Relocation of the coal processing plant and tailings storage facility (SACMH)

Gert Sibande District Municipality, Msukaligwa Local Municipality, Mpumalanga Province

Farm: Portion 5 and 10 Voorslag 274 IS.

Fourie, H. Dr heidicindy@yahoo.com

012 0000040/012 993 3110

Palaeontological Impact Assessment: Phase 1 Field study

Commissioned by: ENVASS

394 Tram Street, New Muckleneuk, 0181, Pretoria, Gauteng

012 460 9768

2014/08/22

EIA Ref 17/2/3 GS-146

B. Executive summary

Outline of the development project: Environmental Assurance (ENVASS) has appointed Dr H. Fourie, a palaeontologist, to undertake a Paleontological Impact Assessment, Phase 1 Field study of the suitability of the proposed relocation of the coal processing plant and tailings storage facility to Portions 5 and 10 of the farm Voorslag 274 IS, at the existing Umlabu Colliery, in the Breyten area, Gert Sibande District, Msukaligwa Local Municipality, Mpumalanga Province.

South African Coal Mine Holdings Limited (Pty) Ltd proposes a relocation of the plant for a mine development with an estimated life of mine of 30 years. The proposed site with corresponding farm portions are near Breyten, approximately 25km north of Ermelo Town as part of the Gert Sibande District Municipality. It will entail the construction of a coal handling and preparation plant (CHPP) and tailings storage facility (TSF). The coal handling and preparation plant will process the coal by washing it of impurities and preparing it for transportation to the end user or market.

Currently there are no mining activities taking place on the proposed site. The mine is situated on the adjacent portion of Mooifontein 109 IT. The farm Voorslag 274 IS is therefore the closest locality for the new proposed construction of the plant.

The Project includes two location Alternatives (see map):
Alternative 1: Two portions of land, portions 5 and 10 are situated adjacent to each other next to the R36 with Breyten 8 km to the north and Ermelo 25 km to the south (26˚ 22' 46.07"S, 29˚ 59'20.54" E).
Alternative 2: No-go. This will entail leaving the coal processing and preparation plant in its present location.

The **National Heritage Resources Act 25 of 1999** requires that all heritage resources, that is, all places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance are protected. The Republic of South Africa (RSA) has a remarkably rich fossil record that stretches back in time for some 3.5 billion years and must be protected for its scientific value. Fossil heritage of national and international significance is found within all provinces of the RSA. South Africa's unique and non-renewable palaeontological heritage is protected in terms of the National Heritage Resources Act. According to this act, palaeontological resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

The main aim of the assessment process is to document resources in the development area and identify both the negative and positive impacts that the development brings to the receiving environment. The PIA therefore identifies palaeontological resources in the area to be developed and makes recommendations for protection or mitigation of these resources.

This report prescribes to the Heritage Impact Assessment of Section 38 of the National Heritage Resources Act 25 of 1999.

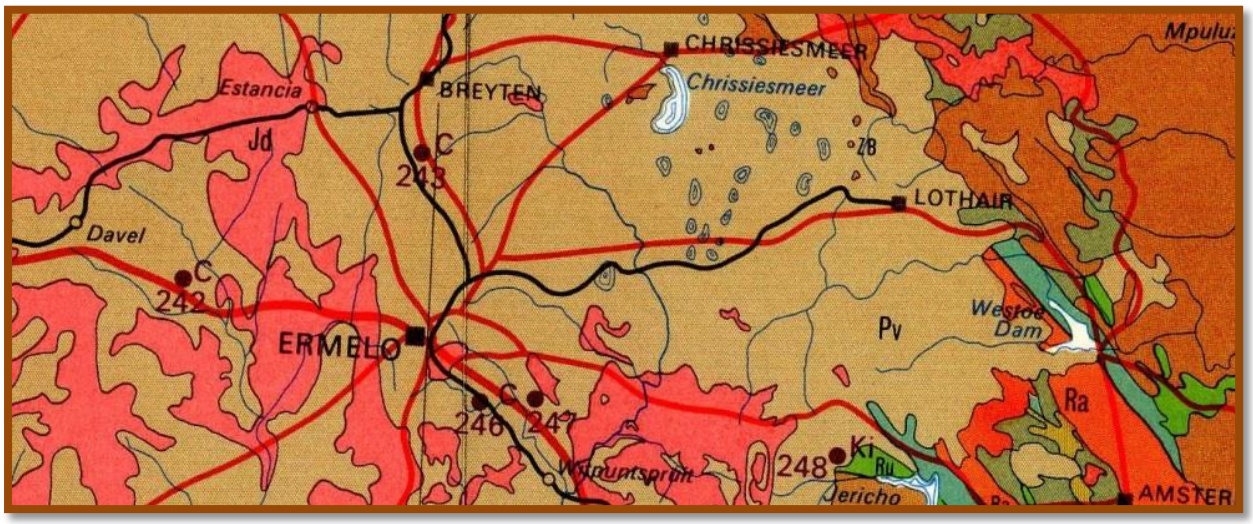
For this study, resources such as geological maps, scientific literature, institutional fossil collections, satellite images, aerial maps and topographical maps were used. It provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations (if any) for further specialist palaeontological input where this is considered necessary.

A Palaeontological Impact Assessment is generally warranted where rock units of LOW to VERY HIGH palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed area is unknown. The specialist will inform whether further monitoring and mitigation are necessary.

Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act, 1999 (No 25 of 1999):
(i) (i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens.
Section 38, 1(b) requires the details of the construction of a bridge or similar structure exceeding 50m in length.

It is proposed to comment and recommend on the impact of the development on fossil heritage, and if mitigation or conservation is necessary.

Outline of the geology and the palaeontology:
The geology was obtained from maps 1:100 000, South Africa (Visser 1984) and East Rand 2628 (Keyser, Botha and Groenewald 1986).



Legend to Map and short explanation.
Pv – (light brown) Sandstone, shaly sandstone, grit, shale, conglomerate and coal, Vryheid Formation, Ecca Group, Karoo Supergroup.
Jd – (pink) Dolerite, Karoo Dolerite Suite, Karoo Supergroup.
C – Coal.

Summary of findings: The Phase 1 Palaeontological Impact Assessment Field study was undertaken during August 2014 and the following is reported:

Formations present are part of the Karoo Supergroup. The Karoo Supergroup is renowned for its fossil wealth. The Vryheid Formation (Pe,Pv), Ecca Group is rich in plant fossils such as the *Glossopteris* flora represented by stumps, leaves, pollen and fructifications. This formation is early to mid-Permian in age and consists of sandstone, shaly sandstone, grit, conglomerate, coal and shale. Coal seams are present in the Vryheid Formation within the sandstone and shale layers. Fossils are mainly present in the grey shale which is interlayered between the coal seams.

The two portions of the Farm Voorslag 274 IS were visited and there are no visible rocky outcrops of the Vryheid Formation on the surface as the overburden is substantial and most of the land is covered in grassland. The topsoil layer is approximately 0.6m thick. The strata, including the coal seams, generally dip towards the west, displaying a weak undulating altitude. The coal seams for the Ermelo sector of the Natal Middle Ecca Stage coal province are alphabetically ordered from E seam at the base through to A seam at the top. The A seam is absent in the study area due to erosion.

Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity is generally LOW to VERY HIGH, and here locally VERY HIGH for the Vryheid Formation.

Recommendation:
The Phase 1 Palaeontological Impact Assessment Field study of the suitability of the proposed development recommend a Phase 2 Palaeontological Impact Assessment, Mitigation with protocol.

The Project includes two location Alternatives (see map):
Alternative 1: Two portions of land, portions 5 and 10 are situated adjacent to each other next to the R36 with Breyten 8 km to the north and Ermelo 25 km to the south (26˚ 22’ 46.07”S, 29˚ 59’20.54” E).
Alternative 2: No-go. This will entail leaving the coal processing and preparation plant in its present location.

Voorslag is directly underlain by rocks of the Vryheid Formation and is presently underutilised. Recent structures are absent. It is located on a gentle facing slope. The development of the plant includes several projects that will need channels and trenches to be dug for the coal processing plant and tailings storage facility foundations and footings.

The impact of the development on fossil heritage is VERY HIGH and therefore a field survey or further mitigation or conservation measures are necessary for this development (according to SAHRA protocol). A Phase 2 Palaeontological Impact Assessment and or mitigation are recommended. The overburden and inter-burden consisting of Ecca rocks must be surveyed for fossiliferous outcrops. Special care must be taken during the digging, drilling, blasting and excavating of foundations, trenches, channels and footings and removal of overburden.

Concerns/threats:

1. Threats are earth moving equipment/machinery during construction, the sealing-in or destruction of the fossils by development, vehicle traffic and human disturbance.

Stakeholders: Developer – South African Coal Mine Holdings (SACMH), R. Hugo, PO Box 55190, Northlands, 2116. 011 025 3103.

Environmental – Environmental Assurance (ENVASS) Pty (Ltd), 394 Tram Street, New Muckleneuk, 0181, 460 9768.

Landowner – SACMH.

C. Table of Contents

D. Background information on the project

Report

This report is part of the environmental impact assessment process under the NEMA (National Environmental Management Act 108 of 1998).

Outline of development

This report discusses the suitability of the relocation of the coal processing plant and tailings storage facility to Portions 5 and 10 of the farm Voorslag 274 IS, at the existing Umlabu mine, in the Breyten area, Mpumalanga Province.

South African Coal Mine Holdings Limited (Pty) Ltd proposes to relocate the plant of the mine with an estimated life of mine of 30 years. The proposed site with corresponding farm portions are near Breyten, approximately 25km north of Ermelo Town as part of the Gert Sibande District Municipality. It will entail the relocation of a coal handling and preparation plant (CHPP) and tailings storage facility (TSF). The coal handling and preparation plant will process the coal by washing it of impurities and preparing it for transportation to the end user or market.

Currently the coal processing and preparation plant is located on the farm Mooifontein 109 IT. This is also the area where most of the current mining activities are undertaken. Therefore, it makes sense to relocate the processing plant as near as possible to mining activities to limit the environmental impact associated with coal mining and processing. This will avoid moving raw coal to the processing plant using heavy vehicles, over treacherous terrain which may ultimately result in unnecessary spillages and incidents. So to limit the environmental impact of the coal mining and processing it is required to relocate and possibly upgrade the existing plant to a location closer to the farm Voorslag 274 IS. The only reserve left is on the Farm Voorslag 274 IS.

The Project includes two location Alternatives (see map):
Alternative 1: Two portions of land, portions 5 and 10 are situated adjacent to each other next to the R36 with Breyten 8 km to the north and Ermelo 25 km to the south (26˚ 22' 46.07"S, 29˚ 59'20.54" E).
Alternative 2: No-go. This will entail leaving the coal processing and preparation plant in its present location.

The four basic operations are comminution, sizing, concentration and dewatering.

The following infrastructure is anticipated:-

1. Stockpile. Will store a maximum of 30 000 ton of ore.
2. Pollution control dam (Co-disposal of mine residue and dewatered slurry).
3. The workshop and/ wash bay. Dedicated workshop, lubricant store, tyre store, and lead battery store.
4. Administrative offices and Security offices for access control.
5. Fuel depot. With fuel tanks.
6. Vehicle parking. Adjacent to the quarry offices.
7. Discard disposal facility. Waste rock dump.
8. Loading and hauling. Via conveyor belts.
9. Pipelines. These will run in trenches.

Construction may entail several projects. The installation of water pipelines, fire water reticulation system, clean and dirty water channels, dams, drains, septic tank, and the sewage water pipeline. Channels and trenches will need to be dug for the pollution control dam, workshop and office complex foundations. Bulk diesel and oil storage tanks will be erected and roads will be scraped. Footings may be needed for the conveyor belt.

Stockpile
The run of mine (ROM) stockpile will store a maximum of 30 000 ton of ore at any one time, at a steady state in the beginning, a stockpile will be built of up to 30 000 tons so as to start up the contractor.

Pollution control dam (Co-disposal of mine residue and dewatered slurry)
For the collection of run-off water into a storm water drainage system.

Workshop/wash bay and associated Administrative and Security building Complex
The workshop complex may consist of refuelling bays, workshops, offices and parking bays. The administrative block may need to have change rooms, ablution facilities, meeting rooms, and lunch/rest rooms for staff and workers. Septic tanks and soak ways will be required. Parking bays will be provided, a dust suppression water tank will be required. A silt trap will carry dirty water to a discard facility. Potable water may have to be used. It is here that the trucks will be maintained. Also present will be the lubricant store, tyre store, and lead battery store.

Fuel depot and vehicle parking
There will be fuel tanks within the bunded facilities on site. Quarry plant vehicles are parked adjacent to the quarry offices when not in use.

Discard disposal facility
After the ore is extracted, waste rock will be placed on the waste rock dump by means of a conveyor belt. The waste rock dump will be positioned near the plant.

Haul roads, Loading and hauling

No new haul roads will be required for access to the mineral reserves. All current road infrastructure will be utilized. Haul trucks will transport coal to the plant and material from underground workings will be transported to the surface via conveyor belts.

Pipelines

Will be embedded in trenches.

Rezoning/ and or subdivision of land: No.

Name of developer and consultant: South African Coal Mine Holdings Limited (Pty) Ltd and Environmental Assurance (ENVASS).

Terms of reference: Dr H. Fourie is a palaeontologist commissioned to do a palaeontological impact assessment: field study to ascertain if any palaeontological sensitive material is present in the development area. This study will advise on the impact on fossil heritage mitigation or conservation necessary, if any.

Dr Fourie obtained a Ph.D from the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand. Her undergraduate degree is in Geology and Zoology. She specialises in vertebrate morphology and function concentrating on the Therapsid Therocephalia. For the past nine years she carried out field work in the Eastern Cape. Dr Fourie has been employed at the Ditsong: National Museum of Natural History in Pretoria (formerly Transvaal Museum) for 20 years.

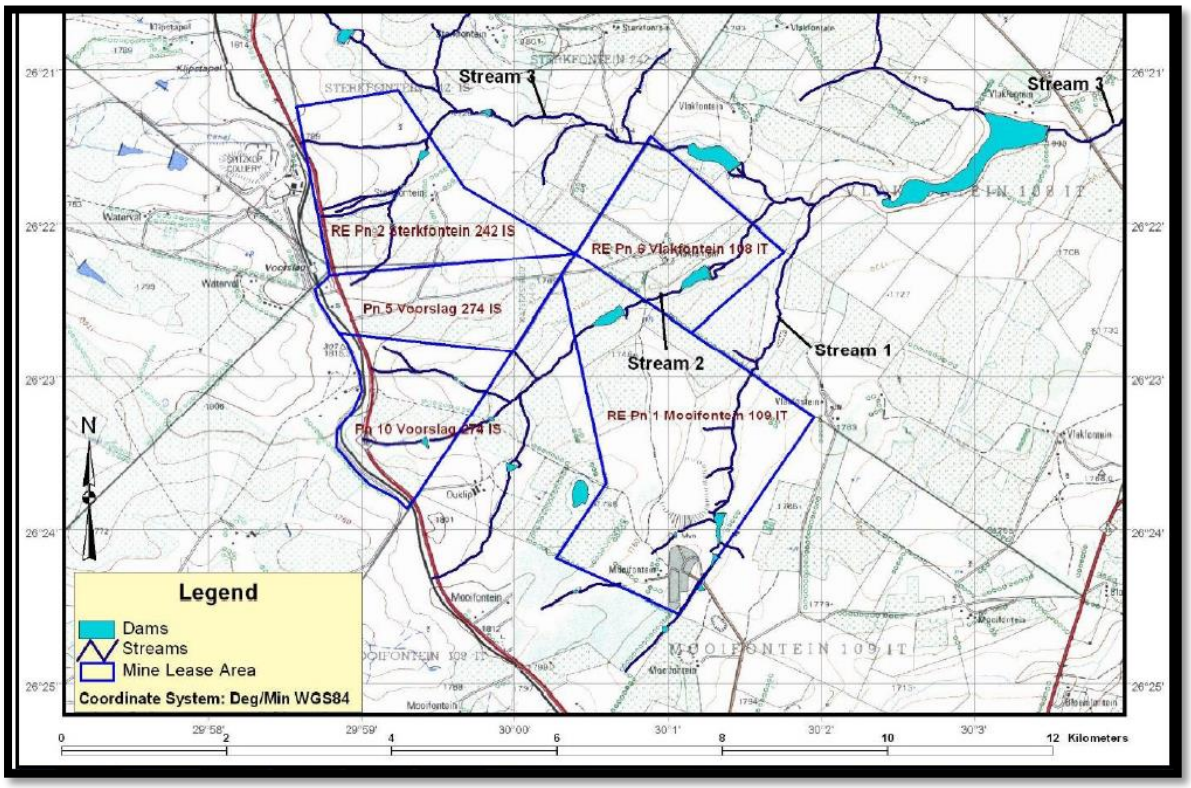
Legislative requirements: South African Heritage Resources Agency (SAHRA) for issue of permits if necessary. National Heritage Resources Act no: 25 of 1999. An electronic copy of this report must be supplied to SAHRA.

E. Description of property or affected environment

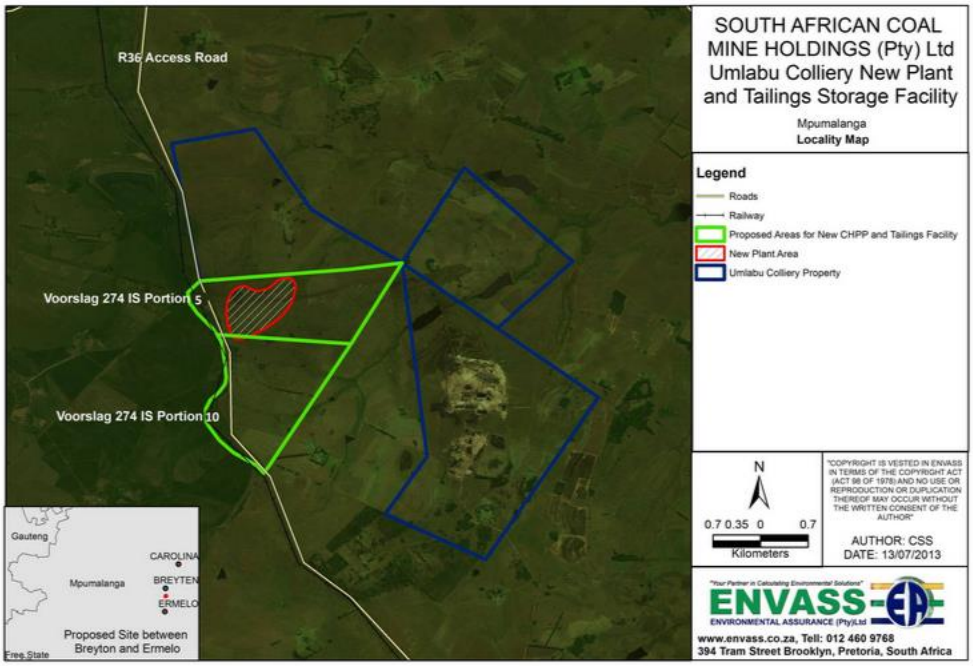
Location:

The relocated coal processing plant and tailings storage facility on Portions 5 and 10 of the farm Voorslag 274 IS, at the existing Umlabu mine, in the Breyten area, Mpumalanga Province.

Topographic map to show location of portions (provided by ENVASS).



Google-earth map below to show locations of portions 5 and 10 (provided by ENVASS).



The Project includes two location Alternatives (see map):
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Alternative 2: No-go. This will entail leaving the coal processing and preparation plant in its present location.

The bulk of the site is on the flat-lying Vryheid Formation of the Ecca Group, Karoo Supergroup sediments. Both portions are covered by grassland, trees, shrubs and bushes.

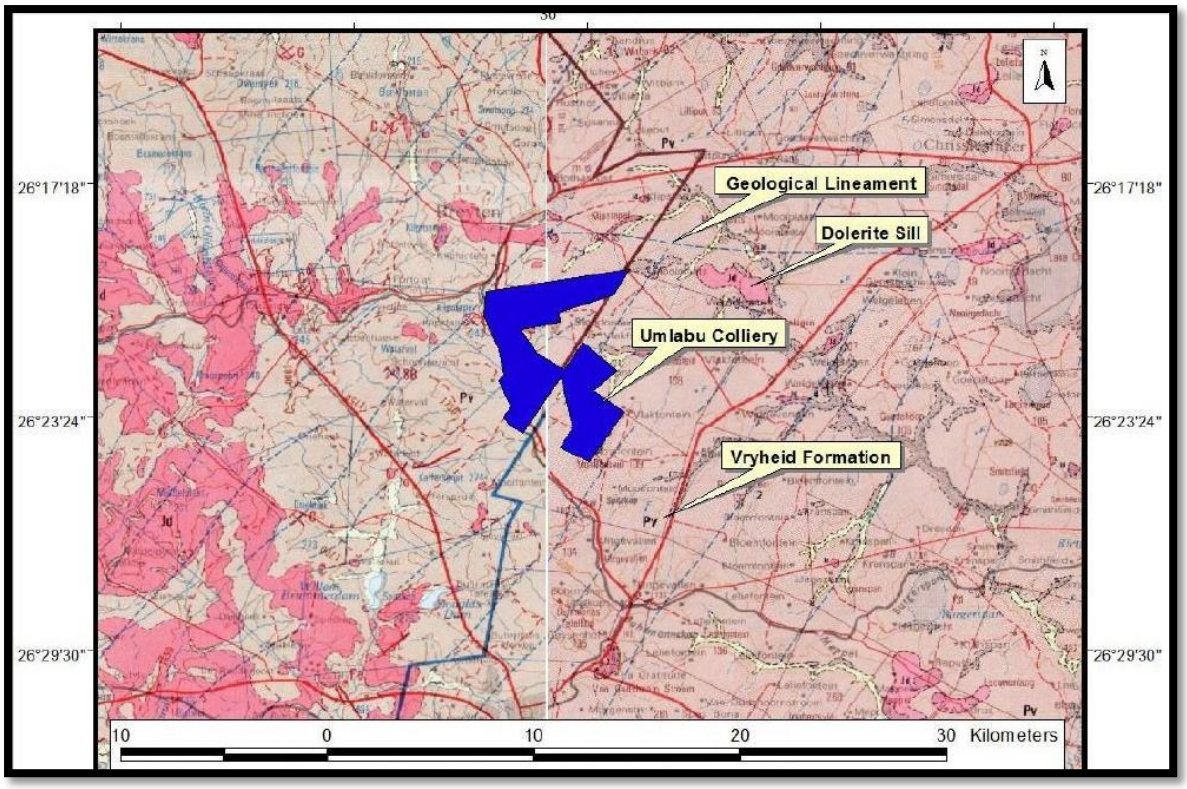
F. Description of the Geological Setting

Description of the rock units:

Large areas of the southern African continent are covered by the Karoo Supergroup. The Ecca Group is early to mid-Permian (545-250 Ma) in age. Sediments of the Ecca group are lacustrine and marine to fluvio-deltaic (Snyman 1996). The Ecca group is known for its coal (mainly the Vryheid Formation) (5 coal seams) and uranium. Coalfields formed due to the accumulation of plant material in shallow and large swampy deltas (see Appendix 1). The Ecca Group conformably overlies the Dwyka Group and is conformably overlain by the Beaufort Group, Karoo Supergroup. It consists essentially of mudrock (shale), but sandstone-rich units occur towards the margins of the present main Karoo basin in the south, west and north-east, with coal seams also being present in the north-east (Johnson 2009) (Kent 1980).

The Vryheid Formation is named after the type area of Vryheid-Volksrust. In the north-eastern part of the basin the Vryheid Formation thins and eventually wedges out towards the south, southwest and west with increasing distance from its source area to the east and northeast (Johnson 2009). The Vryheid Formation consists essentially of sandstone, shale, and subordinate coal beds, and has a maximum total thickness of 500 m. It forms part of the Middle Ecca (Kent 1980). This formation has the largest coal reserves in South Africa. The prodelta sediments are characterised by trace and plants fossils (Snyman 1996).

Coal has always been the main energy source in industrial South Africa. It is in this part of Mpumalanga, south of the N4, that most of the coal-fired power stations are found. Eskom is by far the biggest electricity generator in Africa. Thick layers of coal just below the surface are suited to open-cast mining and where the overlying sediments are too thick, shallow underground mining. In 2003, coal was South Africa's third most valuable mineral commodity and is also used by Sasol for fuel- and chemicals-from-coal (Norman and Whitfield 2006).



Geological map (taken from the ENVASS draft report) (2528 Pretoria, 2530 Baberton).

The Voorslag 274 project area is located on Ecca strata, including the coal seams, which generally dip towards the west, displaying a weak undulating altitude. The coal seams for the Ermelo sector of the Natal Middle Ecca Stage coal province are alphabetically ordered from E seam at the base through to A seam at the top. The A seam is absent in the study area due to erosion (ENVASS report).

The Project includes two location Alternatives (see map):
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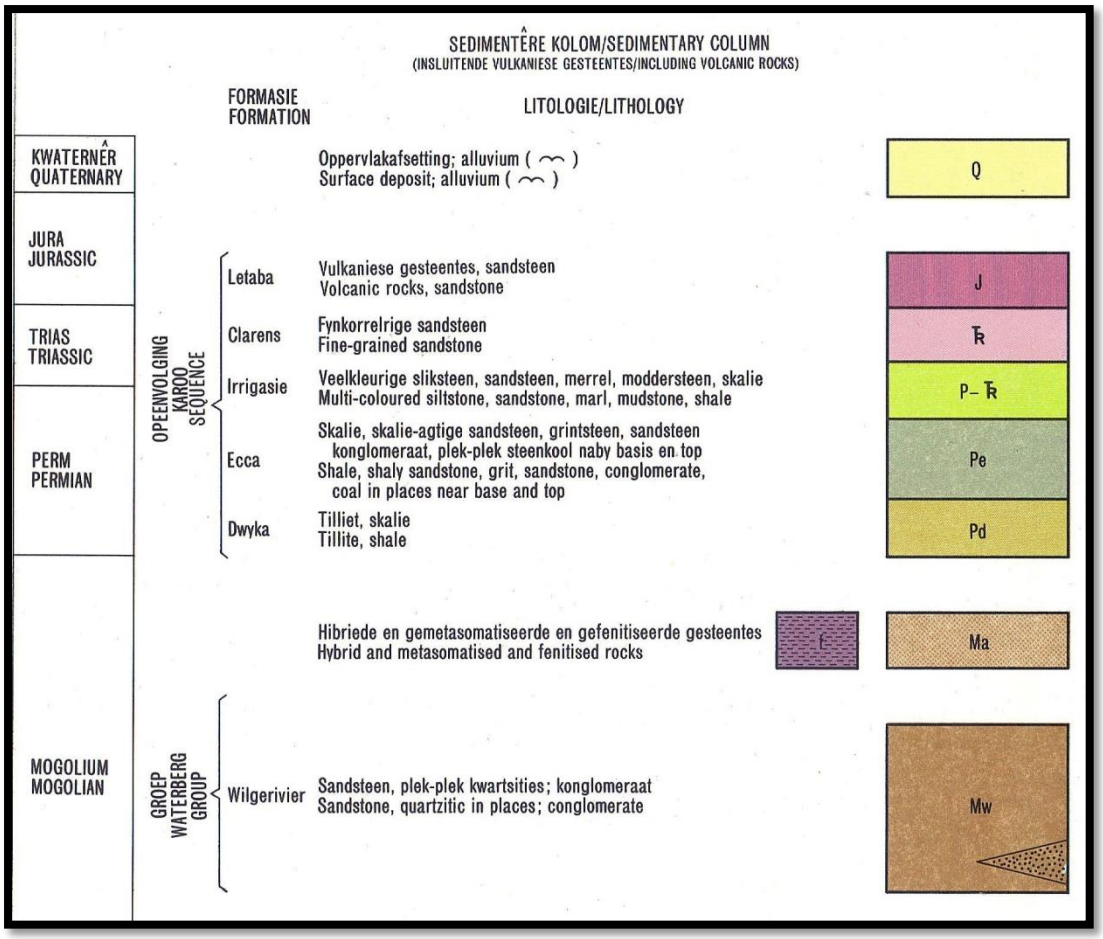
Lithostratigraphic column to show the Ecca Group within the Karoo Supergroup (Walrafen 1978).



Ecca rocks are stable and lend themselves well to developments. It is only unstable in or directly above mining activities (Snyman 1996). The site itself is situated on the flat-lying Vryheid Formation, Ecca Group, Karoo Supergroup. The overburden and inter-burden was closely inspected for fossiliferous outcrops. Dolerite dykes do occur throughout the Karoo Supergroup. Structural geological features such as dykes and faults can have a measurable influence on ground water flow and mass transport.

The typical colours for the Vryheid Formation are grey and yellow for the sediments and black for the coal seam. The thickness of the grey shale can vary and this is interlayered with the also variable yellow sandstone and coal seams.

The study area shows two portions, portion 5 which is roughly rectangular and portion 10 which is more triangular. Portion 5 borders over the R36 and directly borders the existing mine road towards the mine office and security office. Two side streams are present on portion 10. Both portions extend over the R 36. A fair amount of levelling will be needed. Both streams are dry at present. The photographs show the gentle sloping topography. Rocky outcrops are absent, but the bulldozed section on portion 5 shows the typical Vryheid Formation rocks. The opencast mine on Mooifontein is also visible.

The photograph below shows a road cutting at portion 5. The thick overburden can be seen in the embankment.

The photograph below shows a bulldozed section on portion 5 with loose boulders and rocks from a stockpile.

View from portion 5 towards the neighbouring farm and portion 10 to the north and the R36. It shows the underdeveloped nature of the study area. The gentle slope is also visible.

The overburden in this area is thick due to the well vegetated grassland, small shrubs and trees.

The photograph above shows some of the shale, coal and sandstone on the surface of the bulldozed area.

Views towards portion 10 and a small patch of invader trees.


12/08/2014


13/08/2014

This area on portion 10 shows a man-made enclosure (feature). This trench below is on portion 5 at 1758m above sea level. This area is close to the R36 and the existing mine road and is at present used for cattle grazing.

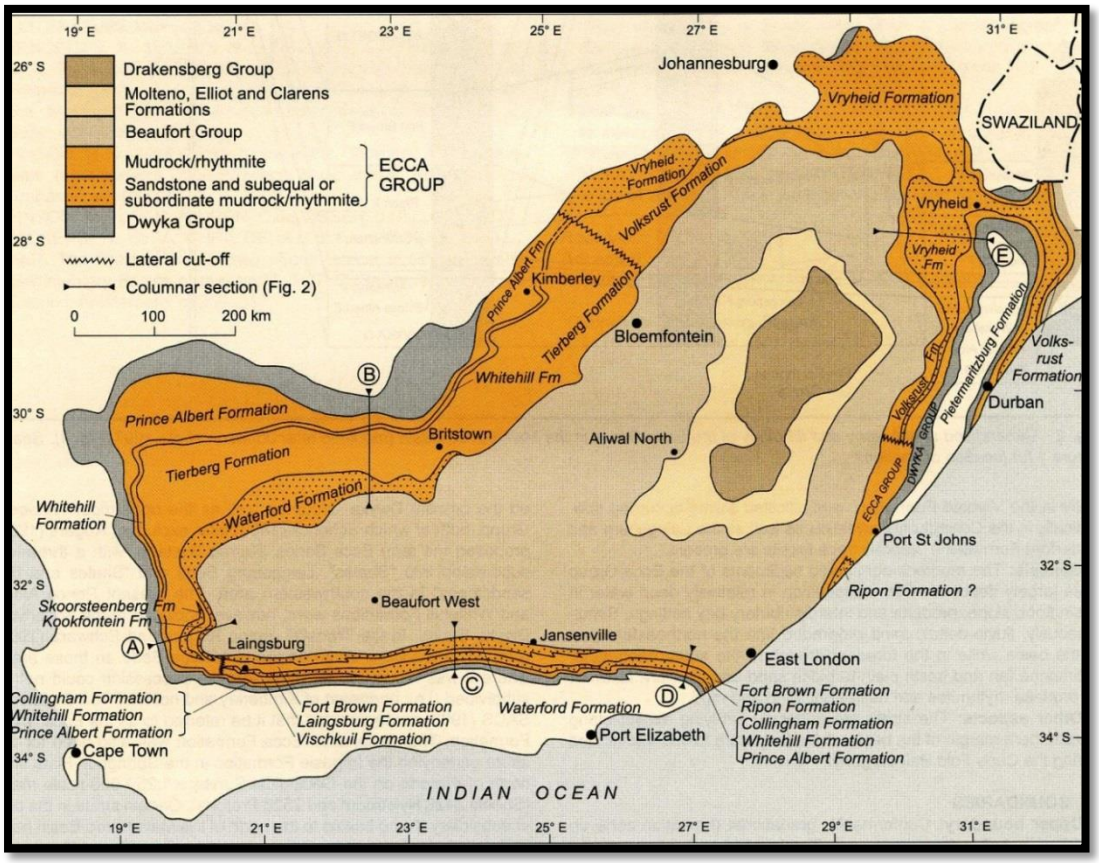
There is very little concern with the size of the property (portion 5 and 10) which SACMH wants to develop for mining as it is large and underdeveloped. At present it is not used for maize production. The overburden is thick in places and care should be taken if foundations for buildings and associated structures are dug. Patches of invader trees and plants are present on portions 5 and 10. Both portions will be affected by the coal handling and processing plant, pollution control dam, roads,

buildings, waste rock dump, coal stockyard, such structures will need several trenches, foundations and footings to be dug which may enter the more solid Vryheid Formation.

It is recommended to wait for the response from SAHRA on the Phase 1 study (this report), and if mitigation is recommended then the SAHRA protocol must be followed. Alternatives will not be feasible as all proposed development portions and surrounding areas are on the Vryheid Formation.

G. Background to Palaeontology of the area

Summary: When rock units of moderate to very high palaeontological sensitivity are present within the development footprint, a desk top and or field scoping (survey) study by a professional palaeontologist is usually warranted. The main purpose of a field scoping (survey) study would be to identify any areas within the development footprint where specialist palaeontological mitigation during the construction phase may be required.



Map from Johnson (2009) to show extent of the Ecca Group, more specifically the Vryheid Formation.

The Ecca Group may contain fossils of diverse non-marine trace, *Glossopteris* flora, mesosaurid reptiles, palaeoniscid fish, marine invertebrates, insects, and crustaceans (Johnson 2009). *Glossopteris* trees rapidly colonised the large deltas along the northern margin of the Karoo Sea. Dead vegetation accumulated faster than it could decay, and thick accumulations of peat formed, which were ultimately converted to coal. It is only in the northern part of the Karoo Basin that the glossopterids and cordaitales, ferns, clubmosses and horsetails thrived (McCarthy and Rubidge 2005).

The Glossopteris flora is thought to have been the major contributor to the coal beds of the Ecca. These are found in Karoo-age rocks across Africa, South America, Antarctica, Australia and India. This was one of the early clues to the theory of a former unified Gondwana landmass (Norman and Whitfield 2006).

Photograph H. Fourie: Fossil courtesy of Prof. Bamford, The Evolutionary Studies Institute. A Horsetail fern stem.

Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity is generally LOW to VERY HIGH, but here locally VERY HIGH for the Vryheid Formation.

Criteria used (Fossil Heritage Layer Browser/SAHRA):

Rock Unit	Significance/vulnerability	Recommended Action
Vryheid Formation (Pv) (Pe)	VERY HIGH	Field assessment and protocol for finds is required
Karoo Dolerite Suite (do/Jd)	Insignificant or Zero	No action required

Databases and collections: Ditsong: National Museum of Natural History. Evolutionary Studies Institute, University of the Witwatersrand (ESI).
Impact: VERY HIGH. There are significant fossil resources that may be impacted by the development.

H. Description of the Methodology

The palaeontological impact assessment field study was undertaken during August 2014. The walk through of the affected portions was done and photographs were taken of the sites with a digital Canon camera. It was not necessary to use a Global Positioning System (GPS) to record fossiliferous finds as the area is covered with thick overburden, grassland, trees, shrubs and bushes.

Assumptions and Limitations:-
The accuracy and reliability of the report is limited by the following constraints:

1. Most development areas have never been surveyed by a palaeontologist or geophysicist.
2. Variable accuracy of geological maps and associated information.
3. Poor locality information on sheet explanations for geological maps.
4. Lack of published data.
5. Lack of rocky outcrops.
6. Insufficient data from mine developer and exact lay-out plan for all structures.

A Phase 2 Palaeontological Impact Assessment: Mitigation will include:

1. Recommendations for the future of the site.
2. Description of work done (including number of people and their responsibilities.
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan.
6. Possible declaration as a heritage site or Site Management Plan.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ,* and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

I. Description of significant fossil occurrences

All Karoo Supergroup geological formations are ranked as LOW to VERY HIGH, and here the impact is potentially VERY HIGH for the Vryheid Formation, Ecca Group. Rocks of Permian age in South Africa are particularly rich in fossil plants (Rayner and Coventry 1985). The fossils are present in the grey shale interlayered with the coal seams. The fossils are not very rare and also occur in other parts of the Karoo stratigraphy. The pollen of the Greenside Colliery also on the Vryheid formation was the focus of a Ph.D study. It is often difficult to spot the greyish fossils as they are the same colour as the grey shale in which they are present as these coalified compressions have been weathered to leave surface replicas on the enclosing shale matrix. A locality close to Ermelo, also Vryheid Formation, has yielded *Scutum, Glossopteris* leaves, *Neoggerathiopsis* leaves, the lycopod *Cyclodendron leslii,* and various seeds and scale leaves (Prevec 2011).

Fossils likely to be found are mostly plants (Appendix 1) such as '*Glossopteris* flora' of the Vryheid Formation. The aquatic reptile *Mesosaurus* and fossil fish may also occur with marine invertebrates, arthropods and insects. Trace fossils can also be present (Johnson 2009).

During storms a great variety of leaves, fructifications and twigs accumulated and because they were sandwiched between thin films of mud, they were preserved to bear record of the wealth and the density of the vegetation around the pools. They make it possible to reconstruct the plant life in these areas and wherever they are found, they constitute most valuable palaeobotanical records (Plumstead 1963) and can be used in palaeoenvironmental reconstructions.

Details of the location and distribution of all significant fossil sites or key fossiliferous rock units could not be determined due to the thick overburden and alluvium. Depth of the overburden may vary a lot. The vast coal mining industry provides palaeontologists with fantastic access to coal-associated plant fossils, while simultaneously resulting in the destruction of important National palaeontological heritage.

The threats are:- earth moving equipment/machinery during mining, sealing-in or destruction of fossils by development, vehicle traffic, and human disturbance. See Description of the Geological Setting (F) above.

J. Recommendation

a. There is no objection (see Recommendation B) to the development of the new coal processing plant and tailings storage facility, but it was necessary to request a Phase 1 Palaeontological Impact Assessment to determine whether the development will affect fossiliferous outcrops as the palaeontological sensitivity is VERY HIGH. A Phase 2 Palaeontological Mitigation will be required as the Phase 1 Palaeontological Assessment found traces of fossiliferous outcrops (grey shale).

b. This project may benefit the economy, the growth of the community and social development in general.

c. Preferred choice: Location Alternative one, but the impact on the palaeontological heritage is VERY HIGH for the Vryheid Formation. Care must be taken during the digging of foundations and removing overburden (see Executive Summary).

d. The following should be conserved: if any palaeontological material is exposed during digging, excavating, drilling or blasting SAHRA must be notified. All construction activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures.

Sampling and collecting:

Wherefore a permit is needed from the South African Heritage Resources Agency (SAHRA).

a. Objections: Cautious. See heritage value and recommendation.
b. Conditions of development: See Recommendation.
c. Areas that may need a permit: Yes.
d. Permits for mitigation: Needed from SAHRA prior to Mitigation.

K. Conclusions

a. All the land involved in the development was assessed and none of the property is unsuitable for development (see Recommendation B).
b. All information needed for the Phase 1 Palaeontological Impact Assessment and Field scope was provided by the Consultant. All technical information was taken from the Scoping Documents provided by ENVASS.
c. Areas that would involve mitigation and may need a permit from the South African Heritage Resources Agency are discussed.
d. The following should be conserved: if any palaeontological material is exposed during digging, excavating, drilling or blasting, SAHRA must be notified. All development activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures. Especially shallow caves.
e. Condition in which development may proceed: It is further suggested that a Section 37(2) agreement of the Occupational, Health and Safety Act 85 of 1993 is signed with the relevant contractors to protect the environment and adjacent areas as well as for safety and security reasons.

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Declaration

I, Heidi Fourie, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project for which I was appointed to do a palaeontological assessment. There are no circumstances that compromise the objectivity of me performing such work.

Heidi Fourie accepts no liability, and the client, by receiving this document, indemnifies Heidi Fourie against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the use of the information contained in this document.

This report may not be altered in any way and any parts drawn from this report must make reference to this report.

HFourie

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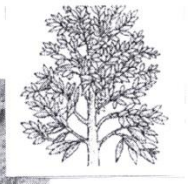
Heidi Fourie
2014/08/22

Appendix 1: Examples of Vryheid Formation fossils.

Ecca Group

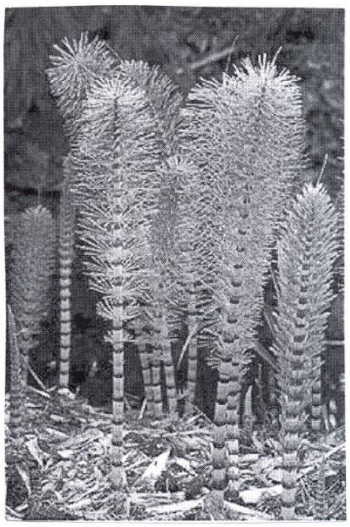
Vryheid Formation

Glossopteris



Ferns

Horsetails



Clubmosses

Example of a plant fossil (courtesy of the ESI). *Glossopteris* leave.

Protocol for finds

The Voorslag 274 IS Portion 5 and 10 report, covers the Phase 1 Field study and recommendations. The developer has not yet surveyed the areas affected by the development and only indicated on plan where the construction will take place. As no trenches have been dug it is uncertain how deep the sediments are (can be a few hundred metres).

Mitigation will involve recording, rescue and judicious sampling of the fossil material present in the layers sandwiched between the coal layers. It must include information on number of taxa, fossil abundance, preservational style, and taphonomy. This can only be done during mining or excavations. In order for this to happen, the mining operations will have to be closely scrutinised by a professional palaeontologist / palaeobotanist to ensure that only the coal layers are mined and the interlayers (siltstone and mudstone) are surveyed for fossils or representative sampling of fossils are taking place.

The palaeontological impact assessment process presents an opportunity to identify, access and possibly salvage fossils and add to the few good plant localities. Mitigation can provide valuable onsite research that can benefit both the community and the palaeontological fraternity.

A Phase 2 study is very often the last opportunity we will ever have to record the fossil heritage within the development area. Fossils excavated will be stored at a National Repository.

A Phase 2 Palaeontological Impact Assessment: Mitigation will include (SAHRA) -

1. Recommendations for the future of the site.
2. Description and purpose of work done (including number of people and their responsibilities).
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan and map.
6. Possible declaration as a heritage site or Site Management Plan.
7. Stakeholders.
8. Detailed report including the Desktop and Phase 1 study information.
9. Annual interim or progress Phase 2 permit reports as well as the final report.

10. Methodology used.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ,* and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

The Palaeontological Society of South Africa (PSSA) does not have guidelines on excavating or collecting, but the following is suggested:

1. The developer needs to clearly stake or peg-out (survey) the areas affected by the mining/ construction/ development operations and dig representative trenches and if possible supply borehole data.
2. A Palaeobotanist (contact SAHRIS for list) must then inspect the affected areas and trenches for fossiliferous outcrops / layers. The contractor may be asked to move structures.
3. If the palaeobotanist is satisfied, development and removing of the topsoil can begin.
4. After this process the same palaeobotanist will have to inspect and offer advice through the Phase 2 Mitigation Process. Bedrock excavations for footings may expose, damage or destroy previously buried fossil material.
5. When permission for the development is granted, the next layer can be removed, if this is part of the Vryheid Formation, then with the removal of each layer of sediment, the palaeobotanist must do an investigation (a minimum of once every two weeks).
6. At this stage the palaeobotanist in consultation with the developer / mining company must ensure that a further working protocol and schedule is in place. Onsite training should take place, followed by an annual visit by the palaeobotanist.

Fossil excavation if necessary during Phase 2:
Photography of fossil / fossil layer and surrounding strata.
Once a fossil has been identified as such, the task of extraction begins.
It usually entails the taking of a GPS reading and recording lithostratigraphic, biostratigraphic, date, collector and locality information.
Using Paraloid as an adhesive and protective glue, parts of the fossil can be kept together (not necessarily applicable to plant fossils).
Slowly chipping away of matrix surrounding the fossil using a geological pick, brushes and chisels.

Once the full extent of the fossil / fossils are visible, it can be covered with a plaster jacket (not necessarily applicable to plant fossils).
Chipping away sides to loosen underside.
Splitting of the rock containing palaeobotanical material should reveal any fossils sandwiched between the layers.

SAHRA does have the following documents in place:
Guidelines to Palaeontological Permitting policy.
Minimum Standards: Palaeontological Component of Heritage Impact Assessment reports.
Guidelines for Field Reports.