



## **S. BOTHMA AND SON TRANSPORT SAND MINE**

**Palaeontological Impact Assessment for the Application of an Integrated Water Use License by Environmental Impact Management Services on the S. Bothma and Son Transport Sand Mine on Remainder Portion of the Farm Boschbank 12, Sasolburg, Free State 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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<b>Report Title</b>	<b>Palaeontological Impact Assessment for the Application of an Integrated Water Use License by Environmental Impact Management Services on the S. Bothma and Son Transport Sand Mine on Remainder Portion of the Farm Boschbank 12, Sasolburg, Free State Province.</b>		
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## **EXECUTIVE SUMMARY**

Heritage and Research Management Services (Pty) Ltd (HRMS) was appointed by PGS Heritage (Pty) Ltd (PGS) to undertake a Palaeontological Impact Assessment of the S. Bothma and Son Transport Sand Mine on the Remainder Portion of the Farm Boschbank 12, Sasolburg, Free State Province for the application of an Integrated Water Use License. The South African Heritage Resources Agency (SAHRA) identified this area as potentially sensitive to palaeontological disturbance due to the presence of the Eccra Group, a geological formation known to preserve fossils from the Permian period (~300 – 260Ma) (Johnson et al. 2006).

PGS contracted HRMS and palaeontological specialist, Stephanie E. Baker (University of Johannesburg) to conduct a survey and report of the potential impact on fossil deposits on the S. Bothma and Son Transport Sand Mine property, located in the Parys District of the Free State Province near Sasolburg.

A survey of the property was conducted on September 18<sup>th</sup>, 2017 covering the areas identified by EIMS that would be impacted by mining.

### Survey Findings:

1. The geological substrate covering the property is comprised of alluvial sediments (coarse-grained sands to clays), which likely measure over 10 meters in depth;
2. The property was highly disturbed by previous mining activities;
3. There was no bedrock exposed on the property;
4. 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 S. Bothma and Son Transport Sand Mine property if mining should take place. The chronologically young alluvial sediments, occurring across the site at the surface and to considerable depth, are likely too thick to expose fossil-bearing deposits through mining activities.

### Recommendation:

If mining activities on this property should reach below the alluvial sediments, further survey work should be conducted by professional palaeontologists to ensure that fossiliferous deposits are not exposed and potentially damaged. Geologically, the local area near Sasolburg is comprised of the Vryheid Formation (Eccra Group), which includes fluvial and deltaic

deposits of coarse sandstone, conglomerate and coal seams (Johnson et al., 2006). As such, fossil plants and insects have been found in this formation and therefore if mining on the S. Bothma and Son Transport Sand Mine should excavate through the sandy, alluvial sediments overlaying the local bedrock, fossil materials may be exposed in the process and a palaeontological survey would be required with potential implications for mitigation.

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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 2 000 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

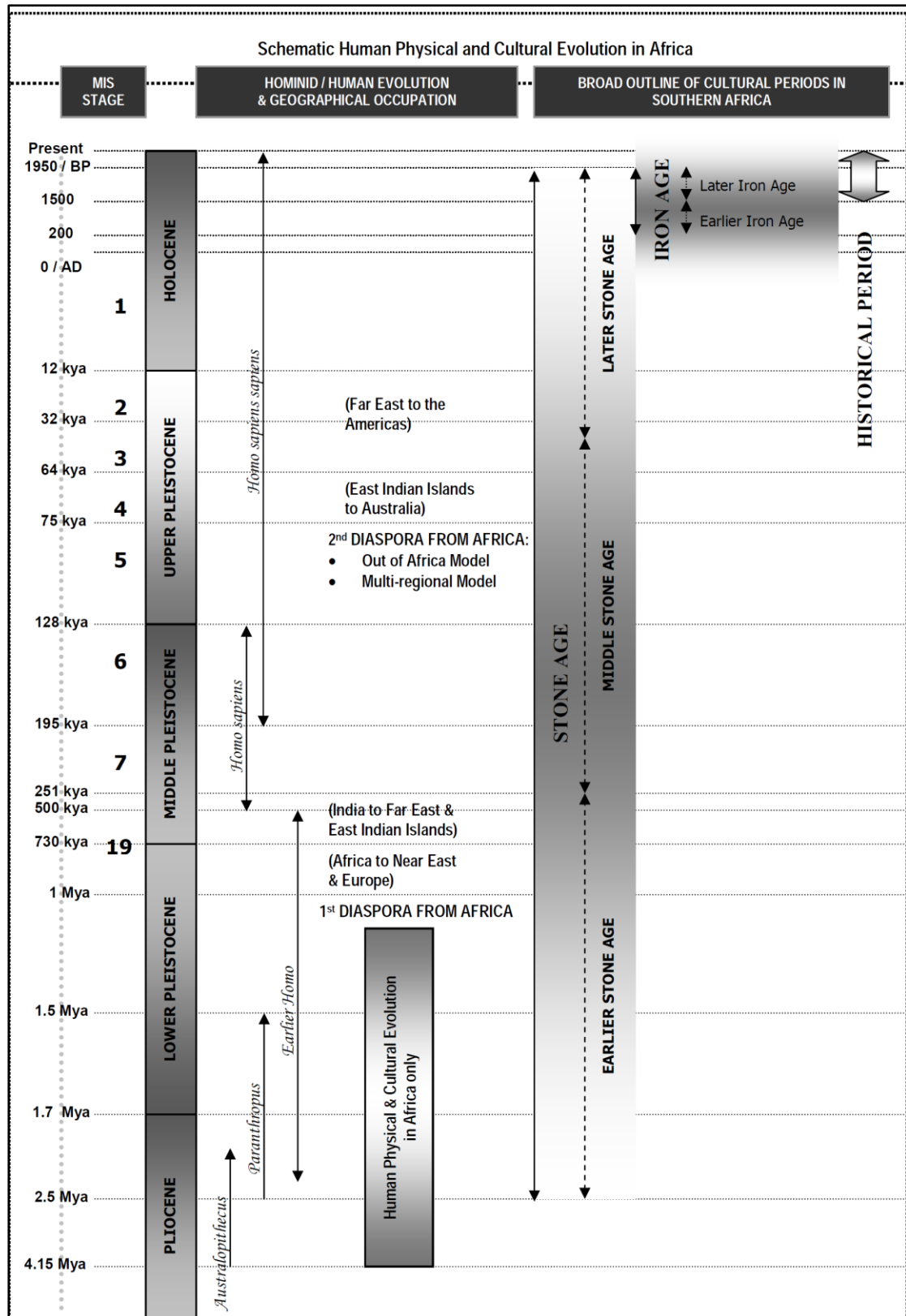


Figure 1 – Human and Cultural Time line in Africa (Morris, 2008)

## 1 INTRODUCTION

Heritage and Research Management Services (Pty) Ltd (HRMS) was appointed by PGS Heritage (Pty) Ltd (PGS) to undertake a Palaeontological Impact Assessment of the S. Bothma and Son Transport Sand Mine on the Remainder Portion of the Farm Boschbank 12, Sasolburg, Free State Province (**Figure 2**), which was flagged by South African Heritage Resources Agency (SAHRA) to be an area potentially sensitive to the disturbance of palaeontological materials based on the sensitivity map provided on the SAHRIS website. PGS contracted HRMS and Stephanie E. Baker to conduct a Phase I report on the property to assess any prospective damage to fossil materials during proposed mining activities.



*Figure 2 – The S. Bothma and Son Transport Sand Mine property (outlined in red).*

### 1.1 Scope of the Study

The aim of the study is to survey the S. Bothma and Son Transport Sand Mine in order to assess the potential for damage or disturbance of any sensitive fossil deposits where mining activities have been proposed by the mine. The resulting PIA provides results of the palaeontological survey conducted by HRMS and recommendations based on these findings. The purpose of this PIA is to

inform S. Bothma and Son Transport of the potential for disturbing palaeontological remains 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 staff of which has 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. Timothy R. 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. 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 preserved in this area, although this geological unit is currently overlain by thick alluvial sediments. Further, not all parts of the property were accessible for the survey as active excavations were taking place during the fieldwork. Also, portions of the property are now covered by wetland environments, i.e. covered by man-made dams and reed-beds, which made surveying impossible in these areas. The areas accessible by vehicle and foot were extensively covered to provide the most comprehensive survey possible.

### **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 the SAHRA (2006) and approved by the 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

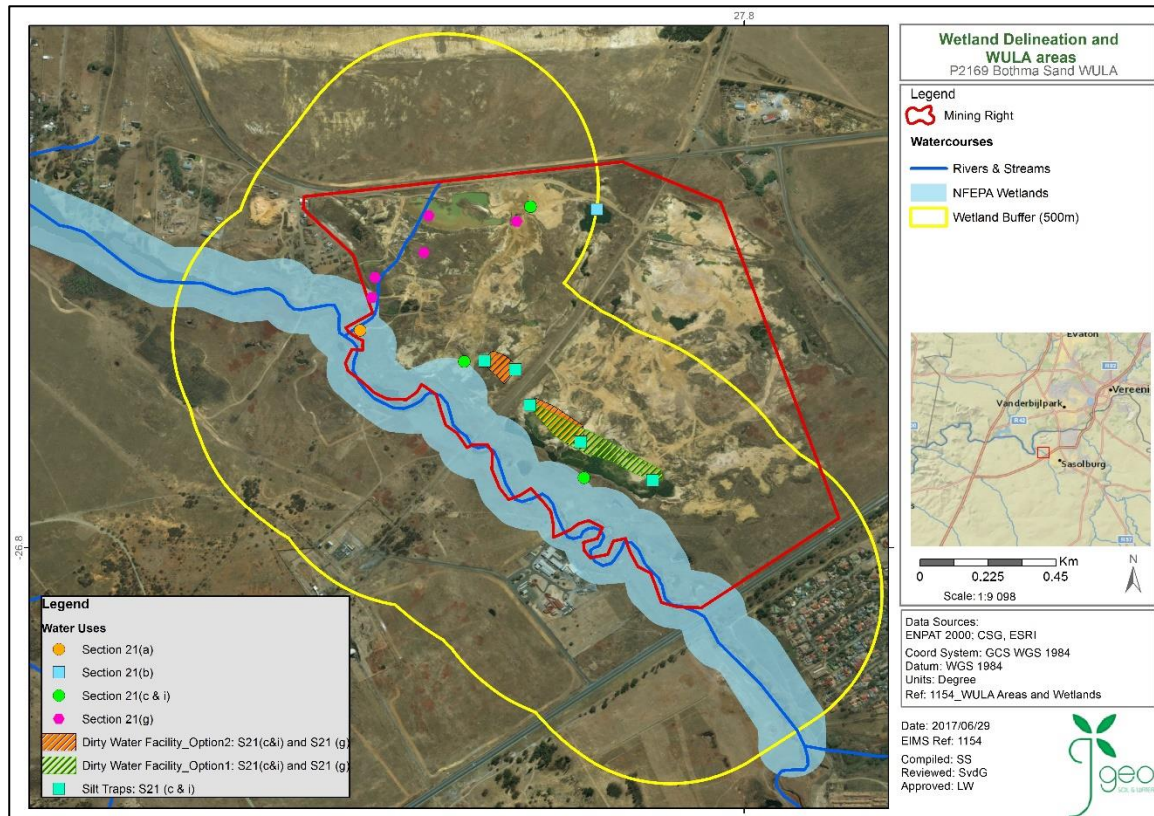
Coordinates	The S. Bothma and Son Transport Sand Mine: 26°47'39.67"S and 27°47'46.55"E
Property	Portion Re of the Farm Boschbank 12, Sasolburg, Parys District, Free State Province
Location	The property is located northwest of Sasolburg (~3Km) in the Parys District of the Free State Province.
Extent	The proposed mining area measures approximately 141 hectares
Land Description	The substrate of the property is sandy alluvium, grading from coarse-grained sand to clay. Dams have developed as a result of mining activities, which have resulted in several localised wetland environments with reed-beds.



## 2.2 Technical Project Description

## 3 BACKGROUND

S. Bothma and Son Transport (Pty) Ltd. has applied for an Integrated Water Use Licence (**Figure 3**). The proposed area of mining is approximately 141 hectares and is located on Re Portion Farm Boschbank 12, near the town of Sasolburg in the Parys District Municipality area of the Free State Province.



*Figure 3 – Map of the proposed mining on the S. Bothma and Son Transport Sand Mine (provided by EIMS).*

The SAHRA reviewed the application and deemed the area of proposed mining potentially sensitive to disturbance of palaeontological resources. They requested an HIA and PIA report be compiled to report on any heritage and fossil materials on the property that might be under threat by future mining. S. Bothma and Son Transport Sand Mine, then appointed PGS Heritage to conduct an integrated HIA that includes a PIA of the property. PGS contracted HRMS and Ms. Stephanie E. Baker to conduct a survey of the property and compile a PIA report, as part of the HIA process, to advise on any potential disturbance of fossil materials.

The Vryheid Formation (Ecca Group) underlays the Sasolburg area in the northern Free State Province, which preserves the Witbank Coalfield, as well as abundant trace-fossils of plants and insects above, inside and below the coal beds (Johnson et al., 2006). This area was thus identified by SAHRA as a potentially sensitive area containing palaeontological materials. Therefore, a PIA has been requested by SAHRA to identify any fossil deposits on the S. Bothma and Son Transport Sand Mine.

#### **4 MINING AND ASSOCIATED INFRASTRUCTURE.**

The S. Bothma and Son Transport sand mine has been operating since 1966 and has extensively mined on the Re Portion the Farm Boschbank 12 property near Sasolburg (Free- State Province). This has resulted in a high level of disturbance of the land, which includes roads being developed on the property.

#### **5 ASSESSMENT METHODOLOGY**

##### **5.1 Methodology for Assessing Heritage Site significance**

This PIA report was compiled by PGS Heritage for the permit to attain an IWUL by the 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 where three surveyors walked at a distance of 2-5m apart over areas of the property identified in the mining 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 18<sup>th</sup> September, 2017, by Drs. Timothy R. Forssman, Matthew V. Caruana and Matt G. Lotter.

**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 - <10/50m<sup>2</sup>
  - Medium - 10-50/50m<sup>2</sup>
  - High - >50/50m<sup>2</sup>
- 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 mining 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). Please note that the impact assessment must apply to the identified Sub Station alternatives as well as the identified Transmission line routes.

## **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 mining 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 mining).
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),
	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.

Aspect	Score	Definition
	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 mining 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*

<b>Public response (PR)</b>	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.
<b>Cumulative Impact (CI)</b>	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 published literature and existing database information provides a critical tool for locating and assessing heritage resources in the study area. The following assessment was done to evaluate the potential effects to palaeontological heritage resources by the proposed Integrated Water Use Licence (IWUL) for the S. Bothma and Son Transport Sand Mine.

The area outside the Boschbank Farm is dominated by sandstone, with interbedded coal deposits of the Vryheid Formation of the Ecca Group in the Karoo Supergroup (Johnson et al., 2006). The Ecca Formation is under- and overlain by the Pietermaritzburg and Volksrust Formations respectively, both of which are argillaceous (comprised of clays) and interdigitate into the Vryheid (**Figure 4**). The Ecca Group Formation is Permian (~300 – 260Ma) in age and has preserved important trace fossils including *Diplocraterion parallelum*, *Skolithos*, *Monocraterwn*, *Scalaruuba*, *Siphonichnus eccaensis* and *Glossopteris flora* (see Anderson and McLauchlan, 1976; Bamford, 2004). The Upper Ecca (which includes the Vryheid) Formation only preserves one of the two large



leaf form taxa for *Glossopteris*, namely *Gangamopteris*. A further extensive review of the plant fossils can be read in Bamford (2004).

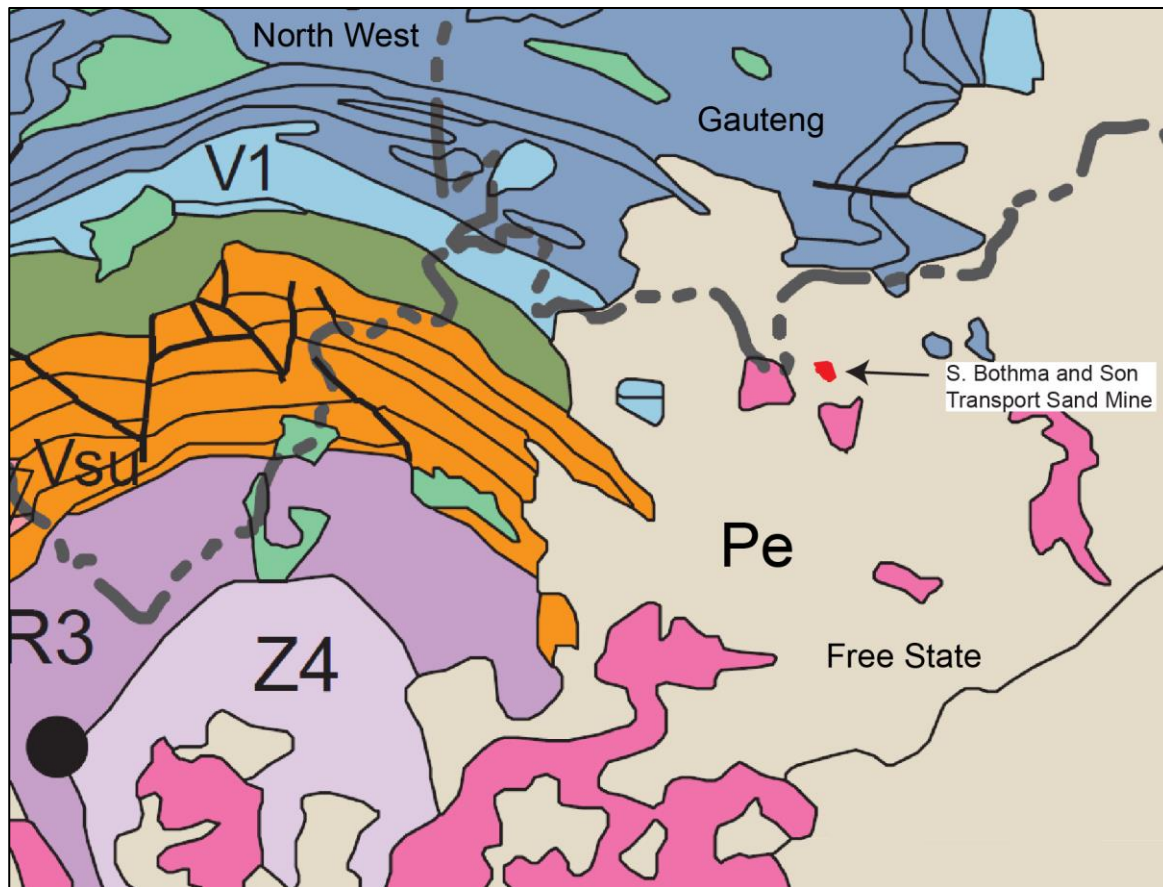


Figure 4 - Geological setting of study area (Pe = Ecce Group formation).

## 8.2 Previous Palaeontological Studies in the Area

- Millsted, B.D. 2014. *Desktop palaeontological heritage impact assessment report on the site of a proposed solar power production facility (the Lethabo Solar Energy Facility) to be located on Farm 1814, Free State Province*. An unpublished report by African Heritage Consultants CC on SAHRIS, Ref. N/A.
- Rubidge, B. 2008. *Installation of High Pressure natural gas transmission pipeline from Sasol Synfuels in Secunda to Sasol Infrachem in Sasolburg, via Balfour – Palaeontological Impact Assessment*. An unpublished report by Nature and Business Alliance Africa (Pty) Ltd. on SAHRIS, Ref. 12/12/20/1067.

### 8.3 Results of the Archival Findings

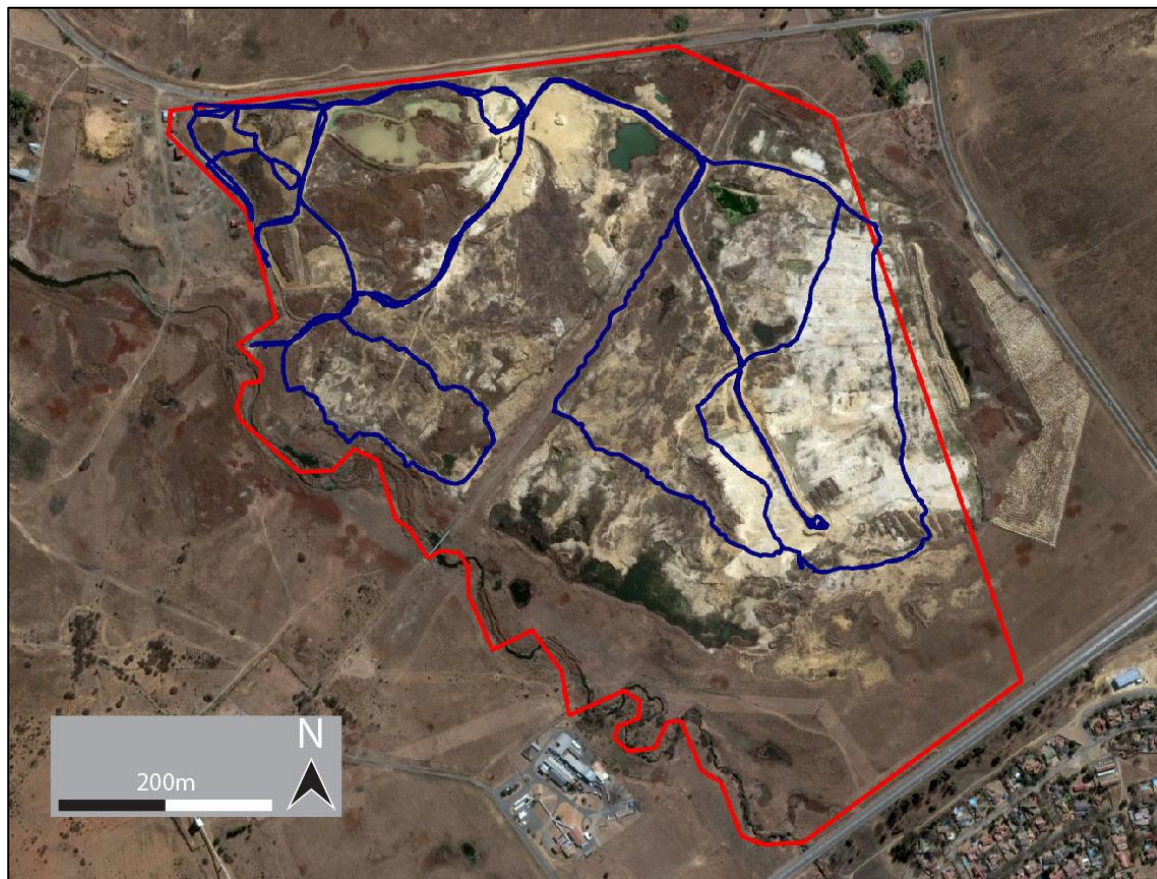
Researching the SAHRA APM Report Mapping Project records and the SAHRIS online database (<http://www.sahra.org.za/sahris>), it was determined that no previous palaeontological studies overlapped or were adjacent to the study area. Only two other PIAs have been done on the study area and the surrounding vicinity. Neither of these impact assessments recommended mitigation of the proposed mining as the area surrounding Sasolburg is heavily disturbed already and has not been recorded to preserve any fossil deposits.

## 9 FIELD WORK FINDINGS

A survey of the S. Bothma and Son Transport Sand Mine was conducted on 18<sup>th</sup> September, 2017 (**Figure 5**). The substrate on the property is a sandy alluvium (grading from coarse-grained sands to clays), likely derived from the erosion of sandstones originating from the Vryheid Formation. This alluvial sediment was deposited by the Vaal River and is thus chronologically younger than the Vryheid Formation, although its exact age is unknown.



*Figure 5 – Context photo of the Farm Boschbank 12 property.*



*Figure 6 – GPS Tracks of survey conducted on the S. Bothma and Son Transport Sand Mine. Red indicates outline/perimeter of property.*

Two areas on the property were significant for assessing the stratigraphic profile of the property, depicted in **Figure 7** and **Figure 8**. **Figure 7** shows the ‘upper’ stratigraphic profile (located on the portion of the property highest in elevation) comprised of coarse-grained, sandy alluvium and clays, which characterizes the majority of this property, as well as the depth of the alluvial deposits.





*Figure 7 – The ‘upper’ stratigraphic profile of alluvial sediments that cover most of the property.*

The property slopes down towards the Vaal River on a shallow gradient. **Figure 8** shows the ‘lower’ stratigraphic profile (located on the portion of the property lowest in elevation), naturally cut by water flow. The surface of this profile cutting was approximately 5 to 10m lower than the ‘upper’ profile and thus suggests that the alluvium is over 10m in depth (by conservative estimates).



*Figure 8 – The ‘lower’ stratigraphic profile of alluvial sediments on the property*

No fossils were located on the property during the survey and thus no POIs were identified. However, some areas exposing stratigraphic profiles were observed, which suggested that the sandy alluvium was over 10m in depth. As such, no mitigation is required for mining on the S. Bothma and Son Transport Sand Mine property.

## 10 IMPACT ASSESSMENT

*Table 9: Palaeontological impact assessment for mining of the S. Bothma and Son Transport Sand Mine*

Impact Name	Palaeontological Resources				
Alternative	All Alternatives				
Phase	Operational				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature of Impact	-1	-1	Magnitude of Impact	1	1
Extent of Impact	1	1	Reversibility of Impact	1	1
Duration of Impact	1	1	Probability	1	1
Environmental Risk (Pre-mitigation)					-1.00
Mitigation Measures					
None					
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
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: It is unlikely tha tmining will reach below the alluvial sediments on the property					
Prioritisation Factor					1
Final Significance					-1.00

**Table 9** suggests a low, negative impact on the S. Bothma and Son Transport Sand Mine from proposed mining under the application for an Integrated Water Use Licence by EIMS.

## 11 CONCLUSION

HRMS was appointed by PGS to undertake a PIA of the S. Bothma and Son Transport Sand Mine on RE Portion of the Farm Boschbank 12, Sasolburg, Free State Province for the application of an Integrated Water Use License. The Vryheid Formation underlying the Sasolburg area (Parys District, Free State Province) where the S. Bothma and Son Transport Sand Mine is located is

known to preserve trace fossils of plants and insects and is thus recognised as an important palaeontological resource in this region of 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. Further, the field survey found that no fossil deposits were located and no bedrock was exposed on the property. As such, there is a low impact predicted for proposed operational phases on the S. Bothma and Son Transport Sand Mine.

However, if mining should excavate below the alluvial deposits on the property, it is recommended that a professional palaeontologist survey the area and assess any potential exposure of fossil deposits from the underlying substrate. Further, if any fossil deposits are discovered during any phase of mining, the managing body responsible for mining should alert SAHRA (South African Heritage Research Agency) immediately so that appropriate mitigation (*e.g.* recording, sampling or collection) can be taken by a professional palaeontologist.

The absence of fossils on the property and no previous mitigation of palaeontological resources in this area, combined with the low, negative impact on palaeontological resources as analysed in **Table 9**, finds that mining of this property as stipulated in the application of EIMS for an Integrated Water Use Licence can proceed without any mitigation required.

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