Greenside Colliery New Discard Facility

eMalahleni Local Municipality, Mpumalanga Province

Farm: Portion 0, 2 and 3 Groenfontein 331JS.

Fourie, H. Dr heidicindy@yahoo.com

Palaeontological Impact Assessment: Phase 1 Field study

Commissioned by: Shangoni Management Services

P.O. Box 74726, Lynwood Ridge, Pretoria, 0040, Gauteng

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2014/04/11

MDEDET 17/2/3N-205

B. Executive summary

Outline of the development project: Shangoni Management Services Pty (Ltd) has appointed Dr H. Fourie, a palaeontologist, to undertake a Paleontological Impact Assessment, Phase 1 field study of the suitability of the proposed development of a new discard facility and associated infrastructure to be located on portions 0, 2 and 3 on the farm Groenfontein 331JS, eMalahleni Local Municipality, Mpumalanga Province.

The Project includes one Alternative (see map):
Alternative 1: Several areas (1-19) marked on map.

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.

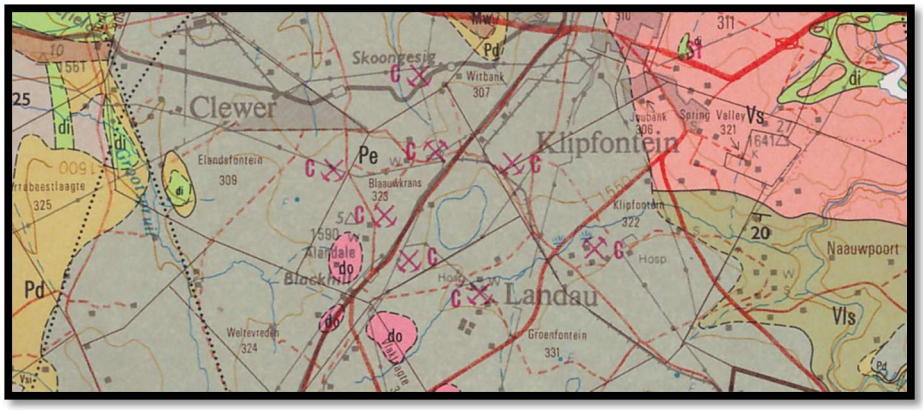
For this study, resources such as geological maps, scientific literature, institutional fossil collections, satellite images, aerial maps and topographical maps were used. It provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations (if any) 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, 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), 2528 Pretoria (Walrafen 1978) and East Rand 2628 (Keyser, Botha and Groenewald 1986).



Legend to Map and short explanation (the farm Groenfontein is present below Landau)
Pe – (light brown) Sandstone, shaly sandstone, grit, shale, conglomerate and coal, Vryheid Formation, Ecca Group, Karoo Supergroup.
do – (pink) Dolerite, Karoo Dolerite Suite, Karoo Supergroup.
Pd – (mustard) Tillite, shale, Dwyka Group, Karoo Supergroup. Permian in age.
Vs – (amber) Volcanic rocks, Selonsriver Formation, Rooiberg Group, Transvaal Supergroup. Vaalian in age.
Vls – (khaki) Shale, sandstone, conglomerate, volcanic rocks, Loskop Formation, Transvaal Supergroup. Vaalian in age.

Summary of findings: The Phase 1 Palaeontological Impact Assessment was undertaken during March and April 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.

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.

Recommendation:
A Desktop Paleontological Impact Assessment of the suitability of the proposed development recommended a Phase 1 Palaeontological Impact Assessment, Field study.

The Project includes one Alternative (see map):
Alternative 1: Several areas (1-19) marked on map.

The construction entails several projects. The installation of water pipelines, a fire water reticulation system for the conveyor, clean and dirty water channels, dams, drains and the sewage water pipeline. Channels will need to be dug for the pollution control dam, discard silo, workshop and office complex foundations. Diesel storage tanks will be erected and roads will be scraped. A bridge will be widened and all access roads will be either upgraded or widened. A dam wall will be increased in height.

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 must be surveyed for fossiliferous outcrops. Special care must be taken during the digging of foundations, trenches, channels and footings.

Stakeholders: Developer – Anglo Thermal Coal, Anglo American (Pty).

Environmental – Shangoni Management Services Pty (Ltd), Block C8, 472 Botterklapper Street, Die Wilgers, 012 807 7036.

Landowner – Anglo American, Greenside Colliery.

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).

Outline of development

This report discusses the suitability of the proposed new development of a new discard dump and associated infrastructure to be located on portions 0, 2 and 3 on the farm Groenfontein 331JS, eMalahleni Local Municipality, Mpumalanga Province.

Anglo American Thermal Coal is mining the Number 4 Coal seam using bord-and-pillar underground mining methods. It was determined that the current safety factors on the pillars would not be able to support the discard facility should it be raised to full height according to the design. Therefore, as a result of limited volumetric air space remaining on the current active coal discard disposal facility a new discard facility is planned. It was also determined that the current safety factors of the pillars would not be able to support the discard facility should it be raised to full height according to the design. The new discard facility will accommodate some 35 million tons of discards. A footprint of approximately 115 hectares with a maximum height of 55m is planned. Combined coarse and fine discards will be deposited by ATD haul trucks and built up in layers. A tree screen will be planted.

The Project includes one Alternative (see map):
Alternative 1: Several areas (1-19) marked on map.

The development will also include:-

1. An overland conveyor system.
2. Bridge crossing.
3. Discard Silo.
4. Haul roads.
5. Dirty and clean water separation system.
6. The workshop and associated Offices Complex.
7. Power lines.

The construction entails several projects. The installation of water pipelines, fire water reticulation system for the conveyor, clean and dirty water channels, dams, drains and the sewage water pipeline. Channels will need to be dug for the pollution

control dam, discard silo, workshop and office complex foundations. Diesel storage tanks will be erected and roads will be scraped. A bridge will be widened and all access roads will be either upgraded or widened. A dam wall will be increased in height.

Overland Conveyor System

Will transport discard from the existing Greenside processing facilities and the proposed discard re-treatment processing plant. Dewatered fines from both of these plants will also be transported on this conveyor to the discard silo at the new discard dump. It will be approximately 2 km. long.
(Marked 3, 3A, 3B, 4, 6 and 7).

Bridge Crossing

The overland conveyor will cross over the N12 on the existing bridge along one side with the other side reserved for light vehicles. The fire deluge system will be included here. The bridge will also be used for potable water and power supply infrastructure from Greenside Colliery to the discard facility office complex. At present as seen here a wide bridge is already present and well maintained.

Discard Silo

A new discard silo rated at 1000 tons will be required adjacent to the discard facility (28m high x 30m diameter). An example are the two green silos seen here, a conveyor belt is also seen.
(Marked as 5).

Haul Routes

The combined discard material and fuel will be hauled from the discard silo across a dam wall in the Greenside spruit and systematically deposited to build up the discard dump. An additional haul road will be required to join the existing routes to the workshop and office complex.
(Marked as 18).

Dirty and clean water Separation System

Dirty water trenches will be established along the northern toe of the facility and extend around the east and west side of the facility. The dirty water will be directed via a silt trap into a 1:50 year polluted storm water attenuation dam. From here water will be pumped, via a pipeline running within the existing clean water culvert. Clean water cut-off trenches will be constructed at the outset and moved south every three years as the dump footprint extends.
(Marked as 10, 11, 12, 13, 16 and 17).

This photograph shows the interlayering of the grey shale with the sandstone, it points to the shallowness of the succession and the variability of the thickness of the overburden in some areas.

Workshop Complex

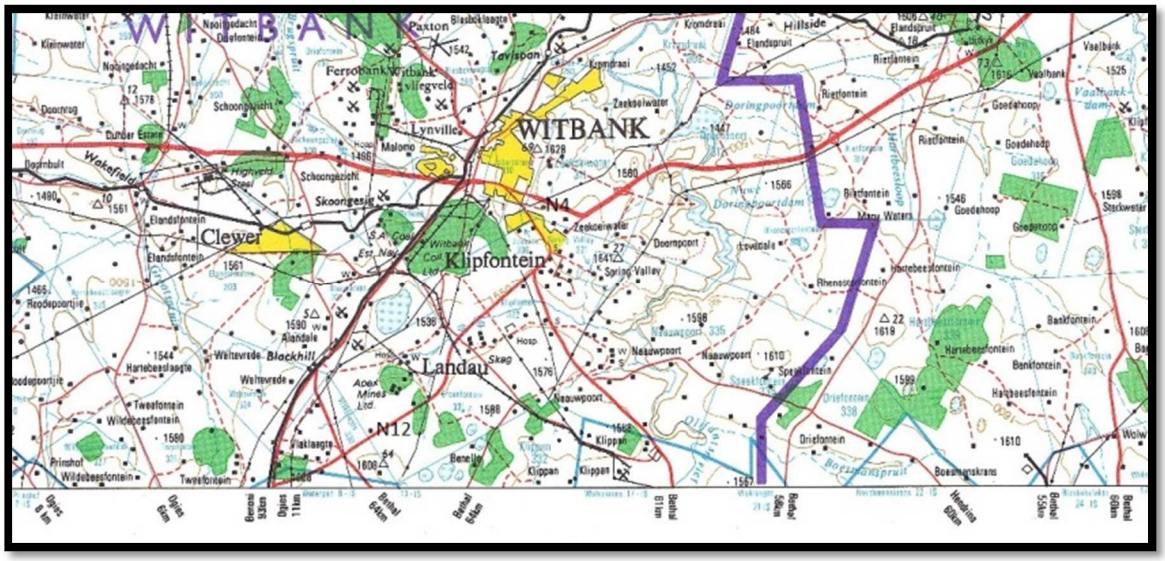
The workshop complex will consist of refuelling bays, workshops, offices and parking bays. The office block will have change rooms, ablution facilities, meeting rooms, and lunch/rest rooms. Septic tanks and soak ways will be required. Parking bays will be provided, a brake test ramp, a dust suppression water tank will be required. A silt trap will carry dirty water to the discard dump. The total footprint will be approximately 14 000 square metres. The site is visible across the bridge to the right within the maize field.
(Marked as 8 and 9).

Power lines and electricity
Power will be reticulated at 6,6kV by means of buried cable or a 22kV overhead line is to be fed from the existing Eskom overhead line within 100m of the proposed affected water pumping infrastructure.
(Marked as 14 and 15).

Rezoning/ and or subdivision of land: None.
Name of developer and consultant: Anglo Thermal Coal, Anglo American and Shangoni Management Services.
Terms of reference: Dr H. Fourie is a palaeontologist commissioned to do a desktop palaeontological impact assessment 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 19 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 proposed development of a new discard dump and associated infrastructure to be located on portions 0, 2 and 3 on the farm Groenfontein 331JS, eMalahleni Local Municipality, Mpumalanga Province. The Greenside Colliery is situated approximately 15km southwest of eMalahleni in the Nkangala District Municipality. Blackhill Siding and an associated village are situated 2km northwest of the mine infrastructure area. The proposed new discard facility and associated infrastructure will be mainly located on Portion 0, 2 and 3 of the farm Groenfontein 331JS with the N12 highway linking Johannesburg to eMalahleni runs northeast-southwest along the south eastern boundary of the Colliery.

Topographic Location map (Groenfontein is just below Landau).



The Project includes one Alternative (see map):
Alternative 1: Several areas (1-19) marked on map.

The bulk of the site is on the flat-lying Vryheid Formation of the Ecca Group, Karoo Supergroup sediments. The site is covered by trees, bushes, wetlands, dumps, building structures, mine plants and associated structures.

F. Description of the Geological Setting
Description of the rock units:

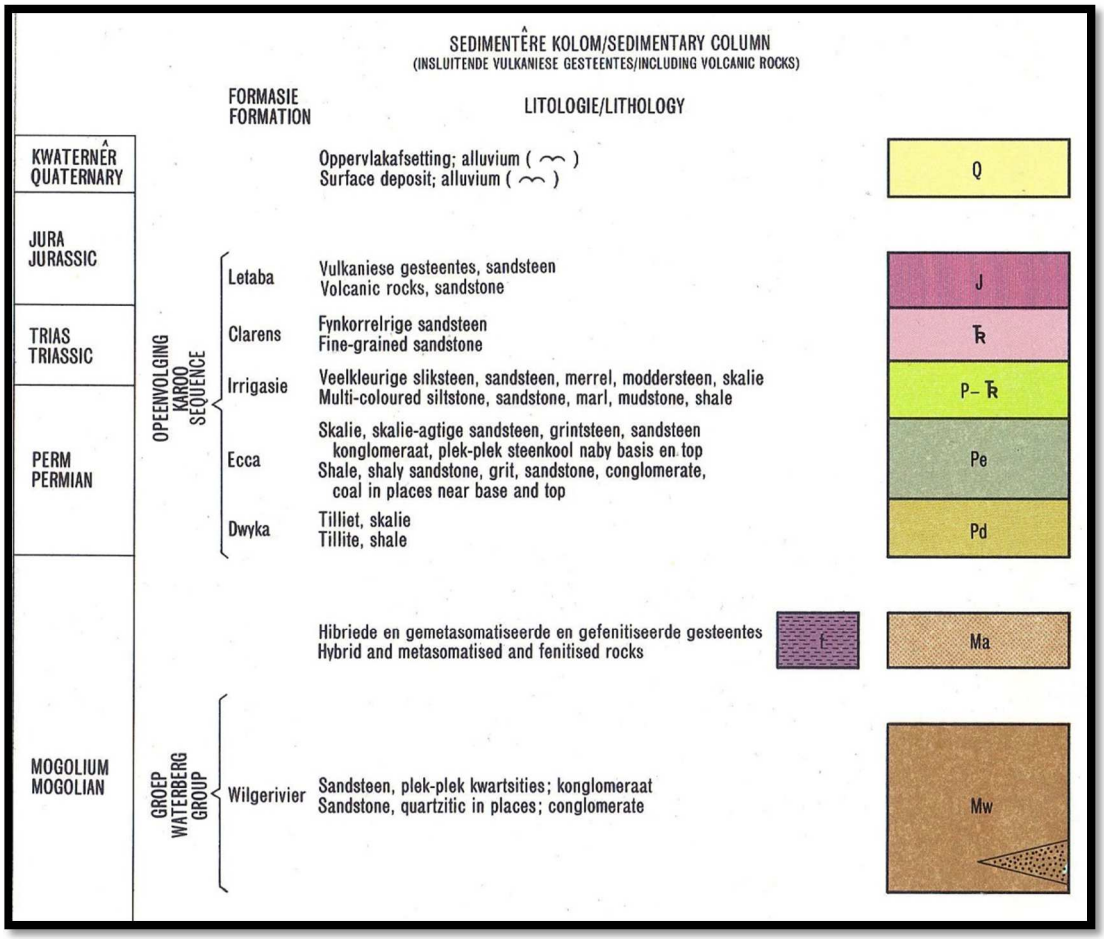
Large areas of the southern African continent are covered by the Karoo Supergroup. The Ecca Group is early to mid-Permian (545-250 Ma) in age. Sediments of the Ecca group are lacustrine and marine to fluvio-deltaic (Snyman 1996). The Ecca group is known for its coal (mainly the Vryheid Formation) (5 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).

The Project includes one Alternative (see map):
Alternative 1: Several areas (1-19) marked on map.

Lithostratigraphic column to show the Ecca Group within the Karoo Supergroup.



Ecca rocks are stable and lend themselves well to developments. It is only unstable in or directly above mining activities (Snyman 1996). There is a north-south striking fault that cuts across the Greenside Colliery. 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 proposed new discard dump will be situated in an area across the N12 on the Kleinkopje mine property. Part of this area is presently being rehabilitated and seen in the photograph below. The depth of the overburden varies from place to place. 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 photograph below shows the location of the toe part of the new discard dump. Grit, shale and coal are present here on large piles. Also note the thickness of the overburden consisting of loose yellow to often red sand. The Vryheid Formation and thick overburden can be seen in the embankment. The area marked '13 Dirty Water Drain' is an area that has been bulldozed, this channel will be dug around the discard dump.

The area marked 'Discharge Trench' (12) (photograph below) already has a structure built on it and the area is mostly surrounded with fine aggregate from a road and pieces of reddish conglomerate. This will be the north pollution control dam. Two areas marked as (14 and 15) are close by. This is where existing power lines will be diverted. Dirty water trenches will be dug around the discard dump, this will require a 1:50 year polluted storm water attenuation dam.

The two wetland areas (photo below) will house the clean water dam and dirty water drain (marked as 16 and 17). Just to orientate, the triangular Greenside waste dump across the N12 is visible to the top of the photograph.

The workshop, office block, haul road and associated structures (marked as 8, 9 and 18) will be constructed in the present maize field. The overburden in this area is thick. The haul road will cross over the existing bridge to the office block and new discard dump. Several roads will be required. These will have to be scraped. The associated structures will include the parking- and refuelling bays.

Areas marked (10 and 11) are for the existing return water dam (10) and the existing stream that combines dirty and clean water (11).

Conveyor belts, a transfer house, and the filter plant will be constructed on the Greenside Colliery property.

The filter plant and blue steam dump retreatment plant are already been built (marked 1 and 2) and it is from here that the conveyor belt (3, 3A, 3B, 4, 6 and 7) will transport discard to the discard silo (marked 5) at the new discard dump. The silo will be built in the wetland around the Greenside Spruit. The conveyor will be approximately 2 km.

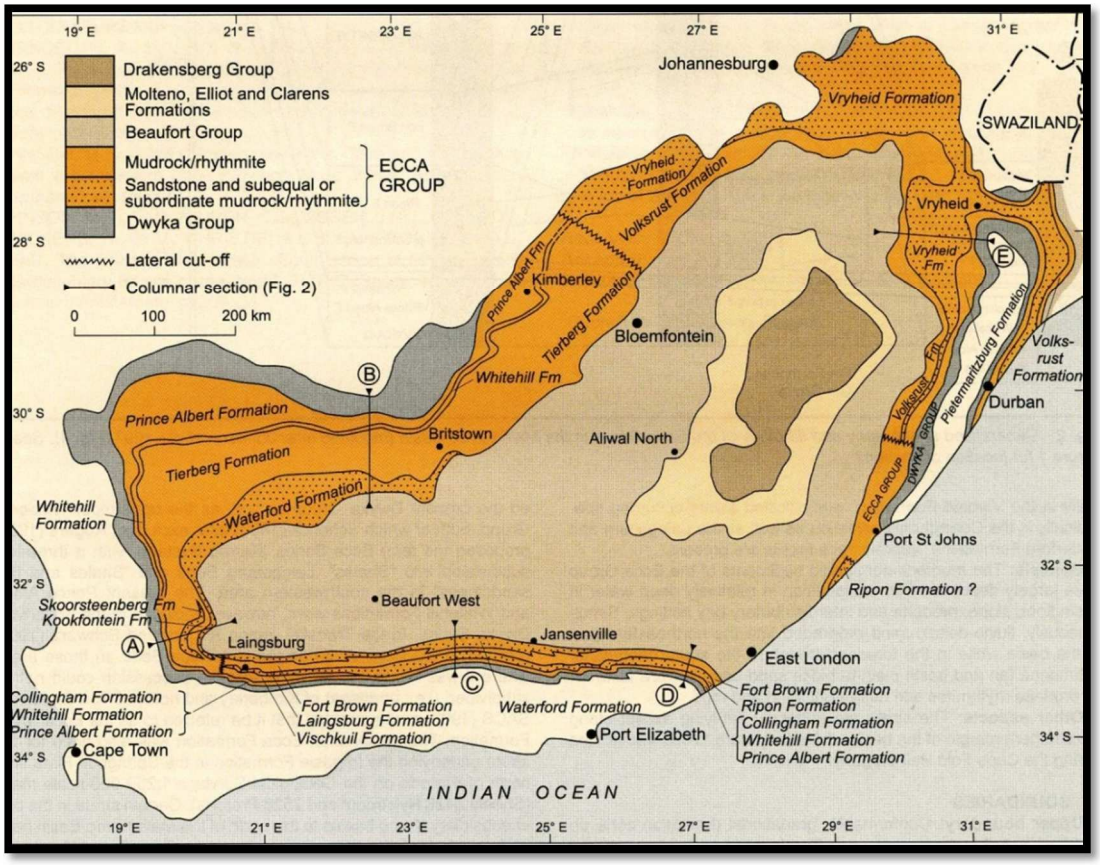
The Topsoil Stockpile area (marked as 19) will be preserved where the maize field is presently. It is close to the office block and associated structures.

The biggest concern with this project it that the mine property has extensively been bulldozed and dug up and lots of construction remnants, stockpiles and channels are present. The overburden is thick in places and care should be taken if foundation for buildings and associated structures are dug. Lots of invader trees and plants are present. The area most affected will be the areas where the buildings will be constructed, such buildings will need several trenches to be dug for water pipes, effluent, electricity, foundations and footings. Several power lines will need footings.

It is recommended to wait for the response from SAHRA and if mitigation is recommended then the SAHRA protocol must be followed. Alternatives will not be feasible as all proposed development sites are on the Vryheid Formation. The wetlands may be sensitive no-go areas from an ecological perspective, but not the focus of this report.

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 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.

Criteria used:

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.
Impact: VERY HIGH. There are significant fossil resources that may be impacted by the development.

H. Description of the Methodology

The desktop palaeontological impact assessment scope was undertaken during March and April 2014.
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.

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. 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 stratigraphy. The pollen of the Greenside Colliery 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.

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).

J. Recommendation

a. There is no objection to the development of the new mine discard dump and associated structures, 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 fossiliferous outcrops (grey shale).
b. This project will benefit the economy, the growth of the community and social development in general.
c. Preferred choice: 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.

K. Conclusions

a. All the land involved in the development was assessed and none of the property is unsuitable for development.
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 Document provided by Shangoni. Mrs E. Prinsloo from Anglo American provided maps. With thanks to the team, Erika, Mafuza, Jerome, Dolly and Bontle.
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.

L. Bibliography

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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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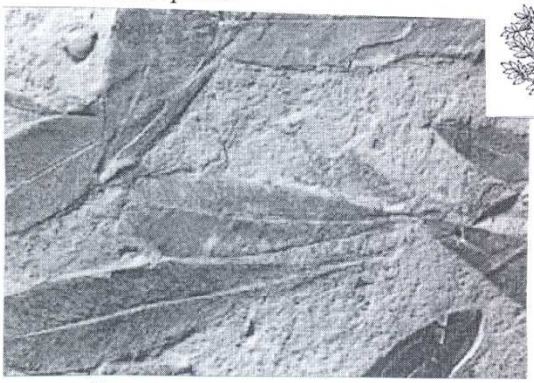
Heidi Fourie
2014/04/11

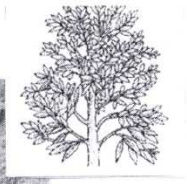
Appendix 1:

Ecca Group

Vryheid Formation

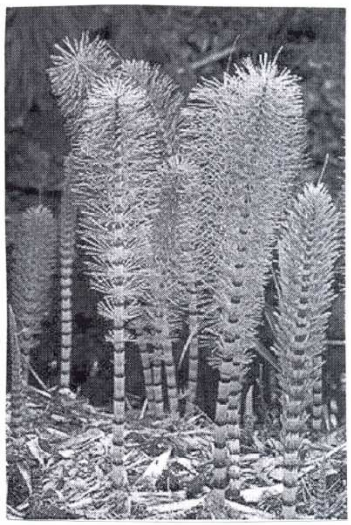
Glossopteris





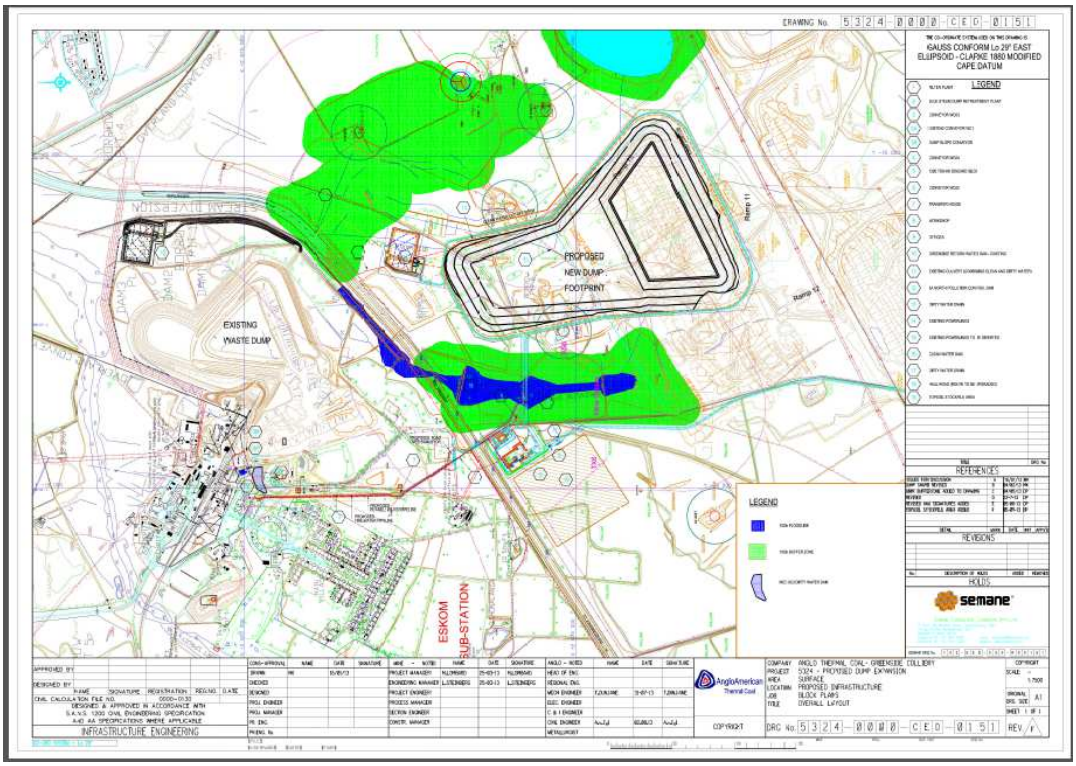
Ferns

Horsetails



Clubmosses

Location map of discard dump and associated structures (marked as hexagons)



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