PALAEONTOLOGICAL STUDY:
PROPOSED INFRASTRUCTURE AND ACTIVITIES ASSOCIATED WITH KOLOMELA MINE NEAR POSTMASBURG, NORTHERN CAPE

DMRE REFERENCE: NC069MR

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Client:	**EXM**
PGS Project No:	**526HIA** – Kolomela Update

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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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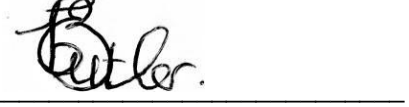
SIGNATURE: 

ACKNOWLEDGEMENT OF RECEIPT

Report Title	Palaeontological Study: Proposed Infrastructure and Activities Associated with Kolomela Mine near Postmasburg, Northern Cape		
Control	**Name**	**Signature**	**Designation**
Author	Elize Butler		Palaeontologist
Reviewed			Principal Heritage Specialist

CLIENT: **EXM**

CONTACT PERSON: **Trevor Hallatt**

SIGNATURE: 

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

Table 1 - NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to **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 Assessment
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure,	Section 1 and 10	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
inclusive of a site plan identifying site alternatives;		
(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	Section 11	
(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		
(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	Section 1 and 10	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
be included in the EMPr, and where applicable, the closure plan		
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(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 proposed infrastructure and activities associated with Kolomela mine near Postmasburg, Northern Cape. This PDA is compiled to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), to confirm if fossil material could potentially be present in the planned development area and to evaluate the impact of the proposed development on the Palaeontological Heritage.

The proposed development is underlain by Quaternary aged sediments of the Kalahari Group as well underlying Griqualand West Basin rocks. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Kalahari Group low but locally high and that of the Griqualand West rocks of the Transvaal Supergroup is moderate. Several Palaeontological site investigations have been conducted since 2019 on the Kolomella Mining area. In each case no fiossilifeous outcrops were identifieds and thus a desktop study has been conducted for the present study. The general low palaeontological sensitivity of the bedrocks and superficial sediments in the proposed development footprint, indicates that the proposed development will have a overall LOW impact significance in terms of palaeontological heritage. It is therefore considered that the development is will not lead to detrimental impacts on the palaeontological resources of the area. 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 Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation can be carry out by a paleontologist.

It is consequently recommended that no further palaeontological heritage studies, ground-truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

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TABLE OF CONTENT

List of Figures

List of Tables

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 2 - Abbreviations

Abbreviations	Description
ASAP	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEFF	Department of Environmental Department of Environment, Forestry and Fisheries
ECO	Environmental Control Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
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
NECSA	Nuclear Energy Corporation of South Africa
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
NGPM	Nkwe Garatau Platinum Mine
PDA	Palaeontological Desktop Assessment
PIA	Palaeontological Impact Assessment
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

1 INTRODUCTION

The Sishen Iron Ore Company (Pty) Ltd forms part of Kumba Iron Ore Limited and owns and operates Kolomela mine. Kolomell mine is situated south west of Postmasburg in the Tsantsabane Local Municipality, Northern Cape Province (Figure 1). A mineral right was granted by the The Minister of Mineral Resources for the mining of iron ore at Kolomela Mine in 2008, {Ref: (NC) 069 MR} and is valid until 2038, unless suspended or cancelled.

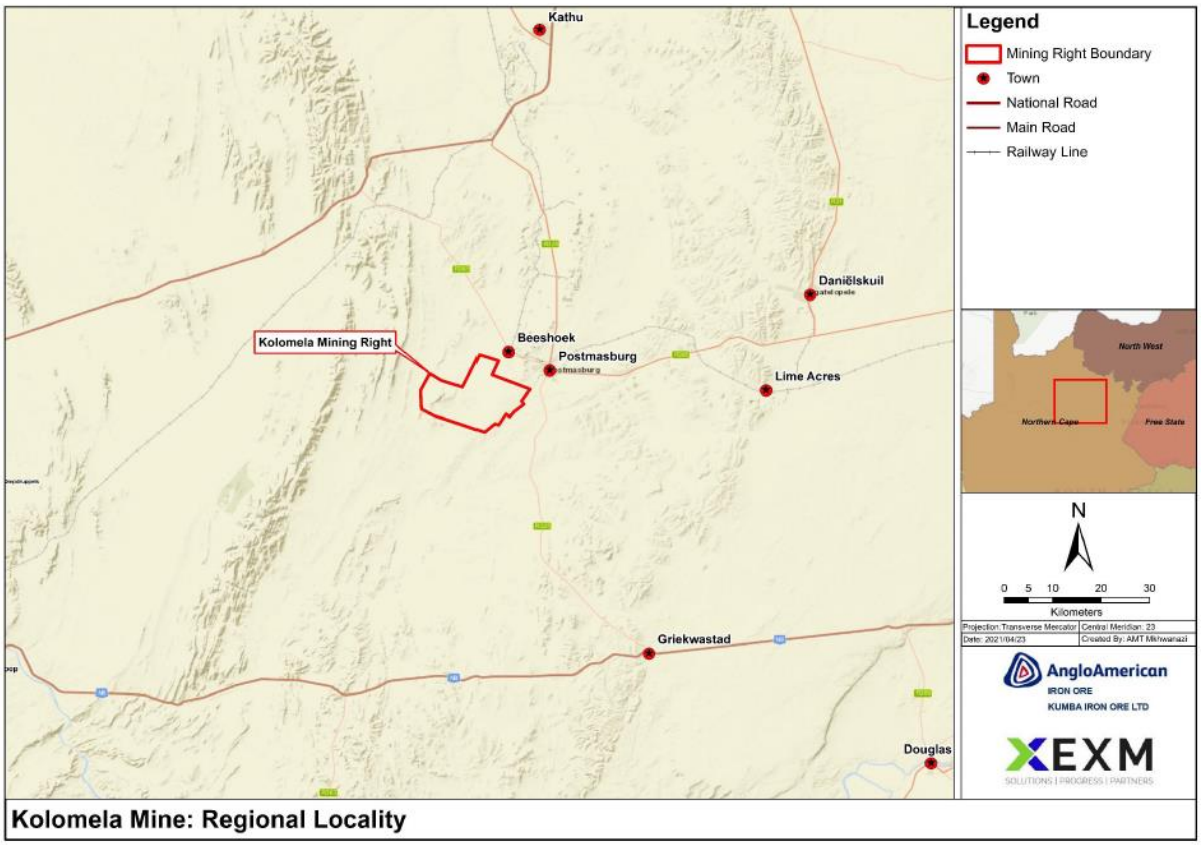


Figure 1 – Regional localit of Kolomella mine.

Kolomela mine operates as a conventional open cast mine where ore is extracted by means of drilling, blasting, loading and hauling. Ore extracted from the pits is transported to a direct shipping ore (DSO) plant which involves the crushing and screening of recovered ore material into stockpiles of 'lump' and 'fines'. The processed iron ore is loaded onto an internal railway line which is connected to a direct rail link to Transnet's Sishen-Saldanha railway line from where the iron ore is transported to the Port of Saldanha for export. Kolomela Mine also utilises a Modular Dense Media Separation (DMS) Processing Plant for the processing of low grade ore not suitable for processing at the DSO plant. Kolomela produced 10.8 million tonnes during its first full year of production in 2013 and currently produces 13-14 million tonnes per annum (Mtpa) facilitated by enhanced stripping techniques and processing of 1-3 Mtpa of lower grade of ore at the Tierbult DMS Modular Plant[1].

Iron ore is currently extracted from three opencast pits, namely Klipbankfontein, Leeuwfontein and Kapstevel North. Kolomela is in the process of developing the Kapstevel South Pit which is required to sustain the mining production at approximately 14 Mtpa (Mtpa) until 2031. The current the Life of Mine (LoM) including the Kapstevel South Pit currently stands at 2032, but with the potential to be extended in future with the development of the Ploegfontein, Tierbult and Heuningkranz ore bodies, the mining of which are already authorised[1].

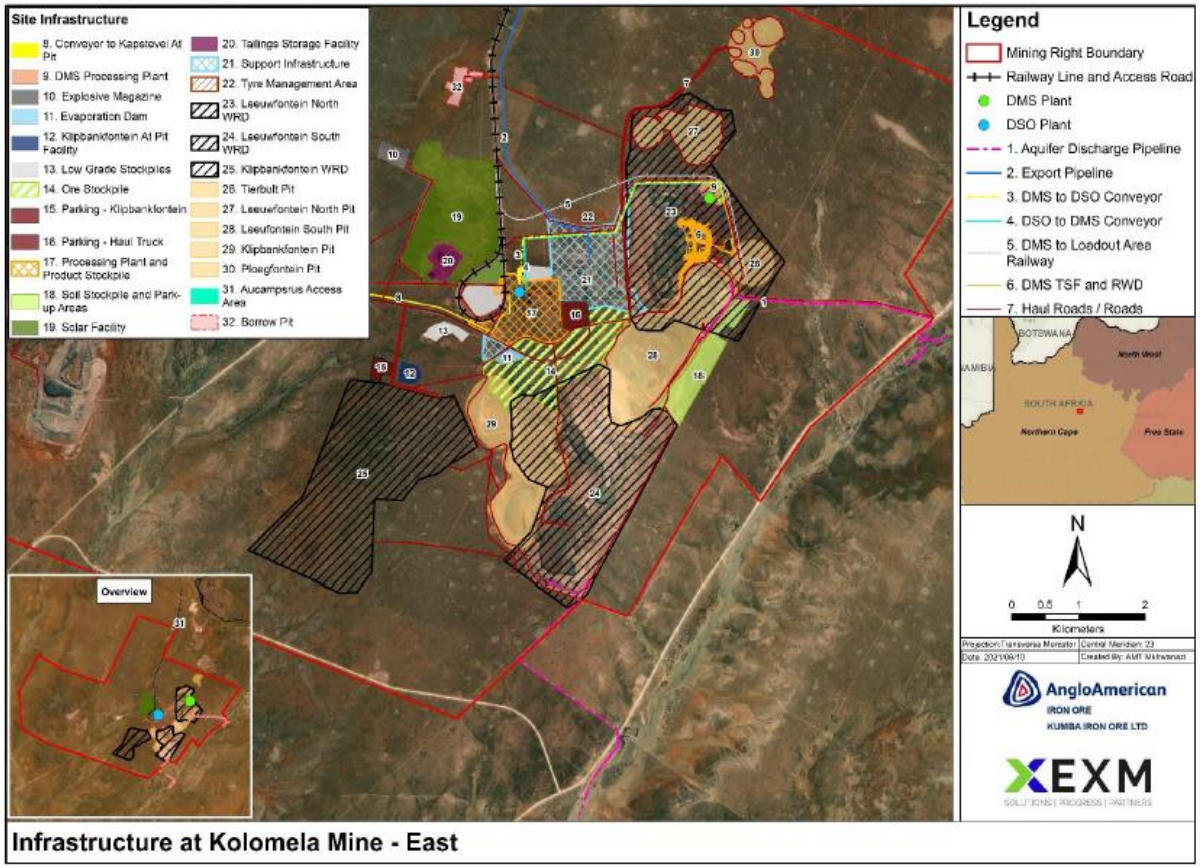


Figure 2 – Infrastructure associated with Kolomela -Eastern Section.

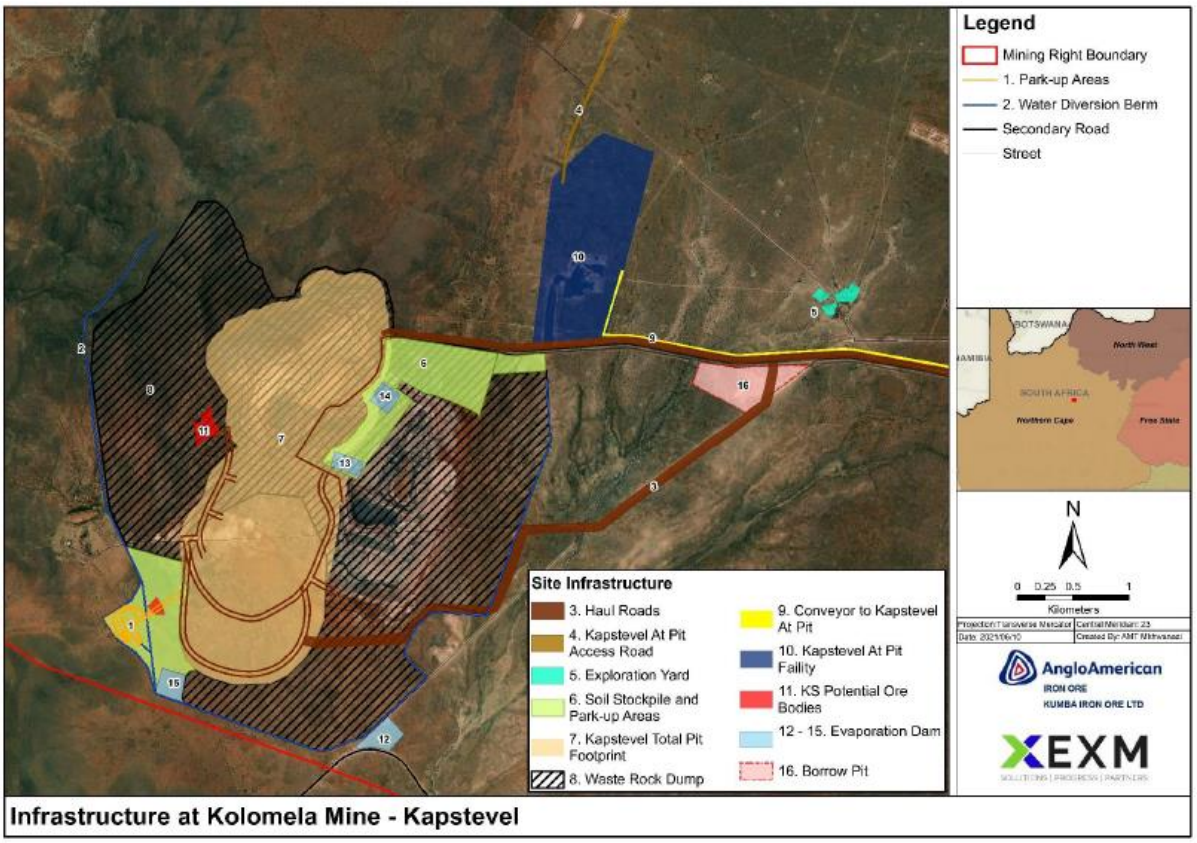


Figure 3 – Infrastructure associated with Kolomela -Kapstevel.

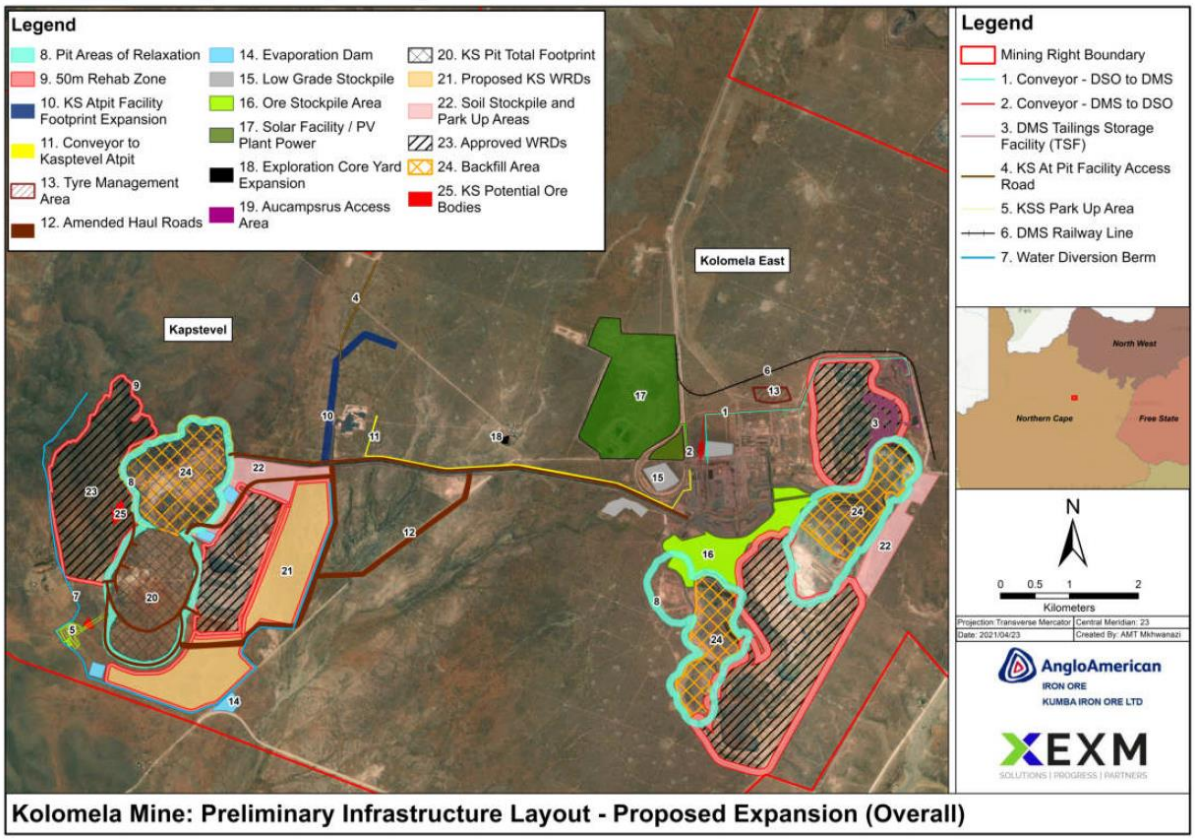


Figure 4 – Preliminary Infrastructure Layout-proposed expansion (overall).

Kolomela proposes to expand and amend some of the existing activities and also develop new infrastructure to support continued and future production at the mine. This includes:

- Amendment of the Kapstevel South Pit footprint area.
- Amendment of the Kapstevel Waste Rock Dumps and haul roads.
- Amendment of Kapstevel Evaporation Ponds and stormwater management infrastructure.
- Additional park-up, laydown and ore stockpile areas.
- Development of new DMS tailings management infrastructure
- A new Photovoltaic Solar Facility.
- A new Waste Tyre Management Facility.
- A conveyor and railway line to transfer material to and from the DMS plant.
- Amendment to the future Kapstevel DMS conveyor footprint to facilitate widened haul roads.
- Amendment of Kapstevel Waste Rock Dumps and Additional Waste Rock Dumps.
- Additional Low Grade Ore Storage Areas.
- New radio masts.
- Provision for an area of relaxation and safety berms around pits[1].

The existing and planned infrastructure at Kolomela mine are shown in (**Figure 2-4**). Authorisation is thus being sought from the Department of Mineral Resources & Energy (DMRE) for activities listed under the National Environmental Management Act (No. 107 of 1998) and the National Environmental Management: Waste Act (No. 59 of 2008) as well as amendment of the environmental management programme in terms of Section 102 of the Minerals & Petroleum Resources Development Act (No. 28 of 2002). The authorisation will cover existing and proposed footprints (**Figure 4**). This will be supported by a Scoping Study and an Environmental Impact Assessment (EIA)[1].

1.1 Previous Studied For Kolomele Mine

Since 2019, Banzai Environmental (Pty) Ltd conducted three (3) Palaeontological Impact Assessments for Kolomella Mine (excluding the present study).

Butler, E., 2019. Palaeontological Field Assessment for the proposed upgrade of the Kolomela Mining Operations, Tsantsabane Local Municipality, Siyanda District Municipality, Northern Cape Province, Northern Cape (Conducted for PGS Heritage).

Butler, E., 2020a. Palaeontological Impact Assessment for the proposed airport development near Postmasburg, Northern Cape (Conducted for PGS Heritage).

Butler, E., 2020b. Palaeontological Field Assessment for the proposed stormwater management infrastructure on Sishen Iron Ore Mine near Kathu, Northern Cape

1.1.1 Finding in previous studies.

Butler, E., 2019. Palaeontological Field Assessment for the proposed upgrade of the Kolomela Mining Operations, Tsantsabane Local Municipality, Siyanda District Municipality, Northern Cape Province, Northern Cape (Conducted for PGS Heritage).

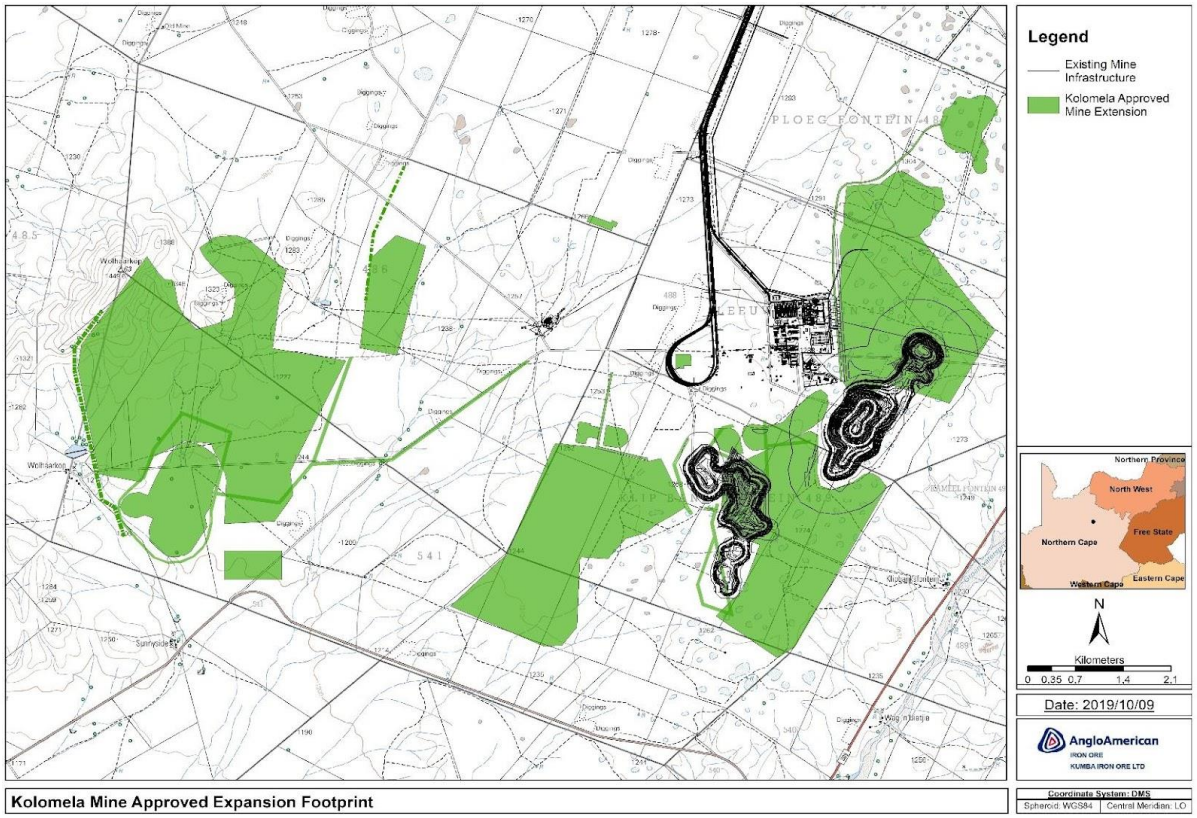


Figure 5:Study conducted in 2019.

Map indicating the authorised extension disturbance footprints areas at Kolomela Mine. *Map drawn by EXM 10.10.2019*

In this report a significant area were investigated (**Figure 5**) for the upgrade of the Mining Operations. Butler (2019) found that the Kolomela Mine is located in the Griqualand West Basin near Postmasburg, in the Northern Cape Province. The Mine is primarily underlain by the Quaternary aged sediments of the Kalahari Group as well as surface limestone and alluvium. The Vaalian age Ghaap Group, Koegas Subgroup, Postmasburg and Olifantshoek Groups (Transvaal Supergroup) are also represented in the northern and western areas of the development footprint. A Very High palaeontological sensitivity has been allocated to the Ghaap Group, while important early Hominin remains could also occur in carbonaceous breccias. The highly sensitive dolomites are overlain by surface limestones, which are known to contain important Quaternary plant and animal fossils. Sediments of the Ghaap Group are known for the presence of stromatolites. The author conducted a two day site investigation in September 2019 of the proposed development and no fossiliferous outcrops were detected. However due to the High Significance of the proposed development a Chance find Protocol was added to the report.

Butler, E., 2020a. Palaeontological Impact Assessment for the proposed airport development near Postmasburg, Northern Cape (Conducted for PGS Heritage).
The proposed development is not itself in the proposed mining area and thus not relevant to the present study.

Butler, E., 2020b. Palaeontological Field Assessment for the proposed stormwater management infrastructure on Sishen Iron Ore Mine near Kathu, Northern Cape
The proposed stormwater management infrastructure on Sishen Iron Ore Mine near Kathu in the Northern Cape is underlain by Quaternary aged sediments of the Kalahari Group as well underlying Griqualand West Basin rocks, Transvaal Supergroup
A 1-day site specific field survey of the development footprint were conducted in November 2020 and again no visible evidence of fossiliferous outcrops was found. The development footprint was overgrown by dense vegetation. A Chance Find Protocol was added to the report.

[1]Information provided by EXM Environmental Advisory

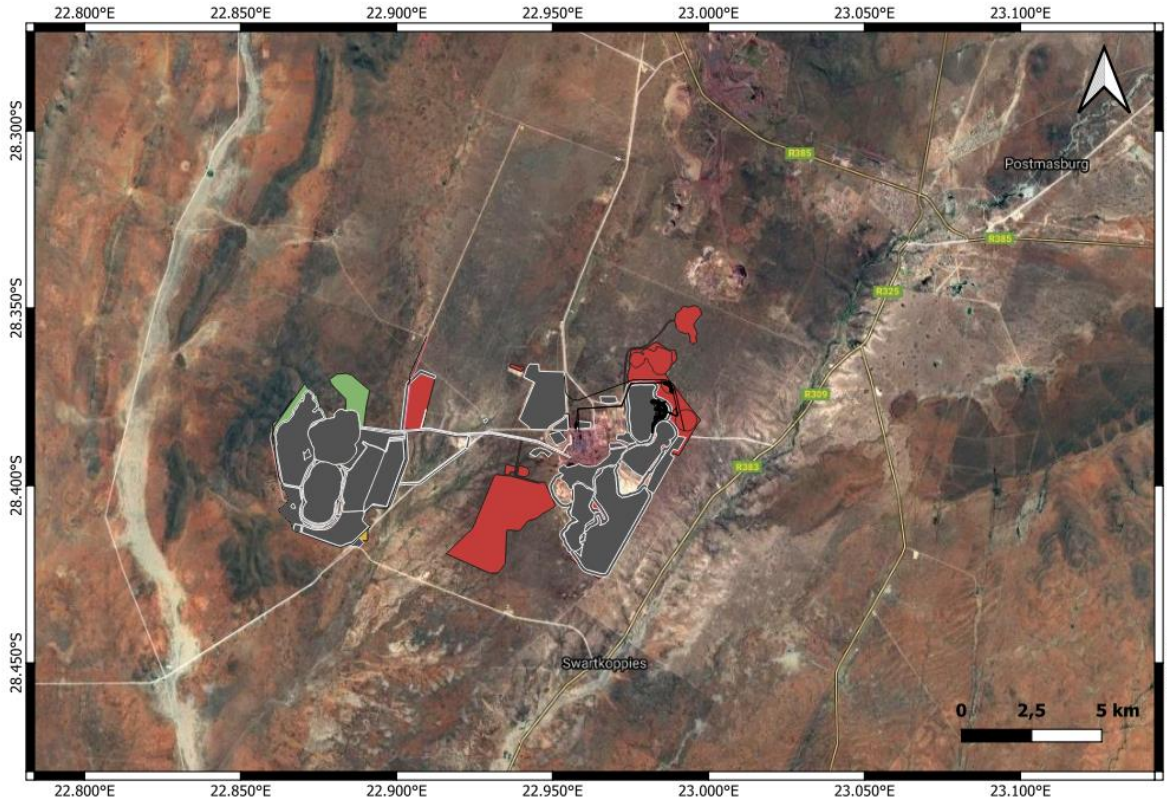


Figure 6:Development foorptints (2019 and 2021)

2019 Footprint indicted in colour while 2021 (present) footprint is indicated in grey

It is thus evident that the whole study area was studied in 2019 and that this 2021 (present) study is just a upgrade (Figure 6).

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

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

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

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

The identification, evaluation and assessment of any cultural heritage site, artefact or finds in the South African context is required and governed by the following legislation:

- National Environmental Management Act (NEMA) Act 107 of 1998
- National Heritage Resources Act (NHRA) Act 25 of 1999
- Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified.

The next section in each Act is directly applicable to the identification, assessment, and evaluation of cultural heritage resources.

GNR 982 (Government Gazette 38282, 14 December 2014) promulgated under the National Environmental Management Act (NEMA) Act 107 of 1998

- Basic Assessment Report (BAR) – Regulations 19 and 23
- Environmental Impacts Assessment (EIA) – Regulation 23
- Environmental Scoping Report (ESR) – Regulation 21
- Environmental Management Programme (EMPr) – Regulations 19 and 23

National Heritage Resources Act (NHRA) Act 25 of 1999

- Protection of Heritage Resources – Sections 34 to 36

- Heritage Resources Management – Section 38

MPRDA Regulations of 2014
Environmental reports to be compiled for application of mining right – Regulation 48

- Contents of scoping report – Regulation 49
- Contents of environmental impact assessment report – Regulation 50
- Environmental management programme – Regulation 51
- Environmental management plan – Regulation 52

The NEMA (No 107 of 1998) states that an integrated EMP should (23:2 (b)) "…*identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage*".

In agreement with legislative requirements, EIA rating standards as well as SAHRA policies the following comprehensive and legally compatible PIA report have been compiled.
Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, 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 aim of a Palaeontological Impact Assessment (PIA) is to decrease the effect of the development on potential fossils at the development site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the purpose of the PIA is: 1) to identify the palaeontological importance of the rock formations in the footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) to clarify the impact on fossil heritage; and 4) to suggest how the developer might protect and lessen possible damage to fossil heritage.

The palaeontological status of each rock section is calculated as well as the possible impact of the development on fossil heritage by a) the palaeontological importance of the rocks, b) the type of development and c) the quantity of bedrock removed.

When the development footprint has a moderate to high palaeontological sensitivity a field-based assessment is necessary. The desktop and the field survey of the exposed rock determine the impact significance of the planned development and recommendations for further studies or mitigation are made. Destructive impacts on palaeontological heritage usually only occur during the construction phase while the excavations will change the current topography and destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

Mitigation usually precede construction or may occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. Preceding excavation of any fossils a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact as possible because our knowledge of local palaeontological heritage may be increased

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.

- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/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 result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed development is depicted on the 1: 250 000 22428 Postmasburg (1977) Geological Map (Council for Geosciences, Pretoria) (**Figure** 7**7**). According to this map the eastern development area is largely inderlain by surface limestone (Ql-yellow) while the western portion of the development is underlain by the Asbestos Hills Subgroup, Ghaap Group (Transvaal Supergroup). The geological Map of this area is now out of print and outdated. Recently, revisions to the stratigraphic subdivision and alignments of the Precambruim rocks present in the Kathu area has been completed. Eriksson *et al.* (2006) conducted stratigraphic studies on the Transvaal Supergroup while Moen (2006) conducted the study for the Olifantshoek Supergoup.

Simplified regional geological maps based on Cairncross and Beukes (2013) and Smith and Beukes (2016) were published. The geological map (**Figure 6**) indicates that the proposed development is located on the western side of the Maremane Dome (a major N-S trending anticline within the Early Proterozoic bedrocks of the Ghaap Group, Transvaal Supergroup). The Maremane Dome comprises of carbonate rocks of the Ghaap Group, Transvaal Supergroup overlain by the Kalahari Group .

In the past the shallow marine carbonates of the Campbell Rand Subgroup (Ghaap Group) were included in the Ghaapplato Formation. It is about 2.6 to 2.5 Ga (billion years old) and was deposited

on the shallow submerged shelf of the Kaapvaal Craton. This carbonate platform is very thick (approximately 1.6 -2.5 km) and comprise of cherts with minor tuffs and siliciclastic rocks as well as dolostones and dolomitic limestones.

Frequent changes in sea level were caused by changing depositional cycles in shallow water facies. Stromatolitic limestones and dolostones, oolites, laminated calcilutites, cherts, with subordinate siliclastics (shales, siltstones) and minor tuffs (Beukes 1980, Beukes 1986, Sumner 2002, Eriksson *et al.* 2006, Sumner & Beukes 2006) are present in this area.

At the western side of the Maremane Dome (Campbell Rand carbonates, Asbesheuwels Banded Iron Formation and Koegas quartzites and iron formation) a major unconformity exist at the base of the Palaeoproterozoic Elim Group (basal Keis Supergroup), This unconformity (about 2.2-2.0 Ga) cuts the folded Ghaap Group succession and is associated with the development of manganese and iron ores. These ores are extensively mined in the Sishen – Postmasburg region of Griqualand West. These ores are associated with the palaeokarst-related Manganore Formation overlying the Campbell Rand Subgroup carbonates of the Maremane Dome as well as the Gamagara Formation at the base of the Elim Group. In the past the Elim Group was included in the Olifantshoek Group (Schalkwyk 2005, Van Niekerk 2006, Da Silva 2011, Cairncross & Beukes 2013, Smith & Beukes 2016). In the greater Kathu region the Postasburg group comprise of basaltic to andesitic lavas of the Ongeluk Formation (dated to 2.2 Ga) that crops out south of the Gamagara River.

In the Sishen region the older Precambrian rocks are mantled by the late Cretaceous to Late Caenozoic aeolian sands, clays, calcretes and gravels of the Kalahari Group [approximately Ca 65 – 2.5 million years old (Ma)]. Studies north west of the proposed development site has shown that the Kalahari Group sediments that overlies the Precambrian rocks are about 80 m thick (Haddon, 2005). The earliest Kalahari beds are assigned to the Wessels Formation (basal gravels) and Budin Formation (calcareous clays) and is probably Late Cretaceous in age (Partridge *et al.* 2006).

The top 15 m of the Kalahari sediments consist of clays, calcretised siltstones, and pebbly horizons with the occurence of solution hollows along joint surfaces (10 m from the surface). Calcretised silcretes with *in situ* brecciation are present close to the surface. Thick pedogenic calcretes (Plio-Pleistocene Mokalanen Formation**)** are mapped along the Ga-Mogara drainage line and underlies the Kalahari sands in this region. These deposits indicate the seasonally arid climates over the last five million years (Truter *et al.* 1938; Boardman and Visser 1958). Surface limestones may be upt o 20 m thick and are locally conglomeratic with clasts of reworked calcrete and foreign pebbles.

Pleistocene Kalahari sands (Gordonia Formation) has been described to mantle thick calcretes and downwasted surface gravels (Almond 2013). He described a range of calcrete types namely

gravelly, brecciated, silicified, honeycomb and karstified facies, the latter with a associated sand- or gravel-infilled solution hollows

Older terrace gravels are described from the banks of the Ga-Mogara drainage line. Unconsolidated, reddish-brown aeolian sands of the Quaternary Gordonia Formation are present in the Sishen area.These sands are Late Pliocene / Early Pleistocene to Recent in age due to the Middle to Later Stone Age stone tools (Dingle *et al*., 1983, p. 291) found in them. Recent studies has dated the Pliocene - Pleistocene boundary from 1.8Ma back to 2.588 Ma and placed the Gordonia Formation almost completely within the Pleistocene Epoch.

Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn corns, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from Quaternary deposits. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts).

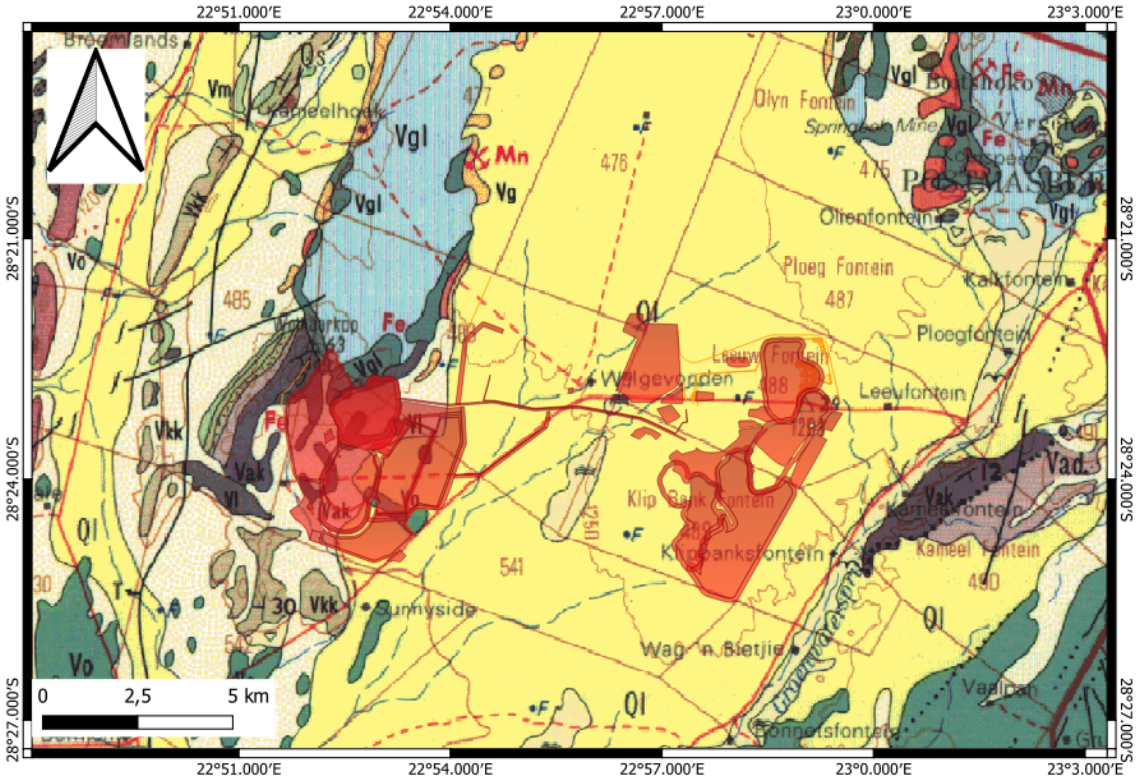
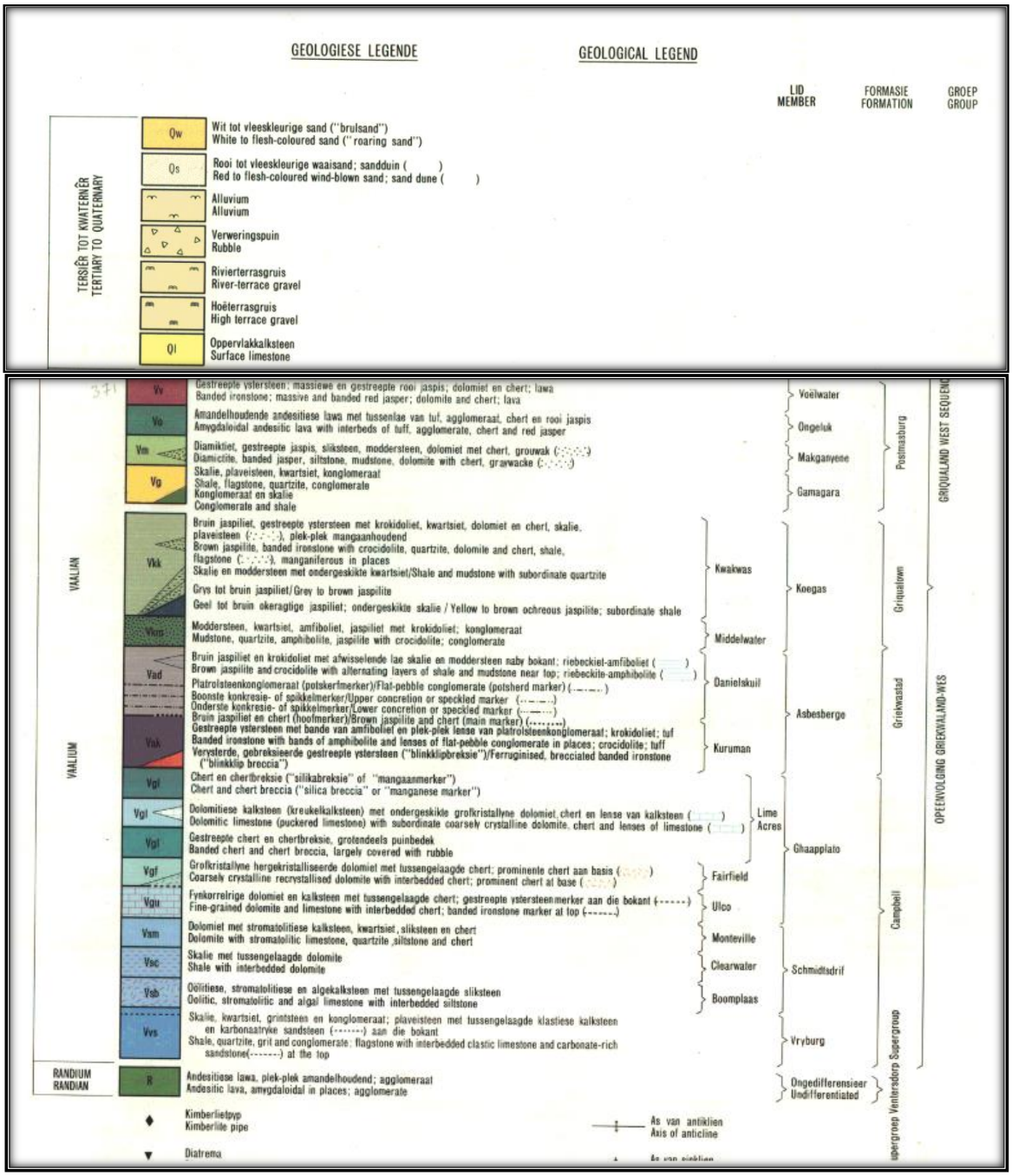


Figure 7 - Extract of the 1: 250 000 000 2428 Postmasburg (1977) Geological Map (Council for Geosciences, Pretoria).indicating the proposed development in red.

The geological mapping and lithostratigraphy shown in this map are now out-of-date. Legend: Older terrace gravels - yellow with double flying bird symbol); Vgd (pale blue) = Campbell Rand Subgroup; red = Manganore Formation (Blinkklip breccia); Vg (orange) = Gamagara Formation with basal Doornfontein conglomerate (dark brown; Vo (blue-grey) = Ongeluk Formation lavas; Qs (pale yellow) = red Kalahari Group sands (Gordonia Formation).

Legend to Map and short explanation (Modified from the 1:250 000 2824 Postmasburg (1977) Geological Map (Council for Geosciences, Pretoria).



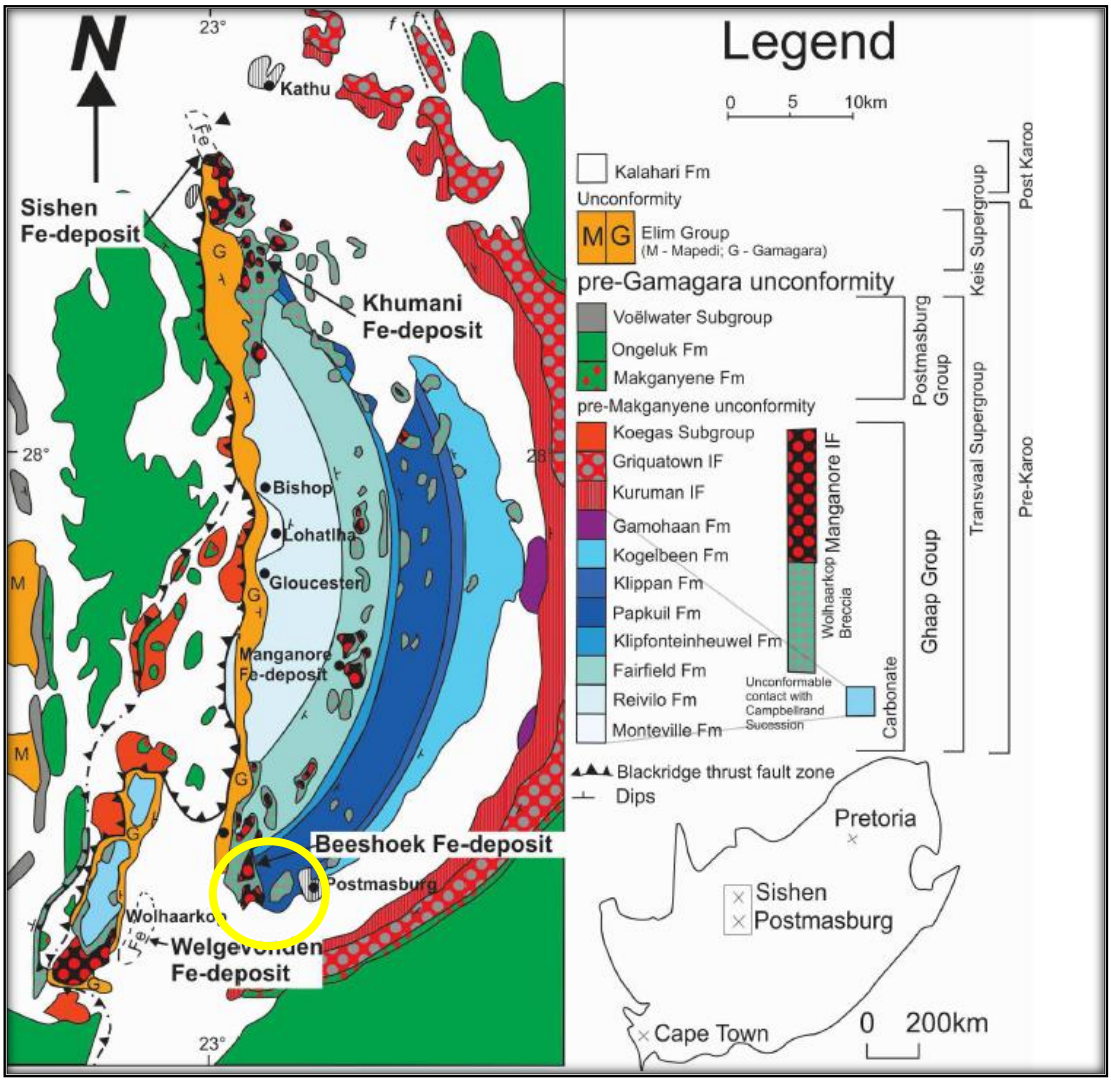


Figure 8:Updated Regional Geology of the Maremane Dome in the Northern Cape (from Smith & Beukes 2016). *The approximate location of the proposed development is indicated by the yellow circle.*

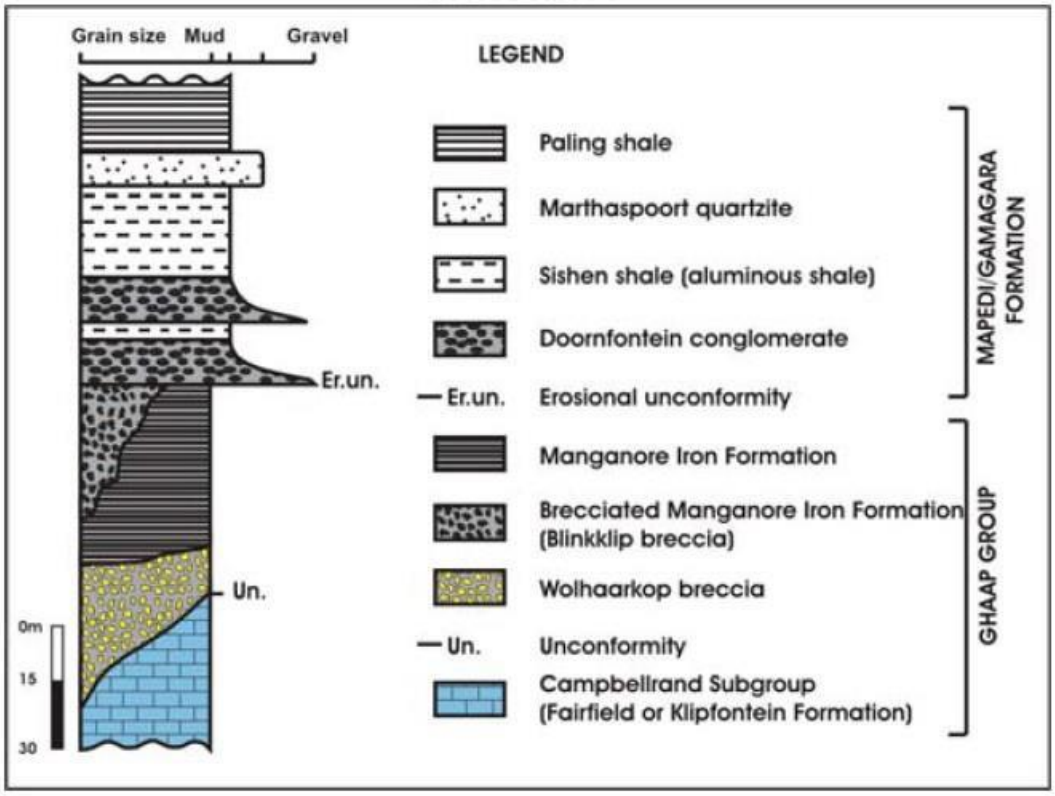


Figure 9: Stratigraphy of the iron formations in the Sishen-Postmasburg area (Schalkwyk 2005). The base of the Elim Group (Kheis Supergroup) is formed by the Gamagara Formation and the ferruginous Doornfontein conglomerates at its base. The Manganore Formation in underlain by the Wolhaarkop Breccia that forms part of a complex, supergene-enriched, lateritic weathering profile below the 2.2-2.0 Ga pre-Gamagara Unconformity associated with the collapse of the Asbestos Hills Subgroup BIF into karstic solution hollows on the Maremane Dome.

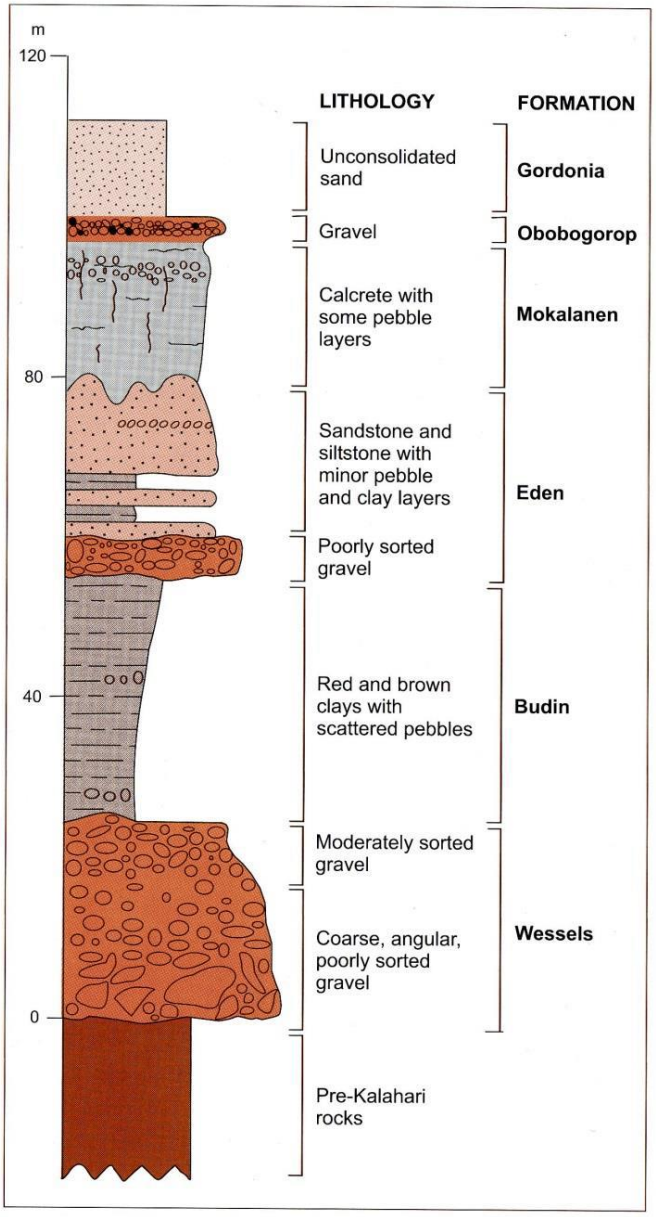


Figure 10:General stratigraphy of the Late Cretaceous to Recent Kalahari Group (Taken from Partridge et al. *2006).*

Figure 11 - Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in purple.

Table 3 - SAHRIS Palaeosensitivity ratings table. The relevant sensitivities are highlighted

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 11**) the proposed development is underlain by sediments with a Very High (red,) High (Orange) and Moderate (green) Palaeontological Significance. (**Figure 11**).

The colors on the PalaeoMap indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero

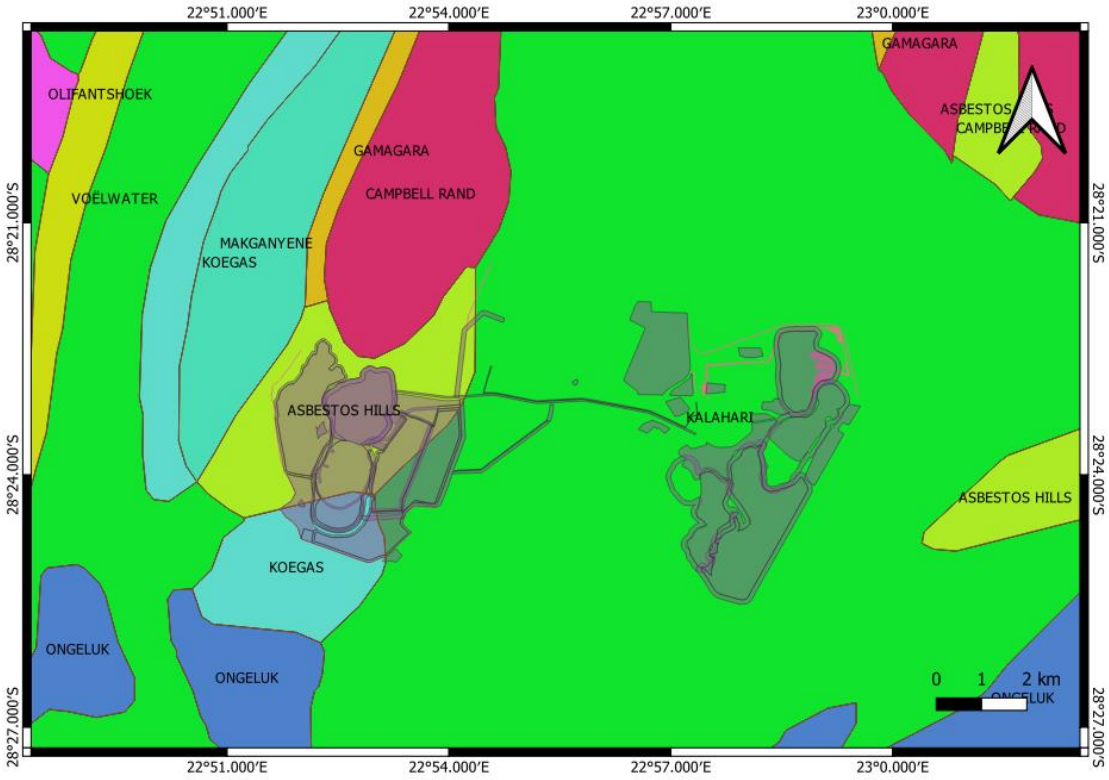


Figure 12: The surface geology of the proposed exploration camp, near Postmasburg in the Northern Cape Province. (Map Drawn by QGIS 3.16; Shape files, Council for Geoscienes)

The surface geology of the proposed development is indicated in **Figure 12**. According to the Shape files provided by the Council for Geosciences (Pretoria) the proposed development is underlain by the Quaternary aged sediments of the Kalahari Group as well as the underlying Asbestos Hills Subgroup (Ghaap Group, Transvaal Supergroup).

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development is located approximately 8 km south west of Postmasburg in the Tsantsabane Local Municipality, Northern Cape Province.

7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes 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.

Please Note: Following comprehensive Palaeontological field studies conducted by the author in the past no fossiliferous outcrops were identified an thus only a desktop study for this specific project was conducted (See Introduction).

7.1 Assumptions and Limitations

When conducting a PIA several factors can affect the accuracy of the assessment. The focal point of geological maps is the geology of the area and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is used to provide information on the existence of fossils in an area that was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **assumed** that exposed fossil heritage is present within the footprint.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- 1: 250 000 2722 Kuruman (1979) Geological Map (Council for Geosciences, Pretoria).
- A Google Earth map with polygons of the proposed development was obtained from PGS Consultants.
- Previous Palaeontological Impact Assessments conducted in the area were found on the internet and include Almond, 2014; Groenewald 2015, These articles are listed in the references as well in Section 1 of this report.

9 IMPACT ASSESSMENT METHODOLOGY

9.1 Introduction

PLEASE NOTE:

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined above, used to evaluate impact significance.

The impacts will be ranked according to the methodology described below. Where possible, mitigation measures will be provided to manage impacts. In order to ensure uniformity, a standard impact assessment methodology will be utilised so that a wide range of impacts can be compared

with each other. 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 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 below.

Table 4 - Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	Proposed site	Incidental
2	LOW	Study area	Short-term
3	MODERATE	Local	Medium/High-term
4	HIGH	Regional / Provincial	Long-term
5	VERY HIGH	Global / National	Permanent

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

9.2 Significance Assessment

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 area affected by atmospheric pollution may be extremely large (1 000 km2) 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 below.

Table 5 - 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 below**.**

Table 6 - Description of the 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 impacts possible and will be felt at a regional scale (District Municipality to Provincial Level).
3	Local	The impact will affect an area up to 10 km from the proposed site.
2	Study Site	The impact will affect an area not exceeding the property.
1	Proposed site	The impact will affect an area no bigger than the ash disposal site.

9.4 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 scale is rated according to criteria set out in table below.

Table 7 - 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/High term	The environmental impact identified will operate for the duration of life of facility.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

9.5 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in **table** below.

Table 8 - 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 9**. 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 9 - 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.
Don't know	The consultant cannot, or is unwilling, to make an assessment given available information.

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:

$$\textit{Impact Risk} = \frac{(\text{SIGNIFICANCE (2)} + \textit{Spatial}\ (2) + \text{Temporal(5)}) \times \text{Probability(1)}}{5}$$

An example of how this rating scale is applied is shown in **below**.

Table 10 - Impact ratings for the proposed development

IMPACT	IMPACT DIRECTION	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
Impact on Paleontological Heritage Resources **Pre-mitigation**	Negative	High (4)	Study site (2)	Permanent (5)	Probable (3)	2.16 Moderate
Impact on Paleontological Heritage Resources **Post-mitigation**	Neutral	High (4)	Study site (2)	Permanent (5)	Unlikely (2)	1.44 Low

Note: **Pre-mitigation:** *The significance, spatial and temporal scales are added to give a total of 11, that is divided by 3 to give a criteria rating of 3.6. The probability (3) is divided by 5 to give a probability rating of 0,6. The criteria rating of 3.6 is then multiplied by the probability rating (0,6) to give the final rating of 2.16*

Post-mitigation: *The significance, spatial and temporal scales are added to give a total of 11, that is divided by 3 to give a criteria rating of 3.6. The probability (2) is divided by 5 to give a probability rating of 0,4. The criteria rating of 3.6 is then multiplied by the probability rating (0,4) to give the final rating of 1.44*

The impact risk is classified according to five classes as described in the **Table 12** below.

Table 11 - 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**

Pre-mitigation: Therefore, with reference to the example above, an impact rating of 2.16 will fall in the **Impact Class 3,** which will be considered to be a **Moderate Impact**.

Post Mitigation: an impact rating of 1.44 will fall in the **Impact Class 2,** which will be considered to be a **Low Impact**.

9.8 SUMMARY OF IMPACT TABLES

The proposed development will have a Moderate negative impact on Fossil Heritage. *Only the site will be affected by the proposed development.* The expected duration of the impact is assessed as potentially permanent to long term. The significance of the impact occurring will be High, as fossil heritage will be destroyed the impact is irreversible.

10 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by Quaternary aged sediments of the Kalahari Group as well underlying Griqualand West Basin rocks. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Kalahari Group low but locally high and that of the Griqualand West rocks of the Transvaal Supergroup is moderate. Several Palaeontological site investigations have been conducted since 2019 on the Kolomella Mining area. In each case no fiossilifeous outcrops were identifieds and thus a desktop study has been conducted for the present study. The general low palaeontological sensitivity of the bedrocks and superficial sediments in the proposed development footprint, indicates that the proposed development will have a overall LOW impact significance in terms of palaeontological heritage. It is therefore considered that the development is will not lead to detrimental impacts on the palaeontological resources of the area. 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 Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation can be carry out by a paleontologist.

It is consequently recommended that no further palaeontological heritage studies, ground-truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

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11 CHANCE FINDS PROTOCOL

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

11.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 25 of 1999) (NHRA).** According to Section 3 of the Act, all Heritage

resources include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**".

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

11.2 Background

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

11.3 Introduction

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

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

11.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (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). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS coordinates.

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

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

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

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APPENDIX A

CV

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

MEMBERSHIP

Palaeontological Society of South Africa (PSSA)	2006-currently

EMPLOYMENT HISTORY

Part time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part time laboratory assistant	Department of Virology University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

TECHNICAL REPORTS

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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.

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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.

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

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

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

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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.

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

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

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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 de-commisioning 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.

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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 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.

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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.

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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 Assessement for Heuningspruit PV 1 Solar Energy Facility near Koppies, Ngwathe Local Municipality, Free State Province.

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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.

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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.

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