



PGS HERITAGE

PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE CONSOLIDATION OF THE LEHATING AND KHWARA MINING RIGHT AREAS AND CHANGES TO THE APPROVED LAYOUT

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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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ACKNOWLEDGMENT OF RECEIPT

| | | | |
|---------------------|---|--|-------------------------------|
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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 vita | Section 1.2 – refer to Appendix A | - |
| (b) A declaration that the person is independent in a form as may be specified by the competent authority | Page ii of the report | - |
| (c) An indication of the scope of, and the purpose for which, the report was prepared | Section 4 – Objective | - |
| (cA) An indication of the quality and age of base data used for the specialist report | Section 5 – Geological and Palaeontological history | - |
| (cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change; | Section 9 | - |
| (d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment | Desktop Study | Not applicable |
| (e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used | Section 7 Approach and Methodology | - |
| (f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives; | Desktop Study | Not applicable. |
| (g) An identification of any areas to be avoided, including buffers | Section 6 | 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 | No monitoring is required. | Not applicable |
| (n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and | Section 10 | |

| Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017 | Relevant section in report | Comment where not applicable. |
|---|--|---|
| (n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and | | |
| (n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMP, and where applicable, the closure plan | Section 10 | - |
| (o) A description of any consultation process that was undertaken during the course of carrying out the study | N/A | Not applicable. A public consultation process was handled as part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) process. |
| (p) A summary and copies if any comments that were received during any consultation process | N/A | Not applicable. To date no comments regarding palaeontological resources that require input from a specialist have been raised. |
| (q) Any other information requested by the competent authority. | N/A | Not applicable. |
| (2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply. | Section 3 compliance with SAHRA guidelines | |

The DEA screening tool indicates that the proposed Lehating and Khwara Mining development falls into an area of Moderate Palaeontological Sensitivity. The findings of this Desktop study concur with the findings of the DEA screening tool.

EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the Palaeontological Desktop Assessment (PDA) to assess the Consolidation of the Lehating and Khwara Mining Right Areas and changes to the approved layout. The National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), states that a PIA is necessary to identify the presence of fossil material within the planned development footprint. This PIA is thus necessary to evaluate the effect of the construction on the palaeontological resources.

The proposed mining development, near Hotazel, Northern Cape is completely underlain by the Cenozoic Kalahari Group as well underlying Griqualand West Basin rocks, Transvaal Supergroup. According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Kalahari Group is moderate while that of the Griqualand West rocks of the Transvaal Supergroup is moderate.

It is therefore considered that the mining development near Hotazel, Northern Cape is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the mining development may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Chance Find Protocol must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carry out by a palaeontologist.

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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Appendix A: CV

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 |
|----------------------|--|
| ASAPA | Association of South African Professional Archaeologists |
| CRM | Cultural Resource Management |
| DRDAR | Eastern Cape Department of Rural Development and Agrarian Reform |
| DEA | Department of Environmental Affairs |
| EA | Environmental Authorisation |
| ECO | Environmental Control Officer |
| EIA practitioner | Environmental Impact Assessment Practitioner |
| EIA | Environmental Impact Assessment |
| EMP | Environmental Management Plan |
| 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 |
| NEMA | National Environmental Management Act |
| NHRA | National Heritage Resources Act |
| NMBM | Nelson Mandela Bay Municipality |
| PDA | Palaeontological Desktop Assessment |
| PIA | Palaeontological Impact Assessment |
| PHRA | Provincial Heritage Resources Authority |
| PPA's | Power Purchase agreements |
| PSSA | Palaeontological Society of South Africa |
| REDS | Cookhouse Renewable Energy Development Zone |
| SADC | Southern African Development Community |
| SAHRA | South African Heritage Resources Agency |
| SAHRIS | South African Heritage Resources Information System |

1 INTRODUCTION

Lehating Mining (Pty) Ltd (Lehating) holds a mining right and approved Environmental Management Programme report (EMPr) for the development of a new underground manganese mining operation near Black Rock in the Joe Morolong Local Municipality, located in the John Taolo Gaetsewe District Municipality, Northern Cape Province. The approved mine will be located on Portion 1 of the farm Lehating 741¹. Lehating recently changed its name to Mn48 (Pty) Ltd (Mn48).

Immediately adjacent and to the south of Lehating, Khwara Manganese (Pty) Ltd (Khwara) holds an approved EMPr for underground mining of manganese on portion 2 of the farm Wessels 227 and the remaining extent and portion 3 and 4 of the farm Dibiaghomo 226. The Khwara underground resource will be accessed via/through the Lehating mine, using Lehating's approved surface infrastructure. In this regard, no surface infrastructure will be established as part of the Khwara Mine. Neither the Lehating nor Khwara Mine have been developed¹.

Khwara and Lehating have entered into an amalgamation agreement which combines the two adjacent, contiguous mineral resources and surface rights comprising the Khwara and Lehating Manganese Mine into a single, high-grade manganese mining company known as Mn48. Mn48 is now proposing to consolidate the Lehating and Khwara mining rights and associated EMPRs. In addition, Mn48 is proposing to amend the approved surface infrastructure layout following the outcome of a Bankable Feasibility Study. The main features of the proposed amendment include:

- The relocation of the primary crushing facilities from underground to surface;
- The extension of the footprint and capacity of the approved WRD;
- The addition of a second PCD, and relocation of footprint for the already approved PCD (note that the previously proposed emergency control dam will no longer be required);
- General re-configuration of approved surface infrastructure on the farm Lehating 741;
- The revision of the site SWMP to accommodate the changes of the surface infrastructure layout; and
- The establishment of proposed new support infrastructure such as a helicopter pad and weighbridge.

In addition to the above, the approved EMPr for Lehating, specified the need for a Tailings Storage Facility (TSF). This will no longer be required. The project has made a fundamental change to the mineral processing methodology whereby a dry screening process will be used, instead of a wet screening process which would produce tailings.

¹ Information provided by SLR Consulting (South Africa) (Pty) Ltd

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty-four years. She has extensive experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa for 14 years. She has been conducting Palaeontological Impact Assessments (PIA) since 2014.

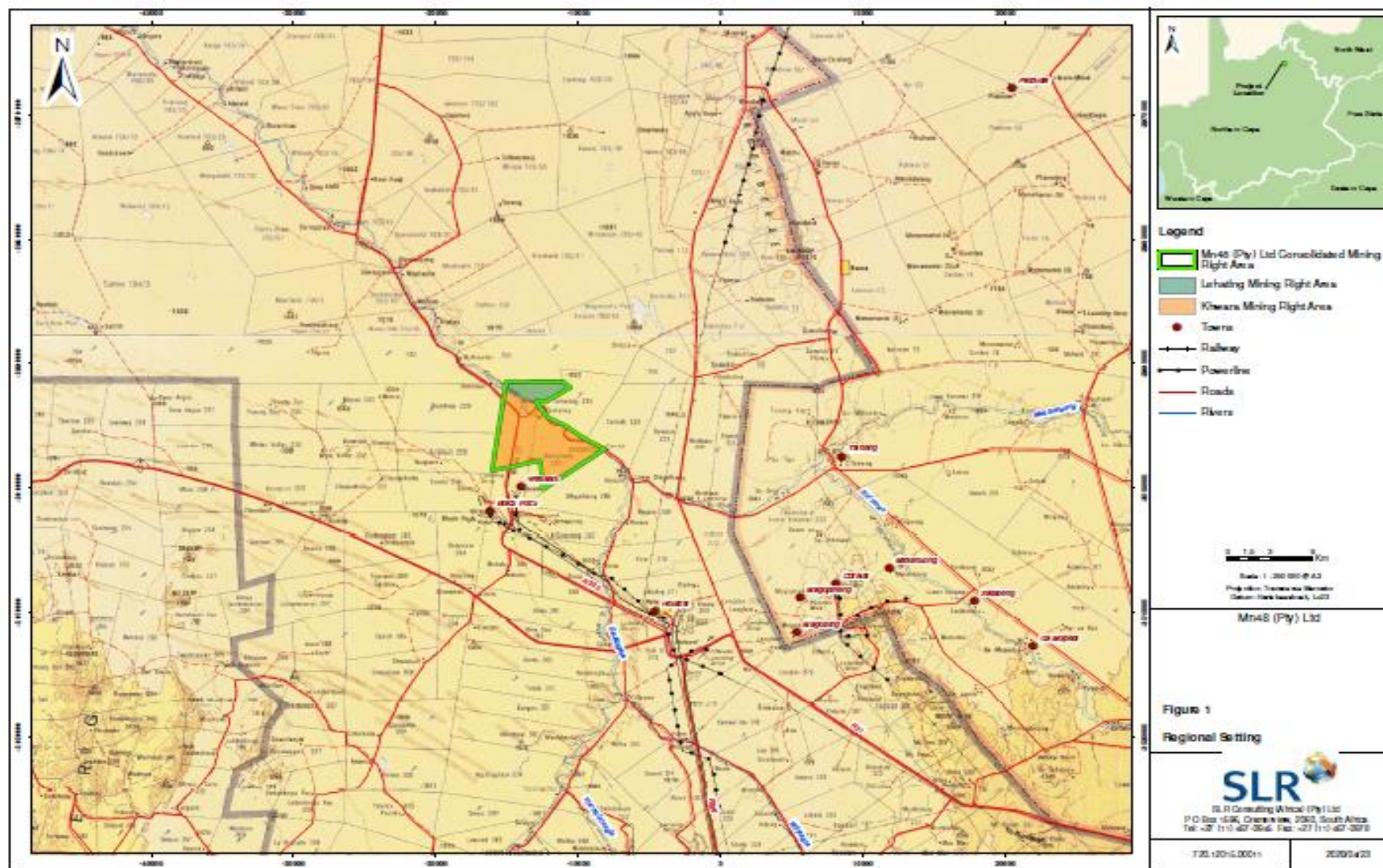


Figure 1 – Regional setting.

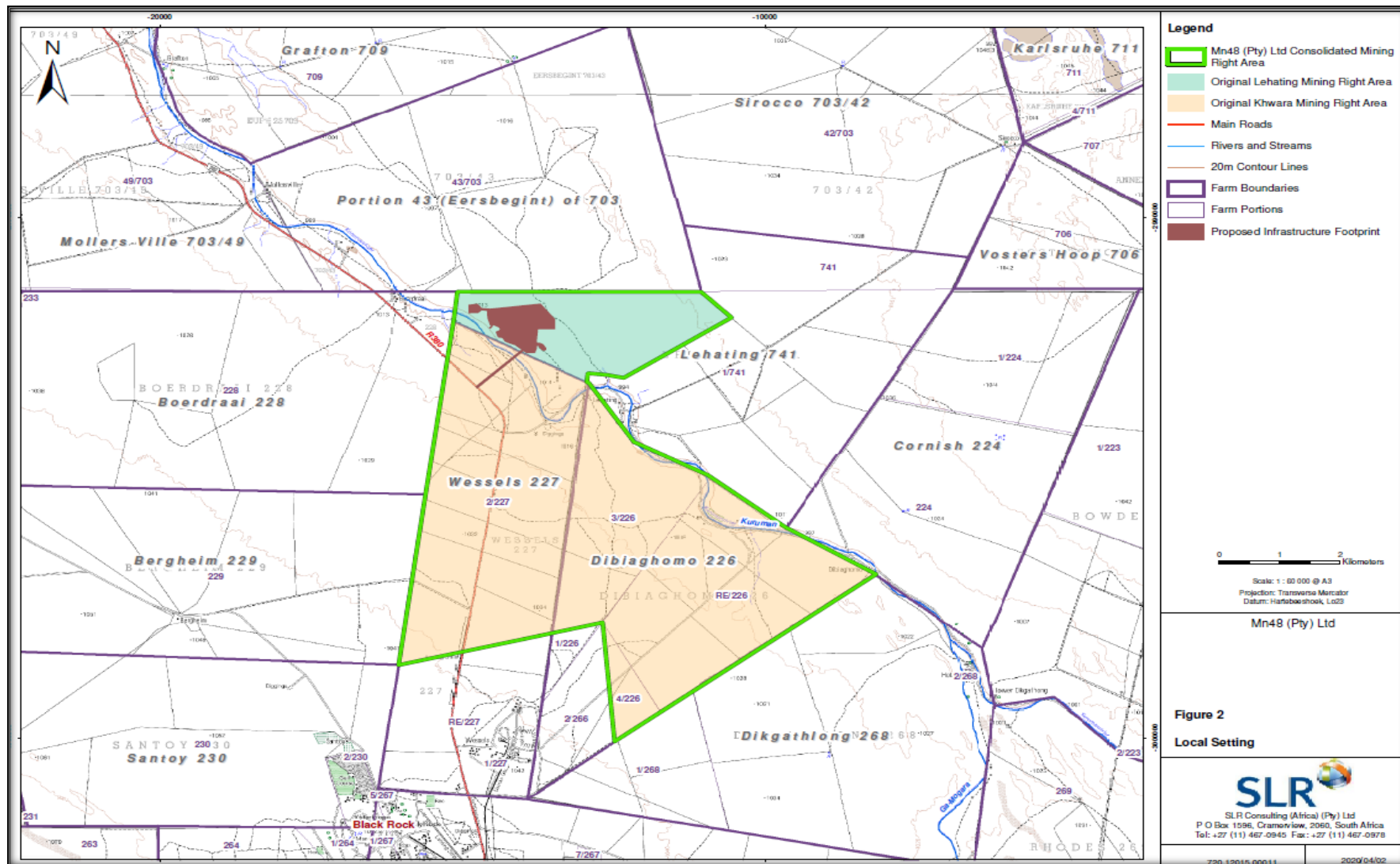


Figure 3 – Local setting.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

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

Palaeontological heritage is 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 PDA 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 m² 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 m² 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 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 Paleontological

Impact Assessment (PIA) are: 1) to **identify** the palaeontological importance of the rock formations in the footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) to determine the **impact** on fossil heritage; and 4) to **recommend** how the property developer should guard against and lessen damage to fossil heritage.

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/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 PALAEOONTOLOGICAL HISTORY

The proposed mining development near Hotazel in the Northern Cape is depicted on the 1:250 000 2722 Kuruman Geological Map (Council of Geosciences) is underlain by Cretaceous to Tertiary Kalahari formation (Qs) (Karoo Supergroup) and underlying Griqualand West Basin rocks, Transvaal Supergroup (Figure 5).

According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Cretaceous to Tertiary Kalahari formation and underlying Griqualand West Basin rocks, Transvaal Supergroup is moderate (Almond *et al*, 2013; SAHRIS website).

Table 3: Generalised Stratigraphic Column and Associated Geology

| Stratigraphy | | | Lithology | |
|-------------------------------|--------------------|--------------------|--------------------------|------------------------|
| Kalahari Formation (Qs and Q) | | | Clay, limestone and sand | |
| Transvaal Supergroup | Postmansburg Group | Voëlwater Subgroup | Hotazel Formation | Iron Formation |
| | | | | Upper Mn ore body |
| | | | | Middle Mn ore body |
| | | | | Iron Formation |
| | | | | Lower Mn ore body |
| | | | | Mn-rich iron formation |
| | | | | Iron Formation |
| | | | Ongeluk Formation | Basaltic lava |

The **Kalahari deposits** is approximately Ca 65 – 2.5 million years old (Ma).

The Cenozoic Kalahari Group is the most widespread body of terrestrial sediments in southern Africa. The Cenozoic sands and calcretes of the Kalahari Group range in thickness from a few meters to more than 180m (Partridge *et al.*, 2006). The youngest formation of the Kalahari Group is the Gordonia Formation which is generally termed Kalahari sand and comprises of red aeolian sands that covers most of the Kalahari Group sediments. The pan sediments of the area originated from the Gordonia Formation and contains white to brown fine-grained silts, sands, and clays. Some of the pans consist of clayey material mixed with evaporates that shows seasonal effects of shallow saline groundwaters. Quaternary alluvium, aeolian sands, surface limestone, silcrete, and terrace gravels are also included in the Kalahari Group (Kent 1980).

The fossil assemblages of the Kalahari are generally moderate in diversity and occur over a wide range and thus the palaeontological diversity of this Group is moderate. These fossils represent terrestrial

Palaeontological Desktop Assessment for the Consolidation of the Lehating and Khwara Mining Right Areas and changes to the approved layout

plants and animals with a close resemblance to living forms (see Table 2). Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods and trace fossils.

Hotazel is in the **Griqualand West Basin**, Northern Cape Province which consists of clastic sediments as well as volcanic rocks, diamictites and banded iron formations. Manganese deposits are present in the Hotazel Formation, upper Postmasburg Group (approximately 2222 Ma). The Vryburg Formation is the basal unit and overlies unconformably the granite and rocks of the Ventersdorp Supergroup. The Campbell Group overlies the Vryburg Formation and consists of the Schmidtsdrif Formation and the upper Ghaap Plateau Formation. The Griquatown Group is divided into two formations namely the Asbestos Hills and Koegas Formations. The Gamagara Formation follows and is positioned on the Maremane Anticline and is overlain by the Makganyene Formation. The Cox Group comprises of the lower Ongeluk Formation and the upper Voëlwater Formation. The Ongeluk Formation was deposited under water and reaches a thickness of between 400 and 900 m. This Formation is basal and is mainly volcanic (Visser 1989). Manganese is present in the upper Voëlwater Formation (Snyman 1996). According to Kent (1980) and Snyman (1996) Griqualand West Basin attains a maximum thickness of 4500 m.

Algal growth structures, also known as “stromatolites”, are fossil structures described from the dolomites of the Transvaal Supergroup. Stromatolites are layered mounds, columns and sheet-like sedimentary rocks. 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-based life). Stromatolites are first found in Precambrian rocks and are known as the earliest known fossils (Figure 4). The oxygen atmosphere that we depend on was generated by numerous cyanobacteria photosynthesizing during the Archaean and Proterozoic Era.



Figure 4 – Example of an Archean Stromatolite

Table 4: Table modified from Palaeotechnical Report (Almond and Pether 2009).

| Subgroup/ sequence | Group | Formation | Fossil Heritage | Comment |
|--------------------------------|-------------|------------------|-----------------------|---|
| Tertiary-Quaternary | Kalahari | - | Terrestrial organisms | Trace fossils, ostracods, bivalves, gastropod shells, diatoms |
| Griqualand West Super Group | Campbell | Ghaapplato (Vgh) | Stromatolites | Cyanobacterial microfossils |
| - | Griquaastad | Asbestos Hills | Stromatolites | Cynanobacterial microfossils |

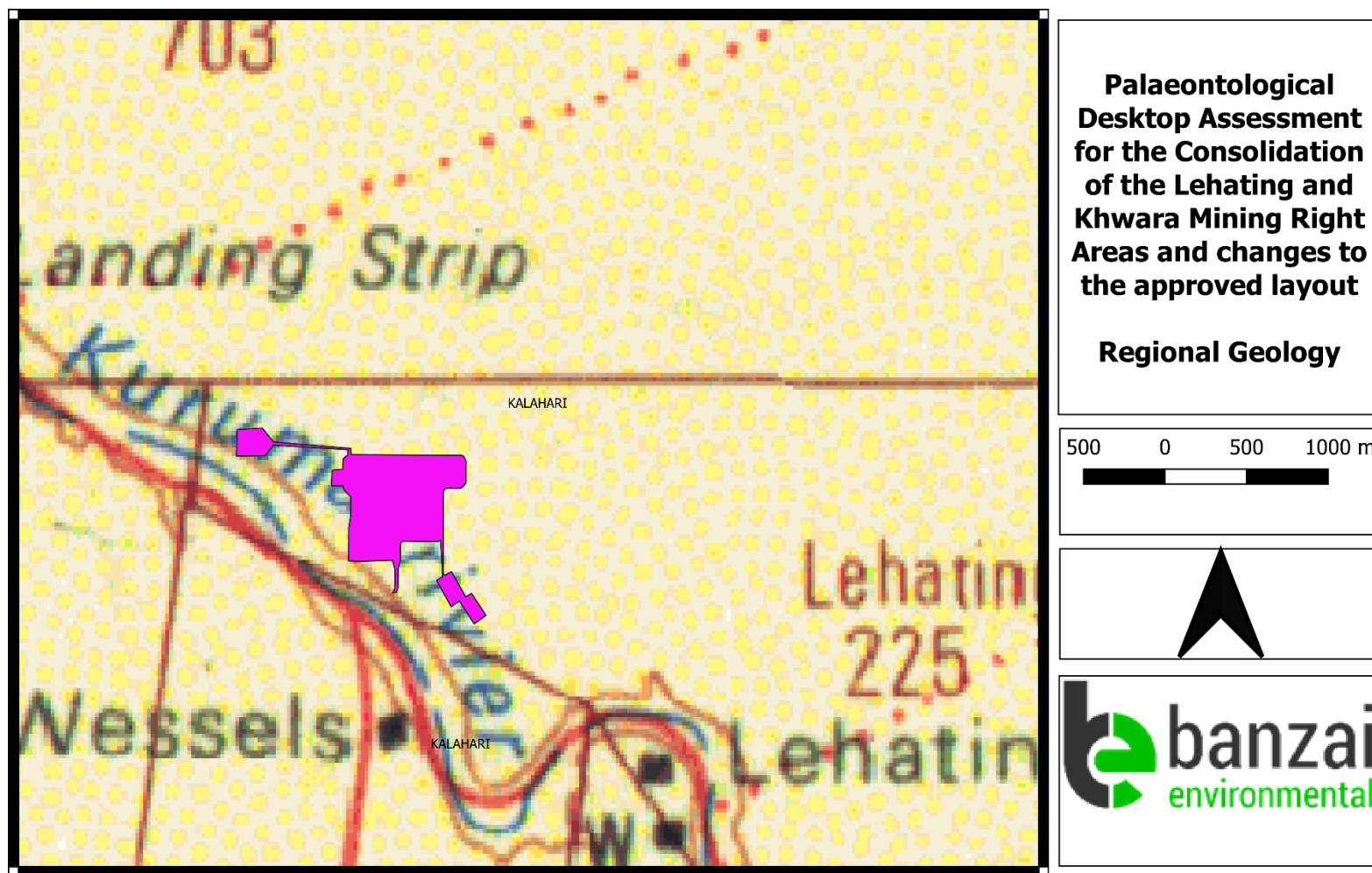


Figure 5 - Extract of the 1: 250 000 2722 Kuruman Geological Map (Council of Geosciences, Pretoria). The study area is underlain by the Gordonia Formation (Kalahari Group). Legend: Qs- Quaternary deposits (Red to flesh coloured wind-blown sand) Kalahari Group (Gordonia Formation)

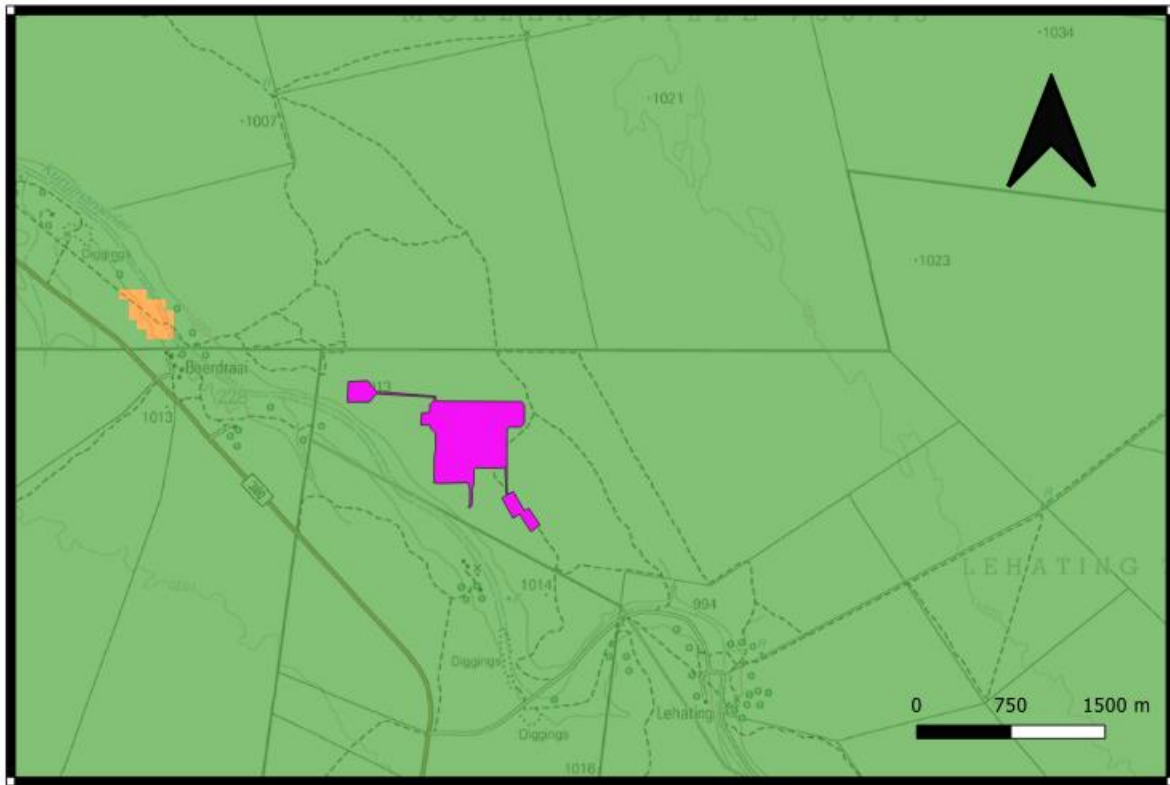


Figure 6 - Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the locality of the proposed development.

| 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 6) there is a moderate chance of finding fossils in this area.

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development is approximately 20 km north of Hotazel on the R380.

7 METHODS

The aim of a PDA 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: PDA reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

7.1 Assumptions and Limitations

When conducting a PDA 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 which 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. A field-assessment is thus necessary to 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 2722 Kuruman Geological Map (Council of Geosciences, Pretoria).
- A Google Earth map with polygons of the proposed development was obtained from PGS Heritage.
- Maps were obtained from SLR Consulting

9 IMPACT ASSESSMENT METHODOLOGY AND HIERARCHY

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 aforementioned assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the aforementioned criteria is given in **Table 5**.

Table 5 - 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.

9.1 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 in **Table 6** below.

Table 6 - Description of the significance rating scale

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

9.2 Spatial Scale

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

Table 7 - 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 development site. |

9.3 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 8**.

Table 8 - Description of the temporal rating scale

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

9.4 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in **Table 9** below.

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

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

9.5 Degree of Certainty

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

Table 10 - Description of the degree of certainty rating scale

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

9.6 Quantitative Description of Impacts

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

$$\text{Impact Risk} = \frac{(\text{SIGNIFICANCE} + \text{Spatial} + \text{Temporal}) \times \text{Probability}}{3 \quad 5}$$

Table 11 – Impact Rating Table

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|-------------------|--------------|---------------|----------------|-------------|--------|
| | Moderate | Proposed site | Permanent | Unlikely | |
| Impact on Fossils | 3 | 1 | 5 | 2 | 1.2 |

Note: The significance, spatial and temporal scales are added to give a total of 9, that is divided by 3 to give a criteria rating of 3. The probability (2) is divided by 5 to give a probability rating of 0,4. The criteria rating of 3 is then multiplied by the probability rating (0,4) to give the final rating of 1.2.

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

Table 12 - Impact Risk Classes

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

Therefore, with reference to the example used for air quality above, an impact rating of 1.2 will fall in the Impact Class 2, which will be considered to be a low impact.

9.7 Summary of Impact Tables

The impact on Fossil Heritage is DIRECT NEGATIVE. *Only the study site will be affected by the proposed development.* The expected duration of the impact is assessed as potentially permanent. The impact is highly destructive but will only occur during the construction phase. The significance of the impact occurring will be **moderate**. As fossil heritage will be destroyed the impact is **irreversible** but the degree to which the impact can cause irreplaceable loss of resources is Low if proper mitigation is to undertaken.

10 FINDINGS AND RECOMMENDATIONS

The proposed mining development, near Hotazel, Northern Cape is completely underlain by the Cenozoic Kalahari Group as well underlying Griqualand West Basin rocks, Transvaal Supergroup.

According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Kalahari Group is moderate while that of the Griqualand West rocks of the Transvaal Supergroup is moderate.

It is therefore considered that the mining development near Hotazel, Northern Cape is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the mining development may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Chance Find Protocol must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that 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.

11 CHANCE FINDS PROTOCOL

A following procedure will only be followed in the event that fossils are uncovered during excavation.

11.1 Legislation

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

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

11.2 Background

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

11.3 Introduction

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

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

11.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work must cease in the immediate vicinity of the find.

- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ECO or site manager. The ECO must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ECO (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 ECO (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.

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Appendix A – Elize Butler CV

CURRICULUM VITAE

ELIZE BUTLER

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 26 years in Palaeontology

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

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

Management Course, 1991
University of the Orange Free State

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

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

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 National Museum, Bloemfontein
and Collection Manager 1998–currently

TECHNICAL REPORTS

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

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