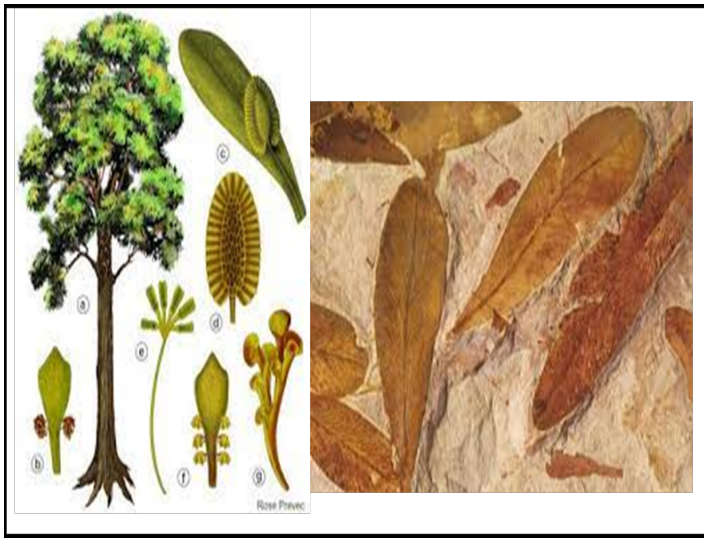
PALAEONTOLOGICAL IMPACT ASSESSMENT (PIA) FOR THE COROBRIK RIETVLEI MINE MINING RIGHT AMENDMENT IN SUPPORT OF SECTION 102 IN ACCORDANCE TO THE MINERAL RESOURCES DEVELOPMENT ACT, ACT 28 OF 2002 AS AMENDED (MPDRA)

FOR

Licebo Environmental and Mining (Pty) Ltd



Glosopteris sp

DATE: 14 August 2023

Specialist Scientist

Dr Gideon Groenewald (*Hon Research Associate: ESI, University of the Witwatersrand***)**

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EXECUTIVE SUMMARY

Dr Gideon Groenewald was appointed by Licebo Environmental and Mining (Pty) Ltd here after referred to as (**LEM**) to undertake a Palaeontological Impact Assessment for the Corobrik (Pty) Ltd Mining Right Amendment Application in terms of MPRDA which includes Phase 1 Palaeontological Assessment Survey on the project area within Remaining Extent of Portion 26 (a Portion of portion 1) and Portion 27 (a Portion of portion 26) of the farm Witkoppies No. 393 JR, situated in both City of Tshwane and Ekurhuleni Metropolitan Municipalities, Gauteng Province**,** South Africa.

Corobrik is currently undertaking the mining of clay with an approved mining right, MR 87 GP. However, the deposit includes minor coal seams of up to 10m in thickness and therefore applied for a section 102 amendment to the current right in June 2022, to include coal reserves and possesses an approved clay mining right, however while mining clay, coal. Corobrik is therefore it is in the process of amending the mining right to include coal in terms of Section 102 of Mineral Petroleum Resources and Development Act (Act No. 28 of 2002) (MPRDA) as amended and Section 24G of National Environmental Management Act (Act 107 of 1998) as amended (NEMA) respectively.

The geology underlying the project area comprises the Malmani Subgroup dolomites and the Ecca Group. Parts of the development will also be underlain by very deep soils.
Rocks of the Malmani Subgroup as well as the Ecca Group are world renowned for significant finds of Palaeontological Heritage objects, including highly significant fossils of stromatolites as well as Permian aged plant fossils.

It is however very important to note that, although a very high sensitivity rating is allocated to large areas underlain by Malmani Subgroup and Ecca Group geology, the actual impact per site of excavation might be limited. This is a fact of matter in the mining industry where specific finds of fossils of exceptional quality as well as scientific significance is unpredictable. The science of palaeontology is unfortunately a field of science in which the scientist only knows the real outcome of exploration when the rocks are broken during actual excavation. Although it is imperative to indicate the very high sensitivity on the initial maps, the *modus operandi* of the project palaeontologist, when appointed, must be to train the ECO and team members to adhere to the “Chance Find Protocol” recommendation.

The full-time presence of a professional palaeontologist would be preferred during all mining activities on this site where the site has been allocated a red and orange colour on the sensitivity map. It might be much less expensive to train the environmental officers to know what to look for during excavation and inform the palaeontologist of a significant find immediately. Fossils recorded during construction and mining, must be curated and

moved to the institute indicated by SAHRA, but preferably the Evolution Studies Institute at Wits, where these fossils are historically studied.

Recommendations

- The EAP and developer must be informed that significant areas are underlain by rocks with a very high sensitivity for palaeontological heritage.
- All excavations that will expose sedimentary strata of the Ecca Group (geotechnical reports) will most probably contain significant fossils. The appointment of a palaeontologist to do a comprehensive Phase 2 PIA assessment (fossils collection during mining) will be a minimum requirement for monitoring of excavations into the Ecca Group strata.
- The project will require a formal "Chance Find Protocol" that will have to be upgraded during the construction as well as mining phases of the project.
- Without mitigation the project will have a very negative impact on palaeontological heritage. With mitigation the project will have a very high positive impact on palaeontological heritage, mainly because mining for coal will expose new bedrock that would not have been exposed for thousands of years.
- Recommendations for palaeontological monitoring and mitigation for significant plant fossil finds recorded on 14th August 2023 (Table 2 of the main document), will have to be incorporated into the EMPr for approval by the SAHRA.

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INTRODUCTION

Licebo Environmental Mining (Pty) Ltd (Hereafter referred as '**LEM'**) have been appointed by Corobrik to undertake the Environmental Authorisation amendment process in terms of Section 24G to rectify the undertaking of listed activities without the required Environmental Authorisation in respect to coal mining activities. This application process will include compilation of required environmental authorisation application documents which will involve the Basic Assessment Report (BAR) and the Environmental Management Programme report (EMPr) as required in terms of the National Environmental Management Act (Act 107 of 1998) as amended and the Environmental Impact Assessment (EIA) regulations as amended (Government Notice Regulation 982 as amended) and the applicable environmental Listing Notice 1 – GNR 983 and Listing Notice 3 – GNR 985.

This Phase 1 Survey is done to prepare a "Chance Find Protocol" (CFP) document to assist with possible future field visits and to complete a Phase 2 PIA (if required) since the entire development site is underlain by geological formations with an inferred High sensitivity for Palaeontological Heritage (Groenewald et al., 2014).

Legal Requirements

This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999 (revised 2017). In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens; and
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

Aims and Methodology

A Phase 1 site investigation is often the only opportunity to record the fossil heritage within the development footprint. These records are very important to understand the past and form an important part of South Africa's National Estate.

Following the "*SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports*" the aims of the palaeontological impact assessment are:

- to identify exposed and subsurface rock formations that are considered to be paleontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

Prior to a field investigation, a preliminary assessment (desktop study) of the topography and geology of the study area was made using appropriate 1:250 000 geological information (2528 Pretoria) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc.) were identified within the study area and the known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience (Groenewald, 1996).

Priority palaeontological areas are identified within the development footprint to focus the field investigator's time and resources. The aim of the desktop survey is to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

The likely impact of the project on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1 below.

Table 1 Palaeontological sensitivity analysis outcome classification

PALAEONTOLOGICAL SIGNIFICANCE/VULNERABILITY OF ROCK UNITS	
The following colour scheme is proposed for the indication of palaeontological sensitivity classes. This classification of sensitivity is adapted from that of (Almond et al., 2009; Almond and Pether, 2008; Groenewald et al., 2014)	
RED	Very high palaeontological sensitivity/ vulnerability. Development will most likely have a very significant impact on the palaeontological heritage of the region. Very high possibility that significant fossil assemblages will be present in all outcrops of the unit. Appointment of professional palaeontologist, desktop survey, Phase I Palaeontological Impact Assessment (PIA) (field survey and recording of fossils) and Phase II PIA (rescue of fossils during construction) as well as application for collection and destruction permit compulsory.
ORANGE	High palaeontological sensitivity/ vulnerability. High possibility that significant fossil assemblages will be present in most of the outcrop areas of the unit. Fossils most likely to occur in associated sediments or underlying units, for example in the areas underlain by Transvaal Supergroup dolomite where Cenozoic cave deposits are likely to occur. Appointment of professional palaeontologist, desktop survey and Phase I palaeontological impact assessment (field survey and collection of fossils) compulsory. Early application for collection permit recommended. Highly likely that a Phase II PIA will be applicable during the construction phase of projects.
GREEN	Moderate palaeontological sensitivity/ vulnerability. High possibility that fossils will be present in the outcrop areas of the unit or in associated sediments that underlie the unit. For example, areas underlain by the Gordonia Formation or undifferentiated soils and alluvium. Fossils described in the literature are visible with the naked eye and development can have a significant impact on the palaeontological heritage of the area. Recording of fossils will contribute significantly to the present knowledge of the development of life in the geological record of the region. Appointment of a professional palaeontologist, desktop survey and Phase I PIA (ground proofing of desktop survey) recommended.
BLUE	Low palaeontological sensitivity/ vulnerability. Low possibility that fossils that are described in the literature will be visible to the naked eye or be recognized as fossils by untrained persons. Fossils of for example small domal Stromatolites as well as micro-bacteria are associated with these rock units. Fossils of micro-bacteria are extremely important for our understanding of the development of life, but are only visible under large magnification. Recording of the fossils will contribute significantly to the present knowledge and understanding of the development of life in the region. Where geological units are allocated a blue colour of significance, and the geological unit is surrounded by highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a blue colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in larger alluvium deposits. At least one site visit by a competent palaeontologist is compulsory. Collection of a representative sample of potential fossiliferous material is recommended.

GREY	Very low palaeontological sensitivity/ vulnerability. Very low possibility that significant fossils will be present in the bedrock of these geological units. The rock units are associated with intrusive igneous activities and no life would have been possible during intrusion of the rocks. It is however essential to note that the geological units mapped out on the geological maps are invariably overlain by Cenozoic aged sediments that might contain significant fossil assemblages and archaeological material. Examples of significant finds occur in areas underlain by granite, just to the west of Hoedspruit in the Limpopo Province, where significant assemblages of fossils and clay-pot fragments are associated with large termite mounds. Where geological units are allocated a grey colour of significance, and the geological unit is surrounded by very high and highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a grey colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in dolerite sill outcrops. It is important that the report should also refer to archaeological reports and possible descriptions of palaeontological finds in Cenozoic aged surface deposits. At least one site visit by a suitably qualified palaeontologist is recommended.

Rocks with very high palaeontological sensitivity are present within the development footprint and palaeontological mitigation measures must be incorporated into the Environmental Management Plan (EMP) for this project. Due to the fact that the 1:250 000 scale vector maps obtained from the Council for Geoscience indicates the rock unit underlying the area applicable to this report as being the Ecca Group of the Karoo Supergroup, lead to an initial assessment that very distinctive fossils will be present. Field work during this survey as well as literature surveys indicated that the rock units that will be exposed most of the time is the potentially fossiliferous Ecca Group, a well-known rock sequence of the Karoo Supergroup that contains highly significant palaeontological heritage (Groenewald D.P., Day O.D., Cameron R. P-C. and Rubidge B.S., 2022; Groenewald, 1996; Groenewald et al., 2001; Johnson et al., 2009; MacRae, 1999; McCarthy and Rubidge, 2005; Rubidge (ed), 1995; Rutherford et al., 2015; Smith et al., 2020; Viglietti et al., 2018).

Scope and Limitations of the Phase 1 Investigation

The scope of a Phase 1 Investigation includes:

- an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units;
- a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports;
- data on the project provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged); where feasible, location and examination of any fossil collections from the study area (e.g. museums); and
- an on-site investigation to assess the identified palaeontological sensitive areas within the development footprint/ study area, including a formal palaeontological

collection if fossils are of collectable quality. The investigation focuses on the bedrock exposure where excavations would most probably require palaeontological monitoring.

The results of the field investigation are used to predict the potential of buried fossil heritage within the development footprint. In some investigations, (as in this study), this involves the examination of similar accessible bedrock exposures, such as road cuttings and quarries, along roads that run parallel to or across the development footprint.

Locality and Project

The project is situated on Remaining Extent of Portion 26 (a Portion of portion 1) and Portion 27 (a Portion of portion 26) the farm Witkoppies 393 JR, situated in both City of Tshwane and Ekurhuleni Metropolitan Municipalities, Gauteng Province (Figure 1).

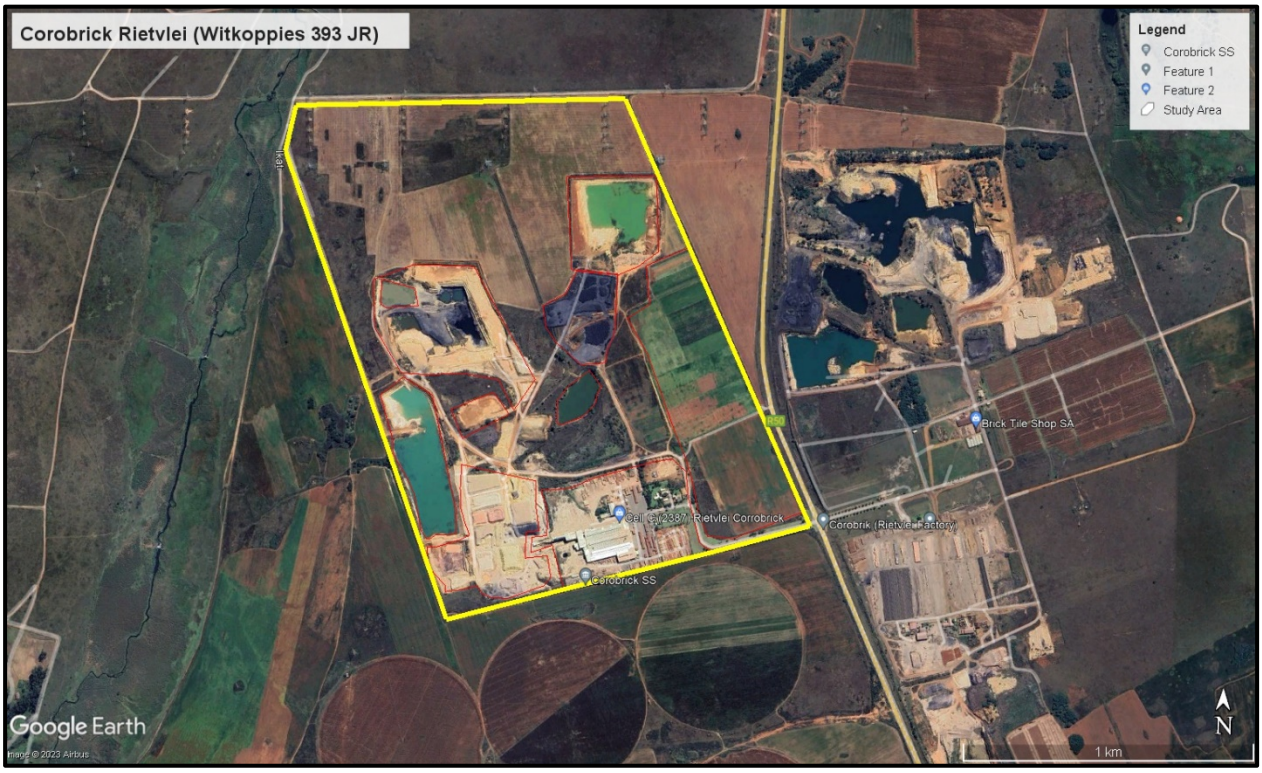


Figure 1 Locality of the farm Witkoppies 393 JR

The project area situated approximately 20km south-east of Pretoria and 40 km south-west of Bronkhorstspruit, with a typical open grassland eco-system, albeit entirely transformed due to agriculture and mining activities. The underlying soils are typically shallow to deep sandy to loamy soils, resulting from weathering of the underlying geology. The geomorphological setting is associated with virtually no outcrops of semi-resistant sandstone layers, interbedded with mudstone that is largely still covered in grassland

vegetation. It is important to note that the project vary from single unit installations (housing, factories and mining development) or specific point sites, to linear road making as well as installation of water and sanitation infrastructure.

This Phase 1 Palaeontological impact survey aims to provide the decision making authority with a general summary of the geology and palaeontology of the development site, with indications of how the specific developments will have to be assessed in more detail once the actual layouts are established. It will be important to note potential very high sensitivity points (excavations sites for trenches and foundations) that are associated with specific geological units recorded during planning of the mining activities going forward.

It is important that the EAP as well as the developer understands the *modus operandi* of Palaeontolotgical Impact assessments in large projects. The professional palaeontologist will indicate a very high sensitivity for palaeontological heritage in rock units where there is a very high likelihood of finding significant fossil remains (in this case plant fossils of Karoo age) in an exposed rock outcrop area of 100m^2 or basically 20m x 5m. During fieldwork, this scenario was duplicated and the entire study area was scanned for outcrops of fossiliferous rocks. Where significant evidence for plant fossils are recorded in outcrop areas of 100m^2, as in the case at Farm Witkoppies, the rock unit is mapped as "very highly sensitive" because it is **very highly likely** that an excavation for the foundation of a house or a open pit mining activity will expose significant fossils. If this is proven, the palaeontologist must train the ECO and dedicated members of the technical team of the contractor, to recognise "**significant" fossils**. (Significant fossils are the remains of plants that are uniquely well preserved and the judgement is subjective, with a very strong element of personal observation by the ECO). The ECO and Resident Engineer will then communicate an urgent call to the **appointed palaeontologist** to come onto site to remove the fossils. It will be impractical and too expensive to employ a full-time professional palaeontologist to "wait and see" on the construction site. The aim of a well-planned "Chance Find Protocol" (which must be part of the EMPr of this project) will be to recover fossils without causing "standing time". If this process is well-planned, no un-planned standing time needs to be generated as a result of palaeontological heritage discoveries.

GEOLOGY

The project area is underlain by rocks of the Vaalian aged Malmani Subgroup, Chuniespoort Group of the Transvaal Supergroup and predominantly deeply weathered Permian aged sandstone and shale of the Ecca Group, Karoo Supergroup (Figure 2). These highly significant geological units are very specifically of Vaalian and Permian age and although the dolomite of the Malmani Subgroup will not be exposed during mining of clay, nor coal, it is noteworthy to note the importance of the rock sequence.

In terms of the coal beds in the Permian aged Ecca Group, the geological unit is very highly sensitive for palaeontological heritage and plant fossils have been recorded in both the sandstone as well as the shale units. In the application for amendment of the mining license for coal mining, the impact of mining on palaeontological heritage will be very high.

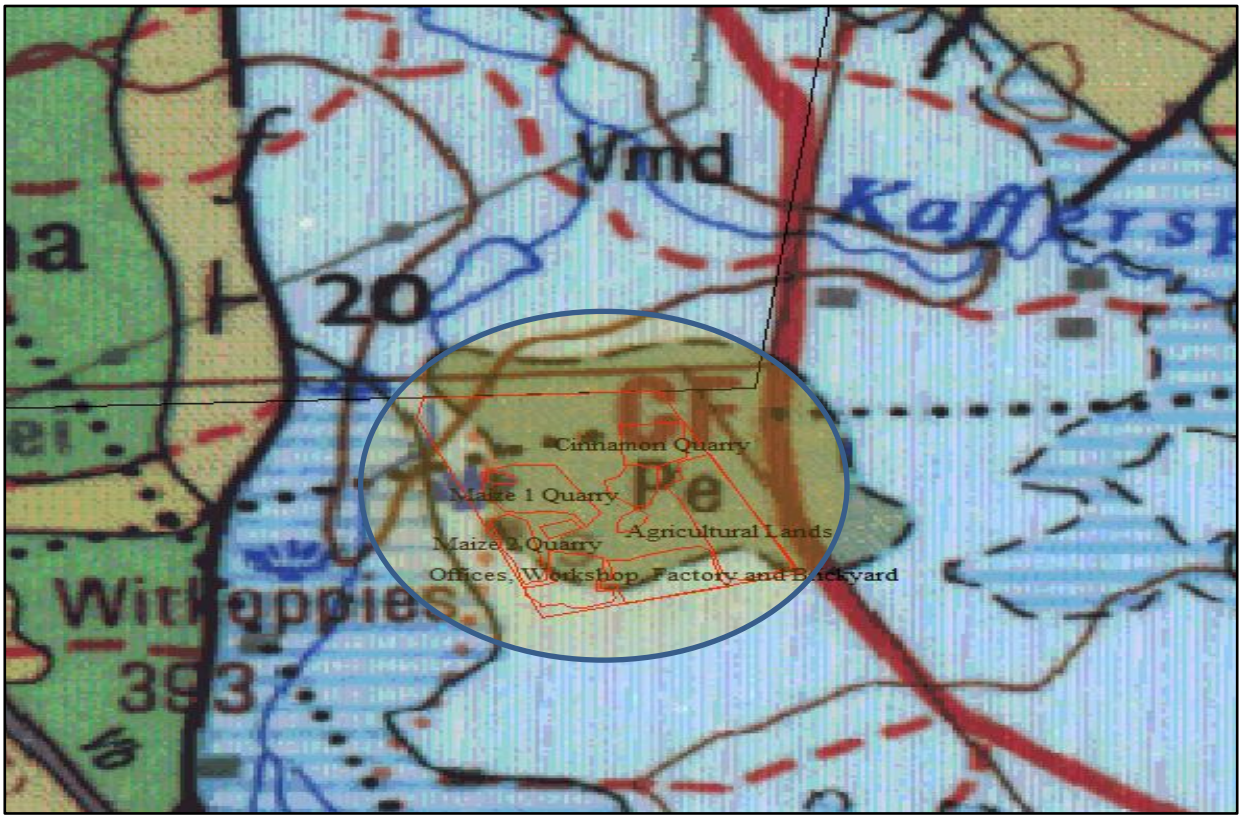


Figure 2 Geology of the study area. The development of the mining activity is restricted to the presence of the Ecca Group (Pe) in this region

Transvaal Supergroup, Chuniespoort Group

Malmani Subgroup

The Malmani Subgroup is a prominent stromatolitic dolomite and this group of rocks underlies the shale and sandstone of the Ecca Group in the study area.

The Malmani Subgroup represents an extensive chemo-sedimentary deposit of dolomite in relatively shallow marine environments with characteristic stromatolite growths that are indicative of carbonate sedimentation similar to the subtital zone conditions in Shark Bay, Australia (MacRae, 1999).

The Malmani Subgroup is overlain by much younger sedimentary rocks of the Karoo Supergroup and in the study area these rocks are assigned to the Ecca Group.

Karoo Supergoup

Ecca Group (Pe)

The Permian aged Ecca Group consists of interbedded coarse-grained sandstone and relatively thick shale sequences. The sedimentary sequences can be very rich in plant remains – hence the discovery of coal at Farm Swartkoppies 393 JQ.

The Ecca Group sediments were deposited in local deltaic environments and are dominated by marsh- or wetland ecological systems, where most of the sediments were water logged for long periods of time. Ecologically it is noteworthy to observe that the Ecca Group sediments were deposited millions of years after the dolomite of the Chuniespoort Group and water logging might be associated with high water tables related to Karts Topography in the dolomites underlying the Ecca Group sediments. Coal deposits will then be uniquely associated with “sinkhole” formations in the ancient floor of the Karoo Basin. This interpretation of the palaeo-environment will then explain the totally unique and unexpected accumulation of plant material for the genesis of coal in the project area.

PALAEONTOLOGY

Transvaal Supergroup, Chuniespoort Group

Malmani Subgroup (Vmd)

The Vaalian aged dolomite of the Malmani Subgroup is a well-known stromatolitic dolomite and is therefore a valuable heritage resource. The rocks of this subgroup will however not be affected by the mining of clay for manufacturing of bricks, nor the mining of coal.

Karoo Supergoup

Ecca Group (Pe)

The Permian aged sedimentary rocks of the Ecca Group is, on the other hand, very highly significant in terms of palaeontological heritage. The field survey on Monday 14th August 2023 confirmed the presence of significant plant fossil, albeit coalified and not easily recognised by inexperienced observers.

Following a detailed desktop survey of existing data, we confirm the fact that the entire area designated for mining of clay and coal is underlain by the very highly sensitive rocks of the Ecca Group (Figure 2) and deep excavation (>1,5m) can expose significant fossils.

Leaves of *Neoggerathiopsis hislopii,* (MacRae, 1999) (Figure 3), and some remains of plants belonging to the well-known Glossopteris Assemblages (Figure 5) with stems of *Phyllotheca sp* (McCarthy and Rubidge, 2005) were observed in sedimentary rocks associated with the coal beds on site, as recorded at GPS site WKP5 (Table 2).

Figure 3 Impression of the leaf of Neoggerathiopsis hislopii, (MacRae, 1999)

Figure 4 Drawings of a typical Glossopteris Assemblage forest/swamp with an insert of Phyllotheca sp

The Ecca Group is well-known for the occurrence of coal beds that resulted from the accumulation of plant material over long periods of time. Plant fossils described from the Ecca Group in the Karoo Basin of South Africa includes the following plant species. *Azaniodendron fertile, Cyclodendron leslii, Sphenophyllum hammanskraalensis, Annularia sp., Raniganjia sp., Asterotheca spp., Liknopetalon enigmata, Glossopteris > 20 species, Hirsutum 4 spp., Scutum 4 spp., Ottokaria 3 spp., Estcourtia sp., Arberia 4 spp., Lidgetonnia sp., Noeggerathiopsis sp. and Podocarpidites sp.* Although it was impossible to confirm if these plants are present at Rietvlei, they are highly likely to be recorded during the lifetime of the mining activities. This statement of potential finds of these fossil plant species provides the reader with an understanding of the exceptionally high chance of finding new fossil plant species at Rietvlei. Finding of new plant fossils will have a global impact on the scientific reasoning regarding the configuration of continents during the existence of Gondwana.

According to Bamford (2011) “Little data have been published on these potentially fossiliferous deposits. Around the coalmines there is most likely to be good material and yet in other areas the exposures may be too poor to be of interest. When they do occur fossil plants are usually abundant and it would not be feasible to preserve and maintain all the sites, however, in the interests of heritage and science such sites should be well recorded, sampled and the fossils kept in a suitable institution (Bamford, 2011).

Although no vertebrate fossils have been recorded from the Ecca Group in the Gauteng region, invertebrate trace fossils have been described in some detail. (Mason and Christie, 1986). It should be noted, however, that the aquatic reptile, *Mesosaurus*, which

is the earliest known reptile from the Karoo Basin, as well as fish (*Palaeoniscus capensis*), have been recorded in equivalent-aged strata in the Whitehill Formation in the southern part of the basin (MacRae, 1999; Modesto, 2006). Indications are that the Whitehill Formation in the main basin might be correlated with the mid-Vryheid Formation. If this assumption proves correct, there is a possibility that Mesosaurus could be found in the Ecca Group (Catuneanu et al., 2005).

Following the desktop surveys and studies of professional journals, the reader must note that the late Carboniferous to early Jurassic aged Karoo Supergroup of South Africa contains economically important coal deposits within the Ecca Group, that will include the coal deposits at Rietvlei. These Karoo aged sediments are almost entirely lacking in body fossils but ichnofossils (trace fossils) are locally abundant. Modern sedimentological and ichnofaunal studies suggest that the north-eastern part of the Karoo basin was marine, but in observations on the Rietvlei site, indications are that the Ecca Group sediments accumulated in a shallow basin margin with a prograding fluvio-deltaic complex forming a broad sandy platform on which coal-bearing sediments were deposited. Ichnofossils expected at Rietvlei will therefore include U-burrows (formerly *Corophioides*) which are assigned to ichnogenus *Diplocraterion* (Mason and Christie, 1986).

PRELIMINARY ASSESSMENT RESULTS

The palaeontological sensitivity was predicted after identifying potentially fossiliferous rock units; ascertaining the fossil heritage from the literature and evaluating the nature and scale of the development itself. The palaeontological sensitivity was predicted as very highly to highly significant, due to the potential abundance of Vaalian aged fossils in the Malmani Subgroup and Permian aged fossils in the Ecca Group (Figure 5).

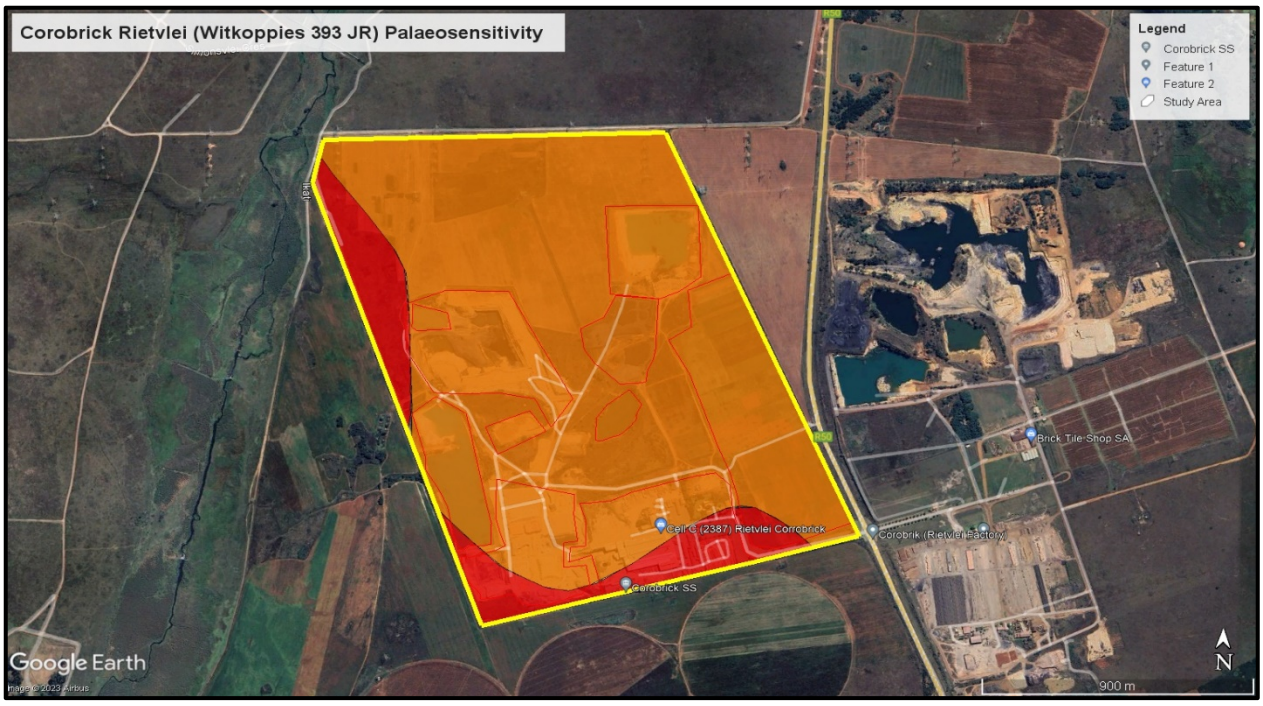


Figure 5 Palaeo-sensitivity of the project area on Witkoppies 393 JR, Corobrik Rietvlei office. For colour coding see Table 1

FIELD INVESTIGATIONS

Dr Gideon Groenewald, experienced fieldworker (GGG Consultants), Lindokuhle Nsibande and Nkhensane Sibanyoni (Licebo Environment and Mining) visited the site of the mining operation at Corobrik (Farm Witkoppies 393 JR) on Monday 14th August 2023. The topography of the area is typically slightly undulating with very broad valleys and extended middle slopes that give an impression of a "flat" landscape. Isolated dolerite capped hills are the only sites with obviously more rugged topography where the vegetation changes from pure grassland to rocky small woody vegetation.

Field investigation confirmed that excavations for the mining developments will expose carbonaceous shale and feldspathic coarse-grained sandstone of the Ecca Group as well as coal of varying quality. Our observations are that significant plant fossils are present in the shales of the Ecca Group (Figure 6).

Figure 6 Clearly defined stem of an unidentified plant, most probably from the Glossopteris assemblage, with associated coalification.

Figure 7 GPS sites (blue pin sites) of photographic recordings on the mining site of Corobrik, Rietvlei Factory, on the farm Witkoppies 393 JR

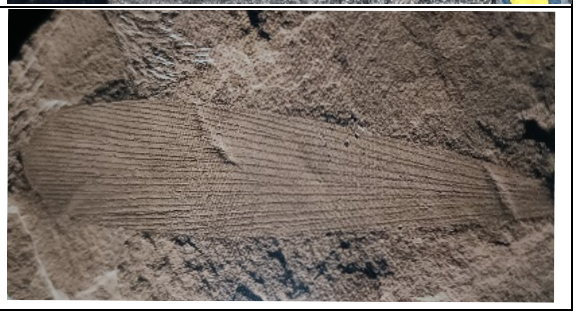
Photographic recordings of geological information and fossils occurring in the outcrops at specific localities (Figure 7) are presented in Table 2 below. These photographic recordings are the first records of Palaeontological heritage for this project. In cases where deep excavation (>1,5m) are planned for mining purposes (geotechnical reports), the author expects that the chance find of well-preserved, significant fossils in this environment is very high.

Corobrik Factory is situated on the eastern boundary of the Rietvlei Nature Reserve and therefore requires even more careful management for nature conservation and mitigation for environmental impact on the wetlands to the west of the development. The impact on heritage conservation in terms of paleontology will only be applicable to areas where open-cast mining is planned, since fossils will only be exposed where mining is actively exposing the coalified remains of Permian aged plant assemblages.

Table 2 Photographic recordings in the study area on farm Witkoppies 393 JR

Photo	(GPS station) Coordinates	Comments	Photographic Record
WKP1	25.928070°S 28.314512°E	The study site is characterised by open plain grassland, underlain by deeply weathered shale and clay with resulting rolling topography. Excavation of clay for brick making exposed fossiliferous shale of the Ecca Group	
WKP2	25.929033°S 28.315815°E	Well-defined remains fossilised, albeit coalified, plant material (wood)	
WKP2	25.929033°S 28.315815°E	Well-defined remains fossilised, albeit coalified, plant material (wood) associated with dark grey to black coloured shale of the Ecca Group	
WKP3	25.928545°S 28.315871°E	Coalified plant remains associated with white feldspathic sandstone of the Ecca Group	

WKP3	25.928545°S 28.315871°E	Well-defined chemical concretions in the shale of the Ecca Group. The genesis of these concretions is unknown but can be ascribed to concentrations of organic material that can be related to seed pods or similar concentrations of organic substances.	
WKP4	25.927094° S 28.314574° E	Coalified remains of plants are associated with carbonaceous shale beds in the Ecca Group	
WKP5	25.920640° S 28.311212° E	Outcrops of fine- to coarse-grained sandstone of the Ecca Group. Coalified remains of plants are associated with the base of these sandstone bodies	

WKP5	25.920640° S 28.311212° E	Very deeply weathered sediments of the Ecca Group. Well-defined concretions are indications of the remains of organic material.	
WKP5	25.920640° S 28.311212° E	Imprint of *Noeggerathiopsis sp as identified from Macrae (1999).*	
WKP5	25.920640° S 28.311212° E	Example of the imprint of *Noeggerathiopsis sp as identified from Macrae (1999).*	

WKP5	25.920640° S 28.311212° E	Coalified stem of Glossopteris sp plants in the silt and sandstone of the Ecca Group.	
WKP5	25.920640° S 28.311212° E	Well-defined imprint of a stem of the Glossopteris sp plant assemblages associated with this mining exposure	
WKP6	25.919859° S 28.311171° E	Outcrops of mudstone and sandstone of the Ecca Grouo that overlies the main coal bed that will be explored during the lifetime of the mine on Witkoppies 393 JR. High water tables result in very fast influx of groundwater into all excavations on site	

WKP7	25.920305° S 28.312196° E	Open cast mining at Witkoppies 393 JR , Corobrik Rietvlei	

PALAEONTOLOGICAL IMPACT AND MITIGATION

The predicted palaeontological impact (Figure 10) of the project is based on the initial mapping assessment and literature reviews, as well as information gathered during the field investigation (Table 2).

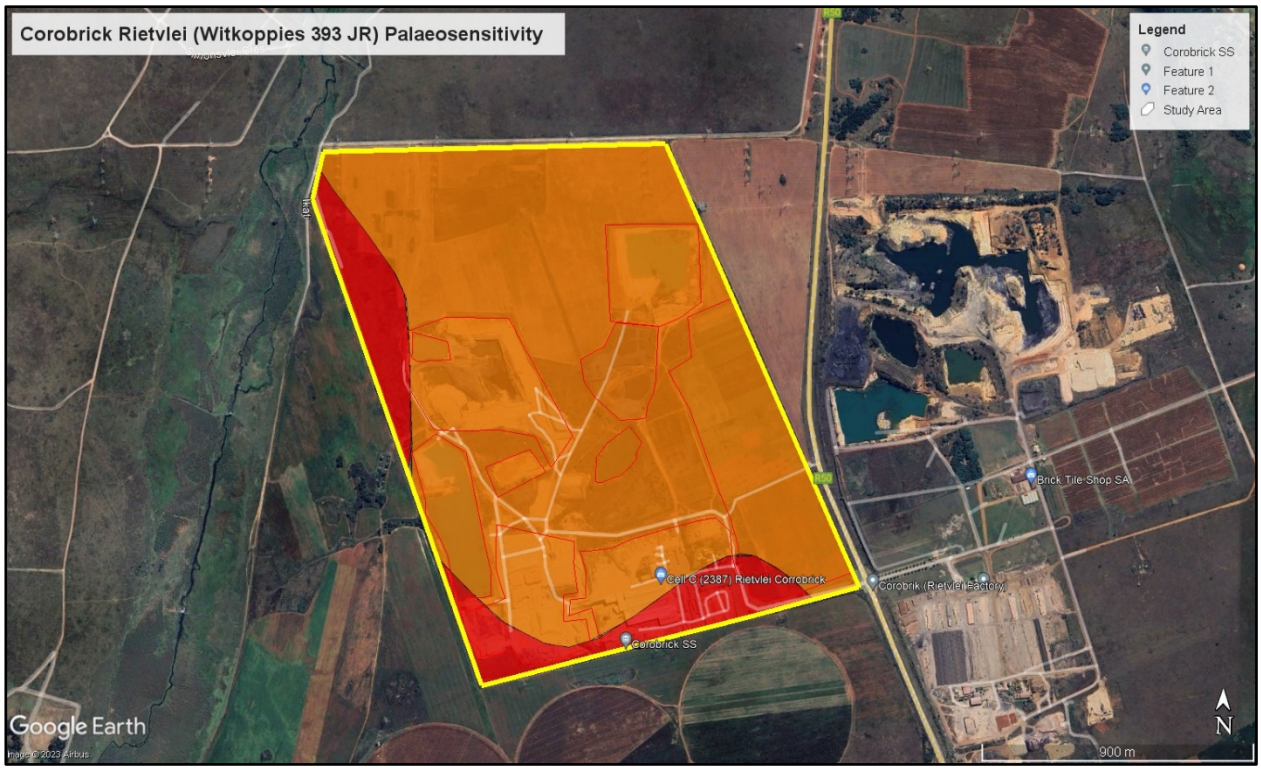


Figure 8 Palaeontological sensitivity is high to very high over the entire study area (for explanation of colors refer to Table 1

The field investigation confirms that the study area is underlain by rocks that range from the very highly sensitive Malmani Subgroup Dolomite to highly sensitive Ecca Group shale.

Following observations during the filed investigation as well as data obtained from previous palaeontological impact assessments in this region, it is our professional opinion that significant fossils from the Karoo Subgroup will be present in most of the areas where bedrock of the Ecca Group is exposed during mining of coal.

The excavations for mining will expose some sediments that are very highly sensitive geological formations and some sites revealed evidence of very highly significant remains of fossils. A significant part of the excavation project will cut into rocks of the Ecca Group of the Karoo Supergroup. This group has a very high sensitivity for palaeontological heritage and the ECO must be on the lookout for vertebrate, invertebrate, insect, plant as well as trace fossils.

It is very important to note that, although the indications are that large areas in the study area are very highly sensitive for palaeontological heritage, the fossils will most probably only be found where excavation of deeper than 1,5m is planned and mapping of the area after completion of the Geotechnical Impact Assessment will contribute significantly towards a reduction in planning for palaeontological mitigation.

Mitigation for fossils will allow preservation of highly significant plant fossils and it therefore recommended that a palaeontologist be appointed who can take responsibility for the palaeontological treasures in the Karoo Basin.

The potential impact assessment pertaining to the different phases of the mining project (Table 3), is summarised in the Environmmental Impact Assessment Report.

Table 3 Impact Assessments for Palaeontology for the three phases of mining activities at Rietvlei

Impact	Significance Rating Before Mitigation Measures									Mitigation Measures	Significance Rating after Mitigation Measures								
	I	F	D	E	P	S	C	IS	SIGNIFICANCE		I	F	D	E	P	S	C	IS	SIGNIFICANCE
Initial Excavation Phase																			
Palaeontological impact during initial excavation	5	4	4	5	1	4,333333	4,666667	4,666667	Negative Very High	•Emphasis on reporting of significant finds following the CFP •Construction contractors should prioritise reporting of any fossils following training by a qualified palaeontologist	5	4	4	5	1	4,333333	4,666667	4,666667	Positive Very High
Operational Phase																			
Palaeontological impact during operation	5	4	4	5	1	4,333333	4,666667	4,666667	Negative Very High	•Emphasis on reporting of significant finds following the CFP •Mining contractors should prioritise reporting of any fossils following training by a qualified palaeontologist.	5	4	4	5	1	4,333333	4,666667	4,666667	Positive Very High
Decommissioning Phase																			
Palaeontological impact during decommissioning	2	1	1	1	0,6	1,333333	1,166667	0,7	Negative Very Low	•Emphasis to observe any unforeseen fossil find and to report to responsible palaeontologist •	5	4	4	5	1	4,333333	4,666667	4,666667	Positive Very High

CONCLUSIONS

The geology underlying the project area for the property of the mining right amendment application on Remaining Extent on Portion 26 (a Portion of portion 1) and Portion 27 (a Portion of portion 26) of the farm Witkoppies no. 393 JR, situated in both City of Tshwane and Ekurhuleni Metropolitan Municipalities, Gauteng Province, comprises the Malmani Subgroup dolomites and the Ecca Group. Parts of the project will also be underlain by very deep soils.

Rocks of the Malmani Subgroup as well as the Ecca Group are world renowned for significant finds of Palaeontological Heritage objects, including highly significant fossils of stromatolites as well as Permian aged plant fossils.

It is however very important to note that, although a very high sensitivity rating is allocated to large areas underlain by Malmani Subgroup and Ecca Group geology, the actual impact per site of excavation might be limited to very specific excavations where significant fossils are discovered. In many cases the plant fossils are present but, due to poor preservation conditions, or so badly damaged during lithification, that they are not worth collecting.

Although it is imperative to indicate the very high sensitivity on the initial maps, the *modus operandi* of the project palaeontologist, when appointed, must be to train the ECO and team members to adhere to the "Chance Find Protocol" recommendation. The full-time presence of a professional palaeontologist would be preferred during initial construction into the areas allocated a red and orange colour on the sensitivity map. It might be much less expensive to train the environmental officers to know what to look for during excavation and inform the palaeontologist of a significant find immediately. Fossils recorded during construction and mining, must be curated and moved to the institute indicated by SAHRA, but preferably the Evolution Studies Institute at Wits, where these fossils are historically studied.

Recommendations

- The EAP and developer must be informed that significant areas are underlain by rocks with a very high sensitivity for palaeontological heritage.
- All excavations that will expose sedimentary strata of the Ecca Group (geotechnical reports) will most probably contain significant fossils. The appointment of a palaeontologist to do a comprehensive Phase 2 PIA assessment (fossils collection during initial excavation) will be a minimum requirement for monitoring of excavations into the Ecca Group strata.
- The project will require a formal "Chance Find Protocol" that will have to be upgraded during the initial excavation, as well as mining phases of the project.

- Without mitigation the project will have a very negative impact on palaeontological heritage. With mitigation the project will have a very high positive impact on palaeontological heritage, mainly because mining for coal will expose new bedrock that would not have been exposed for thousands of years.
- Recommendations for palaeontological monitoring and mitigation will have to be incorporated into the EMPr for approval by the SAHRA.

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QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeo-ecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

DECLARATION OF INDEPENDENCE

I, Gideon Groenewald, declare that I am an independent specialist consultant and have no financial, personal or other interest in theproject, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of palaeontological heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

Dr Gideon Groenewald
Geologist

CHANCE FIND PROTOCOL FOR PALAEONTOLOGICAL HERITAGE

Application for the amendment of Corobrik mining right in terms of Section 102 of MPRDA and Section 24G of NEMA on Remaining Extent of Portion 26 (a Portion of portion 1) and Portion 27 (a Portion of portion 26) of the farm Witkoppies no. 393 JR, situated in both City of Tshwane and Ekurhuleni Metropolitan Municipalities, Gauteng Province

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Mitigation for excavation Impact on Palaeontological Heritage Resources Farm Wikoppies 393 JR.

It is essential that suitably qualified and accredited (member of PSSA) Palaeontologist be appointed by Corobrik. The appointed palaeontologist, in consultation with the Project Environmental Manager, or the Mine Manager, contractors and ECO's of the excavation works, develop a short-term strategy for the recovery of significant fossils during the excavation operation. As part of such a strategy, the discussions with the Palaeontologist must include:

- Initially, and at least for the *duration of excavation*, site visits on request of the ECO of the specific construction site, to ensure recording of all potentially significant fossil strata. Due to the longevity of this contractual involvement it is not possible to have pre-determined timing on further visits by the Palaeontologist and it is a conclusion from present observations, that more frequent visits by a Palaeontologist during excavations into the Karoo Supergroup sediments, will **definitely** be required.
- Determine a short-term strategy and budget for the recording of significant fossils (only if deep (>1,5m) excavations into bedrock are planned). This strategy is simply an oral agreement on when the site is to be inspected and what the finds are that might be recorded. The site visit must include an introduction session with all the managers of the Project Team, including training of the ECO and site managers by the appointed palaeontologist, to basically train people to know what to look out for in terms of fossil heritage on site. This action will be required at the start of each individual construction activity for the duration of construction in the "greenfield sections" of the site.
- **Following the site visit on Monday 14th August 2023, follow-up visits are recommended where excavation into bedrock might expose highly significant fossils.**
- In the case of reporting of any unusual sedimentary structures, the Palaeontologist must be notified, and a site visit must be arranged at the earliest possible time with

the Palaeontologist. In the case of the site ECO or the Site Manager becoming aware of suspicious looking material that might be a "Significant Find", the construction must be halted in that specific area and the Project Environmental Manager (PEM) must be informed - who will inform the Project Engineer (also referred to as the Resident Engineer in some projects). The Palaeontologist must be given enough time to reach the site and the PEM will request a Site Instruction from the Resident Engineer (RE) to allow for removal the material before excavation continues.

Mitigation Measures Normally Encountered by Developers

1. Mitigation of palaeontological material must begin as soon as possible and preferably when "trial excavation" takes place. The appointed specialists must acquaint themselves with the operation and determine feasible mitigation strategies.
2. A plan for systematic sampling, recording, preliminary sorting and storage of palaeontological and sedimentological samples will be developed during the early stages of the project, in collaboration with the Evolutionary Studies Institute (ESI) at WITS University, which is the closest Institute to the site.
3. Mitigation will involve an attempt to capture all rare fossils and systematic collection of all fossils discovered. This will take place in conjunction with descriptive, diagrammatic and photographic recording of exposures, also involving sediment samples and samples of both representative and unusual sedimentary or biogenic features. The fossils and contextual samples will be processed (sorted, sub-sampled, labelled, boxed) and documentation consolidated, to create an archive collection from the excavated sites for future researchers. (NB – The developer is not responsible for any costs of **future** research activities on site)

Functional responsibilities of the Developer and Project Environmental Managers for the Project

1. Ensuring, at their cost, that a representative archive of palaeontological samples and other records is assembled to characterise the palaeontological occurrences affected by the excavation operation.
2. Provide field aid, if necessary, in the supply of materials, labour and machinery to excavate, load and transport sampled material from the excavation areas to the sorting areas, removal of overburden if necessary, and the return of discarded material to the disposal areas. In the case of this project it is foreseen that plant and trace fossils will be present. (*If more fossils of Permian age are exposed, it will be Very Highly significant and the Palaeontologist will obviously be in close communication with the site ECO and the PEM to act as required by SAHRA without causing undue standing time for the contractors).*

3. “Facilitate” systematic recording of the stratigraphic and palaeo-environmental features of exposures in the fossil-bearing excavations, by allowing time to describe and measure geological sections, and by providing aid in the surveying of positions where significant fossils are found. *(In the case of this specific development, the likelihood of such finds is* ***very high****).*
4. Provide safe storage for fossil material found routinely during excavation operations by construction personnel. In this context, isolated fossil finds in disturbed material qualify as “normal” fossil finds.
5. Provide covered, dry storage for samples and facilities that is defined as a work area for sorting, labelling and boxing/bagging of samples.
6. Costs of basic curation and storage in the sample archive at the ESI, WITS University (labels, boxes, shelving and, if necessary, specifically-tasked temporary employees).

Documentary record of palaeontological occurrences

1. The contractors will, after consultation with the PEM and in collaboration with the Palaeontologist, make the excavation plan available to the appointed specialist, in which the following information are indicated on the plan in the site office at the excavation site. This must be done in conjunction with the appointed specialist and form part of the on-going revision of this “Chance Find Protocol” (CFP) during the excavation stage of the project:
1.1. Initially, all known specific palaeontological information will be indicated on the plan. This will be updated throughout the excavation period.
1.2 Locations of samples and measured sections are to be pegged, and routinely accurately surveyed. Sample locations, measured sections, etc., must be recorded three-dimensionally if any significant fossils are recorded during the time of excavation. This information must be recorded during the first site visit and a clearance from the Palaeontologist (e-mail message and whatsapp images will suffice) must be followed up with subsequent e-mail communications with the Site Specific ECO, Site Manager and the PEM.

Functional responsibilities of the appointed Paleontologist

1. Apply for a permit to collect, as well as for the destruction of fossils during the lifetime of the Project. Establishment of a representative collection of fossils and a contextual archive of appropriately documented and sampled paleoenvironmental and sedimentological geodata in collaboration with the ESI at WITS University.
2. Undertake an initial evaluation of potentially affected areas and of available exposures in excavations. A short training session, inclusive of the PEM, Project Managers and the ECO’s or their representatives, must be presented during the second site visit to this project.

3. On the basis of the above, and evaluation during the early stages of excavation development, in collaboration with the PEM and the contractor management team, more detailed practical strategies to deal with the fossils encountered routinely during excavation, as well as the strategies for major finds must be agreed on (e-mail communication will suffice).
4. Informal on-site training in responses applicable to "normal" fossil finds must be provided for the PEM, ECO and environmental staff by the appointed specialist. This step will only be arranged following the discovery of **significant fossils** at the time of the Phase 2 PIA site visits.
5. Respond to significant finds and undertake appropriate mitigation.
6. Initially, for the first month of operation, and if the PEM or the appropriate ECO indicates significant "strange looking rocks" that might be similar to the fossils indicated to the staff during the information sessions, visit at least once in four weeks to "touch base" with the monitoring progress. Document interim "normal" finds and undertake an inspection and documentation of new excavation faces. A strategy for further visits during the lifetime of the excavation must be discussed.
7. Transport of material from the site to the ESI, WITS University or the allocated Institute where an expert on the specific fossils discovered, is presently employed.
8. Reporting on the significance of discoveries, as far as can be preliminarily ascertained. This report is in the public domain and copies of the report must be deposited at ESI and the South African Heritage Resources Authority (SAHRA). It must fulfil the reporting standards and data requirements of these bodies.
9. Reasonable participation in publicity and public involvement associated with palaeontological discoveries.

Exposure of paleontological material

1. In the event of construction exposing new palaeontological material, not regarded as normative/routine as outlined in the initial investigation, such as a major fossil find (for example an articulated fossilised skeleton), the following procedure must be adhered to:
1.1 The appointed specialist or alternates (SAHRA; ESI Wits University) must be notified by the responsible officer (e.g. the PEM, Chief Engineer, ECO or Contractor Manager), of major or unusual discoveries during excavation, found by the Contractor Staff.
1.2 Should a major *in situ* occurrence be exposed, excavation will immediately cease in that area so that the discovery is not disturbed or altered in any way until the appointed specialist or scientists from the ESI at WITS University, or its designated representatives, have had reasonable opportunity to investigate the find. Such work will be at the expense of the Developer.

Very highly significant fossils were observed during the first site visit (14th August 2023). Excavations can proceed, on the proviso that any suspicious material will be indicated to the Palaeontologist via emailed photographic information.

CONCLUSION

The project area is situated on Remaining Extent of Portion 26 (a Portion of portion 1) and Portion 27 (a Portion of portion 26) of the farm Witkoppies no. 393 JR, situated in both City of Tshwane and Ekurhuleni Metropolitan Municipalities, Gauteng Province, falls on very highly significant sedimentary rocks (Malmani Subgroup, and Ecca Group) that contain significant fossils. Fossils were observed and **arrangements must be made to obtain necessary permits** for collecting and destruction of the fossils that are exposed.

Following the site visit of 14th August 2023 the conclusion is that the potential for finding significant plant and trace-fossils, in any excavation into sediments of the Ecca Group, Karoo Supergroup, is **very high.** The cooperation of the entire team of engineers and contractors, is of critical importance. The interest and cooperation of the management team will be highly appreciated and it is essential that the excavations be monitored during the entire period of excavation and that this "Chance Find Protocol" be updated on a regular basis during the life-time of the excavation period for the Project. It is essential that the Palaeontologist be notified of the final sign-off of the project date, for final posting of the "Chance Find Protocol" on the SAHRIS Website for record purposes.
It is recommended that:

- The EAP, PEM and ECO's must be informed of the fact that a very high Palaeontological Sensitivity was allocated to the entire development and due to the covered nature of the material, significant fossils are only expected during further excavations on site if excavations are deeper than 1,5m into un-weathered bedrock of Ecca Group mudstone, siltstone and sandstone.
- This "Chance Find Protocol" must be included in the EMPr of the Project and a reasonable budget must be allocated to ensure compliance with the legal responsibility of the developer in terms of the proper conservation of and storage of Palaeontological Heritage.
- The SAHRA must be informed of the content of this "Chance Find Protocol" and EMPr arrangements by the PEM and the Developer, before final conclusion of the Project.
- **Following the site visit of 14th August 2023 it is the professional opinion of Dr Gideon Groenewald, accredited palaeontologist, that further mitigation for Palaeontological Heritage is required, specifically where deep (>1,5m) excavations into un-weathered sedimentary rocks of the Ecca Group are planned (see geotechnical reports).**