



VLAKVARKFONTEIN COAL MINE

Palaeontological Impact Assessment for the Expansion of Open Cast Mining, a New Integrated Water Use License and the Establishment of a Coal Processing Facility by Ntshovelo Mining Resources (Pty) Ltd on Farm Vlakvarkfontein 213R, Victor Khanye Local Municipality, Mpumalanga Province

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Declaration of Independence

I, *Stephanie E. Baker*, declare that –

General declaration:

- *I act as the independent palaeontological practitioner 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 heritage 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 from an heritage practitioner 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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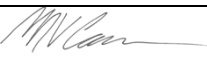




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Report Title	Palaeontological Impact Assessment for the Expansion of Open Cast Mining, a New Integrated Water Use License and the Establishment of a Coal Processing Facility by Ntshovelo Mining Resources (Pty) Ltd on Farm Vlakvarkfontein 213R, Victor Khanye Local Municipality, Mpumalanga Province.		
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ACKNOWLEDGEMENT OF RECEIPT

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EXECUTIVE SUMMARY

Ntshovelo Mining Resources (Pty) Ltd has requested permits for the extension of open cast mining operations, and a new integrated water use license to relocate the pollution control dam, as well as establish a new coal processing (washing) facility on Farm Vlakvarkfontein 213R. To do so, the completion of an Environmental Impact Assessment (EIA) is required as per legislative requirements. Environmental Impact Management Services (EIMS) was appointed to produce the EIA, who then contracted PGS Heritage to conduct the necessary fieldwork. This report is a Palaeontological Impact Assessment (PIA), which is required by the South African Heritage Resources Agency (SAHRA) due to the presence of fossil formations in the local area. This report serves to inform SAHRA and any other parties involved in developments of the Vlakvarkfontein property, and on the status of palaeontological resources where construction has been proposed.

Farm Vlakvarkfontein 213R is located near Kendal in the Victor Khanye Local Municipality of the Mpumalanga Province, approximately 23km north east of Delmas and 15km west of Ogies. It is situated in an area geologically dominated by the Eccu Group formation (Karoo Supergroup), which is known to harbour fossil materials from the Permian Period (~300 – 250Mya) (Ogg et al., 2016). The property is situated within the Vryheid Formation (a geological unit of the Eccu Group) dating to the Middle Permian Period, which has yielded important trace fossils of plants and insects (Johnson et al., 2006).

To assess any potential disturbance of palaeontological resources on the Farm Vlakvarkfontein, a survey was conducted on September 27th, 2017 covering the areas that would be impacted by the development.

Survey Findings:

1. The Vryheid Formation is exposed on the property;
2. The property was highly disturbed by previous mining activities;
3. There were no fossil resources identified on the property.

The results of the survey conclude that there is no predicted impact for fossil deposits on the property should development take place. Previous Phase I PIA reports have concluded that no fossils have been found in this particular portion of the Vryheid formation and previous mining on the Vlakvarkfontein property has likely disturbed any fossil deposits that may have existed (Bamford, 2013).

Recommendation:

If construction activities on this property should expose any fossil deposits, a professional palaeontologist should be contacted to assess whether mitigation actions are necessary. Fossil plants are associated with the Witbank Coalfield as a part of the Vryheid Formation, although it is unlikely that they will be of any importance (Bamford, 2013). As such, the development proposed by Ntshovelo Mining Resources can proceed.

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Terminology and Abbreviations

Archaeological resources

This includes:

- i. material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;
- ii. rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation; wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- iii. features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

- i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- ii. carrying out any works on or over or under a place;
- iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- iv. constructing or putting up for display signs or boards;
- v. any change to the natural or existing condition or topography of land; and
- vi. any removal or destruction of trees, or removal of vegetation or topsoil

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means place or object of cultural significance.

Late Iron Age (Early Farming Communities)

The archaeology of the last 2000 years up to the 1800s associated with ironworking and farming activities such as herding and agriculture.

Later Stone Age (LSA)

The archaeology of the Stone Age period lasting from ~40-20 000 to 500 years ago, represented by Early, Robberg, Oakhurst, Wilton, Final and Ceramic Final phases. The LSA is associated with *H. sapiens sapiens*.

Middle Stone Age (MSA)

The archaeology of the Stone Age from ~300 000 to 40-20 000 years ago – a period represented by Early, Klasies River, Mossel Bay, Pre -Still Bay, Still Bay, Howieson's Poort, Sibudu, Final phases. The MSA is associated with archaic *H. sapiens* and (modern) *H. sapiens sapiens*.

Earlier Stone Age (ESA)

The archaeology of the Stone Age from ~3.2 Million years ago to 250 000 years ago – a period represented by the Lomekwian, Oldowan and Acheulean industries. The ESA is associated with Australopith-grade hominins (e.g. *Au. afarensis*, *Au. garhi*, *K. platyops*, *P. robustus*) and early Homo hominins (*H. habilis*, *H. erectus*, *H. heidelbergensis*).

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.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past and any site which contains such fossilised remains or trace.

Abbreviations	Description
ASAPA	Association of Southern African Professional Archaeologists
CMP	Conservation Management Plan
CRM	Cultural Resource Management
EIA	Environmental Impact Assessment
EMPR	Environmental Management Programme Report
ESA	Earlier Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
LIA	Late Iron Age
LSA	Later Stone Age
MSA	Middle Stone Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
HRMS	Heritage and Research Management Services (Pty) Ltd
PGS	PGS Heritage (Pty) Ltd
PHRA	Provincial Heritage Resources Authority
PIA	Palaeontological Impact Assessment
POIs	Points of Interest
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

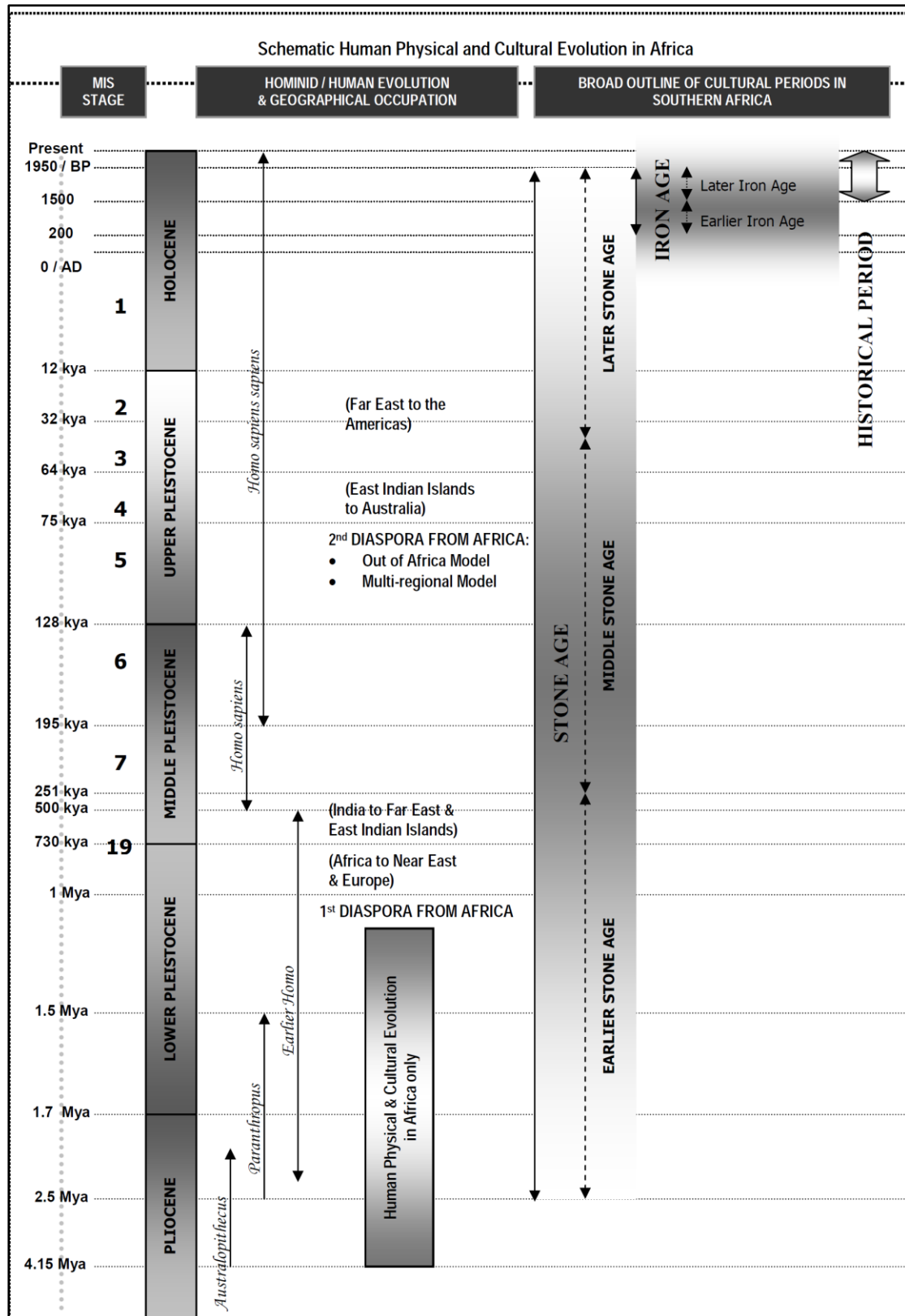


Figure 1 – Human and Cultural Time line in Africa (Morris, 2008)

1 INTRODUCTION

Heritage Research and Management Specialists (Pty) Ltd (HRMS) was appointed by PGS Heritage (Pty) Ltd to undertake a Palaeontological Impact Assessment of the Farm Vlakvarkfontein 213R, currently the site of the Vlakvarkfontein Colliery, located near Kendal in the Victor Khanye Local Municipality of the Mpumalanga Province (**Figure 2**). This action is required by the South African Heritage Resources Agency (SAHRA) because this area has been deemed as potentially sensitive to the disturbance of palaeontological resources based on the Paleo-Sensitivity Map provided on the SAHRIS website. HRMS conducted a Phase I report on the property to assess any prospective damage to fossil materials during development activities proposed by Ntshovelo Mining Resources (Pty) Ltd (**Figure 3**).



Figure 2 – Outline of the Farm Vlakvarkfontein 213R Property (red) and the area of proposed development (blue).

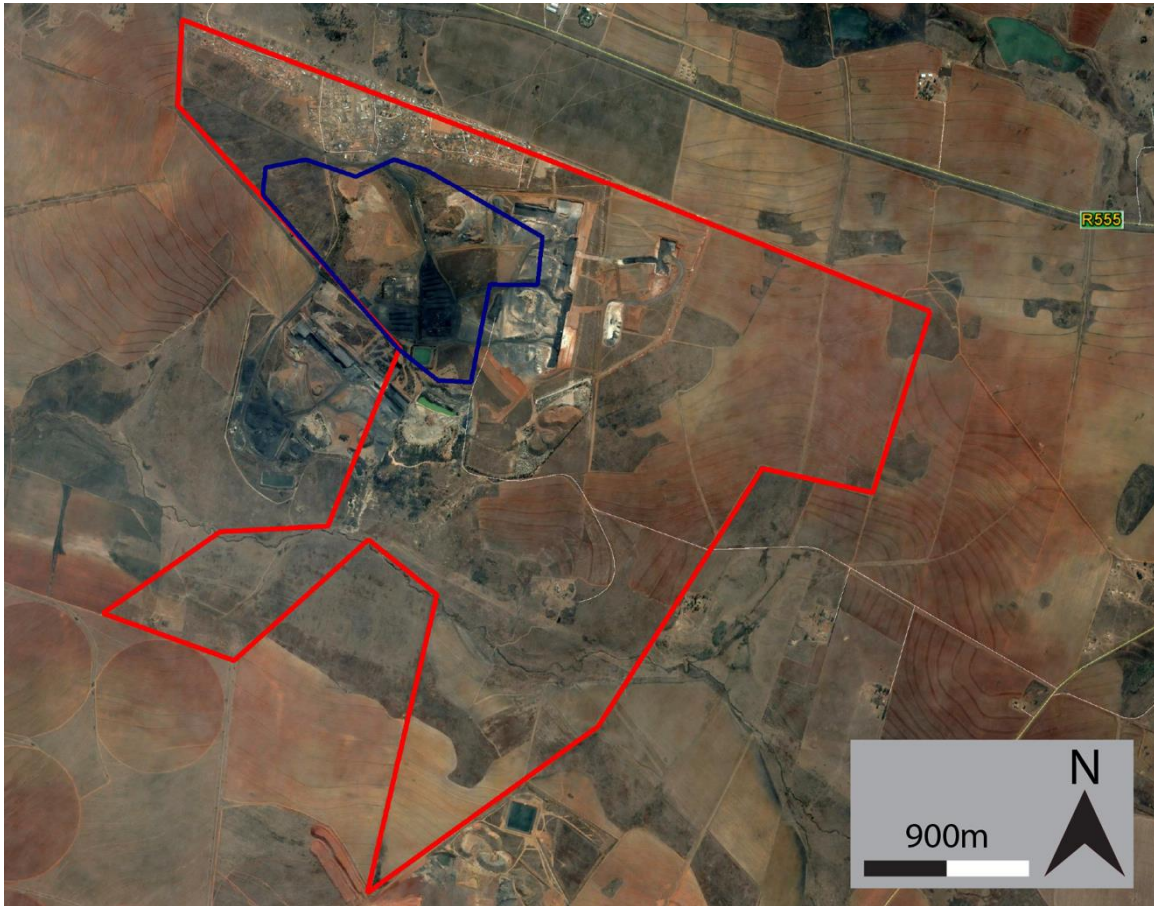


Figure 3 – Close-up of Farm Vlakvarkfontein 213R outline (red) and the proposed area for development (blue) by Ntshovelo Mining Resources (Pty) Ltd.

1.1 Scope of the Study

The aim of the study is to identify any palaeontological resources, i.e. fossil deposits, in the area of proposed development within the Farm Vlakvarkfontein 213R boundary (**Figure 3**), as well as assess any potential for damage or disturbance of any sensitive fossil deposits where construction activities occur. This PIA provides both the results of a survey, conducted on 27th September 2017, and the recommendations based on the findings of this fieldwork. The purpose of this PIA is to inform the Ntshovelo Mining Resources (Pty) Ltd of any potential disturbance of fossil deposits according to the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This Palaeontological Impact Assessment was compiled by HRMS for PGS Heritage, the latter of which staff have a combined experience of nearly 50 years in the heritage consulting industry and have extensive experience in managing HIA processes.

Mr. Wouter Fourie, Principal Heritage Specialist for this project, is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA) and has CRM accreditation within the said organisation, as well as being accredited as a Professional Heritage Practitioner with the Association of Professional Heritage Practitioners – Western Cape (APHP).

Dr. Tim Forssman acted as a Stone Age specialist and surveyor. He has undertaken extensive and in-depth research at several Stone Age, Iron Age and rock art localities around southern Africa. He has also published several scientific articles with a focus on the Later Stone Age, Iron Age, rock art and archaeological method. He is registered with the Association of Southern African Professional Archaeologists (ASAPA) and has CRM accreditation within the said organisation.

Dr. Matthew V. Caruana acted as a Stone Age specialist and surveyor. He has undertaken extensive and in-depth research at several palaeoanthropological localities around southern Africa including Swartkrans, Drimolen and Taung. He has also published several scientific articles with a focus on Earlier Stone Age technologies, as well as palaeoanthropological finds. He is registered with the Association of Southern African Professional Archaeologists (ASAPA) and has CRM accreditation within the said organisation.

Dr. Matt G. Lotter acted as a Stone Age specialist and surveyor. He has undertaken extensive and in-depth research at several Earlier, Middle and Later Stone Age localities around southern Africa. He has also published several scientific articles with a focus on Earlier Stone Age technologies and geoarchaeology. He is registered with the Association of Southern African Professional Archaeologists (ASAPA) and has CRM accreditation within the said organisation.

Ms. Stephanie E. Baker acted as a Palaeontological expert to review data collected from the survey and write the PIA report. She currently holds an MSc in Palaeontology and is the permit holder for the Drimolen fossil site (Plio-Pleistocene age) in the Cradle of Humankind (Gauteng Province, South Africa). She has several publications focused on the analysis of fossil remains from southern Africa. She is currently a member of the Palaeontological Society of South Africa (PSSA).

1.3 Assumptions and Limitations

Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the lack of palaeontological resources located during the survey does not represent an overall lack of fossil-bearing deposits in the area. The presence of the Vryheid Formation indicates possible trace fossils, such as plant and insects preserved in this area. Further, not all parts of the property were accessible for the survey as the property is actively mined. The Safety Officer, Jan Vilakase, escorted the surveyor on the property and indicated where portions of the property were accessible on foot. The remaining portions were driven due to safety protocols on the mine.

1.4 Legislative Context

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

- i. National Environmental Management Act (NEMA), Act 107 of 1998
- ii. National Heritage Resources Act (NHRA), Act 25 of 1999
- iii. Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

- i. National Environmental Management Act (NEMA) Act 107 of 1998
 - a. Basic Environmental Assessment (BEA) – Section (23)(2)(d)
 - b. Environmental Scoping Report (ESR) – Section (29)(1)(d)
 - c. Environmental Impact Assessment (EIA) – Section (32)(2)(d)
 - d. Environmental Management Plan (EMP) – Section (34)(b)
- ii. National Heritage Resources Act (NHRA) Act 25 of 1999
 - a. Protection of Heritage Resources – Sections 34 to 36; and
 - b. Heritage Resources Management – Section 38
- iii. Mineral and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
 - a. Section 39(3)

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34(1) of the NHRA states that, “no

person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority...” The NHRA is utilized as the basis for the identification, evaluation and management of heritage resources and in the case of CRM those resources specifically impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through NEMA, MPRDA legislation. In the latter cases the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorizations are granted for development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impacts Processes required by NEMA and MPRDA. This change requires us to evaluate the Section of these Acts relevant to heritage (Fourie, 2008).

The NEMA 23(2)(b) states that an integrated environmental management plan should, *“...identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage”*.

A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b) and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of the impacts of the proposed activity on these resources, the identification of alternatives and the management procedures for such cultural resources for each of the documents noted in the Environmental Regulations. A further important aspect to be taken account of in the Regulations under NEMA is the Specialist Report requirements laid down in Section 33 of the regulations (Fourie, 2008).

1.5 Heritage Significance Grading

Heritage Site significance classification standards prescribed by SAHRA (2006) and approved by ASAPA for the Southern African Development Community (SADC) region were used for the purpose of this report.

Table 1 - Site significance classification standards as prescribed by SAHRA.

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	-	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	-	Medium Significance	Recording before destruction
Generally Protected C (GP.C)	-	Low Significance	Destruction

2 TECHNICAL DETAILS OF THE PROJECT

2.1 Site Location and Description

Coordinates	Vlakvarkfontein Coal Mine (Farm Vlakvarkfontein 213R) -26.063414°"S and 28.899370°"E
Property	Farm Vlakvarkfontein 213R, Kendal, Victor Khanye Local Municipality of the Mpumalanga Province
Location	The property is located 7km west of Kendal, 23km north-east of Delmas and 15km west of Ogies
Extent	The proposed development area measures approximately 103 hectares
Land Description	The property is largely covered in sandy, coarse-grained sediment, with exposures of the Vryheid Formation, i.e. quartzite and shale layers. The property is heavily disturbed by mining activities.

2.2 Technical Project Description

3 BACKGROUND

Ntshovelo Mining Resources (Pty) Ltd wishes to develop their mining operations on the Farm Vlakvarkfontein 213R in terms of an extension of open cast mining operations, a new integrated water use license to relocate the pollution control dam, and to establish a new coal processing (washing) facility. Ntshovelo Mining Resources (Pty) Ltd appointed Geo Soil and Water CC (GSW)

to compile an Environmental Impact Assessment (EIA) for this proposed development, who then appointed Environmental Impact Management Services (Pty) Ltd (EIMS) to facilitate the necessary fieldwork and report preparation. PGS was appointed to conduct a Palaeontological Impact Assessment of the property, a necessary component of the EIA, required by SAHRA. PGS contracted HRMS to conduct a survey of the property and compile a PIA report, to advise on any potential disturbance of palaeontological resources.

The Vryheid Formation (Ecca Group) geologically dominates the area where Vlakvarkfontien 213R is situated in the western portion of the Mpumalanga Province. This formation preserves the Witbank Coalfield, one of the most extensive coal deposits in South Africa (Johnson et al., 2006). Furthermore, this formation is abundant in trace-fossils of plants and insects above, inside and below the coal beds (Johnson et al., 2006; Bamford, 2013). This area was thus identified by SAHRA as a potentially sensitive area containing palaeontological materials according to the Palaeo-Sensitivity Map located on the SAHRIS website. Therefore, a PIA has been requested by SAHRA to identify any fossil deposits within the boundary of the proposed area of development on Farm Vlakvarkfontein 213R (**Figure 3**).

4 MINING AND ASSOCIATED INFRASTRUCTURE.

The Vlakvarkfontein Coal Mine is an active mining operation that has heavily disturbed the area and surrounding deposits. The mine has numerous structures on the property including office trailers, a pollution control dam and other ancillary infrastructure (**Figure 4**).

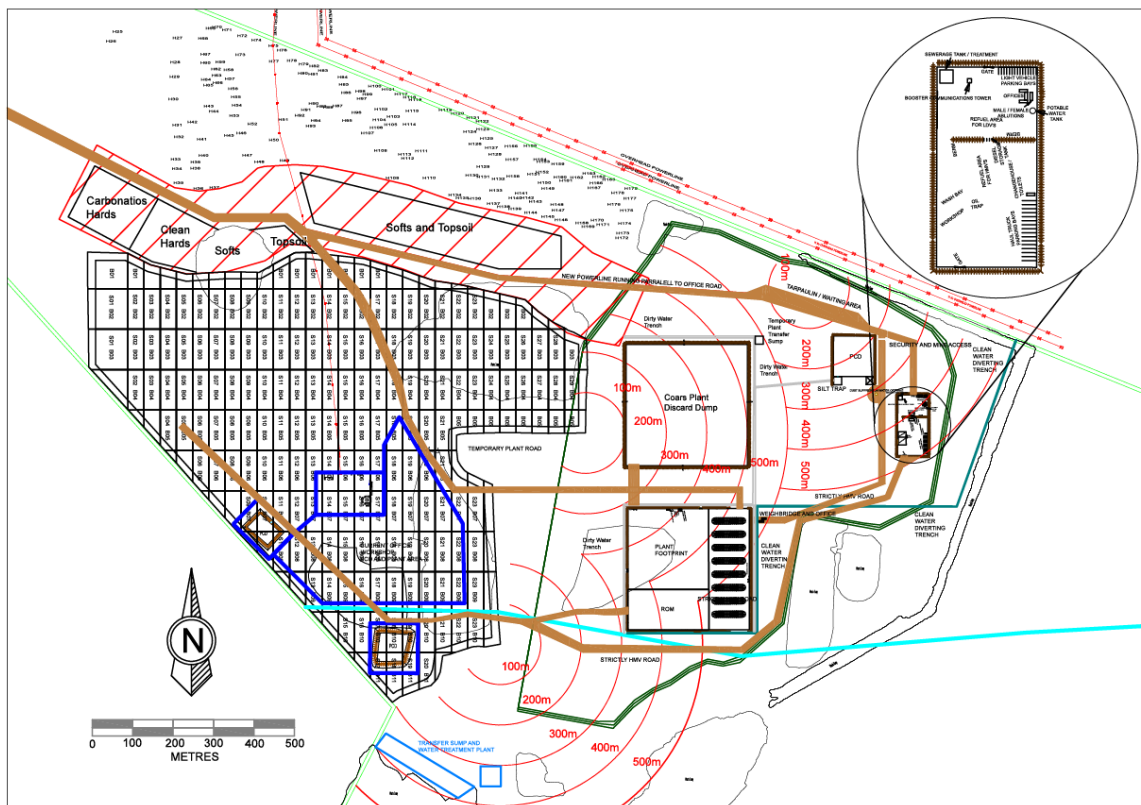


Figure 4 – Infrastructure plan of the Vlakvarkfontein Coal Mine provided by EIMS.

5 ASSESSMENT METHODOLOGY

5.1 Methodology for Assessing Heritage Site significance

This PIA report was compiled by PGS Heritage for the development of the Vlakvarkfontein Coal Mine. The applicable maps, tables and figures are included as stipulated in the NHRA (no 25 of 1999) and the National Environmental Management Act (NEMA) (no 107 of 1998). The PIA process consisted of three steps:

Step I – Literature Review: The background information to the field survey was based on archival reports available in SAHRIS, as well as available academic literature.

Step II – Physical Survey: The physical survey consisted of field-walking the area using transects at a distance of 2-5m apart over the areas for proposed development identified in the development plans provided by EIMS. The identification of ‘points of interest’ (POI) were based on the presence of fossil materials (although see Results section below). Stratigraphic profiles

were exposed on the property, which provided an understanding of the local sedimentological sequence at depth. These profiles were inspected for subterranean occurrences of palaeontological materials. All relevant profiles were photographed and reported on here. The field work was conducted on 27th September, 2017 by Dr Matthew V. Caruana.

Step III – Report: The final step involved the recording and documentation of the survey results, which were analysed and summarized here by Ms. Stephanie E. Baker.

The significance of heritage sites was based on four main criteria:

- Site integrity (i.e. primary vs. secondary context);
- Amount of deposit, abundance of fossil materials;
- Density of scatter (dispersed scatter);
 - Low - <10/50m²
 - Medium - 10-50/50m²
 - High - >50/50m²
- Uniqueness; and
- Potential to answer present research questions.

Recommendation and mitigation actions, which will result in a reduction in the impact on the sites, will be expressed as follows:

- No further action necessary;
- Mapping of the site and controlled sampling required;
- No-go or relocate development position;
- Preserve site, or extensive data collection and mapping of the site.

5.2 Methodology for Impact Assessment

The impact assessment methodology is guided by the requirements of the NEMA EIA Regulations (2010). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/likelihood (P) of the impact occurring. This determines the environmental risk. In addition other factors, including cumulative impacts, public concern, and potential for

irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S).

6 DETERMINATION OF ENVIRONMENTAL RISK

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER). The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$C = (E + D + M + R) \times N$$

4

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in **Table 2**.

Table 2: Criteria for Determining Impact Consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site)
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),

Aspect	Score	Definition
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per **Table 3**.

Table 3: Probability Scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

$$ER = C \times P$$

Table 4: Determination of Environmental Risk

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in **Table 5**.

Table 5: Significance Classes

Environmental Risk Score	
Value	Description
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥9; <17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

7 IMPACT PRIORITISATION

In accordance with the requirements of Regulation 31 (2)(l) of the EIA Regulations (GNR 543), and further to the assessment criteria presented in the Section above it is necessary to assess each potentially significant impact in terms of:

- Cumulative impacts; and
- The degree to which the impact may cause irreplaceable loss of resources.

In addition it is important that the public opinion and sentiment regarding a prospective development and consequent potential impacts is considered in the decision making process.

In an effort to ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 6: Criteria for Determining Prioritisation

Public response (PR)	Low (1)	Issue not raised in public response.
	Medium (2)	Issue has received a meaningful and justifiable public response.
	High (3)	Issue has received an intense meaningful and justifiable public response.
Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 6. The impact priority is therefore determined as follows:

$$\text{Priority} = \text{PR} + \text{CI} + \text{LR}$$

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (Refer to **Table 7**).

Table 7: Determination of Prioritisation Factor

Priority	Ranking	Prioritisation Factor
3	Low	1
4	Medium	1.17
5	Medium	1.33

6	Medium	1.5
7	Medium	1.67
8	Medium	1.83
9	High	2

In order to determine the final impact significance the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is to be able to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential, significant public response, and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 8: Final Environmental Significance Rating

Environmental Significance Rating	
Value	Description
< 10	Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
≥10 <20	Medium (i.e. where the impact could influence the decision to develop in the area),
≥ 20	High (i.e. where the impact must have an influence on the decision process to develop in the area).

8 BACKGROUND STUDY

8.1 Archival Findings – Palaeontological Background

The examination of PIA reports on the SAHRIS website and published academic literature provides a background for understanding the significance of palaeontological resources in and/or surrounding the study area. Several PIA reports have been compiled in the Delmas area, necessitated by the proposed mining of the Witbank Coalfield. The following provides a summary of past PIAs and academic studies that are important for the impact assessment of the Vlakvarkfontein Coal Mine property.

The area surrounding Farm Vlakvarkfontein 213R is dominated by the Eccca Group Formation (Karoo Supergroup) (**Figure 5**), in particular, the Vryheid Formation, which is comprised of interbedded sandstones and shales that preserve valuable fossils and remains of plants and insects (Johnson et al., 2006). The Eccca Group Formation is Permian (~300 – 260Ma) in age and preserves important plant trace fossils including *Diplocraterion parallelum*, *Skolithos*, *Monocraterwn*, *Scalaruuba*, *Siphonichnus ecccaensis* and *Glossopteris* flora (see Anderson and McLauchlan, 1976; Bamford, 2004). The Upper Eccca (which includes the Vryheid) Formation only preserves one of the two large leaf form taxa for *Glossopteris*, namely *Gangamopteris*, which have contributed to the formation of the Witbank Coalfield (Rubidge, 2013). An extensive review of the plant fossils in this area can be read in Bamford (2004). While no macro-fossils (i.e. animals) have been found in the Vryheid Formation, its trace fossils have been critical for understanding palaeoenvironmental conditions during the Permian Period (Stainstreet et al., 1980).

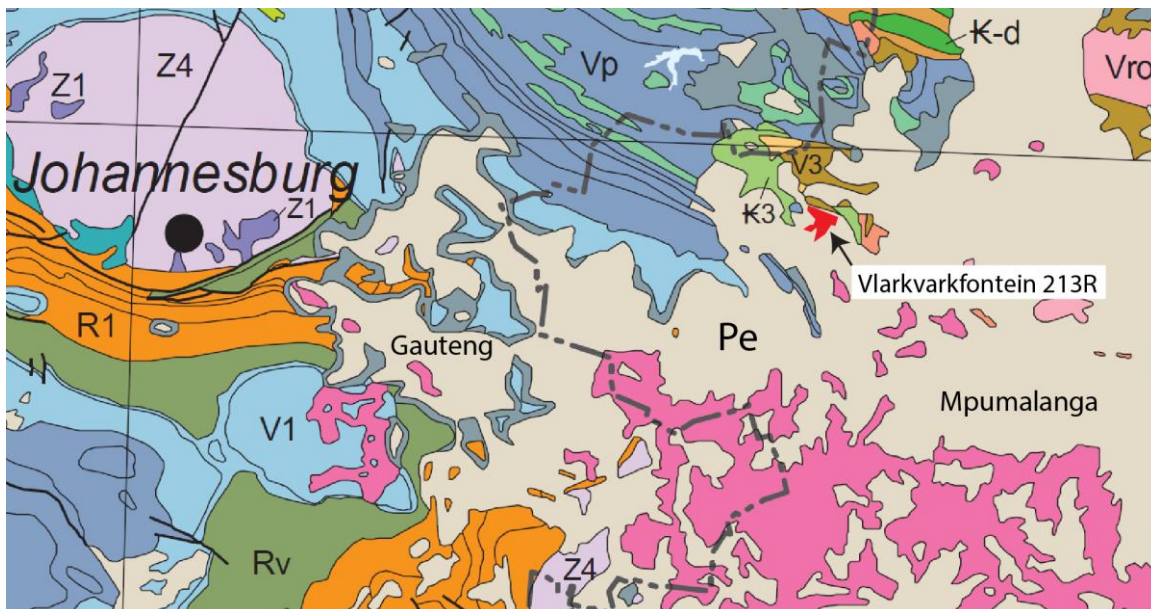


Figure 5 - Geological setting of study area (Pe = Eccca Group formation).

8.2 Previous Palaeontological Studies in the Area

- Bamford, M. 2013. Palaeontological Impact Assessment for the Establishment of a 600 MW Power Plant and Ash Disposal Facility at Delmas (Mpumalanga/Gauteng). Phase I Report.
- Rubidge, B. 2013. Palaeontological Desktop Study Leeuwpan Mine, Delmas, Nkangala District Municipality, Mpumalanga Province. Phase I Report.

- Fourie, H. 2015. Palaeontological Impact Assessment: Phase 1 Field study - Ngululu Resources Opencast Coal Mine, Nkangala District Municipality, Mpumalanga Province. Farm: Portion 26, 46 and 47 Droogenfontein 242 IR. Phase I Report.

8.3 Results of the Archival Findings

Researching the SAHRA APM Report Mapping Project records and the SAHRIS online database (<http://www.sahra.org.za/sahris>), it was determined that no previous palaeontological studies overlapped with the study area, although three Phase I reports in the Delmas area provided some context for previous palaeontological finds near the study area. None of these impact assessments recorded important fossils nor recommended mitigation. The area around Delmas, Kendal and Ogies is highly disturbed by established mining activities, as well as human settlements. As such, it is unlikely that any important palaeontological resources will be exposed or disturbed by the continuation of mining development (Bamford, 2013; Rubidge, 2013).

9 FIELD WORK FINDINGS

A survey of the proposed development area within the Vlakvarkfontien Coal Mine was conducted on the 27th of September, 2017 (Spring season) (**Figure 6**). The substrate on the property is coarse-grained sand with minimal exposure of the Vryheid Formation, although the property has been heavily disturbed by previous and current mining activities (**Figure 7**). No POIs were identified during the survey as no fossil deposits were found.

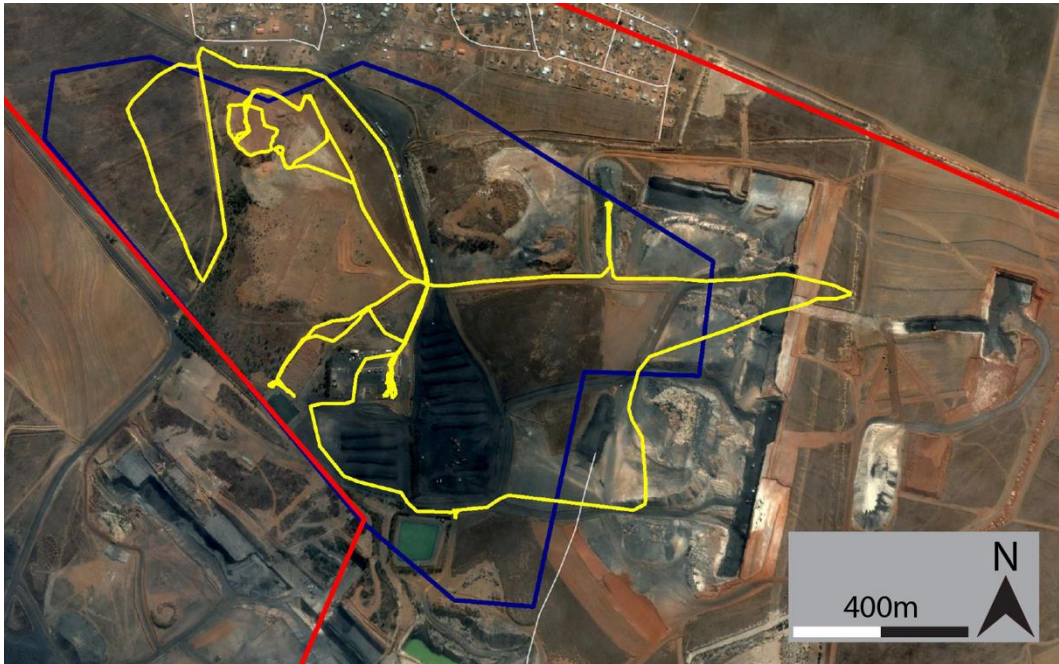


Figure 6 – GPS Tracks (yellow) of survey conducted within the area proposed for development (blue) within the Vlakvarkfontein Coal Mine. Red indicates farm boundary.



Figure 7 – Context photo of the area proposed for development on the Vlakvarkfontein Coal Mine property. Note heavily disturbed landscape and extensive relocation of surface sediments down to considerable depth.

A stratigraphic section within the survey zone was located and thoroughly inspected for fossil materials (**Figure 8**). This sedimentary profile shows a thin exposure of the Vryheid Formation (sandstone uncomfortably overlaying shale), although no fossils were located.

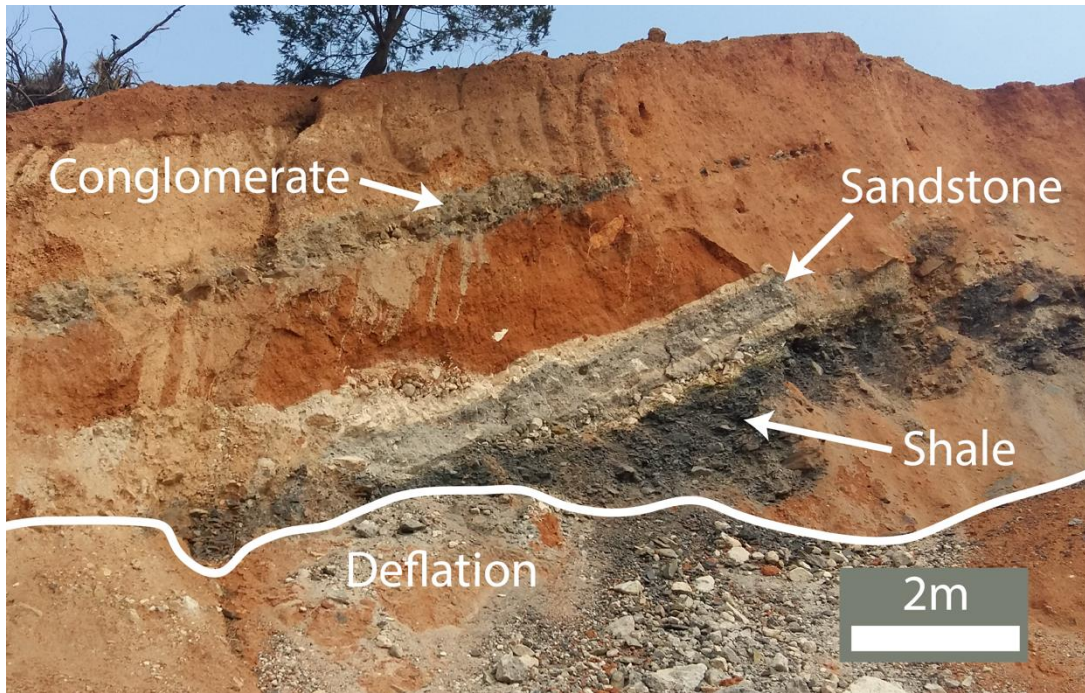


Figure 8 – Exposed profile of the Vryheid Formation showing interbedding sandstone and shale layering.

The entire Vlakvarkfontein property is highly disturbed by previous and current mining activities, infrastructure developments, roads and human settlements. As such, the conclusion of the survey is that there is a low chance that in-tact, important fossil deposits will be exposed and/or disturbed as a result of the proposed developments by Ntshovelo Mining Resources (Pty) Ltd on the Vlakvarkfontein Coal Mine property.

10 IMPACT ASSESSMENT

Table 9: Palaeontological Impact Assessment for development of the Vlakvarkfontein Coal Mine.

Impact Name	Palaeontological Resource Impact				
Alternative	All Alternatives				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	1	1	Magnitude	1	1
Extent	1	1	Reversibility	1	1
Duration	1	1	Probability	1	1
Environmental Risk (Pre-mitigation)					1.00
Mitigation Measures					
Environmental Risk (Post-mitigation)					1.00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					1

Low: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	1
Low: Where the impact is unlikely to result in irreplaceable loss of resources.	
Prioritisation Factor	1.00
Final Significance	1.00

Table 9 suggests a low, negative impact on any palaeontological resources by the proposed developments in Farm Vlakvarkfontien 213R by Ntshovelo Mining Resources (Pty) Ltd.

10.1 Assessment of Processing Alternatives

1. Design or Layout of Activity (S1a & S1b): The spatial positioning of mining activity and infrastructure layouts are unlikely to affect any palaeontological resources. Given the area is already highly disturbed by previous mining and human settlement and the only outcrop of the Vryheid Formation is non-fossil-bearing, mining activities are not expected to impact any important fossil deposits.
2. Mining Method (P1a & P1B): The method of mining, i.e. open cast or underground pillar extraction is unlikely to affect any palaeontological resources. Bamford (2013), a qualified palaeo-botanist, recently stated that the Vryheid Formation in the Delmas area is unlikely to yield critical plant fossils to add any new information towards palaeoenvironments in the Permian period. Further previous disturbance of Vlakvarkfontein farm renders any fossil deposits as low significance.
3. Disposal of Waste (P2a & P2b; P3a-d): Because Vlakvarkfontein farm is already highly disturbed by previous mining and human settlement activities, waste disposal is unlikely to affect palaeontological resources. The minimal outcropping of the Vryheid Formation in this area are not expected to yield any important fossil deposits (Bamford, 2013).
4. De-watering (P4a & P4B): Because Vlakvarkfontein farm is already highly disturbed by previous mining and human settlement activities, de-watering activities are unlikely to affect palaeontological resources. Any potential fossil deposits in this area are likely to be of low significance (Bamford, 2013).
5. Water Supply (P5a & P5b): The use of water resources are not expected to have any impact on potential palaeontological resources in the area surrounding Vlakvarkfontein farm. Previous mining and human settlement activities render any fossil deposits as low significance (Bamford, 2013).

10.2 Assessment of Technology Alternatives

The use of technology, i.e. processing and transport are not applicable to this report.

10.3 Assessment of Activity Alternatives

1. Activities (A1 & A2): Either mining or farming activities are not expected to impact any sensitive palaeontological resources as previous mining and human settlement activities render any fossil deposits as low significance (Bamford, 2013).

11 CONCLUSION

HRMS was appointed by PGS to undertake a PIA on the Vlakvarkfontein Coal Mine property (Farm Vlakvarkfontein 213R, Kendal, Victor Khanye Local Municipality of the Mpumalanga Province) for the extension of open cast coal mining, a new integrated water use license and the development of a new coal processing facility by Ntshovelo Mining Resources (Pty) Ltd. The Vryheid Formation underlays the Vlakvarkfontein Coal Mine property, which is known to preserve trace fossils of plants and insects that have been valuable for palaeoenvironmental reconstructions of Gondwanaland during the Permian Period (Anderson & McLauchlan, 1976; Stainstreet et al., 1980). As such, the Vryheid Formation is recognised as an important palaeontological resource in northern South Africa.

The results of the archival study show that no previous PIAs conducted near the study area concluded a need for mitigation of sensitive fossil deposits. In fact, conclusions reached in this work suggested that it is highly unlikely that any significant fossils will be exposed and/or disturbed by development activities (Bamford, 2013). Furthermore, the fieldwork component of this study found no fossils exposed on the property.

However, if developments should expose any fossil deposits, SAHRA should be contacted immediately and a professional palaeontologist should be brought in to assess their significance and provide recommendations (*e.g.* recording, sampling, collection, mitigation).

The absence of fossils on the property, combined with a lack of mitigation of palaeontological resources in the local area and the low negative impact score provided here (as analysed in

Table 9), finds that the developments proposed by Ntshovelo Mining Resources (Pty) Ltd can proceed without the need for palaeontological resource mitigation at this present time.

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Education and Qualifications

PhD	Palaeozoology with a focus on carnivore taxonomy & ecology (University of Johannesburg). Registered part-time.
MSc	Palaeozoology with a focus on large raptor ecology (University of the Witwatersrand). Graduated June 2013.
BSc Hons	Palaeontology with a focus on site management & fauna (University of the Witwatersrand). Graduated April 2011.
BSc	Ecology & Zoology. Minor in Environment & Conservation (University of the Witwatersrand). Graduated April 2010.

Associated Experience

2011 to present	Field school co-ordinator for annual international excavation groups at Drimolen Fossil Hominin Site (UNESCO World Heritage Site)
2012 to present	Laboratory manager for the Drimolen fossil repository (University of Johannesburg)
2013 to present	Permit holder & site manager for Drimolen
2014 to present	Lecturer: Comparative Osteology (honours level); University of Johannesburg
2014	Co-supervisor to multiple postgraduate students (University of Johannesburg)
2015	Lecturer: first year Anthropology; University of Johannesburg

Publications

Published Articles:

1. Hopley PJ *et al.* (2013). "Beyond the South African cave paradigm - *Australopithecus africanus* from Plio-Pleistocene palaeosol deposits at Taung". American Journal of Physical Anthropology, 151 (2): 316-324.
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5. "A detailed analysis of fossil fauna from Taung, North West Province". Published in the proceedings of the 16th conference of the Palaeontological Society of southern Africa, Howick, August 5-8, 2010.

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1. Herries AIR *et al.* (c. 2017). New 2.6-2.0 Ma fossil bearing palaeokarst deposits from the Drimolen Palaeocave System and implications for understanding cave life histories in the Malmani dolomite of Gauteng Province, South Africa. *Quaternary Science Reviews*.
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Conference Presentations:

1. "A detailed analysis of fossil fauna from Taung, North West Province" at the 16th Proceedings of the PSSA in Howick, August 2010.
2. "Accumulation behaviours and taphonomic signatures for extant verreaux's eagle nests, *Aquila verreauxii*, in southern Africa" at the annual Birds of Prey Program Conference in Bulawayo, Zimbabwe, May 2011.
3. "Verreaux's eagles and their importance in the fossil record" at the annual Birds of Prey Program Conference in Phalaborwa, May 2013.
4. "Phylogeny of a false sabre-tooth cat, *Dinofelis*, in southern Africa." at the Annual University of Johannesburg Inter-Faculty Postgraduate Symposium, October 2015.
5. "Taung... A river ran through it." Hopley P, Herries AIR, Baker SE, Menter CG, Caruana MV, Bountalis A, Kuhn BF. Seventy-first anniversary annual meeting of The Society of Vertebrate Palaeontology, Las Vegas, 2nd -5th November 2011.

Conference awards:

1. Best Speaker at the Annual University of Johannesburg Inter-Faculty Postgraduate Symposium, October 2015