Palaeontological Impact Assessment for the proposed New Musa Special Needs School, between Nongoma and Ulundi, northern KwaZulu-Natal Province

Desktop Study

For

SASHEQ Consultants

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Expertise of Specialist

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Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 30 years research; 20 year PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Jean Beater on behalf of SASHEQ, South Africa. The views expressed in this report are entirely those of the author, Jean Beater and SASHEQ and no other interest was displayed during the decision making process for the project.

Specialist: …….. Prof Marion Bamford……..

Signature: ……. 

Executive Summary

The desktop Palaeontological Impact Assessment for the proposed site for the construction of the new Musa Special Needs School, between Nongoma and Ulundi in northern KwaZulu Natal. The site is in the Carboniferous Dwyka Formation, and the Permian Vryheid Formation, Ecca Group where there potentially could be fossil plants of the *Glossopteris* flora associated with the shales between the coal seams but not in the coal itself. It is possible that some fossil plants could be destroyed in the process but they have not been reported from this area and would be very sparsely distributed if present. Since there is a small chance that fossil plants could be discovered when excavations or drilling commences a Chance Find protocol and monitoring programme have been added to the report. It is concluded that the project may continue as far as the palaeontology is concerned.

Palaeontological Impact Assessment for the proposed New Musa Special Needs School, between Nongoma and Ulundi, northern KwaZulu Natal Province

1. Background

A desktop palaeontological assessment for the proposed new Musa Special Needs School which is to be situated between Nongomo and Ulundi in KZN has been requested on behalf of SHEQ. The school and associated infrastructure are planned to be a single project, utilizing non-maintenance materials (i.e. no wood because of the termites), solar power, own sanitation system, paraplegic access, etc., as outlined in the Musa School Design Report 2014-10-14. The coordinates for the midpoint of the site are: 27°58'36.1"S and 31°37'37.4"E. According to the SAHRIS fossil sensitivity the site is situated in an area ranked as very high fossil sensitivity.

The National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998) requires that the proposed development must be preceded by the relevant impact assessment, in this case for palaeontology.

This report complies with the requirements of the NEMA and environmental impact assessment (EIA) regulations (GNR 982 of 2014). The table below provides a summary of the requirements, with cross references to the report sections where these requirements have been addressed.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014)

A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain:	Relevant section in report
Details of the specialist who prepared the report	Prof Marion Bamford
The expertise of that person to compile a specialist report including a curriculum vitae	Palaeontologist (PhD Wits 1990) CV attached
A declaration that the person is independent in a form as may be specified by the competent authority	Page 2
An indication of the scope of, and the purpose for which, the report was prepared	Section 1, page 3
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	n/a Seasons make no difference to fossils
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2, page 4
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	See table 2
An identification of any areas to be avoided, including buffers	n/a
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	n/a
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 6, page 9
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	n/a
Any mitigation measures for inclusion in the EMPr	n/a
Any conditions for inclusion in the environmental authorisation	n/a

Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8, page 9
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and	n/a
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	n/a
A description of any consultation process that was undertaken during the course of carrying out the study	Section 3 page 5
A summary and copies if any comments that were received during any consultation process	n/a
Any other information requested by the competent authority.	n/a

2. Methods and Terms of Reference

1. In order to determine the likelihood of fossils occurring in the affected area geological maps, literature, palaeontological databases and published and unpublished records must be consulted.

2. If fossils are likely to occur then a site visit must be made by a qualified palaeontologist to locate and assess the fossils and their importance.

3. Unique or rare fossils should either be collected (with the relevant South African Heritage Resources Agency (SAHRA) permit) and removed to a suitable storage and curation facility, for example a Museum or University palaeontology department or protected on site.

4. Common fossils can be sacrificed if they are of minimal or no scientific importance but a representative collection could be made if deemed necessary.

The published geological and palaeontological literature, unpublished records of fossil sites, catalogues and reports housed in the Evolutionary Studies Institute, University of the Witwatersrand, and SAHRA databases were consulted to determine if there are any records of fossils from the sites and the likelihood of any fossils occurring there.

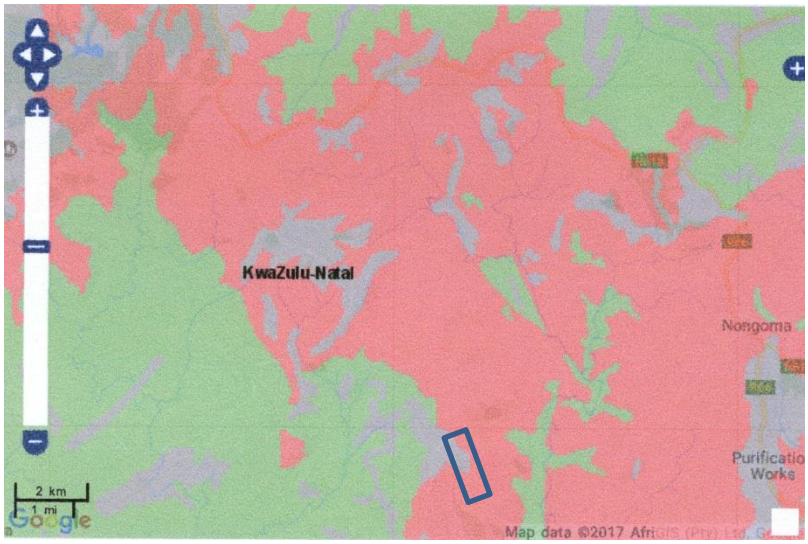


Figure 1: SAHRIS Palaeosensitivity map for the area west of Nongoma and north od Ulundi. The proposed school site is within the blue rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero

3. Consultation Process

No consultations were carried out during the palaeontological desktop study.

4. Geology and Palaeontology

<u>Project location and geological setting</u>

According to the geological map (Figure 2) the New Musa School site lies in the Carboniferous Dwyka Formation and Permian Ecca Vryheid Formation and these are “red” in the SAHRIS palaeosensitivity map (Fig 1). Non fossiliferous Jurassic dolerite dykes are also in the near vicinity. There are minor coal deposits in this region yielding anthracite (Snyman, 1998) and are of economic importance. On average the uppermost seam is more than 50m below the surface.

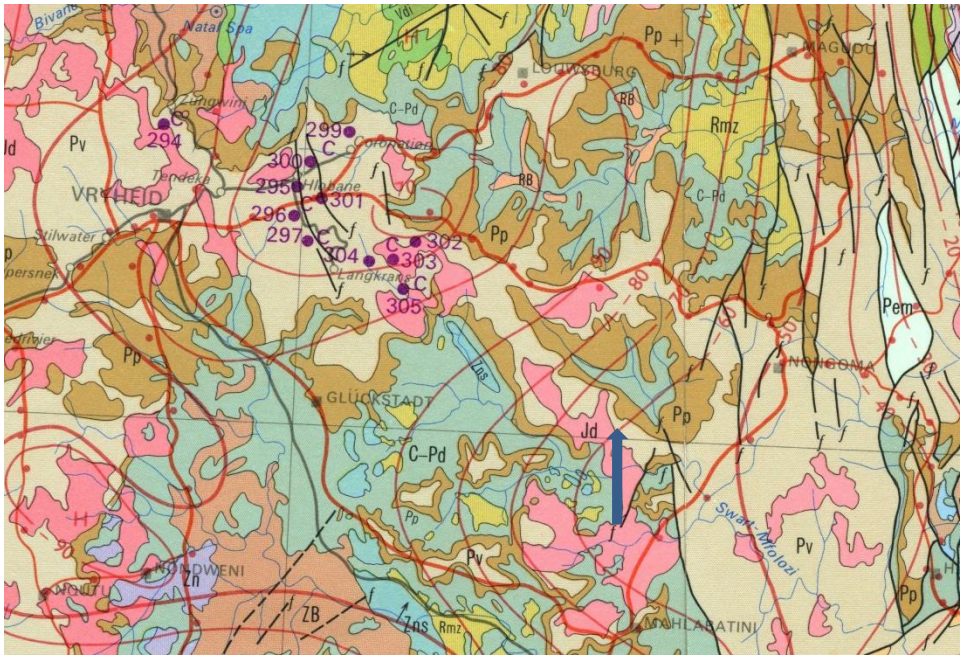


Figure 2: Geological map of the area west of Nongoma and north of Ulundi that has been selected for the new Musa Special Needs School. The approximate location of the proposed project is indicated with the arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984

Table 2: Explanation of symbols for the geological map and approximate ages (Barbolini et al., 2016; Erikssen et al., 2006; Johnson et al., 2006). SG = Supergroup; Fm = Formation

Symbol	Group/Formation	Lithology	Approximate Age
Jd	Jurassic	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pa	Adelaide & Estcourt Fms	Mudstones, shales	Upper Permian, Lower Beaufort (min. 260 Ma)
Pvo	Volksrust Fm	Deep water shale	Middle Permian,Upper Ecca
Pv	Vryheid Fm	Shales, sandstone, coal	Lower Permian, Middle Ecca
Pp	Pietermaritzburg Fm	Deep water shale	Lower Permian, Lower Ecca
C-Pd	Dwyka Fm	Tillites	Carboniferous
Rmz	Mozaan Group, Pongola Sequence	Quartzite, shale, hornfels	Ca 3090 Ma
Zns	Nsuze Group, Pongola Sequence	Basalt, andesite, quartzite	Ca 3090 Ma
ZB	unnamed	Potassic granite and granodiorite	>3090 Ma

Geology

The ancient granites and Pongola sequence quartzites, shales, basalts, andesites and hornfels are too volcanic in origin and are too old to contain any body fossils.

Dwyka Group sediments are mostly tillites and these would not contain fossils but occasionally there are fossil leaves and stems in the associated shales. Shales of the

overlying Pietermaritzburg Formation are deep water deposits and do not contain fossils. The Ecca Vryheid Formation, however, contains coal seams and in this north eastern part of the Karoo Basin some of the seams contain anthracite. They are mostly more than 50m below the ground surface in this area (Snyman, 1988).

The Jurassic dykes are volcanic and intrusive in origin but they destroy any fossils in their near vicinity. Thus this dolerite will not contain fossils.

Palaeontology
(Refer to Figure 1 for SAHRIS palaeosensitivity)

Although coal is formed from compressed and heat altered plant material it is of no interest to palaeontologists because no plant structures can be seen. Anthracite is completely amorphous and not even bedding planes can be seen. Fossil plants are preserved in the shales and partings between and within some coal seams. Here impressions or compressions of leaves of the *Glossopteris* plants, lycopods, sphenophytes and ferns can be preserved. They are of interest to palaeobotanists but in general they are widely scattered and difficult to locate. This flora is well known but there is always a very small chance that some new taxa may be discovered. To date no fossils have been reported from the Nongoma and Ulundi area. Fossil vertebrates of this age are extremely rare and there are no known occurrences of vertebrate fossils associated with coals in southern Africa. Insect wings can occur with the leaves but they are extremely rare and difficult to find.

Based on the literature (See list in Johnson et al., 2006) and from personal experience in visiting South African coal mines, fossil plants are present in the shales and mudstones between coal seams but seldom within coal seams. The distribution, however, is extremely sporadic and unpredictable. Furthermore, coal flora plant species are not rare as they have been recovered from other sites. It takes time and opportunistic finds to locate any pockets of preserved plants. Insect wings are extremely rare and vertebrates are never present.

The area is undisturbed and there is a very small chance that fossil plants could be found where new excavations are made for the fences, buildings, access roads and sanitation.

5. Impact assessment

Using the criteria in the table below, the impact of the relatively shallow excavations for the buildings and infrastructure has been assessed.

The surface activities would impact on the fossil heritage, only if preserved in this area, as the rocks are sedimentary and the correct age, however the coal seams and associated shales are well below ground level. The IMPACT is very low (according to the scheme in Table 3).

TABLE 3: CRITERIA FOR ASSESSING IMPACTS

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

Excavation for water, sewerage, foundations, road access and infrastructure would not penetrate down to the topmost seam 2. If these penetrate the shales closely associated with the coal the chance of finding fossil plants would be very small so there would be minor deterioration of the surface of sites and a minor impact on any potential fossils. Therefore the SEVERITY/NATURE of the environmental impact would be L.

DURATION of the impact would be permanent: H.

Since only the possible fossils within the area would be fossil plants such as leaf impressions from the *Glossopteris* flora in the shales, the SPATIAL SCALE will be localised within the site boundary: L.

There is a very small chance of finding leaf fossils in the shales between coal seams because these have been reported from the same formations but not in this particular area. However, the PROBABILITY of affecting any fossils is unlikely or seldom: L

6. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the basement rocks, dolomites, sandstones, shales, coals, quartzites, basalts and volcanic rocks are typical for the country and do not contain any fossil material. The shales of the Vryheid Formation could contain impression fossils of plants of the *Glossopteris* flora, however, they have yet to be recorded from the proposed site for the school.

7. Recommendation

It is unlikely that many fossils occur in the proposed building and infrastructure sites in the shales between coal seams. Furthermore, no fossils have been recorded from this area. Nonetheless rocks of this type and age are potentially fossiliferous, as indicated in the SAHRIS palaeosensitivity map (Fig 1). As there is a chance find, a monitoring protocol is recommended.

As far as the palaeontology is concerned the proposed development can go ahead. Any further palaeontological assessment would only be required after excavations and drilling have commenced and if fossils are found by the geologist or environmental personnel. The procedure can be added to the EMPr.

8. Monitoring Programme for Palaeontology – to commence once the excavations begin.

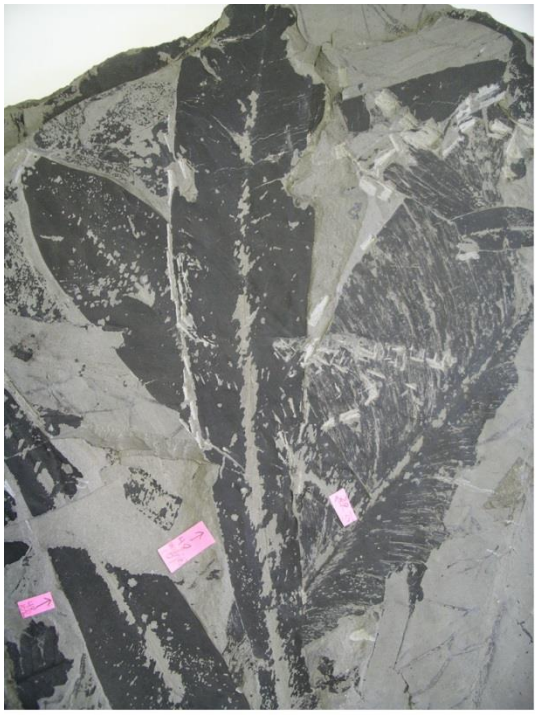
1. The following procedure is only required if fossils are seen on the surface and when excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, plants, insects, bone, and coal) should be put aside in a suitably protected place. This way the construction activities will not be interrupted.
3. Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones (for example see Figure 3). This information will be built into the EMPr's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. On a regular basis, to be agreed upon by the developer and the qualified palaeontologist sub-contracted for this project, the palaeontologist should visit the site to inspect the selected material and check the dumps where feasible. The frequency of inspections should be monthly until foundations are complete. However, if the onsite designated person is diligent and extracts the fossil material then inspections can be less frequent.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then no site inspections would be necessary a final report by the palaeontologist can be sent to SAHRA.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

9. References

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Snyman, C.P., 1998. Coal. In: Wilson, M.G.C., and Anhaeusser, C.P., (Eds) The Mineral Resources of South Africa: Handbook, Council for Geosciences 16, 136-205.



Wide and narrow Glossopteris leaves

Narrow Glossopteris leaves

Lycopod stem with leaf abscission scars

Astertotheca (fern)

Hammanskraal fossil plants

Figure 3: Examples of fossil leaf impressions and compressions of the *Glossopteris* flora (Ecca Group) that could possibly be found