KONGIWE
ENVIRONMENTAL SCIENCE & ENGINEERING

APPENDIX D13:

Palaeontology

Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province

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Revision No.: v0.1

Client:

PGS Project No:

PGS Heritage (Pty) Ltd
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Reg. No 2003/008940/07

DECLARATION

This report has been compiled for PGS Heritage (Pty) Ltd by Banzai Environmental, an independent palaeontological service provider. The views stipulated in this report are purely objective and no other interests are displayed during the decision-making processes discussed in this report.

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ACKNOWLEDGEMENT OF RECEIPT

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Declaration of Independence

I, Elize Butler, declare that –

General declaration:

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

Disclosure of Vested Interest

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

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Report Title	Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province		
Control	**Name**	**Signature**	**Designation**
Author	Elize Butler		Palaeontologist
Reviewed	Ilan Smeyatsky		Principal Heritage Specialist
Client			

ABBREVIATIONS USED IN THIS DOCUMENT

ABBREVIATIONS	DESCRIPTION
CM	Continuous Miners
DMS	Dense medium separation
EIA	Environmental Impact Assessment
EMPR	Environmental Management Programme Report
FM	Formation
GMLM	Govan Mbeki Local Municipality
HIA	Heritage Impact Assessment
LOM	Life of Mine
NHRA	National Heritage Resources Act
PGS	PGS Heritage
PIA	Palaeontological Impact Assessment
PR	Prospecting Right

Terminology

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects (The Burra Charter, 2013).

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment

Cultural heritage

(i) tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values;

(ii) unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes, and waterfalls; and

(iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles (International Finance Corporation, 2012).

EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the Palaeontological Desktop Assessment Report for the development of the proposed Leslie 1 Mining Project (Leslie Coal Mine) near Leandra, Mpumalanga Province. According to the National Heritage Resources Act (No 25 of 1999, section 38), a palaeontological impact assessment is (PIA) key to detect the presence of fossil material within the proposed development footprint and it is thus necessary to evaluate the impact of the construction on the palaeontological resources.

The proposed development footprint is underlain by the Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup) as well as Jurassic aged Dolerite (Karoo Supergroup). The Vryheid Formation of the Ecca Group is well-known for the presences of coal beds which has been formed due to the accumulation of plant material over long periods of time. Trace fossils, fish, small crustaceans, insects, as well as plant fossils are common in this Formation. According to the SAHRIS PalaeoMap the sedimentary rocks of the Vryheid Formation have a very high palaeontological sensitivity while the Dolerite of the Jurassic has a very low palaeontological sensitivity as these rocks are unfossiliferous.

Alternatives have been suggested for this project but they all fall in the same geology and thus not one is a preferred alternative in palaeontological terms.

No significant fossils are expected to be found before deep excavation (>1.5m) are completed. Though, it is possible that significant fossils will be documented during excavations. The recording of fossils will enhance our knowledge of the Palaeontological Heritage of the development area.

It is thus recommended that an EIA level palaeontology report will be conducted during deep excavation to assess the value and importance of fossils in the development area and the effect of the proposed development on the palaeontological heritage. This involves a Phase 1 field-based assessment by a professional palaeontologist. The purpose of the EIA Report is to elaborate on the concerns and potential impacts identified during the scoping phase. This is accomplished by site visits and research in the site-specific study area as well as a comprehensive assessment of the impacts identified during the scoping phase.

It is recommended that:

- The EAP and ECO must be informed that a Very High Palaeontological Sensitivity is allocated to the whole study area. A Phase 1 PIA document and “Chance Find Protocol” must be completed during the first month of excavation.
- The developer must apply for a collection and destruction permit for plant fossils encountered during the mining operation.
- A qualified palaeontologist must be employed to visit the present mining operations to record any fossils where the palaeontologist will look out for extraordinarily well preserved fossils and collect representative samples of these fossils for further study at an appropriate institution.
- These recommendations must be incorporated in the EMPr of this project.

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1 INTRODUCTION

The development of the Leslie 1 Mining Project near Leandra, Mpumalanga Province is proposed (**Error! Reference source not found.**-3).

1.1 Project Description

Information provided by Kongiwe

Anglo Operations (Pty) Ltd (henceforth Anglo) plans to submit an application for a Mining Right through a joint venture company known as Leslie Coal Mine (Pty) Ltd (hereafter Leslie Coal Mine).

Anglo aims to develop underground mining operations, with mining primarily developing the No. 2 and No 4. coal seam within the Witbank Coalfield. Bituminous Coal, Pseudocoal and Torbanite will be mined if encountered. The Coal mined by the Project will be for the local South African market (primarily Eskom) and possibly other domestic and export markets.

It is estimated that the total Life of Mine (LOM) period will be about 35 years and includes a ramp-up period, a tapering-down period and rehabilitation period. The mine will process a total of approximately 125 million tonnes of coal during the LOM (Table 1). The No 5 seam encountered during the construction of the incline shafts will also be mined (approximately 116 000 tonnes ROM for Leslie 1A).

It is anticipated that two processing plants will be constructed which will be located at Leslie 1A and Leslie 1C. If the plant at Leslie 1C is not constructed, the ROM will be tucked to the plant at Leslie 1A. The proposed mine infrastructure include current farm (private) and public roads (including the R50 and N17), railway siding and railway line, and Eskom electricity infrastructure. Water will be obtained from boreholes and recycled from pollution control dams. The water usage strategy for the colliery is designed to operate as a closed water system and most of the water on site will be recycled. Eskom will supply the electricity for the project. Additional infrastructure will include stockpile areas, loading bays, water diversion berms for dirty water/clean water separation, storm water management systems, mobile security offices for access control, a weighbridge, potable water tanks, bulk diesel storage facility, oil storage facilities, explosive storage facilities and stores (for spares and material), ventilation shafts, a railway siding and railway, and mobile ablution facilities. Individual mining area will be connected via a network of gravel roads that branch off from the main tar roads.

It is anticipated that the Leslie Coal mine will employ about 685 people at full production, with most of the labour coming from the GMLM and the surrounding areas. All employment will take place in line with all the relevant legislation.

The alternative plant layouts for Leslie 1A are:

Option 1. The initial layout planned by the client and per the scoping report.

Option 2. This option looks at: altering from a boxcut to an access portal to decrease dust impacts and impact on surface ecology and soils; decreasing the size of the required infrastructure; and shifting the layout to avoid all sensitive features, as well as removing the eastern access road and rail siding. As follows and per maps attached.

- Incline portal 500m x 70m. Topsoil stockpile and waste rock (overburden) around access portal, for use in rehabilitation. Topsoil to be vegetated.
- Access roads for heavy vehicles: 32 m wide, tarred from main road to Product Stockpile.
- Access road for normal vehicles, tarred.
- Conveyor belt running from the incline portals (x2) to the ROM pad. Includes a dirt access road adjacent to the conveyor, low traffic, only there to service incline portal with light vehicles.
- Mine residue facility (co-disposal). A second MRF might be constructed if Option 2 for Leslie 1C does not go ahead and Option 3 is chosen.
- Coal wash plant with product stockpile
- ROM pad
- Mine office infrastructure
- Return water dam (RWD)
- Pollution control dam + pump station with pipeline to RWD
- Dirty water trenches (concrete)

The western access point will only have the incline portal, temporary infrastructure, emergency ROM buffer stockpile and a conveyor running to the ROM pad situated at the main surface infrastructure.

Option 3. This option looks at accessing the underground seams from the open pit areas of the approved, adjacent Springboklaagte mine and to partially make use of Springboklaagte mine's plan and surface infrastructure. This option would require an agreement between Leslie 1 and Springboklaagte Mine. In this case there is no surface impact on the Leslie 1 A area.

Option is preferred as Springboklaagte does not have approval to run the volume of coal for both projects, and this option is a contingency.

Leslie 1C

The alternative surface infrastructure layouts for Leslie 1C are:

Option 1. The initial layout proposed by the client and per the scoping report.

Option 2. This option looks at: changing from a boxcut to an access portal to reduce dust impacts and impact on surface ecology and soils; reducing the size of the required infrastructure; and shifting the layout to avoid all sensitive features, as well as removing the eastern access road and rail siding. As follows and per maps attached.

- Incline portal 500m x 70m. Topsoil stockpile and waste rock (overburden) around access portal, for use in rehabilitation. Topsoil to be vegetated.
- Access roads for heavy vehicles: 32 m wide, tarred from main road to Product Stockpile.
- Access road for normal vehicles, tarred.
- Conveyor belt running from the incline portals to the ROM pad. Includes a dirt access road adjacent to the conveyor, low traffic, only there to service incline portal with light vehicles.
- Mine residue facility (co-disposal)
- Coal wash plant with product stockpile
- ROM pad
- Mine office infrastructure
- Return water dam (RWD)
- Pollution control dam + pumpstation with pipeline to RWD
- Dirty water trenches (concrete)

Option 3. This option looks at not having substantial surface infrastructure at 1 C, but does include an incline portal with minor surface infrastructure on Salpeterskranz with trucking of unprocessed coal to 1A for beneficiation.

Option 2 is also the preferred option, while option 3 is a contingency.

Mining Method

Coal will be mined by underground mining methods, with Continuous Miners (CM). The “bord and pillar” mining technique will be used to ensure a stable surface. In mechanized bord and pillar mining, extraction is achieved by developing a series of roadways (bords) in the coal seam and connecting them by splits (cut-through) to form pillars that act as the primary roof support system. No pillar extraction is envisaged.

Coal seams will be accessed through an incline shaft. Leslie 1A will have 2 incline shafts (East and West) to access the east and west portions of the mining area. While Leslie 1B, 1C, 1D and 1E will have one incline shaft respectively. The incline shafts allow for conveying and travelling, as well as return airways and escape routes. Ventilation within the underground pits will occur via a mine ventilation shaft, when required. Coal will be transported via conveyor belt from the underground to the surface from where it will be sent by rail or truck to its final destination.

Spoil Handling

Overburden consist of the surface materials covering the mineral deposit/coal that must be removed. Spoil refers to the removed overburden (excavated materials) which will be used during rehabilitation. Rehabilitation of the Leslie Mine will include, stripping and rehabilitation practices that involve:

- Topsoil on the infrastructure and incline shaft areas is removed first and placed on stockpiles to be re-used in the final rehabilitation.
- Overburden/spoils will be removed by truck and shovel and stockpiled for reuse as fill material during Incline shaft closure.

Coal Handling and Processing

Coal beneficiation (coal washing) comprises crushing the coal into smaller pieces and passing it through a process called dense medium separation (DMS). This process make use of the differences in mass density (mass per unit volume) between the coal and the impurities (ash, rock and soil particles) to separate the coal from the impurities. The waste removed during the coal washing process (coal discard), is a combustible (physically and chemically) unstable waste that needs special handling and long-term disposal and management. It is predicted that the extracted coal will be crushed and placed on ROM stockpiles at the two plant areas. ROM or product coal will then be removed off site to its final destination (Eskom and possibly other domestic and export markets).

Infrastructure

Infrastructure required for coal beneficiation includes:

- Wash Plant

The primary plant will consist of a DMS drum and a cyclone. The plant will have the flexibility to bypass the fine fraction of the ROM coal at the same time as washing the coarse fraction. Portions of the drum and cyclone products could be washed for sized inland products.

- Eskom Plant

This crushing and screening facility is where raw coal from the pit will be crushed to market specifications.

- Water and Electricity Supply:

It is expected that the mining operations will require a volume of 3ML/day to ensure effective and efficient mining operations.

- Domestic water required will be sourced from boreholes.

Water necessary for the wash plant, crusher, service systems and dust suppression will be extracted from the dirty water system. Water supply options are being considered for the project. This may include: recycling of water, collection of rainfall and runoff on site, water from the municipality, natural springs in the area, boreholes drilled into aquifers to provide water, or a combination of the above.

Run-off water accumulated from disturbed areas will be collected and stored in holding ponds/pollution control dams situated near the pits. The water will be routed by utilising a series of diversion berms. Collected water will be used for the mining and treatment processes and all water generated by the mining activities will be stored in a high-density polyethylene-lined (HDPE) PCD and re-used in the beneficiation plant as well as for dust-control purposes on the haul roads.

Power will be required during the construction phase and at this point in time it is assumed that Eskom supply will be used during the construction phase. Currently the location of a water treatment plant has not been determined, as it is considered that water treatment will only be required towards the end of the LOM.

Road Network

Direct access to the mine areas will be through main roads. Existing access roads will be utilised where possible or constructed as a two-by-two road way which will be operating in both directions. New access roads which will be constructed will be a 4 m wide gravel road with storm water earth channels and mitre drains to protect the road structure from flood damage. Intersections will be adequately designed to provide safe entry and exit into the mining area. Approvals from the provincial roads authority will be obtained where necessary and a Water Use Licences (WUL) will be applied for where access roads are anticipated to impact on water courses.

Railway Network

Railway sidings at Leslie 1A and 1C will be constructed and the potential establishment of a railway connection to the main railway line at Leandra is considered.

Rehabilitation

Rehabilitation will entail the removal of infrastructure from site, incline shafts being sealed, levelled and topsoil replaced. Topsoil will be replaced after final levels have been achieved. Natural revegetation and succession will be encouraged.

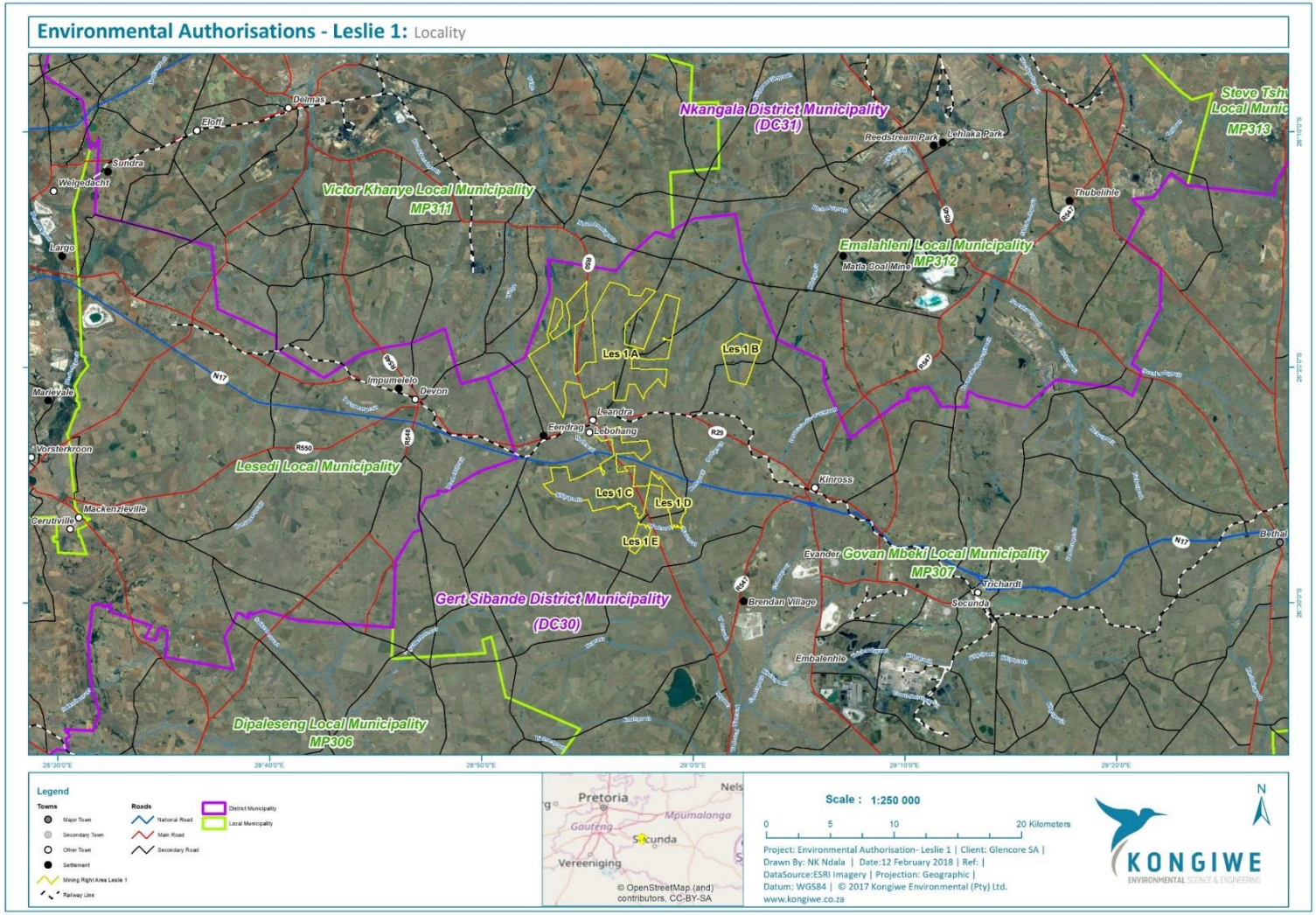


Figure 1. Locality map of Leslie 1. Map provided by Konigwe.

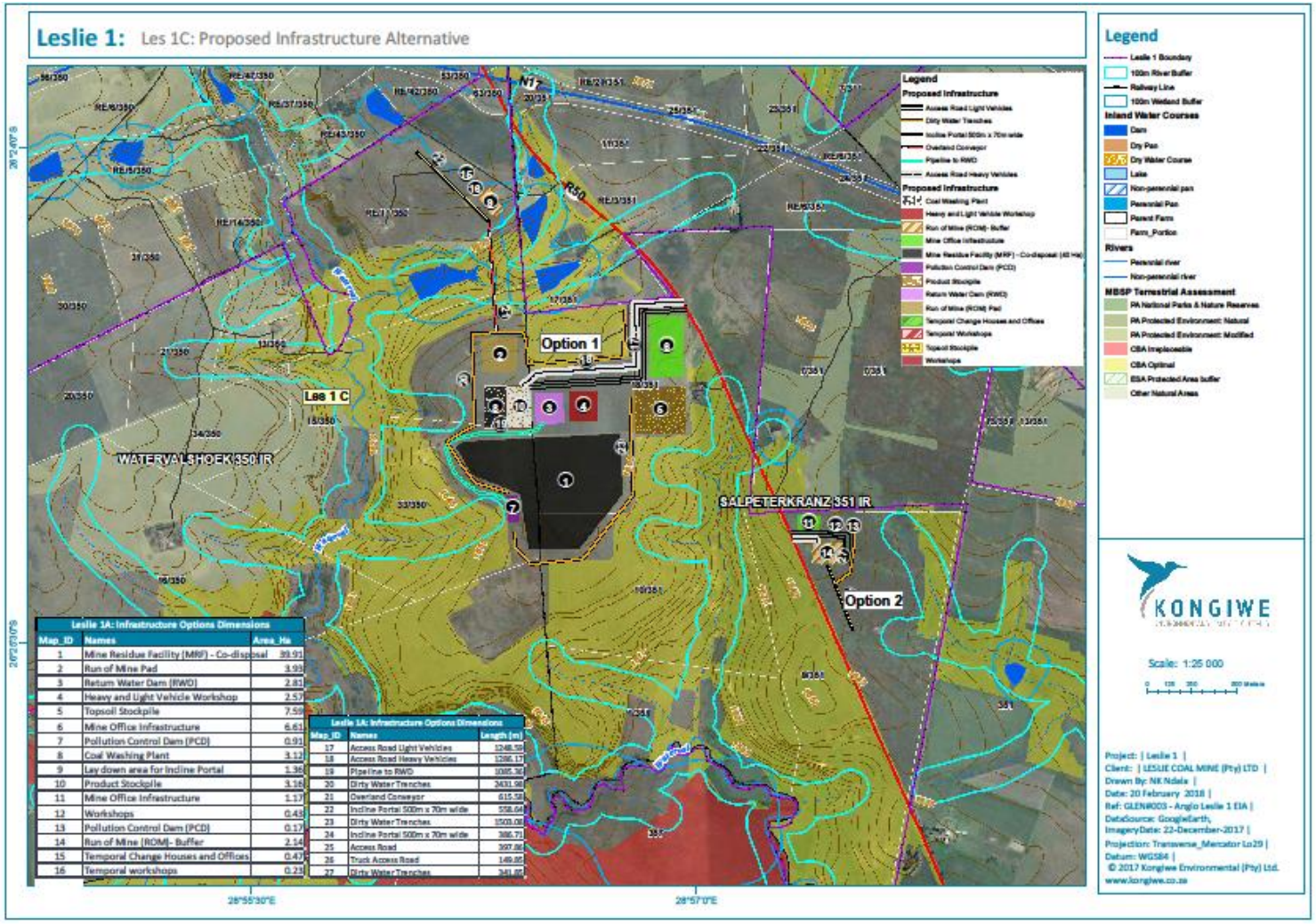
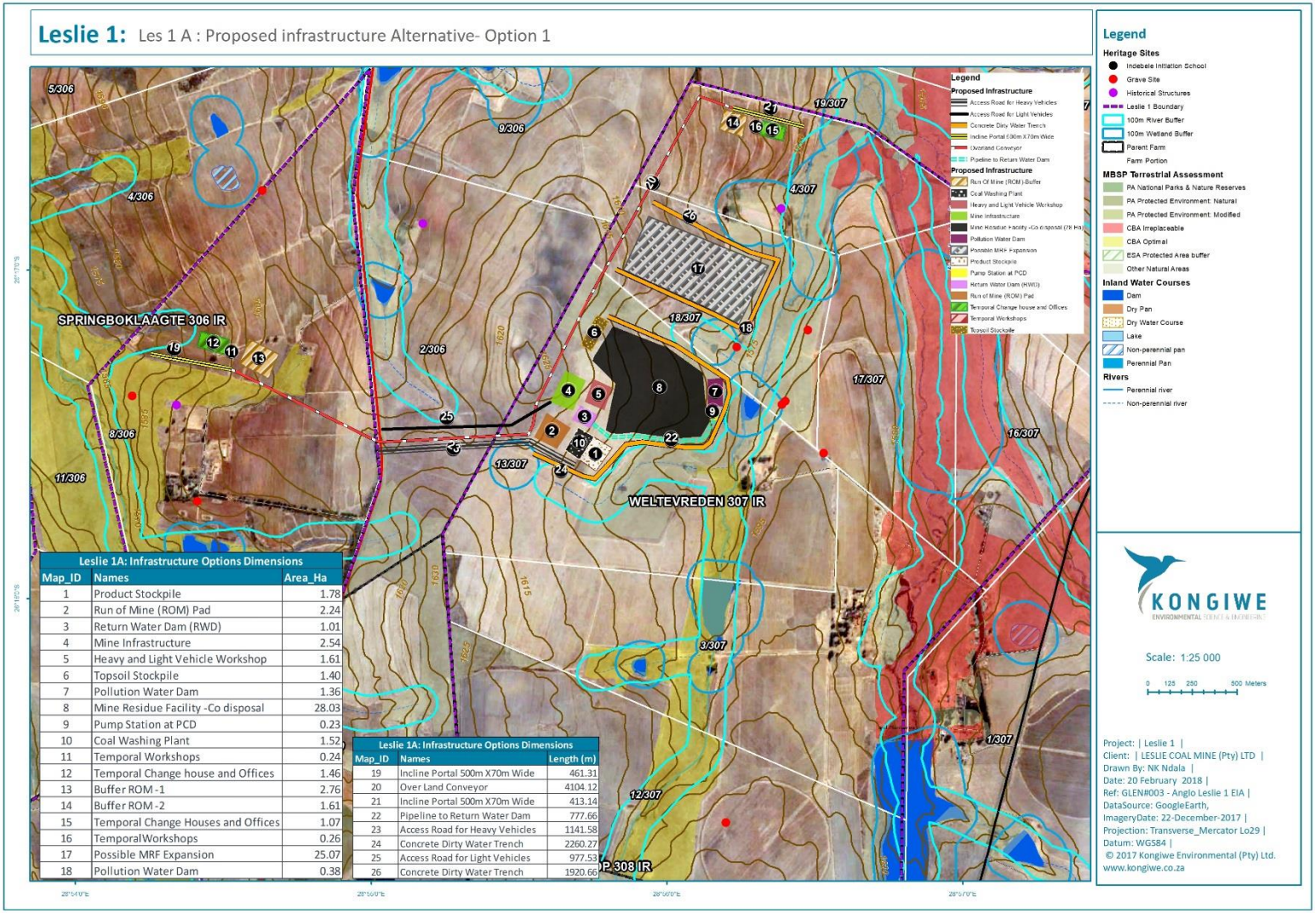


Figure 2. Proposed infrastructure on Leslie 1C Alternative. Map provided by Konigwe.



Leslie 1A: Infrastructure Options Dimensions

Map_ID	Names	Area_Ha
1	Product Stockpile	1.78
2	Run of Mine (ROM) Pad	2.24
3	Return Water Dam (RWD)	1.01
4	Mine Infrastructure	2.54
5	Heavy and Light Vehicle Workshop	1.61
6	Topsoil Stockpile	1.40
7	Pollution Water Dam	1.36
8	Mine Residue Facility -Co disposal	28.03
9	Pump Station at PCD	0.23
10	Coal Washing Plant	1.52
11	Temporal Workshops	0.24
12	Temporal Change house and Offices	1.46
13	Buffer ROM -1	2.76
14	Buffer ROM -2	1.61
15	Temporal Change Houses and Offices	1.07
16	TemporalWorkshops	0.26
17	Possible MRF Expansion	25.07
18	Pollution Water Dam	0.38

Leslie 1A: Infrastructure Options Dimensions

Map_ID	Names	Length (m)
19	Incline Portal 500m X70m Wide	461.31
20	Over Land Conveyor	4104.12
21	Incline Portal 500m X70m Wide	413.14
22	Pipeline to Return Water Dam	777.66
23	Access Road for Heavy Vehicles	1141.58
24	Concrete Dirty Water Trench	2260.27
25	Access Road for Light Vehicles	977.53
26	Concrete Dirty Water Trench	1920.66

Figure 3. Proposed infrastructure alternative –Option 1. Map provided by Kongiwe.

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 10 years. She has been conducting Palaeontological Impact Assessments since 2014.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

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

Palaeontological heritage is unique and non-renewable and is protected by the NHRA. Palaeontological resources may not be unearthed, moved, broken or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Desktop Assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:
the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
the construction of a bridge or similar structure exceeding 50 m in length;
any development or other activity which will change the character of a site—
(exceeding 5 000 m^2 in extent; or
involving three or more existing erven or subdivisions thereof; or
involving three or more erven or divisions thereof which have been consolidated within the past five years; or

the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority

the re-zoning of a site exceeding 10 000 m² in extent;

or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

The objective of a Palaeontological Desktop Assessment is to determine the impact of the development on potential palaeontological material at the site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the aims of the palaeontological impact assessment are: 1) to identify the palaeontological importance of the exposed and subsurface rock formations in the development footprint 2) to evaluate the palaeontological importance of the formations 3) to determine the impact of the development on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

When a palaeontological desktop study is compiled, the potentially fossiliferous rocks (i.e. groups, formations, etc.) present within the study area are established from 1:250 000 geological maps. The topography of the development area is identified using 1:50 000 topography maps as well as Google Earth Images of the development area. Fossil heritage within each rock section is obtained from previous palaeontological impact studies in the same region, the PalaeoMap from SAHRIS; and databases of various institutions (identifying fossils found in locations specifically in areas close to the development area). The palaeontological importance of each rock unit of the development area is then calculated. The possible impact of the proposed development footprint on local fossil heritage is established on the following criteria: 1) the palaeontological importance of the rocks and 2) the type and scale of the development footprint and 3) quantity of bedrock excavated.

In the event that rocks of moderate to high palaeontological sensitivity are present within the study area, a field-based assessment by a professional palaeontologist is required. Based on both the desktop data and field examination of the rock exposures, the impact significance of the planned development is measured with recommendations for any further studies or mitigation. In general, destructive impacts on palaeontological heritage only occur during construction. The excavations

will transform the current topography and may destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

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

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed Leslie 1 mine development is entirely underlain by Permian aged sedimentary rocks of the Vryheid Formation, (Ecca Group, Karoo Supergroup) and Jurassic aged Karoo Dolerite.

5.1 Geology

Vryheid Formation

The Vryheid Formation is characterized by light grey, fine to course sandstone and siltstone sediments. The dark coloured siltstones can be accredited to the existence of carbon enrichment and coal beds. Infrequent coal seams, deltaic mudrocks and sandstones as well as coastal and fluvial deposits are present in this formation. These sediments were probably deposited on a sandy shoreline that stretched out beyond massive swamplands. In these swamps, plants accumulated and formed the coal deposits that are mined today (Johnson et al, 2006).

Karoo Dolerite Suite

The Karoo Dolerite Suite were formed in the Early Jurassic Period (approximately 183 million years ago). The Karoo Dolerite Suite is a widespread system of igneous bodies (dykes, sills) that encroached into the sediments of the Main Karoo Basin. These igneous rocks are unfossiliferous.

5.2 Palaeontology

Vryheid Formation

The Vryheid Formation (Ecca Group) is world renowned for the occurrence of coal beds formed by the accumulation of plant material over long periods of time. Bamford (2011) described numerous plant fossils from this formation (e.g. *Azaniodendron fertile*, *Cyclodendron leslii*, *Sphenophyllum hammanskraalensis*, *Annularia sp., Raniganjia sp., Asterotheca spp.*, *Liknopetalon enigmata*,

Hirsutum sp., *Scutum sp., Ottokaria sp*., *Estcourtia sp.*, *Arberia sp*., *Lidgetonnia sp*., *Noeggerathiopsis sp*., *Podocarpidites s*p as well as more than 20 *Glossopteris* species).

Bamford (2011) is of the opinion that only a small amount of data have been published on these potentially fossiliferous deposits and that most likely good material are present around coal mines and in other areas the exposures are poor and of little interest. When plant fossils do occur they are usually abundant. According to Bamford it is not feasible to preserve all the sites but in the interests of science these sites ought to be well documented, researched and the collected fossils must be housed in an accredited institution.

The Vryheid Formation is also characterised by its trace fossil assemblages of the non-marine *Mermia* Ichnofacies, insect fossils track ways, fish and small crustaceans. The *Mesosaurus* reptile may also be present

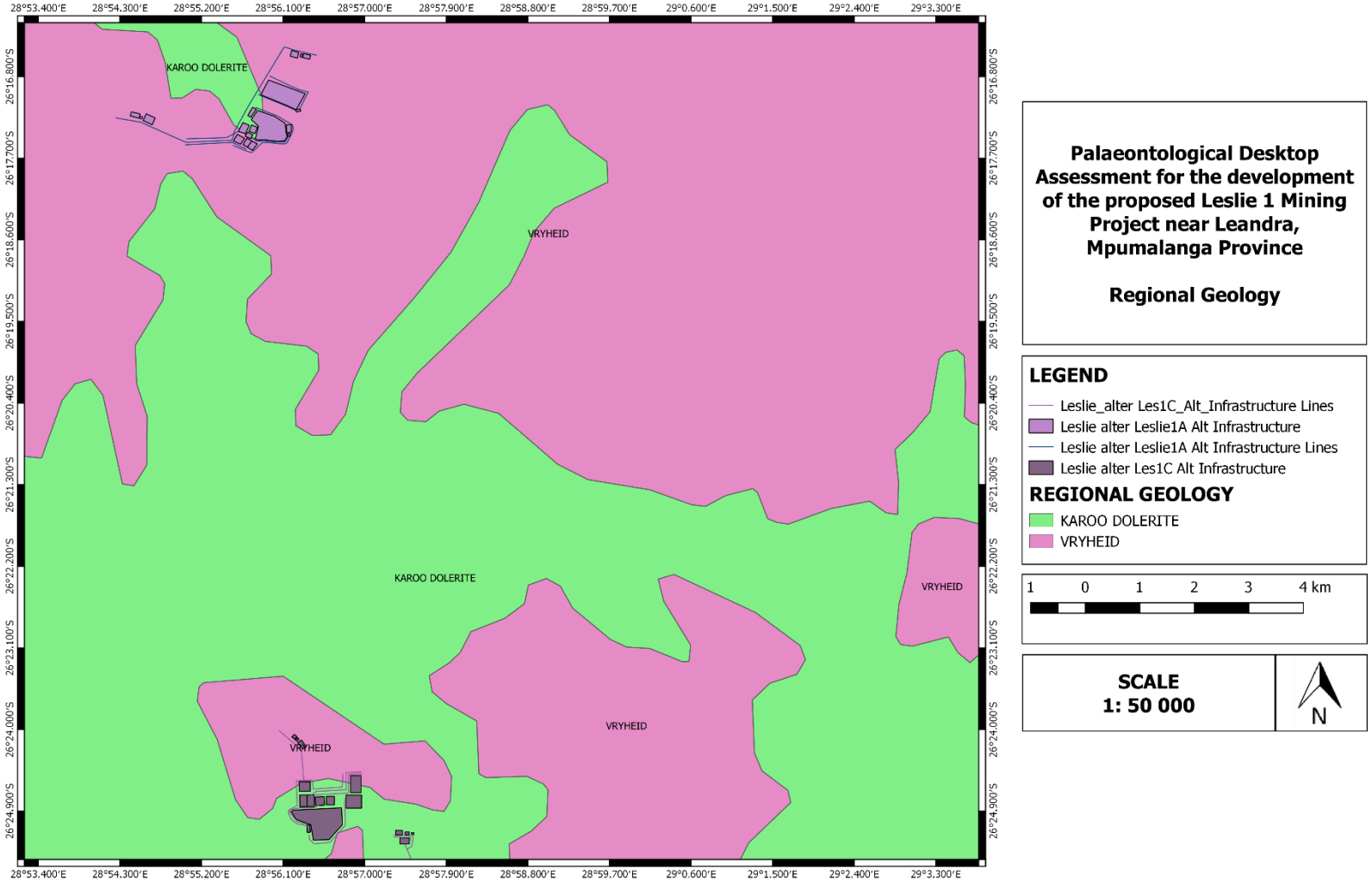


Figure 4. The surface geology of the proposed Leslie 1 Coal mine near Leandra, Mpumalanga province. The development site is underlain by rocks of the Permian Vryheid Formation (Ecca Group, Karoo Supergroup and Karoo Dolerite. Map drawn QGIS Desktop 2.18.14.

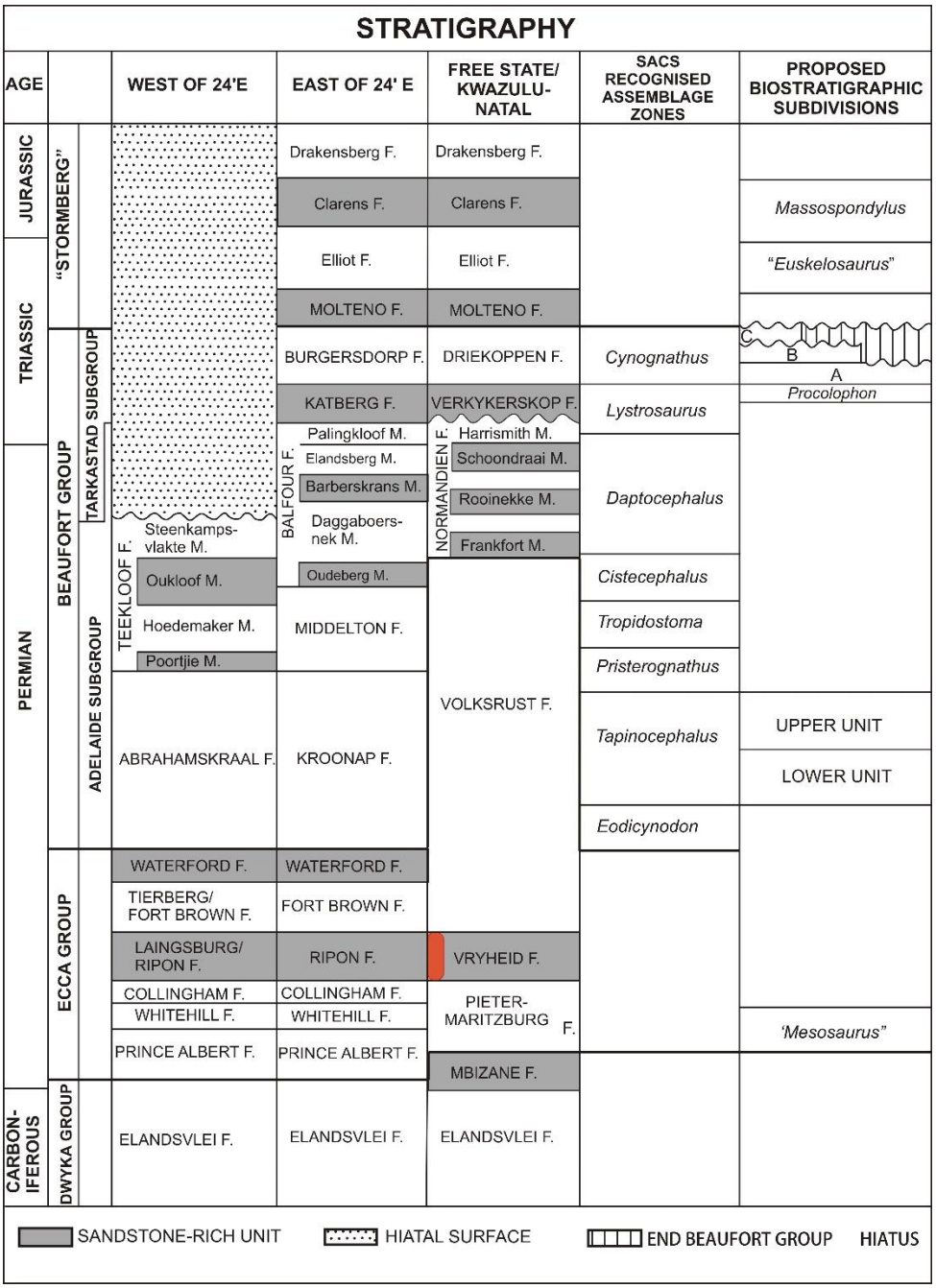


Figure 2. Lithostratigraphic (rock-based) and biostratigraphic (fossil-based) subdivisions of the Ecca and Beaufort Group of the Karoo Supergroup with rock units and fossil assemblage zones relevant to the present study marked in orange (Modified from Rubidge 1995). The subdivisions of the Ecca Group include the Vryheid Formation which is Early Permian in age. Abbreviations: F. = Formation, M. = Member

6 GEOGRAPHICAL LOCATION OF THE SITE

The Proposed Leslie 1 Mining Project is approximately 9 705 hectares in extent and situated in the Govan Mbeki Local Municipality.

7 METHODS

A Palaeontological Scoping study was conducted to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed area of development. The author's experience, aerial photos (using Google, 2015), topographical and geological maps and other reports from the same area were used to assess the proposed area of the development

7.1 Assumptions and Limitations

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

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

8 FINDINGS AND RECOMMENDATIONS

The proposed development footprint is underlain by the Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup) as well as Jurassic aged Dolerite (Karoo Supergroup). The Vryheid Formation of the Ecca Group is well-known for the presences of coal beds which has been formed due to the accumulation of plant

material over long periods of time. Trace fossils, fish, small crustaceans, insects, as well as plant fossils are common in this Formation. According to the SAHRIS PalaeoMap the sedimentary rocks of the Vryheid Formation have a very high palaeontological sensitivity while the Dolerite of the Jurassic has a very low palaeontological sensitivity as these rocks are unfossiliferous.

Alternatives have been suggested for this project but they all fall in the same geology and thus not one is a preferred alternative in palaeontological terms.

No significant fossils are expected to be found before deep excavation (>1.5m) are completed. Thought, it is possible that significant fossils will be documented during excavations. The recording of fossils will enhance our knowledge of the Palaeontological Heritage of the development area.

It is thus recommended that an EIA level palaeontology report will be conducted during deep excavation to assess the value and importance of fossils in the development area and the effect of the proposed development on the palaeontological heritage. This involves a Phase 1 field-based assessment by a professional palaeontologist. The purpose of the EIA Report is to elaborate on the concerns and potential impacts identified during the scoping phase. This is accomplished by site visits and research in the site-specific study area as well as a comprehensive assessment of the impacts identified during the scoping phase.

It is recommended that:

- The EAP and ECO must be informed that a Very High Palaeontological Sensitivity is allocated to the whole study area. A Phase 1 PIA document and “Chance Find Protocol” must be completed during the first month of excavation.
- The developer must apply for a collection and destruction permit for plant fossils encountered during the mining operation.
- A qualified palaeontologist must be employed to visit the present mining operations to record any fossils where the palaeontologist will look out for extraordinarily well preserved fossils and collect representative samples of these fossils for further study at an appropriate institution.
- These recommendations must be incorporated in the EMPr of this project.

9 IMPACT TABLE

9.1 Assessment Methodology

Please use the methodology below, and the Risk Assessment Matrix in Appendix B when determining the significance of impacts associated with the proposed project.

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 impact significance rating system is presented in Table 1, Table 2 and Table 3 and involves three parts:

1. **Part A**: Define impact consequence using the three primary impact characteristics of magnitude, spatial scale/ population and duration;
2. **Part B**: Use the matrix to determine a rating for impact consequence based on the definitions identified in Part A; and
3. **Part C**: Use the matrix to determine the impact significance rating, which is a function of the impact consequence rating (from **Part B**) and the probability of occurrence.

9.2 Part A: Defining Consequence in Terms of Magnitude, Duration and Spatial Scale:

Use these definitions to define the consequence in Part B.

Table 1: Consequence Rating Methodology

IMPACT CHARACTERISTICS	DEFINITION	CRITERIA
Magnitude	Major -	Substantial deterioration or harm to receptors; receiving environment has an inherent value to stakeholders; receptors of impact are of conservation importance; or identified threshold often exceeded
	Moderate -	Moderate/measurable deterioration or harm to receptors; receiving environment moderately sensitive; or identified threshold occasionally exceeded
	Minor -	Minor deterioration (nuisance or minor deterioration) or harm to receptors; change to receiving environment not measurable; or identified threshold never exceeded

IMPACT CHARACTERISTICS	DEFINITION	CRITERIA
	Minor +	Minor improvement; change not measurable; or threshold never exceeded
	Moderate +	Moderate improvement; within or better than the threshold; or no observed reaction
	Major +	Substantial improvement; within or better than the threshold; or favourable publicity
Spatial scale or population	Site or local	Site specific or confined to the immediate project area
	Regional	May be defined in various ways, e.g. cadastral, catchment, topographic
	National/ International	Nationally or beyond
Duration	Short term	Up to 18 months.
	Medium term	18 months to 5 years
	Long term	Longer than 5 years

9.3 Part B: Determining Consequence Rating:

Rate consequence based on definition of magnitude, spatial extent and duration.

Table 2: Consequence Rating Methodology

			SPATIAL SCALE/ POPULATION		
			Site or Local	**Regional**	**National/ international**
MAGNITUDE					
Major	**DURATION**	**Long term**	Medium	Medium	High
		Medium term	Low	Low	Medium
		Short term	Low	Low	Medium
Moderate	**DURATION**	**Long term**	Medium	High	High
		Medium term	Medium	Medium	High

			SPATIAL SCALE/ POPULATION		
			Site or Local	Regional	National/ international
		Short term	Low	Medium	Medium
Major	DURATION	Long term	High	High	High
		Medium term	Medium	Medium	High
		Short term	Medium	Medium	High

9.4 Part C: Determining Significance Rating:

Rate significance based on consequence and probability.

Table 3: Significance Rating Methodology

		CONSEQUENCE		
		Low	Medium	High
PROBABILITY (of exposure to impacts)	Definite	Medium	Medium	High
	Possible	Low	Medium	High
	Unlikely	Low	Low	Medium

10 SPECIALIST CHECKLIST:

Please complete this checklist and cross reference were applicable:

EIA REGULATIONS 2017 GNR 327, 325 and 324 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Completed according to the EIA regs	Cross-reference in this scoping report
For example,	X	[i.e. Chapter 2 or Section b etc]
(a) details of— the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	X	P8
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	x	Piii
(c) an indication of the scope of, and the purpose for which, the report was prepared	x	P9
(CA) an indication of the quality and age of Base Data used for the specialist report	x	n/a
(CB) a description of existing impacts on the site, cumulative impacts of the proposed development and the levels of acceptable change	x	P15
(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	x	n/a
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	x	P14
(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.	x	P15
(g) an identification of any areas to be avoided, including buffers;	x	n/a
(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	x	P12
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	x	P14
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities	x	P15
(k) any mitigation measures for inclusion in the EMPr	x	n/a
(l) any conditions for inclusion in the environmental authorisation;	x	n/a
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	x	n/a
(n) a reasoned opinion— i. whether the proposed activity, activities or portions thereof should be authorised; and (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or	x	n/a

EIA REGULATIONS 2017 GNR 327, 325 and 324 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Completed according to the EIA regs	Cross-reference in this scoping report
portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;		
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	x	n/a
(p) any other information requested by the competent authority	x	N/a

11 REFERENCES

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