

Palaeontological Impact Assessment for the proposed WWTW near Ngwenya Lodge, Mpumalanga Province

Desktop Study

For

Nuleaf Planning and Environmental

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Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford


Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf

Experience: 30 years research; 22 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Nuleaf Planning and Environmental, Pretoria, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

The proposed new sewerage treatment facility for Ngwenya Lodge is on Portion 213 Tenbosch 162, situated within the Nkomazi local Municipality, in the Ehlanzeni District Municipality, approximately 15 km northwest of Komatipoort. Ancient volcanic rocks surround the region but the site is on undifferentiated Permo-Triassic sediments. From borehole cores the Vryheid and Volksrust Formations (Ecca Group), Nyoka Formation (Molteno Group) and Ntabene and Cave Sandstone of the Clarens Group Formation could occur below the site. Surface soils have already been disturbed by agricultural activities but there is a very small chance that fossils could occur below the surface. It is recommended, therefore, that a Chance Find Protocol be included in the EMPr so that once excavations commence the responsible person will check for fossils and contact the palaeontologist concerned to assess the scientific value of the fossils. As far as the palaeontological heritage is concerned the project can continue and no further assessment is required until fossils are found.

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1. Background

In terms of the 2014 Environmental Impact Assessment (EIA) Regulations, published in terms of Section 24(5) of the National Environmental Management Act 107 of 1998 (NEMA), the Project Applicant has given notice of its intention to apply for Environmental Authorisation from the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA) as the competent authority, for the proposed development of a sewage treatment facility near Ngwenya Lodge, Mpumalanga Province.

The Basic Assessment process provided for in Regulation 19 read with Appendix 1 of GN R326 of 4 December 2014 of the 2014 EIA Regulations, as amended published under NEMA will be followed for the application for Environmental Authorisation.

The reason for the development of a new sewage treatment facility near Ngwenya Lodge is to replace the current aging facility. Significant advances have been made in sewage treatment systems technology and the applicant now wishes to install a better, more environmentally responsible facility. The affected property, Portion 213 Tenbosch 162, is situated within the Nkomazi local Municipality, in the Ehlanzeni District Municipality, approximately 15 km northwest of Komatipoort.

The proposed development entails the construction of a new Sewage Treatment Facility to serve both the existing Ngwenya Lodge, its proposed extension and eventually the Ngwenya Royale Development. The facility, located on Portion 213 Tenbosch 162, will comprise a new Sewage Treatment Plant (Violeo System, Two Phases 400m³ & 300m³, 30 x 15m each), associated pipelines to discharge treated wastewater to an existing dam on site and connections to the existing Ngwenya Lodge, as well as a new sump. The current sewage treatment facility will also be decommissioned.

As required here is the palaeontological impact assessment for the project.

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	Appendix A
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A
A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
An indication of the scope of, and the purpose for which, the report was prepared	Section 1
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2

The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4 Figure 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 5
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
Any mitigation measures for inclusion in the EMPr	Section 7
Any conditions for inclusion in the environmental authorisation	n/a
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 7
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	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	N/A
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



Figure 1: Detailed map from Google Earth of the proposed WWTW route near Ngwenya Lodge, northwest of Komatipoort, on Portion 213 Tenbosch 162 farm, Mpumalanga Province. Sections are shown in white, blue and green lines

2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.

The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance;
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected.

3. Geology and Palaeontology

i. Project location and geological context

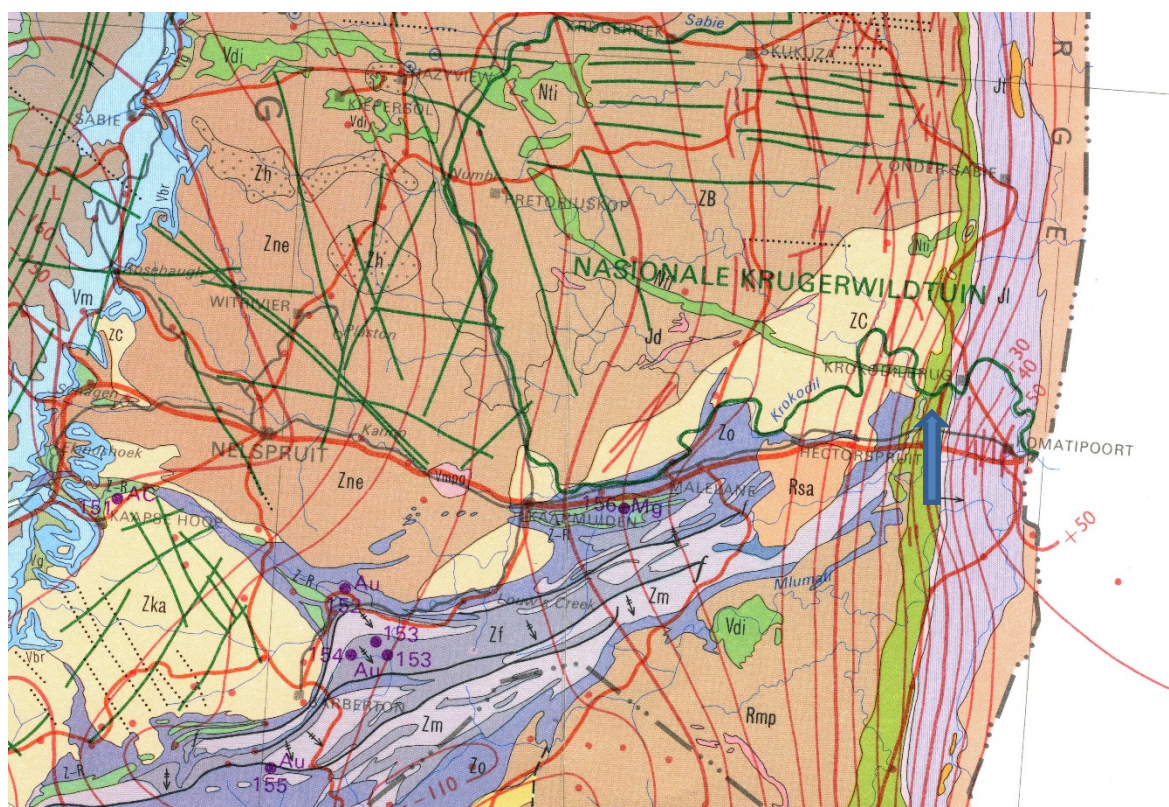


Figure 2: Geological map of the area northwest of Komatipoort, Mpumalanga Province where the proposed WWTW will be situated. The proposed site is indicated by the blue arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

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

Symbol	Group/Formation	Lithology	Approximate Age
P-Tr	Permo-Triassic	Undifferentiated Karoo sediments, shale, coal, sandstone, mudstone	Ca 300 – 180 Ma
Jm	Movene Fm, Lebombo Group	Basalt	Ca 195 – 160 Ma
Jj	Jozini Fm, Lebombo Group	Rhyodactite	Ca 178 Ma
Jl	Letaba Fm, Lebombo Group	Picritic basalt	Ca 183 Ma
Jt	Tshokwane granophyre	Granophyre	Ca 140 Ma
Rmp	Mpuluzi Granite	Quartz monzonite	
ZC	Unnamed	Granite	

Symbol	Group/Formation	Lithology	Approximate Age
ZB	Unnamed	Potassic granite and granodiorite	
Zm	Moodies Group, Barberton Sequence	Sandstone, shale, conglomerate	>3300 Ma
Zo	Onverwacht Group, Barberton Sequence	Lava, pyroclastic rocks	

To the west of the proposed site are several outcrops of the oldest rocks in South Africa, those of the Barberton Supergroup which is mid Archean in age (Brandl et al., 2006). Included here is the banded ironstone of the Ngwenya Formation.

The Lebombo Mountains to the east of South Africa are igneous in origin and comprise easily distinguishable formations of different types of basalt and rhyolite (Duncan and Marsh, 2006). Running parallel to these mountains is a north-south exposure of Karoo sequence deposits that has not been well studied. The Komatipoort Coalfield north of Swaziland was described by Willson (1977) (not seen; in Johnson et al., 2006) as comprising the middle Ecca Vryheid Formation, upper Ecca Volksrust Formation, Molteno Group Nyoka Formation and Clarens Group Ntabene and Cave Sandstone Formations. The coals have been described by Jordaan (1986) and Smith and Whittaker (1986). It should be noted that Willson's information is based on borehole core material only and not on surface exposures.

The proposed site for the WWTW lies on rocks of the Permian and Triassic that have not been differentiated on the map but are known from borehole cores.

ii. Palaeontological context

Ecca sediments of the Vryheid formation in particular, and possibly the Volksrust Formation, could possibly contain fossil plants in the form of leaf impressions, seeds and stems of the *Glossopteris* flora, the main coal-producing flora in southern Africa (Plumstead, 1969; Anderson and Anderson, 1985; Johnson et al., 2006). In the Nyoka Formation there could be fossil plants of the slightly younger *Dicroidium* flora that is Molteno Group age. The Clarens Group rocks could preserve silicified woods and/or vertebrate fossils. No fossils have been reported from this area. The stratigraphy as described here was reported from borehole cores.

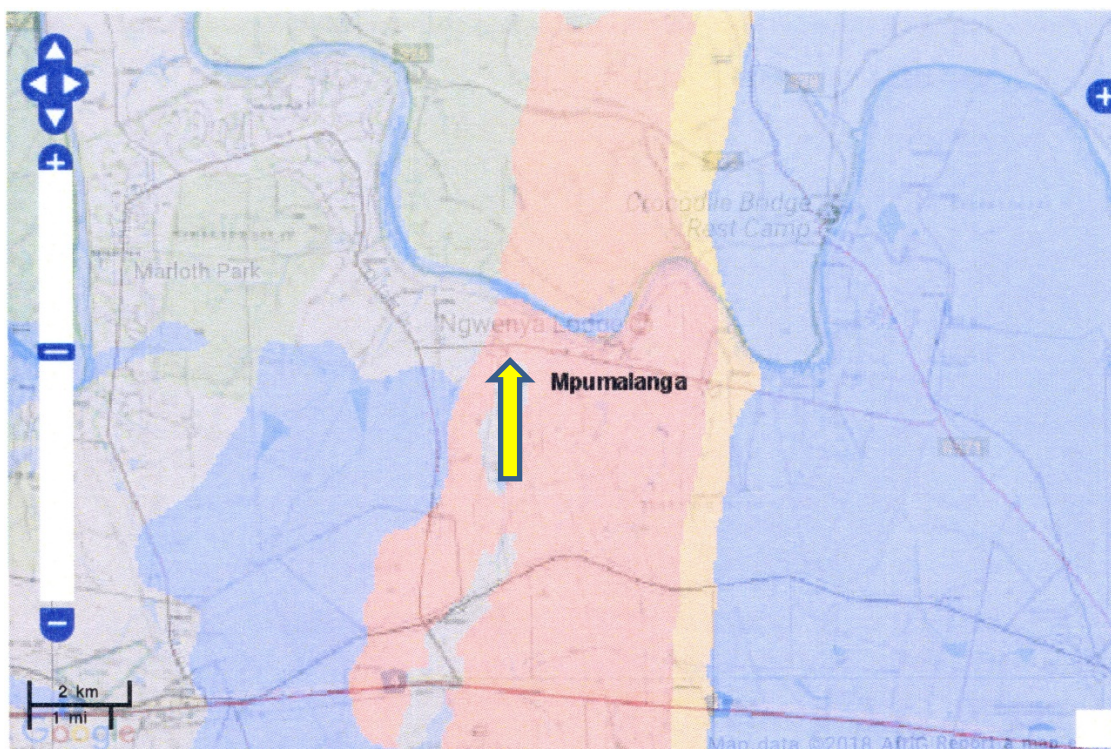


Figure 3: SAHRIS palaeosensitivity map of the region around Ngwenya Lodge. The site in the red area (arrow). Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

TABLE 3A: 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.
	L	Localised - Within the site boundary.

Criteria for ranking the SPATIAL SCALE of impacts	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

TABLE 3B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	H	-
	M	-
	L	There is a small chance of fossils being found here
	L+	-
	M+	-
	H+	-
DURATION	L	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	L	The spatial scale is extremely small.
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	There is a small chance of finding fossils in the surrounding rocks or in the sand.

Based on the nature of the project, the surface soils will be excavated to a depth of several metres. It will comprise a new Sewage Treatment Plant (Violeo System, Two Phases 400m³ & 300m³, 30 x 15m each), associated pipelines to discharge treated wastewater to an existing dam on site and connections to the existing Ngwenya Lodge, as well as a new sump. The current sewage treatment facility will also be decommissioned. The area has been disturbed by agricultural activities so the surface soils will not contain any fossils of any scientific value. However, there is a very small chance of finding fossils once excavations have commenced, although to date there are no reports of fossils. Since there is a very small chance of finding fossils a Chance Find Protocol must be included in the EMPr. Only to lay the piping, alluvial sands only will be removed and the ground would not be penetrated. Since there is no chance of finding fossils in either the hard rock or loose surface sands there would be no impact on the fossil heritage. There is no chance of finding fossils BEFORE excavations commence a phase 2 or site visit is NOT recommended at this stage. Taking account of the defined criteria, the potential impact to fossil heritage resources is very low.

5. 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 gneisses, schists, granites and basalts are typical for the country and do not contain any microfossils, fossil plant, insect, invertebrate and

vertebrate material. The Permian and Triassic shale, sandstones mudstones and coals could potentially contain fossils typical of the Eccles, Molteno and Clarens groups, the formations that have been recognised in borehole core material. No fossils, however, have been reported from this region.

6. Recommendation

Based on the age of the sediments, although no fossils have been recorded from this area, there is a very small chance that fossils would be identified in the proposed site but only once excavations have commenced. No further palaeontological assessment is required until such time and only if any fossils have been seen by the responsible person. A "Chance Find Protocol" is included in this report and must be included in the EMP. As far as the palaeontology is concerned the project may commence but will have to be re-assessed if fossils are found in the excavations.

7. Chance Find Protocol

Monitoring programme is outlined below.

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

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 (plants, insects, bone, 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 4). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. As required and 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 samples where feasible. The frequency of inspections should be determined by the finding of interesting material. 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 the site inspections by the palaeontologist can be reduced to annual events until construction has ceased. Annual reports by the palaeontologist must be sent to SAHRA.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

8. References

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodrum of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Cornell, D.H., Thomas, R.J., Moen, H.F.G., Reid, D.L., Moore, J.M., Gibson, R.L., 2006. The Namaqua-Natal Province. 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 325-379.

Duncan, A.R., Marsh, J.S., 2006. The Karoo Igneous Province. 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 501-520.

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.

Jordaan, J., 1986. Highveld coalfield. In: Mineral Deposits of Southern Africa, II C.R. Anhaeusser, C.R. and Maske, S., (eds). Geological Society of South Africa, Johannesburg, p 1985 – 1994.

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.

Smith, D.A.M., Whittaker, R.R.L.G., 1986. The Springs-Witbank coalfield. In: Mineral Deposits of Southern Africa, II C.R. Anhaeusser, C.R. and Maske, S., (eds). Geological Society of South Africa, Johannesburg, p 1969 – 1984.

Willson, A.B., 1977. The geology of the Komatiopoort coalfield with special reference to the 1953-1957 and 1975 drilling programmes of the Geological Survey. Unpublished Report of the Geological survey of South Africa, BS 736. (not seen).

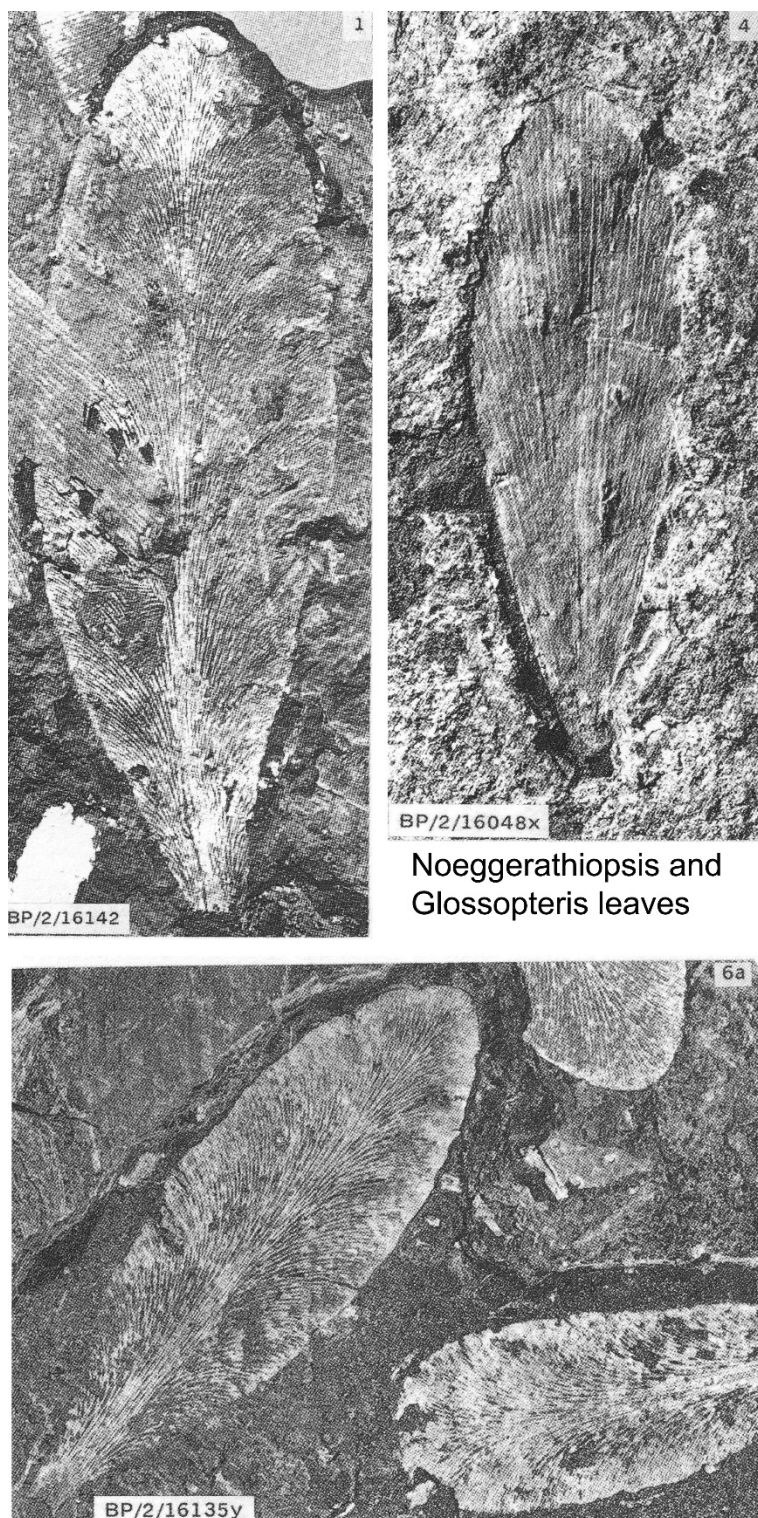


Figure 4: Examples of leaf impressions of *Glossopteris* species.

Appendix A – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD January 2018

i) Personal details

Surname : **Bamford**
First names : **Marion Kathleen**
Present employment : Professor; Director of the Evolutionary Studies Institute.
Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa-
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Fax : +27 11 717 6694
Cell : 082 555 6937
E-mail : marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) Professional qualifications

Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+

Botanical Society of South Africa
 South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
 SASQUA (South African Society for Quaternary Research) – 1997+
 PAGES - 2008 –onwards: South African representative
 ROCEEH / WAVE – 2008+
 INQUA – PALCOMM – 2011+onwards

vii) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	5	2
Masters	6	3
PhD	9	3
Postdoctoral fellows	5	3

viii) Undergraduate teaching

Geology II – Palaeobotany GEOL2008 – average 65 students per year
 Biology III – Palaeobotany APES3029 – average 25 students per year
 Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology;
 Micropalaeontology – average 2-8 students per year.

ix) Editing and reviewing

Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
 Guest Editor: Quaternary International: 2005 volume
 Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
 Cretaceous Research: 2014 -

Review of manuscripts for ISI-listed journals: 25 local and international journals

x) Palaeontological Impact Assessments

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources

- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC

xi) Research Output

Publications by M K Bamford up to January 2018 peer-reviewed journals or scholarly books: over 110 articles published; 5 submitted/in press; 8 book chapters.

Scopus h index = 22; Google scholar h index = 24;

Conferences: numerous presentations at local and international conferences.

xii) NRF Rating

NRF Rating: B-2 (2016-2020)

NRF Rating: B-3 (2010-2015)

NRF Rating: B-3 (2005-2009)

NRF Rating: C-2 (1999-2004)