**PALAEONTOLOGICAL DESKTOP ASSESSMENT: PROPOSED MINING RIGHT APPLICATION FOR TURNOVER TRADING (PTY) LTD - STERKFONTEIN 155, PUTFONTEIN 62, OMGEGA 478, HOLGAT 63, WILDFONTEIN 201, LEEUWFONTEIN 64 & FARM 533**

**DMRE REG: NW30/5/1/2/2/10186MR**

**SAHRA** CaseID: 16786

**Compiled for:**

**Milnex CC**

**Potchefstroom Office**

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Prepared by

Banzai Environmental

October 2021

**Declaration of Independence**

I, Elize Butler, declare that –

General declaration:

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

**Disclosure of Vested Interest**

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


**PALAEONTOLOGICAL CONSULTANT:** Banzai Environmental (Pty) Ltd

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**SIGNATURE:** 

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

*Table 1 - NEMA Table*

| **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 | Section 1 and 10 | Desktop Study |
| (e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used | Section 7 Approach and Methodology | - |
| (f) details of an assessment of the specific identified sensitivity of the | Section 1 and 10 | |

| Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017 | Relevant section in report | Comment where not applicable. |
|---|---|---|
| site related to the proposed activity or activities and its associated structures and infrastructure, 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 1 and 10 | |
| (l) Any conditions for inclusion in the environmental authorisation | Section 1 and 10 | |
| (m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation | Section 1 and 10 | |
| (n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and | Section 1 and 10 | |
| (n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and | | |

| Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017 | Relevant section in report | Comment where not applicable. |
|---|---|---|
| (n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan | Section 1 and 10 | - |
| (o) A description of any consultation process that was undertaken during the course of carrying out the study | N/A | Not applicable. A public consultation process will be conducted as part of the EIA and EMPr process. |
| (p) A summary and copies if any comments that were received during any consultation process | N/A | |
| (q) Any other information requested by the competent authority. | N/A | Not applicable. |
| (2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply. | Section 3 compliance with SAHRA guidelines | |

## EXECUTIVE SUMMARY

Banzai Environmental was appointed by Milnex CC to conduct the Palaeontological Desktop Assessment assessing the proposed Mining Right combined with a Waste License Application of Turnover Trading 251 (Pty) Ltd near Coligny Registration Division: IP, North West Province. To comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PDA is necessary to confirm if fossil material could potentially be present in the planned development and to evaluate the impact of the proposed development on the Palaeontological Heritage.

The proposed mining footprint is underlain by the following:

- Gravel, Diamondiferous in places
- Black Reef Formation of the Transvaal Supergroup
- Oaktree Formation of the Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup
- Allanridge Formation of the Ventersdorp Supergroup

While the operational area is underlain by

- Gravel, Diamondiferous in places
- Black Reef Formation of the Transvaal Supergroup
- Allanridge Formation of the Ventersdorp Supergroup

According to the PalaeoMap of the South African Heritage Resources Information System the Palaeontological Sensitivity of the Quaternary gravel, Black Reef Formation (of the Transvaal Supergroup) and Allanridge Formation (of the Ventersdorp Supergroup) (operational area) has a Moderate Palaeontological Sensitivity while that of the Malmani Subgroup is Very High, (Almond and Pether 2008, SAHRIS website). As the current development (operational area) is underlain by sediments of a Moderate Palaeontological Sensitivity (Quaternary gravel, Black Reef Formation of the Transvaal Supergroup as well as the Allanridge Formation of the Ventersdorp Supergroup) a LOW Palaeontological Significance has been allocated to the development and it is therefore considered that the construction of the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. The construction of the development may be authorised and no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of fossils. (**However, if construction of any kind would ever expand into the Malmani Subgroup a site visit by a professional palaeontologist will be required**. **This requirement should be incorporated into the EMPr).**

If any fossil remains are discovered during any phase of construction (for the current application), either on the surface or uncovered by excavations the ECO/site manager in charge of these developments must be notified immediately. These discoveries ought to be protected (if possible, *in situ*) and the ECO must report to SAHRA (Contact details: NWPHRA, 1 st Floor Gaabomotho Building, 760 Dr.James Moroka Drive, Mmabatho Tel: 0183882826; Fax: +27 (0)43 7450889. Web: www.nwpg.gov.za) so that correct mitigation (recording and collection) can be carry out by a palaeontologist.

The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA

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**Appendix A: CV.**

# 1 INTRODUCTION

Banzai Environmental was appointed by Milnex CC to conduct the Palaeontological Desktop Assessment assessing the proposed Mining Right combined with a Waste License Application of Turnover Trading 251 (Pty) Ltd for the mining of Diamonds General (D) on the RE of Portions 6, 7, 10 and Portions 8, 17, 19 of the Farm Sterkfontein 155. Portion 29, 30, 31, 32, 33, 34, 45, 46, 47, 48, 49, 50, 51, 52 53, 54, 55, 56, 57, 58, 59, 60, 61, 63, 64, 65, 68, 69, 70, 66 and a certain portion of portion 62, the RE of Portion 1 & 7 of the Farm Putfontein 62. Portion 1, 2 & the RE of the Farm Omega 478. Portion 3 & the RE of the Farm Holgat 63. Portion 4, 5 & the RE of Portion 2 of the farm Wildfontein 201. The RE of portion 5 & 31 of the farm Leewufontein 64. Certain Portion of the RE of Farm 533; Registration Division: IP, North West Province (**Figure 1-2**).

Information provided by Milnex CC

Mining has played a vital role in the economy of South Africa for over 100 years. In 2015 the mining industry contributed R286 billion towards South African Gross Domestic Product (GDP) representing 7.1% of overall GDP. Mining is a significant contributor to employment in the nation, with 457 698 individuals directly employed by the sector in 2015. This represents just over 3% of all employed nationally. Diamond mining has 17 885 direct employees. Diamonds, arguably the ultimate luxury mineral, comprise an intricate lattice of carbon atoms, a crystalline structure that makes them harder than any other form in nature. This characteristic makes diamonds not only popular in jewellery, but also desirable in high-tech cutting, grinding and polishing tools (Chamber of Mines, South Africa, 12:2016). According to the Chamber of Mines the country's diamond sector is far from reaching the end of its life even though diamond mining has been taking place in South Africa for almost a century and a half. The primary sources of all of South Africa's diamonds are kimberlites in ancient, vertically dipping volcanic pipes most of which were located in the vicinity of the city of Kimberley, and which were initially amenable to open cast.

Economic growth - South Africa's total reserves remain some of the world's most valuable, with an estimated worth of R20.3- trillion. Overall, the country is estimated to have the world's fifth-largest mining sector in terms of GDP value. It has the world's largest reserves of manganese and platinum group metals (PGMs), according to the US Geological Survey, and among the largest reserves of gold, diamonds, chromite ore and vanadium. With South Africa's economy built on gold and diamond mining, the sector is an important foreign exchange earner, with gold accounting for more than one-third of exports. In 2009, the country's diamond industry was the fourth largest in the world. Mining is a cornerstone of the economy, making a significant contribution to economic activity, job creation and foreign exchange earnings. Mining and its related industries are critical to South Africa's socio-economic development.

Diamondiferous gravels in the North West Province are distributed predominantly in three major areas, namely the area underlain by dolomite from the east of Ventersdorp towards Lichtenburg and Bakerville

and beyond (VLB), the Lichtenburg–Delareyville–Bloemhof–Klerksdorp–Lichtenburg area (LDBKL), which is mostly underlain by Ventersdorp Supergroup basalt and Dwyka Group tillite and the area associated with the Vaal River terraces and gravels. Diamondiferous gravels are concentrated along straight and meandering runs, sinkholes and dolines in the VLB area. In the LDBKL area, the diamonds are present in ancient and current river channels, terraces or banks and as elluvial and colluvial deposits.

The Orange-Vaal River system is recognised as the primary secondary resource for alluvial diamonds. The extensive diamondiferous gravels of the Lower Vaal, Harts, and Middle Orange River ("MOR") valleys are associated with remnants of outwash deposits formed during the retreat of the ancient Ghaap (Kaap) Valley glacial system and subsequent reworking and alluvial deposition by major rivers. Studies have shown that majority of the alluvial diamonds in gravel deposits along all the terraces along the Orange River are derived from two distinct gravel horizons. These comprise an upper deflation deposit (Rooikoppie) and an underlying (Primary fluvial-alluvial) gravel unit.

**Primary fluvial-alluvial gravel deposits**

The primary palaeo-fluvial succession comprises various proportions of gravel, sand and silt, typically with a basal gravel unit of up to 2m in thickness and an overlying finer-grained unit of up to 6m (the so-called “middlings” gravels). The poorly sorted gravels vary from pebble to cobble gravels, generally with a fair percentage of boulders (rarely +1m diameter). Interbedded sandy or granule beds and lenses occur frequently in sandier, matrix supported gravel successions.

**Deflation of ‘Rooikoppie’ deposits**

These deposits represent derived gravel and consist mainly of well-rounded and polished siliceous pebbles and reddish colored sand. The clastic material is believed to originate the fluvial alluvial gravel units and consists of its most resistant components, in particular chert, agate, jasper, quartzite and vein quartz. Due to the decomposition and winnowing of the less resistant clastic and matrix material there has been a substantial concentration of the more durable components in the original gravel, including diamonds.

## 2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

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

## 3 LEGISLATION

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

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

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.

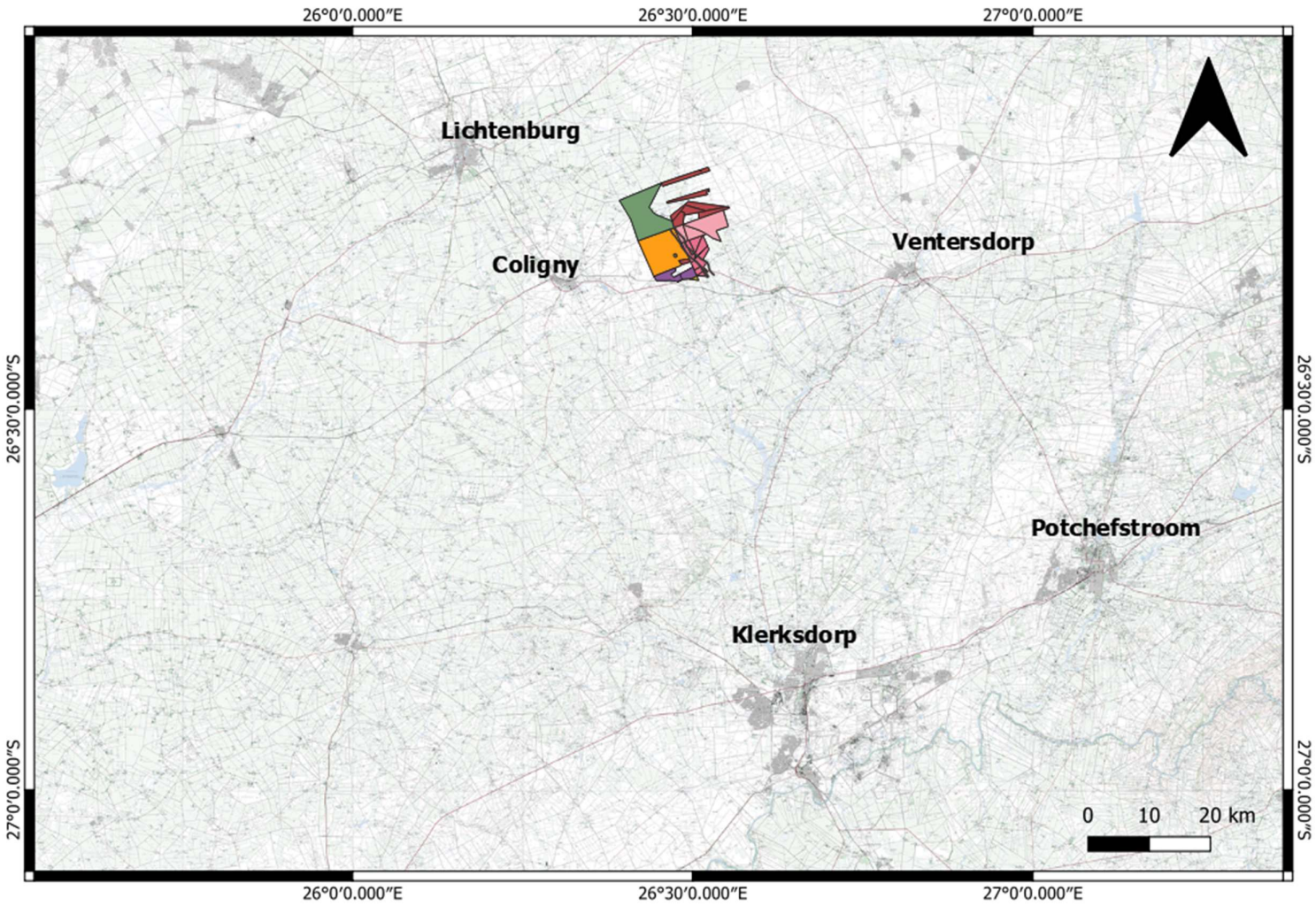


***Figure 1**: Regional context of the proposed Mining Right combined with a Waste License Application of Turnover Trading 251 (Pty) Ltd near Coligny Registration Division: IP, North West Province.*

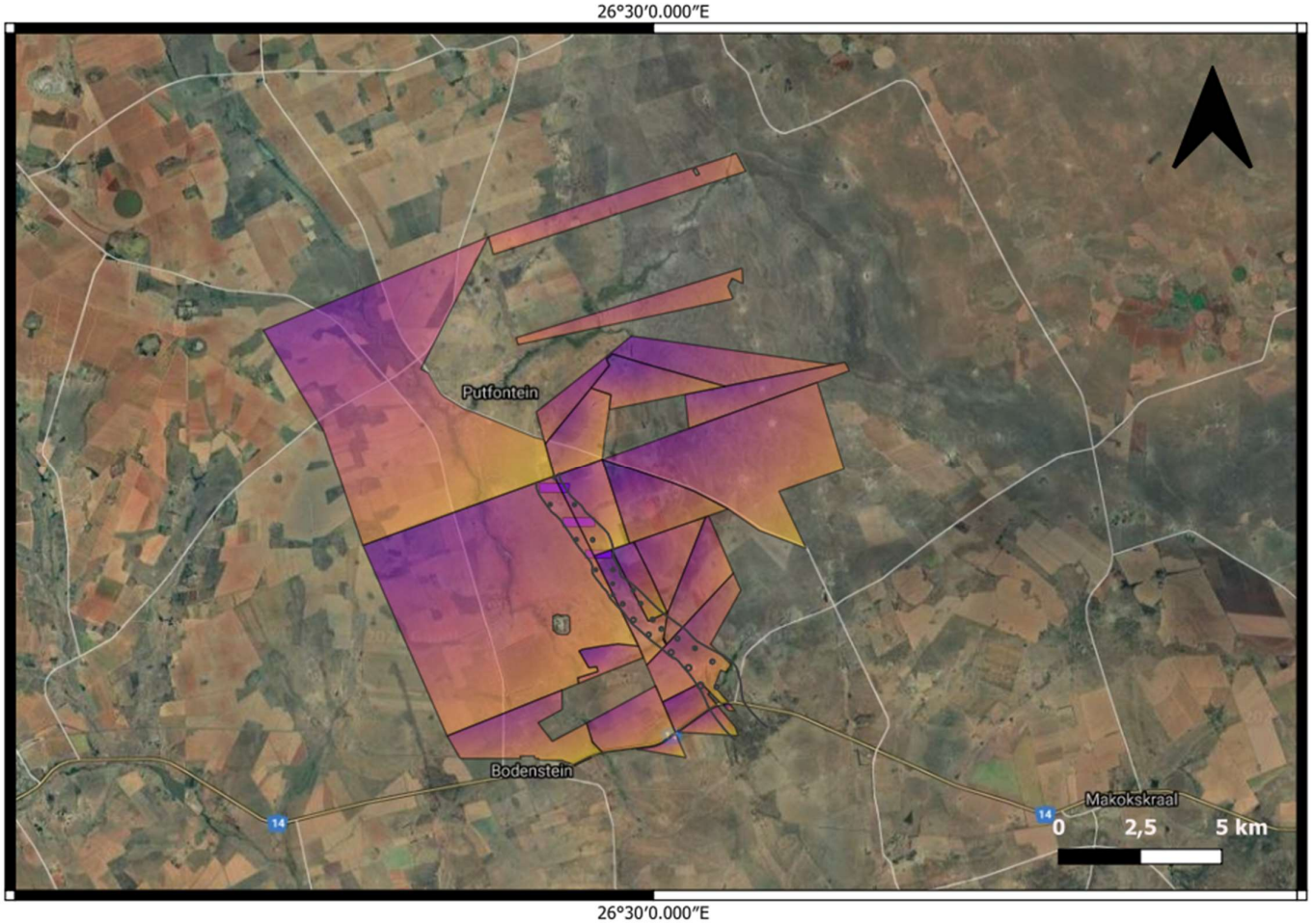


***Figure 2**: Google Earth Image (2020) indicating the locality of the proposed Mining Right combined with a Waste License Application of Turnover Trading 251 (Pty) Ltd near Coligny, Registration Division: IP, North West Province.*
*Footprint is indicated by variegated colours while the operational area is indicated by black lines*

## 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 mining development near Coligny in North West is depicted on the 1:250 000 2626 WestRand Geological Map 1986 (Council of Geoscience, Pretoria) (**Figure 3-5**).

The proposed mining footprint is underlain by the following:

- Gravel, Diamondiferous in places (Qg)
- Black Reef Formation of the Transvaal Supergroup (Vbr – Quartzite, conglomerate, shale)
- Oaktree Formation of the Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup (Vo – Dark chert, poor dolomite)
- Allanridge Formation of the Ventersdorp Supergroup (Va- Basaltic amygdaloidal lava)

While the operational area is underlain by

- Gravel, Diamondiferous in places
- Black Reef Formation of the Transvaal Supergroup
- Allanridge Formation of the Ventersdorp Supergroup

According to the PalaeoMap of the South African Heritage Resources Information System the Palaeontological Sensitivity of the Quaternary gravel, Black Reef Formation (of the Transvaal

Supergroup) and Allanridge Formation (of the Ventersdorp Supergroup) (operational area) has a Moderate Palaeontological Sensitivity while that of the Malmani Subgroup (Vmm) is Very High, (Almond and Pether 2008, SAHRIS website).

The Quaternary deposits (Q) are the youngest and most widespread body of terrestrial sediments in southern Africa. The sands and calcretes range in thickness from a few metres to more than 180m (Partridge et al., 2006). The fossil assemblages of the Quaternary are generally Low in diversity and occur over a wide range. These fossils represent terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods and trace fossils. The palaeontology of the Quaternary superficial deposits has been relatively neglected in the past. Late Cenozoic calcrete may comprise of bones, horn corns as well as mammalian teeth. Tortoise remains have also been uncovered as well as trace fossils which includes termite and insect's burrows and mammalian trackways. Amphibian and crocodile skeletons have been uncovered where the depositional settings in the past were wetter.

The eastern portion of the development footprint is underlain by Precambrian dolomites and associated marine sedimentary rocks that are allocated to the Malmani Subgroup (Chuniespoort Group) within the Transvaal Supergroup. The Malmani Subgroup carbonates of the Transvaal Basin comprise of an assortment of stromatolites (microbial laminates), ranging from supratidal mats to intertidal columns and large subtidal domes (Eriksson *et al.* 2006). Stromatolites are layered mounds, columns and sheet-like sedimentary rocks (**Figure 6**). These structures were originally formed by the growth of layer upon layer of cyanobacteria, a single-celled photosynthesizing microbe. Cyanobacteria are prokaryotic cells (simplest form of modern carbon-bases life). Stromatolites are first found in Precambrian rocks and are known as the earliest known fossils. The oxygen atmosphere that we depend on today was generated by numerous cyanobacteria photosynthesizing during the Archaean and Proterozoic Era.

Stromatolites and oolites from the Transvaal Supergroup have been described by various authors (Eriksson and Altermann, 1998). Detailed descriptions of South African Archaean stromatolites are available in the literature (Altermann, 2001; Buick, 2001; and Schopf, 2006). The Malmani stromatolites literature includes articles by Truswell and Eriksson (1972, 1973, 1975), Eriksson and MacGregor (1981), Eriksson and Altermann (1998), Sumner (2000), Schopf (2006).

The Malmani Subgroup succession is about 2 km-thick and consists of a series of formations of oolitic and stromatolitic carbonates (limestones and dolomites), black carbonaceous shales and minor secondary cherts. The Malmani Dolomites also consist of historic lime mines, and palaeocave fossil deposits. Dolomite (limestone rock) forms in warm, shallow seas from slow gathering remainders of marine microorganisms and fine-grained sediment. Dolomites of the

Malmani Subgroup has a higher magnesium content than other limestones. These materials contain high levels of calcium carbonate and are often referred to as carbonates.

The Black Reef Formation comprises of relatively mature quartz arenites with lesser conglomerates and subordinate mudrocks mantling older successions (Eriksson and Reczko, 1995; Eriksson et al., 2006, 2012; Fuchs et al., 2016; Zeh et al., 2020). This formation forms a very extensive thin layer of sandstone, varying between a few meters to about a maximum of about 60 m occurring in the west of the basin. Currently two general models exist for the deposition of the Black Reef Formation namely initially a fluvial setting followed by shallow marine conditions or a purely fluvial model (ibid). To date no fossils have been recorded from the Black Reef Formation.

The Ventersdorp Supergroup comprise of the biggest and most wide-spread volcanic system in the Kaapvaal Craton. Some of the best exposures of the Ventersdorp Supergroup is in the North West Province. This Supergroup consists of (from oldest to youngest) the Klipriviersberg Group (Rk) at the base, which is overlain by the Platberg Group, followed by the sedimentary Bothaville Formation (Vb) and the volcanic Allanridge Formation (Va) (uppermost Ventersdorp unit and youngest Formation). The Klipriviersberg Group comprise of an immature conglomerate arranged in subangular to rounded pebbles of varying size. The Platberg Group is subdivided in four formations namely the Kameeldoorns-, Goedgenoeg-, Makwassie-, and Rietgat Formations. These formations consist of heterogenous rock varying from chemical and classic sediments, to felsic and mafic volcanics (Visser et al, 1975-1976, Buck, 1980). Lacustrine stromatolites as well as possible organic walled microfossils in chert have been reported from the Rietgat Formation (Platberg Group).

The Allanridge Formation (Va) comprise mostly of light-greenish grey porphyritic lava, dark-green amygdaloidal lava, and pyroclastic rocks (Keyser, 1992). The lavas are approximately 2700 million years old. The Allanridge Formation is unfossiliferous.

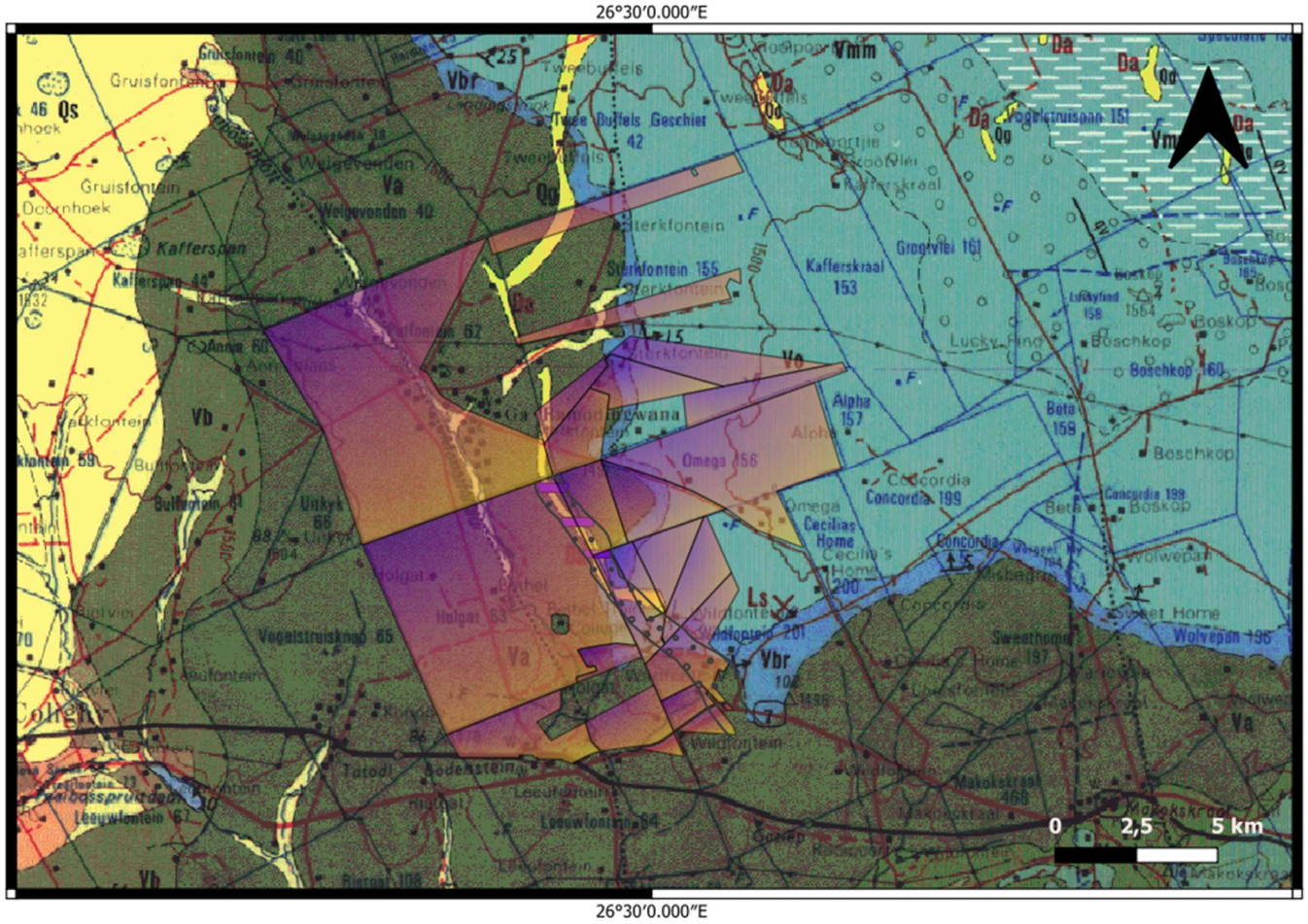


**Figure 3**: Extract of the 1:250 000 2626 WestRand Geological Map 1986 (Council of Geoscience, Pretoria) indicating the proposed Mining Right combined with a Waste License Application near Coligny, Registration Division: IP, North West Province.

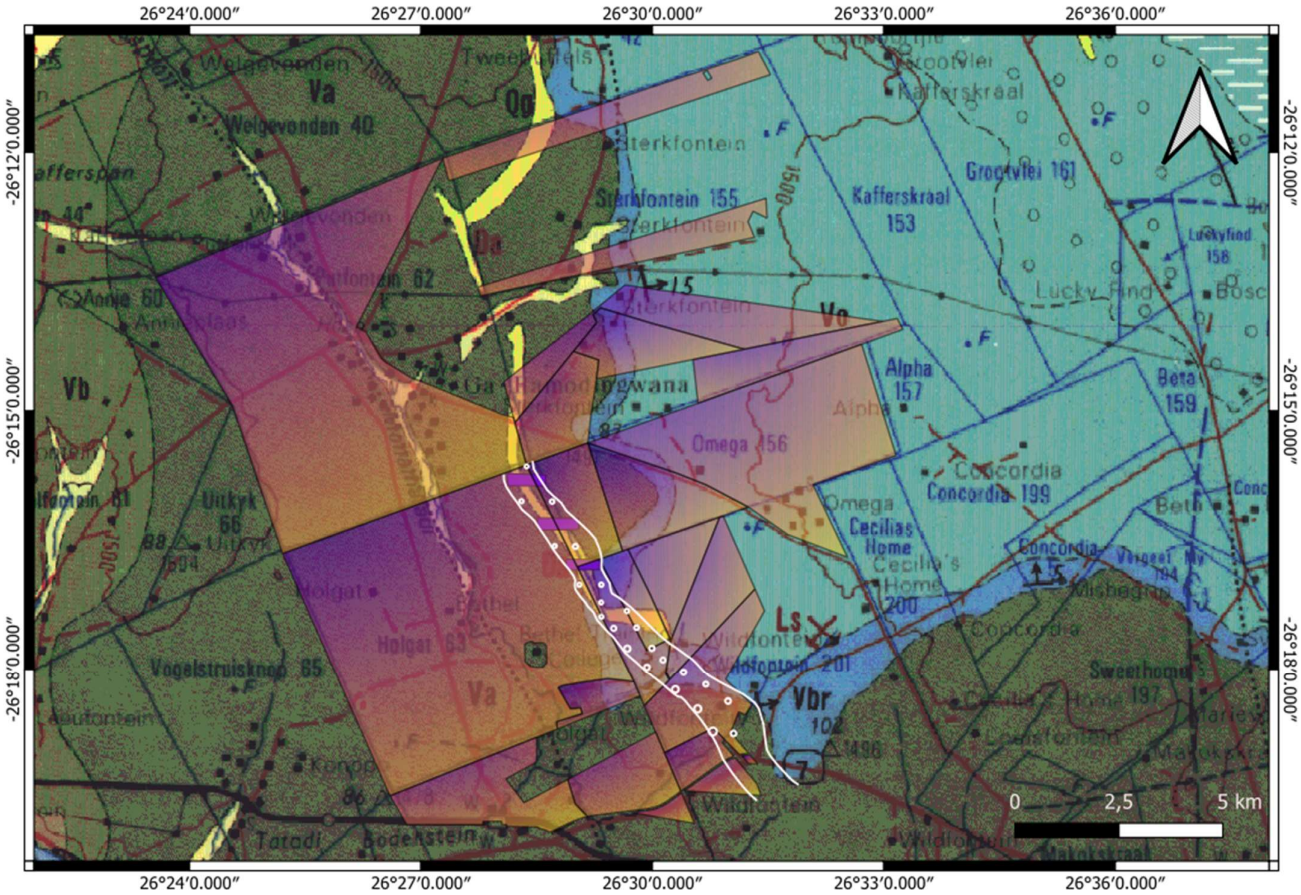


**Figure 4**: Close up view of the 1:250 000 2626 WestRand Geological Map (1986) (Council of Geoscience, Pretoria). Surface geology indicates that the development footprint is underlain by the Quaternary sands, the Malmani Subgroup (Chuniespoort Group) as well as the Black Reef Formation and Allanridge Formation of the Ventersdorp Supergroup, Platberg Group and Ventersdorp Supergroup

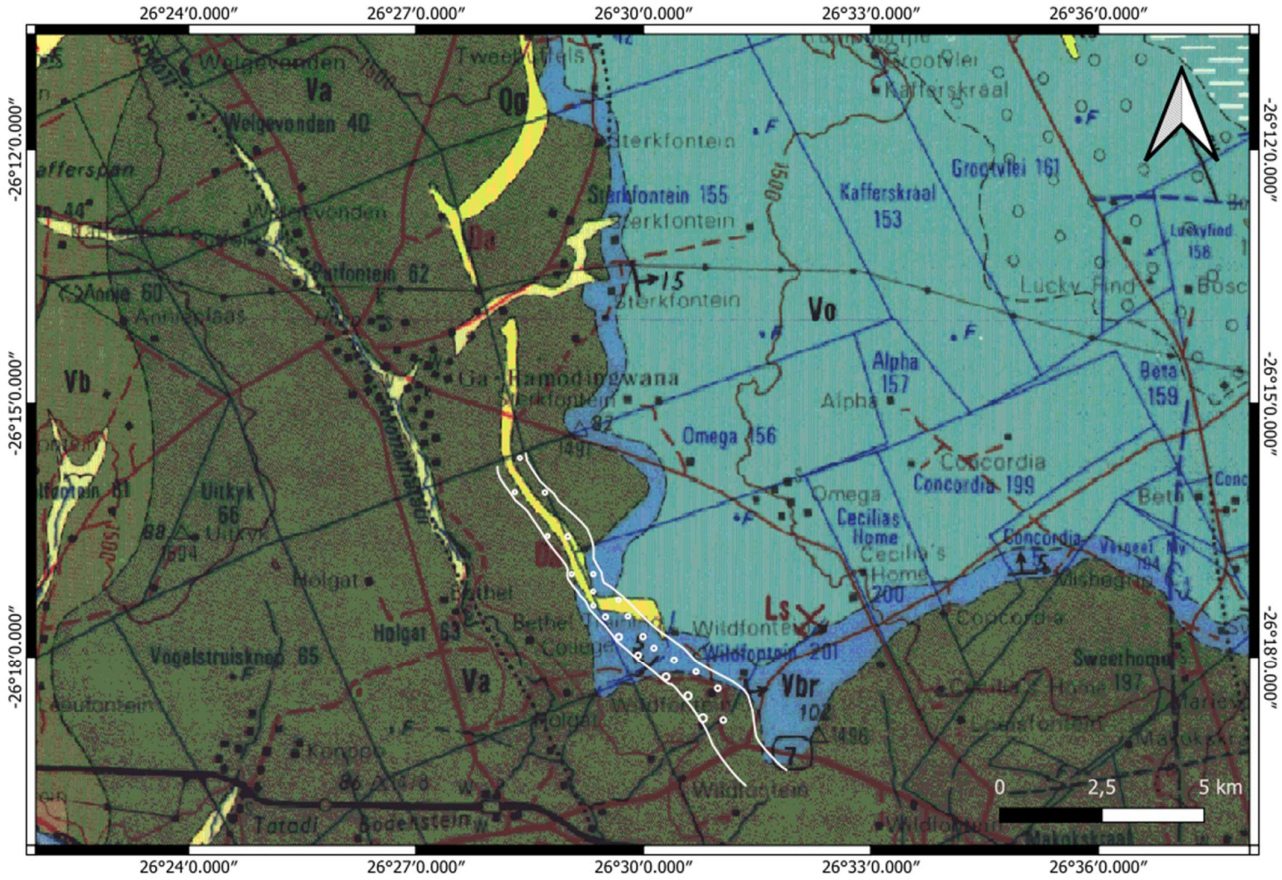


**Figure 5**: Close up view of the operational area on the 1:250 000 2626 WestRand Geological Map (1986) (Council of Geoscience, Pretoria).This area is underlain by gravel, diamondiferous gravel (Qg- yellow) as well as the Black Reef Formation (Vbr-blue) and the Allanridge Formation (Va) .

**Legend of 250 000 2626 WestRand Geological Map (1986) (Geological Map) (Council for Geosciences, Pretoria)**

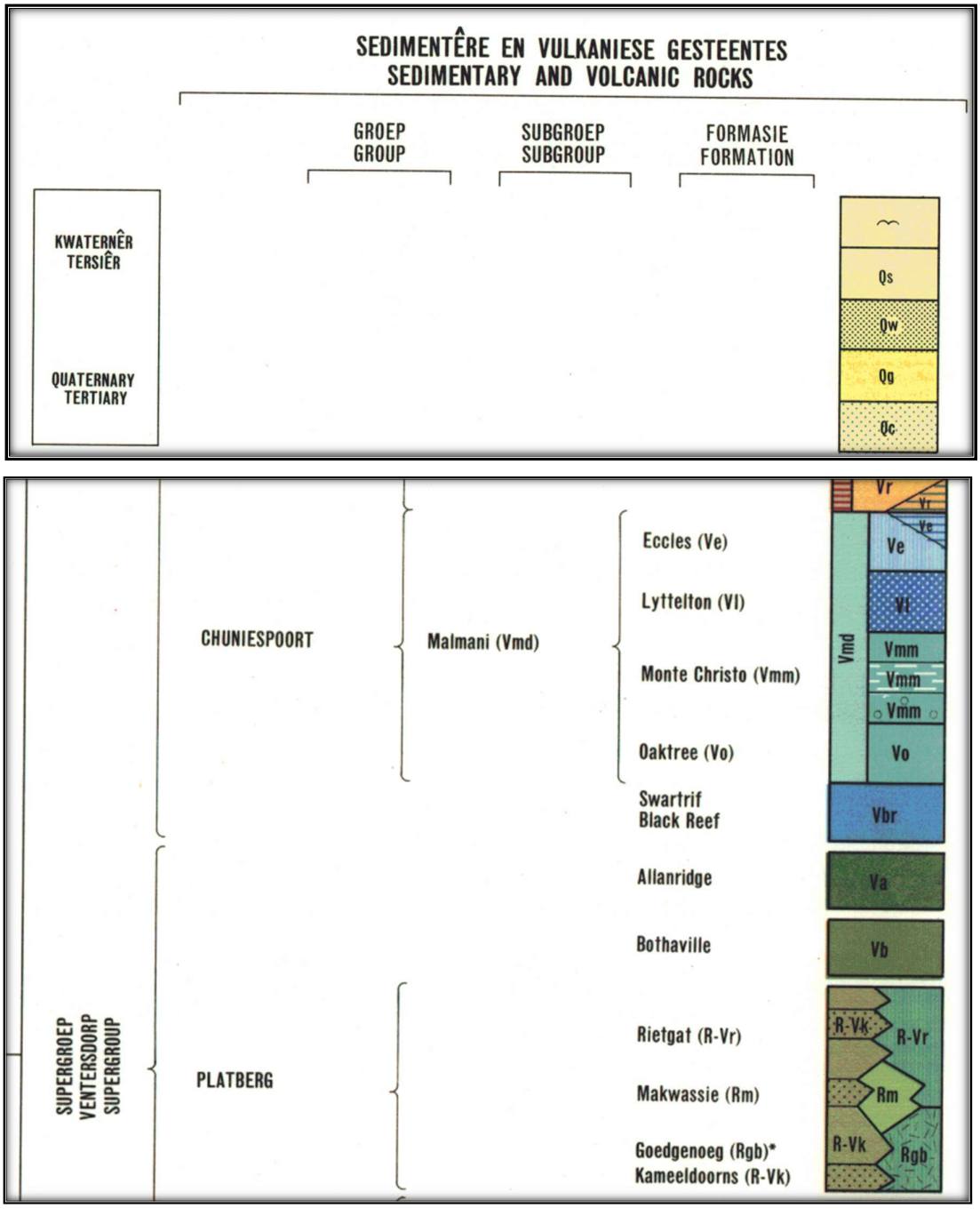

*Table 2:* Legend to Map and short explanation of the development and surrounding sediments (Modified from the *1:250 000 2626 West Rand Geological Map (1993) (Council of Geosciences, Pretoria)*.

| Symbol | Stratigraphy | Lithology |
|---|---|---|
| **Qs** | Quaternary | Soil cover |
| **Qw** | Quaternary | Aeolian sand |
| Qg | Quaternary | Gravel, Diamondiferous in places |
| Qc | Quaternary | Calcrete |
| C-Pd | Dwyka Group, Karoo Supergroup | Dianictite, shale |
| Ve | Eccles Fm, Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup | Chert-rich dolomite, chert and remnants of chert breccia of Rooihoogte Fm |
| Vmm | Monte Christo, Fm Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup | Chert-rich dolomite, interbedded banded chert, interbedded Oolitic chert |
| Vo | Oaktree Fm, Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup | Dark chert-poor dolomite |
| Vbr | Black Reef, Transvaal Supergroup | Quartzite, conglomerate, shale |
| Va | Allanridge Formation, Ventersdorp Supergroup | Basaltic amygdaloidal lava |
| Vb | Bothaville Formation, Ventersdorp Supergroup | Quartzite, greywacke, conglomerate |
| R-Vr | Rietgat Formation, Platberg Group Ventersdorp Supergroup | Amygdaloidal lava, agglomerate, tuff |
| R-Vk | Kameeldoorns Formation, Platberg Group, Ventersdorp Supergroup | Breccia, conglomerate; greywacke, shale limestone and tuff |
| Rk | Klipriviersberg Group, Ventersdorp Supergroup | Basaltic lava, agglomerate and tuff |

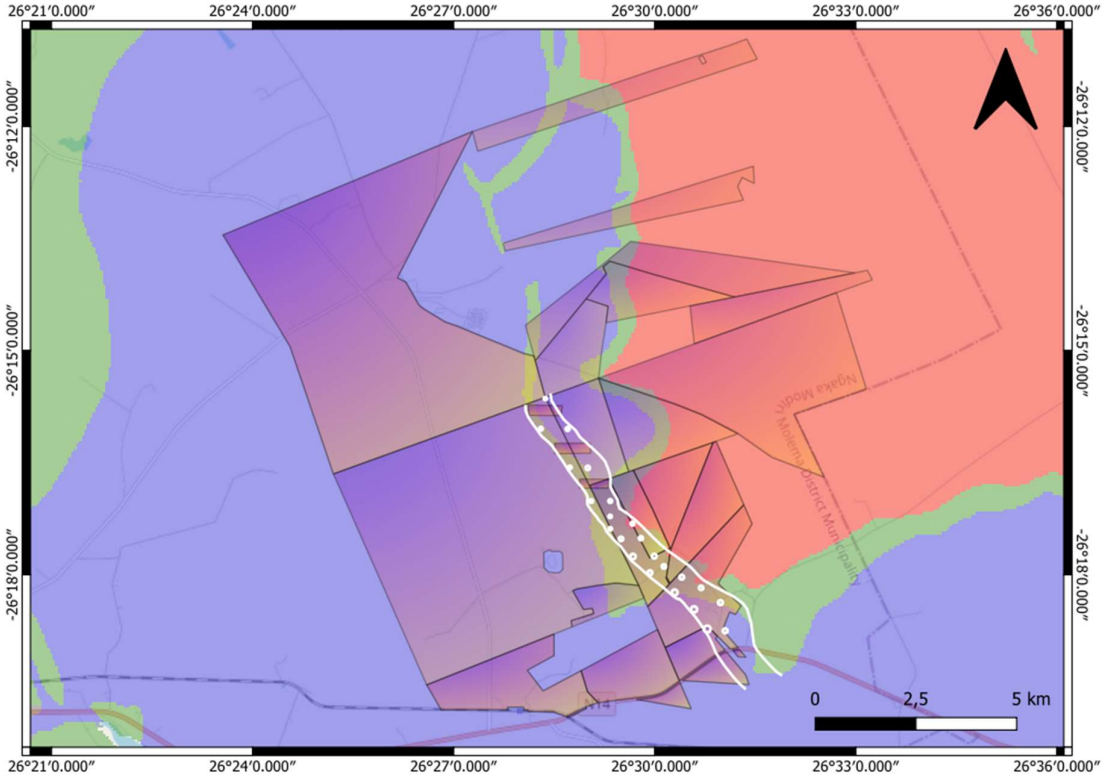


**Figure 6:** Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences).

According to the SAHRIS Palaeosensitivity map (**Figure 6**) the proposed development is underlain by sediments with a Low (blue), Moderate (green), and Very High Sensitivity (red)

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

| 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. |

## 6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development is located about 25km northeast of Coligny. The application area is 15 484.0614 hectares in extent while the area required for the infrastructure will be about 1.5 ha

## 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 Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

### 7.1 Assumptions and Limitations

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

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

## 8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984).
- 1: 250 000 2626 WestRand Geological map (1986) (Council of Geoscience).
- Google Earth map with polygons of the proposed development was obtained from Milnex CC
- 1:50 000 Topographical maps 2626AB, 2626AC, 2626 AD and 2626BA.

## 9 IMPACT ASSESSMENT METHODOLOGY

### 9.1 Impact Rating System

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

• Construction

• Operation

• Decommissioning

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

*Table 3: The rating system*

| | | |
|---|---|---|
| **NATURE** | | |
| Loss of fossil Heritage. | | |
| **GEOGRAPHICAL EXTENT** | | |
| This is defined as the area over which the impact will be experienced. | | |
| 1 | Site | The impact will only affect the site. |
| 2 | Local/district | Will affect the local area or district. |
| 3 | Province/region | Will affect the entire province or region. |
| 4 | International and National | Will affect the entire country. |
| **PROBABILITY** | | |
| This describes the chance of occurrence of an impact. | | |
| 1 | Unlikely | The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence). |
| 2 | Possible | The impact may occur (Between a 25% to 50% chance of occurrence). |
| 3 | Probable | The impact will likely occur (Between a 50% to 75% chance of occurrence). |
| 4 | Definite | Impact will certainly occur (Greater than a 75% chance of occurrence). |
| **DURATION** | | |

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

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

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

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

### *9.1.1 Summary of Impacts*

Only the site will be affected (1). It is probable that the impact will occur (2). The expected duration of the impact is assessed as potentially permanent to long term (4). The impact on fossil heritage will be irreversible and a complete loss of fossil heritage will take place (4). The cumulative effect of the impact will be Low (1). The magnitude of the impact happening will be low (1)

Significance = (Extent (1) + probability (2) + reversibility (4) + irreplaceability (4) + duration (4) + cumulative effect) (2) x magnitude/intensity (1) =17.

The Impact significance will therefore be a negative Low Impact.

## 10 FINDINGS AND RECOMMENDATIONS

The proposed mining footprint is underlain by the following:

- Gravel, Diamondiferous in places
- Black Reef Formation of the Transvaal Supergroup
- Oaktree Formation of the Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup
- Allanridge Formation of the Ventersdorp Supergroup

While the operational area is underlain by

- Gravel, Diamondiferous in places
- Black Reef Formation of the Transvaal Supergroup
- Allanridge Formation of the Ventersdorp Supergroup

According to the PalaeoMap of the South African Heritage Resources Information System the Palaeontological Sensitivity of the Quaternary gravel, Black Reef Formation (of the Transvaal Supergroup) and Allanridge Formation (of the Ventersdorp Supergroup) (operational area) has a Moderate Palaeontological Sensitivity while that of the Malmani Subgroup is Very High, (Almond and Pether 2008, SAHRIS website). As the current development (operational area) is underlain by sediments of a Moderate Palaeontological Sensitivity (Quaternary gravel, Black Reef Formation of the Transvaal Supergroup as well as the Allanridge Formation of the Ventersdorp Supergroup) a LOW Palaeontological Significance has been allocated to the development and it is therefore considered that the construction of the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. The construction of the development may be authorised and no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of fossils. (**However, if construction of any kind would ever expand into the Malmani Subgroup a site visit by a professional palaeontologist will be required**. **This requirement should be incorporated into the EMPr).**

If any fossil remains are discovered during any phase of construction (for the current application), either on the surface or uncovered by excavations the ECO/site manager in charge of these developments must be notified immediately. These discoveries ought to be protected (if possible, *in situ*) and the ECO must report to SAHRA (Contact details: NWPHRA, 1 st Floor Gaabomotho Building, 760 Dr.James Moroka Drive, Mmabatho Tel: 0183882826; Fax: +27 (0)43 7450889. Web: www.nwpg.gov.za) so that correct mitigation (recording and collection) can be carry out by a palaeontologist.

The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA

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**ELIZE BUTLER**

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