PALAEONTOLOGICAL IMPACT ASSESSMENT OF THE PROPOSED KALABASFONTEIN MINING RIGHT APPLICATION, NEAR BETHAL, MPUMALANGA

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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 favourable 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 favourable 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 realise that a false declaration is an offence 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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ACKNOWLEDGEMENT OF RECEIPT

Report Title	Palaeontological impact assessment of the proposed Kalabasfontein Mining Right Application, near Bethal, Mpumalanga		
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The Palaeontological Impact Assessment report has been compiled taking into account the NEMA Appendix 6 requirements for specialist reports as indicated in the table below.

NEMA Regs (2014) - Appendix 6	Relevant section in report
1. (1) A specialist report prepared in terms of these Regulations must contain- details of- the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page ii of Report – Contact details and company and Appendix 2
a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ii
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 8- No existing impacts
the date, duration and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A Desktop assessment
a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 7 Methodology
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, Section 5
an identification of any areas to be avoided, including buffers;	Desktop assessment, Phase 1 to follow
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;	Desktop assessment, Phase 1 to follow
a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1.– Assumptions and Limitation
a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section 8, Section 9
any mitigation measures for inclusion in the EMPr;	Section 9
any conditions for inclusion in the environmental authorisation;	Section 9
any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
a reasoned opinion- as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and 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 9 – Conclusion
a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable.
a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not applicable. To date not comments regarding heritage resources that require input

	from a specialist have been raised.
any other information requested by the competent authority.	Not applicable.
2) Where a government notice *gazetted* 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.	Refer to section 4 compliance with SAHRA guidelines

EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the Desktop Palaeontological Impact Assessment (DPIA) for the proposed Kalabasfontein Project Mining Right Application situated on the farm Kalabasfontein 232IS, near Bethal, Mpumalanga. According to the National Heritage Resources Act (No 25 of 1999, section 38), a DPIA is key to detect the presence of fossil material within the proposed development footprint and it is thus necessary to evaluate the impact of the construction on the palaeontological resources.

The proposed development footprint of the proposed Kalabasfontein development is entirely underlain by sedimentary rocks of the Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup). The Vryheid Formation of the Ecca Group has a **Very High Palaeontological** Sensitivity. Although **no fossils** have been found in the current mining area, it is possible that important fossils namely the Glossopteris flora will be documented during excavations. This flora is associated with the shales between the coal seams but not in the coal itself. The recording of fossils will improve our knowledge of the Palaeontological Heritage of the development area.

Two alternative sites have been suggested for a **new ventilation shaft**, namely Portion 7 of the farm Uitgedacht 229 IS and Portion 22 of the farm Uitgedacht 229 IS. The planned **extension of the current mining area** will involve minimal new surface infrastructure as the mining method is underground mining and existing surface infrastructure from the Forzando South mine will be utilized. As the geology of the mine extension and ventilation shaft alternatives is similar, there are none preferred alternative for either of the ventilation shafts.

As **no fossils** have been recovered from the existing mining area the proposed development is deemed feasible and will not lead to detrimental impacts on the palaeontological resources of the area. However, a chance find protocol for finding fossils from the proposed development site is included in this report.

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TERMINOLOGY AND ABBREVIATIONS

Archaeological resources

This includes:

- material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;
- rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

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 influence 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

Early Stone Age

The archaeology of the Stone Age between 700 000 and 2 500 000 years ago.

Fossil

Mineralised 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;

Holocene

The most recent geological time period which commenced 10 000 years ago.

Late Stone Age

The archaeology of the last 30 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 30 000-300 000 years ago, associated with early modern humans.

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.

Abbreviations	Description
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DPIA	Desktop Palaeontological Impact Assessment
EA	Environmental authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
EIMS	Environmental Impact Management Services
EMPR	Environmental Management programme
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
MWP	Mine Works Programme
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
WULA	New Water Use Licence Application

1 INTRODUCTION

The proposed Kalabasfontein project is situated on the farm Kalabasfontein 232 IS near Bethal in Mpumalanga, within the Msukaligwa Local Municipality (**Figure 1**).

The Department of Mineral Resources (DMR) received an application of Forzando Coal Mines (Pty) Ltd for the change of Old Order Mining Rights to New Order Mining Rights for its mining operations at the Forzando North Shaft and Forzando South Shaft. These changes were approved in November 2011 and implemented on 28 June 2013.

This application is applicable for the extension of the current mining areas (under Section 102 of MPRDA (Act No. 28 of 2002) by inclusion of connecting areas which are held under Prospecting Rights 1035PR & 1170PR. Economically viable blocks of coal have been defined and will be accessed via the existing Forzando South incline. Coal will be removed through underground mining.

Extending these Prospecting Rights into the existing Forzando South Mining Right is driven by the reduction of Reserves at Forzando North Shaft. This decrease in reserves is as a result of unexpected poor ground conditions as well as burnt coal (Forzando Coal Mines (Pty) Ltd. 2018).

The Prospecting Right Application includes two alternatives for a new ventilation shaft as well as the extension of the current mining area. The two alternative sites suggested for the new ventilation shaft is located on Portion 7 of the farm Uitgedacht 229 IS and Portion 22 of the farm Uitgedacht 229 IS. The planned extension of the current mining area will involve minimal new surface infrastructure as the mining method is underground mining. The planned extension will utilize the existing surface infrastructure from the Forzando South mine.

Forzando Coal Mines (Pty) Ltd has employed Environmental Impact Management Services (Pty) Ltd (EIMS) to act as the independent Environmental Assessment Practitioner (EAP) to undertake the Environmental Impact Assessment for the planned Kalabasfontein project. An application for the amendment to the current Mine Works Programme (MWP) and EMPR, through an MPRDA Section 102 Application, and a full Environmental Impact Assessment (EIA) for the planned new mining area is, essential to support an application for environmental authorisation (EA). A new water use licence application (WULA) for the relevant water use triggers associated with the proposed project will also be undertaken.

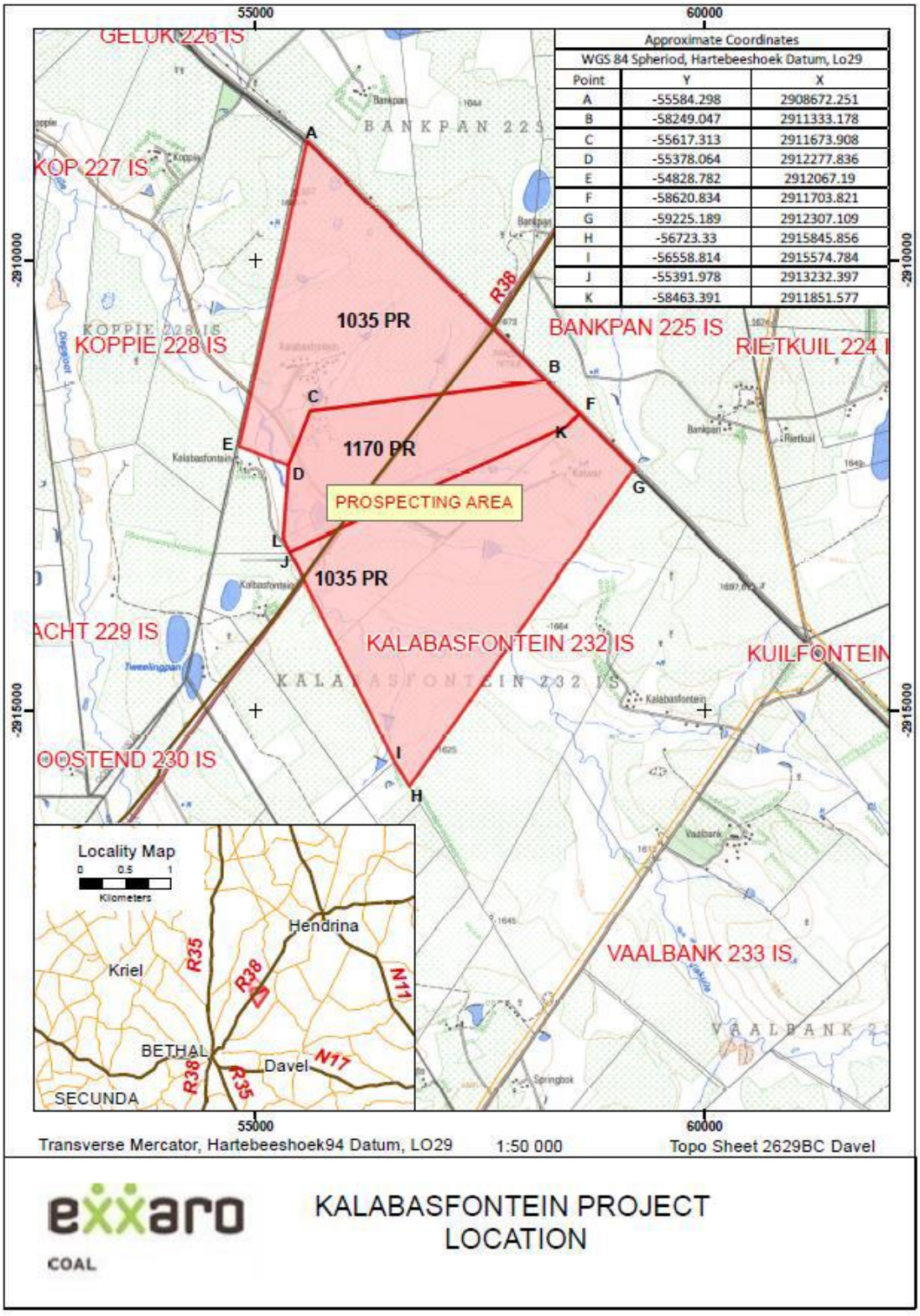

Figure 1 - Kalabasfontein project location. (Map provided by Exxaro Coal).

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 12 years. She has been conducting Palaeontological Impact Assessments 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, moved, broken 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 DPIA 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^2 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 SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m^2 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 DPIA 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 DPIA 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 appropriate best practice guidelines, relevant legislation and authority requirements;
- Provide a thorough overview of all applicable legislation, guidelines;
- Identification sensitive areas to be avoided (including providing shapefiles/kmls);
- Assessment of the significance of the proposed 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. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
    b. Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place 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. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.
- Comparative assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures in order to minimise the impact of the proposed development; and

- Implications of specialist findings for the proposed development (e.g. permits, licenses etc).

5 METHODOLOGY

A desktop study is conducted to evaluate the possible risk to palaeontological heritage (this includes fossils as well as trace fossils) in the proposed development area.

The potentially fossiliferous rocks present within the development are established from 1:250 000 geological maps. The topography of the development is identified by 1:50 000 topography maps and Google Earth Images. Previous palaeontological impact studies in the same region, the PalaeoMap from SAHRIS; and databases of various institutions which identify fossils found in close proximity to the development is used to identify the fossil heritage within each rock.

The palaeontological status of each rock component in the development area is calculated and the possible impact of the development on fossil heritage is determined by
a) the palaeontological importance of the rocks;
b) the scale and type of development; and,
c) the quantity of bedrock removed.

5.1 Assumptions and Limitations

The accurateness of a desktop DPIA is reduced by old fossil databases that do not always include relevant locality or geological formations. The geology in various remote areas of South Africa may be less accurate because it is based entirely on aerial photographs. The accuracy of the sheet explanations for geological maps is inadequate as the focus was never intended to be on palaeontological material.

The entirety of South Africa has not been studied palaeontologically. Similar Assemblage Zones but in different areas, might provide information on the presence of fossil heritage in an unmapped area. Desktop studies of similar geological formations generally assume that unexposed fossil heritage is present within the development area. Thus, the accuracy of the desktop DPIA is improved by a field-survey.

6 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The Kalabasfontein Mining Project is completely underlain by sedimentary rocks of the Permian aged Vryheid Formation, Ecca Group, Karoo Supergroup (**Figure 4**). This Formation is known to contain a rich assemblage of plant fossils and thus coal can be mined. The Vryheid formation has a very high palaeontological sensitivity.

6.1 Geology

Ecca Group

Table 1: Ecca Group and Formations. (Modified from Johnson et al, 2006).

<table>
<tr><th>Period</th><th>Supergroup</th><th>Group</th><th>Formation West of 24^0 E</th><th>Formation East of 24^0 E</th><th>Formation Free State / KwaZulu Natal</th></tr>
<tr><td rowspan="8">Permian</td><td rowspan="8">Karoo Supergroup</td><td rowspan="8">Ecca Group</td><td>Waterford Formation</td><td>Waterford Formation</td><td rowspan="2">Volksrust Formation</td></tr>
<tr><td>Tierberg / Fort Brown Formation</td><td>Fort Brown Formation</td></tr>
<tr><td>Laingsburg / Rippon Formation</td><td>Rippon Formation</td><td>Vryheid Formation</td></tr>
<tr><td>Collingham Formation</td><td>Collingham Formation</td><td rowspan="3">Pietermaritzburg Formation</td></tr>
<tr><td>Whitehill Formation</td><td>Whitehill Formation</td></tr>
<tr><td rowspan="2">Prince Albert Formation</td><td rowspan="2">Prince Albert Formation</td></tr>
<tr><td>Mbizane Formation</td></tr>
</table>

This Group consists of the following Formations (DWA, 1998):

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.

6.2 Palaeontology

The Vryheid Formation (Ecca Group) is world renowned for the occurrence of coal beds formed by the accumulation of plant material over long periods of time. Bamford (2011) described numerous plant fossils from this formation (e.g. *Azaniodendron fertile*, *Cyclodendron leslii, Sphenophyllum hammanskraalensis, Annularia sp., Raniganjia sp., Asterotheca spp., Liknopetalon enigmata, Hirsutum* sp., *Scutum* sp., *Ottokaria* sp., *Estcourtia* sp., *Arberia* sp., *Lidgetonnia* sp., *Noeggerathiopsis* sp., *Podocarpidites* sp as well as more than 20 Glossopteris species.

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.

The occurrence of fossil insects are 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.

Figure 2: Example of Glossopteris leaves.
https://heatherkellyblog.files.wordpress.com/2015/04/scotts-glossopteris.jpg

Figure 3: *Glossopteris browniana*

http://www.fossilmall.com/Science/plantae/Glossopteris-browniana/AAF546D.jpg

Figure 4 - Surface geology of the proposed Kalabasfontein Project, near Bethal, Mpumalanga. The proposed development is entirely underlain by the Vryheid Formation (Ecca Group, Karoo Supergroup).) Map drawn by QGIS Desktop 2.18.18.

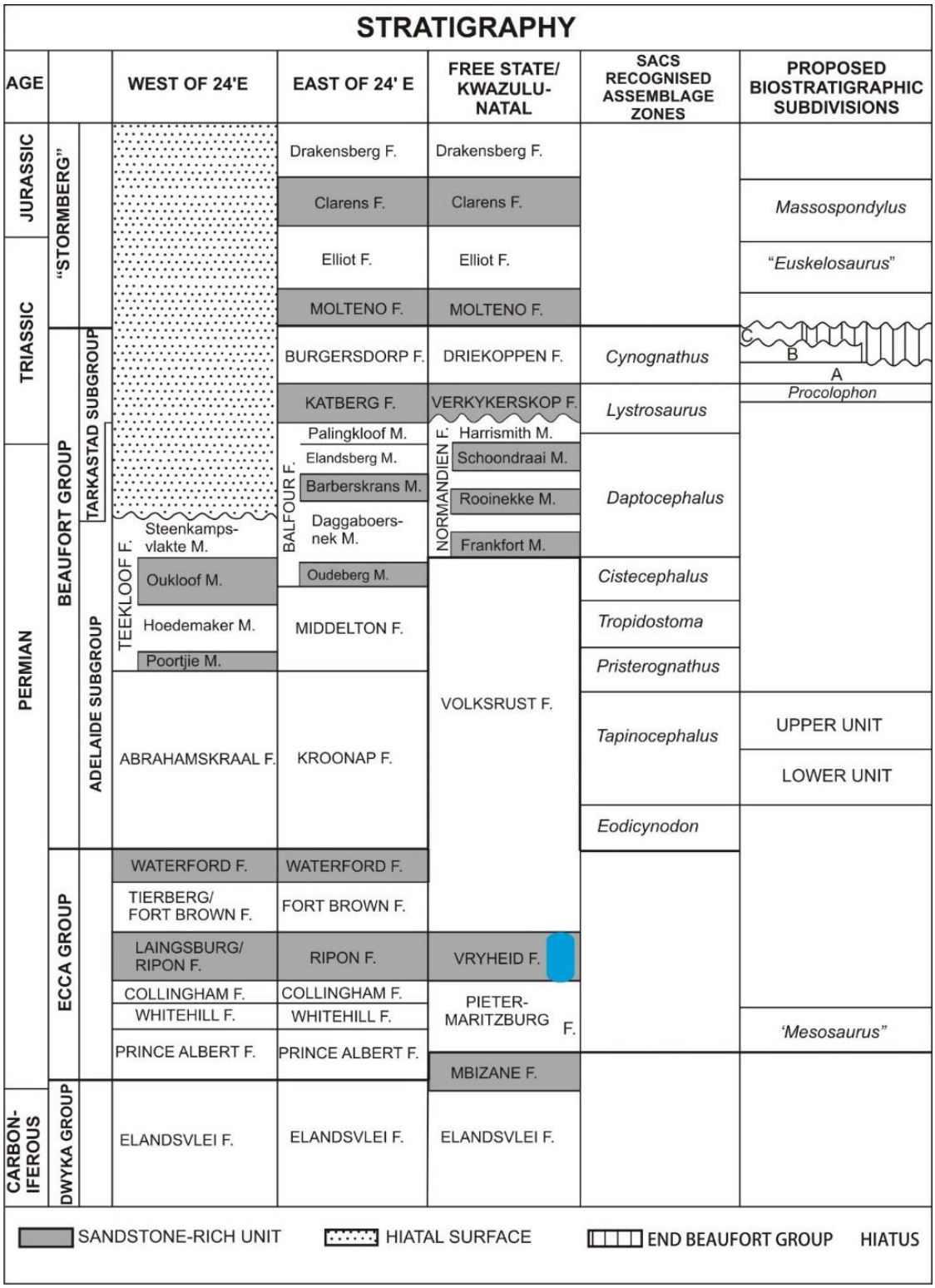

Figure 5 - Lithostratigraphic (rock-based) and biostratigraphic (fossil-based) subdivisions of the Ecca and Beaufort Group of the Karoo Supergroup with rock units and fossil assemblage zones relevant to the present study marked in red (Modified from Rubidge 1995).

7 GEOGRAPHICAL LOCATION OF THE SITE

The proposed Kalabasfontein project area is 20 kilometres north of Bethal and 20 kilometres east of Ga-Nala (Kriel) in Mpumalanga and within the Msukaligwa Local Municipality. It is located to the south and east of the present Forzando South 380MR and Forzando North 381MR respectively. The project area comprises of two prospecting rights, 1035PR & 1170PR which is approximately 1 547.8296ha in extent and is located on portions 7, 8, Remaining Extent (RE), 11 and 13 of the farm Kalabasfontein 232 IS.

8 FINDINGS

The proposed development footprint of the proposed Kalabasfontein development is entirely underlain by sedimentary rocks of the Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup). The Vryheid Formation of the Ecca Group has a Very High Palaeontological Sensitivity. No significant fossils are expected to be found before deep excavation (>1.5m) are completed. It is very possible that important fossils namely the Glossopteris flora will be documented during excavations. This flora is associated with the shales between the coal seams but not in the coal itself. The recording of fossils will improve our knowledge of the Palaeontological Heritage of the development area. But, it is important to note that to date no fossils have been discovered in this mining area.

Two alternative sites have been suggested for a new ventilation shaft, namely Portion 7 of the farm Uitgedacht 229 IS and Portion 22 of the farm Uitgedacht 229 IS. The planned extension of the current mining area will involve minimal new surface infrastructure as the mining method is underground mining and existing surface infrastructure from the Forzando South mine will be utilized. As the geology of these alternatives for the ventilation shaft is similar, there are none preferred alternative for either of the ventilation shafts.

8.1 IMPACT ASSESMENT

Impact on Palaeontological Heritage will only occur during the construction phase of the proposed development with no impacts on the preconstruction, operational and decommissioning phases. The impact of the development will only occur on the **site** but most probably the fossil heritage will be negatively impacted on. When fossil heritage is destroyed the impact will be irreversible. The impact will be long term to permanent and the magnitude and **probability** of the impact will be **high**. The overall Environmental significance rating before implementation of the recommended mitigation measures is rated as **medium**. The implementation of mitigation measure will reduce the final impact significance to **Low** for both alternatives.

Table 2: Impact assessment for the Ventilation shaft alternative 1

A. Loss of fossil heritage - Ventilation shaft Alternative 1: Portion 7 of the farm Uitgedacht 229 IS					
Impact Name	**Loss of fossil heritage**				
Alternative	**Alternative 1**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	2
Extent of Impact	2	2	Reversibility of Impact	5	5
Duration of Impact	4	4	Probability	2	1
Environmental Risk (Pre-mitigation)					-7.50
Mitigation Measures					
As no fossils have been recovered from the existing mining area the proposed development is deemed feasible and will not lead to detrimental impacts on the palaeontological resources of the area. A chance find protocol for finding fossils from the proposed development site is thus included in this report					
Environmental Risk (Post-mitigation)					-3.25
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1.50
Final Significance					-4.88

Table 3: Impact assessment for the Ventilation shaft alternative 2

A. Loss of fossil heritage - Ventilation shaft Alternative 2: Portion 22 of the farm Uitgedacht 229 IS					
Impact Name	**Loss of fossil heritage**				
Alternative	**Alternative Impact assessment for the Ventilation shaft alternative 2**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	2
Extent of Impact	2	2	Reversibility of Impact	5	5
Duration of Impact	4	4	Probability	2	1
Environmental Risk (Pre-mitigation)					-7.50
Mitigation Measures					

As no fossils have been recovered from the existing mining area the proposed development is deemed feasible and will not lead to detrimental impacts on the palaeontological resources of the area. A chance find protocol for finding fossils from the proposed development site is thus included in this report	
Environmental Risk (Post-mitigation)	-3.25
Degree of confidence in impact prediction:	High
Impact Prioritisation	
Public Response	1
Low: Issue not raised in public responses	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1.50
Final Significance	-4.88

Table 4: Impact assessment for the Kalabasfontein Underground mining project

A. Loss of fossil heritage - Kalabasfontein Underground mining project					
Impact Name	**Loss of fossil heritage**				
Alternative	**Sole Alternative**				
Phase	**Mining/Operational phase**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	2
Extent of Impact	2	2	Reversibility of Impact	5	5
Duration of Impact	4	4	Probability	2	1
Environmental Risk (Pre-mitigation)					-7.50
Mitigation Measures					
As no fossils have been recovered from the existing mining area the proposed development is deemed feasible and will not lead to detrimental impacts on the palaeontological resources of the area. A chance find protocol for finding fossils from the proposed development site is thus included in this report					
Environmental Risk (Post-mitigation)					-3.25
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1.50

Final Significance	-4.88

9 PROTOCOL FOR CHANCE FINDS

- When excavations starts the rocks must be inspected by the environmental officer or designated person. Any fossiliferous material (this include the coal, plants, trace fossil and insects) should be put aside in an appropriately protected place. This will ensure that the construction activities will not be interrupted. Photographs of possible fossil plants are provided to help recognizing the fossil plants in the shales and mudstones. This information will be added to the EMP's training and awareness plan and measures.

- Photographs of the assumed fossils may be sent to the palaeontologist for a preliminary assessment.

- Regularly site visits by a palaeontologist (to be agreed upon by the developer and the qualified palaeontologist sub-contracted for this project), must be conducted to inspect the selected material and check the dumps where possible. (If fossils are present these inspections should be conducted monthly but if the onsite designated person is diligent the fossil material may be inspections less frequent).

- Fossil that are considered to be of good quality or scientific important must be removed, catalogued and housed in a accredited institution where they can be made available for further study. However, before the fossils are removed from the site a SAHRA permit must be obtained and annual reports must be submitted to SAHRA as required by the relevant permits.

- In the event that no good fossil material is recovered from the mine, the site inspections by the palaeontologist may be reduced to annual events until construction has ceased. Annual reports by the palaeontologist must be sent to SAHRA.

10 CONCLUSION

The proposed development footprint of the proposed Kalabasfontein development is entirely underlain by sedimentary rocks of the Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup). The Vryheid Formation of the Ecca Group has a Very High Palaeontological Sensitivity. No significant fossils are expected to be found before deep excavation (>1.5m) are completed. It is very possible that important fossils namely the Glossopteris flora will be documented during excavations. Fossil plants are preserved in the shales and separations between and within some coal seams. These fossils are important but is generally widely distributed and difficult to find. This flora is well researched but there is always a small chance that new taxa may be exposed.

As no fossils have been recovered from the existing mining area the proposed development is deemed feasible and will not lead to detrimental impacts on the palaeontological resources of the area. A chance find protocol for finding fossils from the proposed development site is thus included in this report

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APPENDIX 1: The Impact Assessment Methodology

The impact assessment methodology is guided by the requirements of the NEMA EIA Regulations (2014). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/likelihood (P) of the impact occurring. This determines the environmental risk. In addition other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S).

Determination of Environmental Risk:

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER).

The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$C = \frac{(E+D+M+R)}{4} \times N$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in **Table 5**.

Table 5: Criteria for Determining Impact Consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).

Aspect	Score	Definition
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined, the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per

Table 6**.**

Table 6: Probability Scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

ER= C x P

Table 7: Determination of Environmental Risk

C o c	5	5	10	15	20	25

	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
		Probability				

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in **Table 8**.

Table 8: Significance Classes

Environmental Risk Score	
Value	**Description**
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥9; <17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

Impact Prioritisation:

In accordance with the requirements of Appendix 3(3)(j) the 2014 EIA Regulations (GNR 982), and further to the assessment criteria presented in the Section above it is necessary to assess each potentially significant impact in terms of:

Cumulative impacts; and

The degree to which the impact may cause irreplaceable loss of resources.

In addition it is important that the public opinion and sentiment regarding a prospective development and consequent potential impacts is considered in the decision making process.

In an effort to ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented. See **Table 9**.

Table 9: Criteria for Determining Prioritisation

	Low (1)	Issue not raised in public response.

Public response (PR)	Medium (2)	Issue has received a meaningful and justifiable public response.
	High (3)	Issue has received an intense meaningful and justifiable public response.
Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in **Table 10**. The impact priority is therefore determined as follows:

Priority = PR + CI + LR

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (Refer to **Table 10**).

Table 10: Determination of Prioritisation Factor

Priority	Ranking	Prioritisation Factor
3	Low	1
4	Medium	1.17
5	Medium	1.33
6	Medium	1.5
7	Medium	1.67
8	Medium	1.83
9	High	2

In order to determine the final impact significance the PF is multiplied by the ER of the post-mitigation scoring (**Table 11**). The ultimate aim of the PF is to be able to increase the post-mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential, significant public response, and significant potential for

irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 11: Final Environmental Significance Rating

Environmental Significance Rating	
Value	**Description**
< 10	Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
≥10 <20	Medium (i.e. where the impact could influence the decision to develop in the area),
≥ 20	High (i.e. where the impact must have an influence on the decision process to develop in the area).

APPENDIX 2: CV

ELIZE BUTLER

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	25 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 D*aptocephalus 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

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