Portion 42 Of Farm Geldunskat No 36 In Jan Kempdorp, Phokwane Local Municipality, Northern Cape Province
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- E. Butler. 2019.** Palaeontological Protocol for Finds for the proposed 16m WH Battery Storage System in Steinkopf, Northern Cape Province
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- E. Butler. 2019.** Palaeontological Exemption Letter of the proposed 2.5ml Process Water Reservoir at Gloria Mine, Black Rock, Hotazel, Northern Cape
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**E. Butler.** 2019. Palaeontological Desktop Assessment of the Proposed Diamond Mining Permit Application Near Kimberley, Sol Plaatjies Municipality, Northern Cape Province

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**E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed seepage interception drains at Duvha Power Station, Emalahleni Municipality, Mpumalanga Province

**E. Butler.** 2019. Palaeontological Desktop Assessment letter for the Proposed PV Solar Facility at the Heineken Sedibeng Brewery, near Vereeniging, Gauteng.

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**E. Butler.** 2019. Palaeontological field Assessment for the Proposed Upgrade of the Kolomela Mining Operations, Tsantsabane Local Municipality, Siyanda District Municipality, Northern Cape Province, Northern Cape

**E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed feldspar prospecting rights and mining application on portion 4 and 5 of the farm Rozyne 104, Kakamas South, Kai! Garib Municipality, Zf Mgcawu District Municipality, Northern Cape

**E. Butler.** 2019. Palaeontological Phase 1 Field Assessment of the proposed Summerpride Residential Development and Associated Infrastructure on Erf 107, Buffalo City Municipality, East London.

**E. Butler.** 2019. Palaeontological Desktop Impact Assessment for the proposed re-commission of the Old Balgray Anthracite Mine near Dundee, Kwazulu Natal.

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**E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Environmental Authorisation and Amendment Processes for Elandsfontein Anthracite Mine.

**E. Butler.** 2019. Palaeontological Impact Assessment and Protocol for Finds of a Proposed New Quarry on Portion 9 (of 6) of the farm Mimosa Glen 885, Bloemfontein, Free State Province

**E. Butler.** 2019. Palaeontological Impact Assessment and Protocol for Finds of a proposed development on Portion 9 and 10 of the Farm Mimosa Glen 885, Bloemfontein, Free State Province

**E. Butler.** 2019. Palaeontological Exemption Letter for the proposed residential development on the Remainder of Portion 1 of the Farm Strathearn 2154 in the Magisterial District of Bloemfontein, Free State

**E. Butler.** 2019. Palaeontological Field Assessment for the Proposed Nigel Gas Transmission Pipeline Project in the Nigel Area of the Ekurhuleni Metropolitan Municipality, Gauteng Province

**E. Butler.** 2019. Palaeontological Desktop Assessment for five Proposed Black Mountain Mining Prospecting Right Applications, Without Bulk Sampling, in the Northern Cape.

**E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Environmental Authorisation and an Integrated Water Use Licence Application for the Reclamation of the Marievale Tailings Storage Facilities, Ekurhuleni Metropolitan Municipality - Gauteng Province.

**E. Butler.** 2019. Palaeontological Impact Assessment for the Proposed Sace Lifex Project, near Emalahleni, Mpumalanga Province.

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**E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Amendment of the Kusipongo Underground and Opencast Coal Mine in Support of an Environmental Authorization and Waste Management License Application.

**E. Butler.** 2019. Palaeontological Exemption Letter of the Proposed Mamatwan Mine Section 24g Rectification Application, near Hotazel, Northern Cape Province

Palaeontological Field Assessment for the Proposed Environmental Authorisation and Amendment Processes for Elandsfontein Anthracite Mine

Palaeontological Desktop Assessment for the Proposed Extension of the South African Nuclear Energy Corporation (Necsa) Pipe Storage Facility, Madibeng Local Municipality, North West Province

Palaeontological Field Assessment for the Proposed Piggery on Portion 46 of the Farm Brakkefontien 416, Within the Nelson Mandela Bay Municipality, Eastern Cape

Palaeontological field Assessment for the proposed Rietfontein Housing Project as part of the Rapid Land Release Programme, Gauteng Province Department of Human Settlements, City of Johannesburg Metropolitan Municipality

Palaeontological Desktop Assessment for the Proposed Choje Wind Farm between Grahamstown and Somerset East, Eastern Cape

Palaeontological Desktop Assessment of the Proposed Prospecting Right Application for the Prospecting of Diamonds (Alluvial, General & In Kimberlite), Combined with A Waste License Application, Registration Division: Gordonia And Kenhardt, Northern Cape Province

Palaeontological Impact Assessment for the Proposed Clayville Truck Yard, Ablution Blocks and Wash Bay to be Situated on Portion 55 And 56 Of Erf 1015, Clayville X11, Ekurhuleni Metropolitan Municipality, Gauteng Province

Palaeontological Desktop Assessment for the Proposed Hartebeesthoek Residential Development

Palaeontological Desktop Assessment for the Proposed Mooiplaats Educational Facility, Gauteng Province

Palaeontological Impact Assessment for the Proposed Monument Park Student Housing Establishment

Palaeontological Field Assessment for the Proposed Standerton X10 Residential and Mixed-Use Developments, Lekwa Local Municipality Standerton, Mpumalanga Province

Palaeontological Field Assessment for the Rezoning and Subdivision of Portion 6 Of Farm 743, East London

Palaeontological Field Assessment for the Proposed Matla Power Station Reverse Osmosis Plant, Mpumalanga Province

## 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.

Butler, E., and J. Botha-Brink. Postcranial skeleton of Galesaurus planiceps, implications for biology and lifestyle. 14<sup>th</sup> Conference of the PSSA, Matjesfontein, South Africa. September 2008:

Butler, E., and J. Botha-Brink. The biology of the South African non-mammaliaform cynodont Galesaurus planiceps. 15<sup>th</sup> Conference of the PSSA, Howick, South Africa. August 2008.

### **INTERNATIONAL VISITS**

Natural History Museum, London

July 2008

Paleontological Institute, Russian Academy of Science, Moscow

November 2014