Palaeontological Impact Assessment for the proposed construction & operation of chicken breeding houses, on Portion 14 of Farm Klippan 452 JS, around Wonderfontein, Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province.

Desktop Study

For

Ecoleges Environmental consultants

16 June 2018

Prof Marion Bamford
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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 Ecoleges Environmental Consultants, 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

A palaeontological Impact Assessment was requested for the prosed construction of a chicken breeding facility on portion 14 of farm Klippan 452 JS, around Wonderfontein, Mpumalanga Province. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development of a sand mining area.

The proposed site lies on the soils and sediments of the Vryheid Formation, Ecca Group (Permian) that has coals seams below ground. Since the uppermost coal seam and associated potentially fossiliferous shales are a minimum of 12m below the surface, it is very unlikely that the vegetation clearing and excavations for building foundations would impact on the fossils. Nonetheless a Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that palaeontological monitoring is required but no site visit is required unless fossils are found.

Table of Contents

1. Background

A background information document(BID) has been submitted for the proposed construction and operation of chicken breeding houses, on Portion 14 of Farm Klippan 452 JS, around Wonderfontein, Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Ecoleges, as the independent Environmental Consultant, has been appointed to manage the Public Participation Process (PPP) as part of the application for a Water Use License (WUL) and Environmental Authorisation (EA), in accordance with Regulations 17 to 19 of the Water Use License Regulations (GN No. R. 267, 24 March 2017), section 41(4) of the National Water Act (Act 36 of 1998), and Chapter 6 of the Environmental Impact Assessment Regulations (GG No. 40772, GN No. 326, 07 April 2017) and section 47D of the National Environmental Management Act (Act 107 of 1998) as amended, respectively; and taking into consideration the Public Participation Guideline Document (DEA, 2017).

PURPOSE OF THE PROJECT
The overall objective is to undertake and complete a robust and defendable EA & WUL process that will serve to inform the Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA) and Department Water & Sanitation (DWS) and allow for a decision on the environmental acceptability of the proposed development.

PROJECT DESCRIPTION
Construction of four (4) chicken breeding sites of 160m x 200m in extent, each entailing:
- Six closed environmentally - controlled chicken breeding houses (each house accommodates approximately 10,000 hens and 1,500 cockerels),
- A rooster spike house to rear males apart that will be placed in with the hens at point of lay,
- Egg room,
- Store room for shavings,
- An office block for admin, ablutions & showering,
- Manager's living quarters,
- Other associated infrastructure including but not limited to; water tanks, waste water treatment plant, LPG tanks for heating purposes, back-up generators, feed silos etc.

The proposed breeding houses and infrastructure trigger the following listed activities, which is subject to a Basic Assessment process:

The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.

To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development the chicken breeding facility.

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 B
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
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 ii **Error! Reference source not found.**
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	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
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: Google Earth map of the proposed site for the chicken breeding facility on the farm Klippan 452JS, near Wonderfontein. Map supplied by Ecoleges.

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, 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

The project area for the proposed chicken breeding facility lies on the sediments of the Vryheid Formation, middle Ecca, early Permian. The formation is the main coal producing

stratum in South Africa and has an uneven basal topography as well as intrusive dolerite dykes that that Jurassic in age.

To the north and east of the site are a number of formations of the Pretoria Group (see map in Fig 2 and rock types in Table 2). The Pretoria Group ranges in age from 2420 to 2222 Ma (Eriksson et al., 2006) and in the Transvaal Basin comprises mudrocks alternating with the sandstones, notable interbedded basaltic-andesitic lavas and lesser amounts of conglomerates, diamictites and carbonate rocks (ibid). These rocks have been metamorphosed to some degree. They most probably represent a shallow marine basin at times and a closed basin at other times. Since these rocks are too distant from the site to be impacted upon they will not be discussed further.
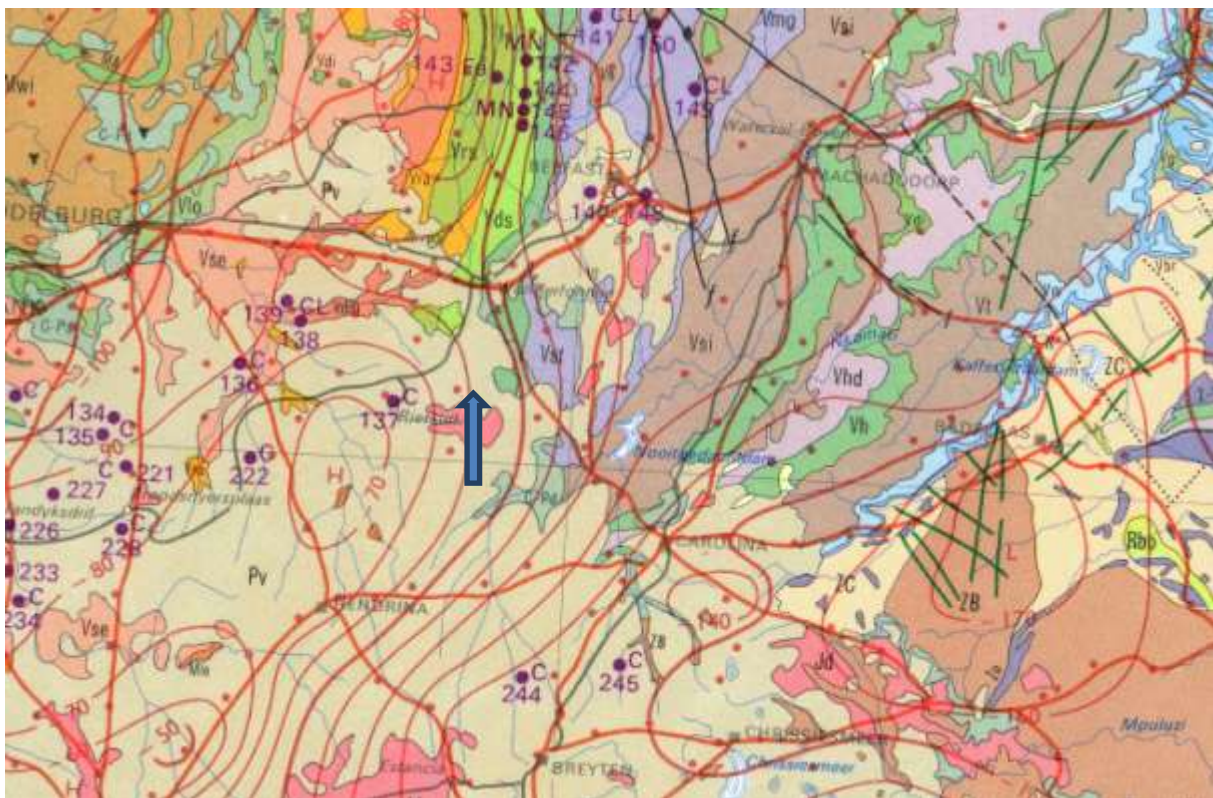

Figure 1: Geological map of the area around Rietkuil, Carolina and Machadadorp. The location of the proposed project is indicated with the arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

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

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present

Symbol	Group/Formation	Lithology	Approximate Age
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pv	Vryheid Fm	Shales, sandstone, coal	Early Permian, Middle Ecca
C-Pd	Dwyka group	Shales, diamictites	Late Carboniferous – early Permian
Vle	Leeuwport Fm, Pretoria Group	Conglomerates, shale sandstones, quartzite,	<2222 Ma
Vsi	Silverton Fm, Pretoria Group	Shale, volcanic rocks	<2222 Ma
Vh	Hekpoort Fm, Pretoria Group	Basaltic andesite, pyroclastic rocks	2224 Ma
Vt	Timeball Hill Fm and Rooihoogte Fm, Pretoria Group, Ventersdorp SG	Quartzite, mudrock, lava	< 2420 Ma
Vbr	Black Reef Fm,	Quartzite, conglomerate, shale, basalt	Ca 2650 – 2640 Ma
Vm	Malmani Subgroup	Dolomite, chert	Ca 2750 – 2650 Ma
ZB	Unnamed Granite, gneiss,	Granite, gneiss	Ca 3100 Ma

ii.   Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3a. The site for development is in the Vryheid Formation, Ecca Group, traditionally dated at early Permian but now considered to be 269-266 Ma or Wordian age (Barbolini et al., 2016) which is upper Permian or in the Guadalupian epoch.

While coals are a product of buried peats (plant matter) that has been compressed and altered by heat over time, the alteration is so extensive that no original plant matter is discernible, making the coals themselves of very limited interest to palaeontologists. Impressions of leaves, stems, seeds from the plants are sometimes preserved in the shales and mudrock lenses closely associated with the coal seams ad these are of palaeontological interest. The flora that formed the coals in southern Africa is the Glossopteris flora and this includes leaves and reproductive structures of *Glossopteris, Noeggerathiopsis*, rare ginkgophytes and abundant lycopods, sphenophytes and ferns (Plumstead, 1969; Anderson and Anderson, 1985). Although a few terrestrial vertebrates had evolved by this time it is extremely rare for them to be preserved with the coal-forming plants because the conditions for preservation are different.
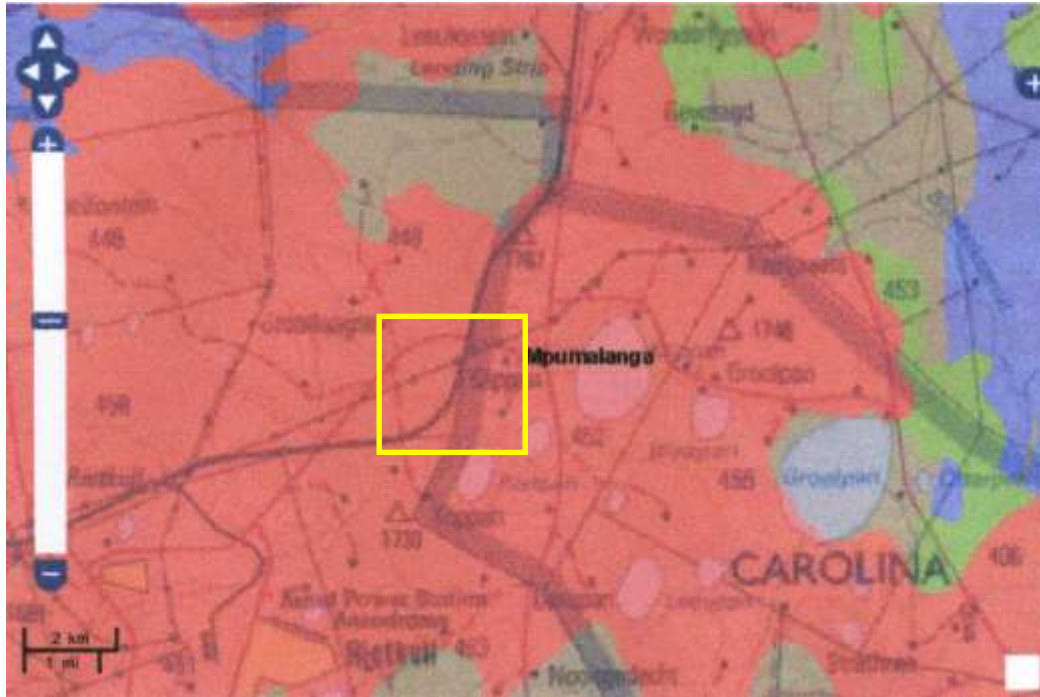
Figure 3: SAHRIS palaeosensitivity maps for the site for the proposed Klippan chicken breeding facility indicated within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

This area is in the Witbank coalfield which has five coal seams preserved (1 – 5, base to top) any vary locally in thickness. The depth of the topmost seam from the land surface varies from 12-50m (Snyman, 1998). All the coal seams are covered by layers of soil, shales and siltstones.

From the SAHRIS map above the area is indicated as highly sensitive (red) so a desktop study is presented here. The area has been disturbed from previous agricultural activities. There are no records of fossil plants from this area but it is likely that they occur well below ground and close to the coal seams, i.e. at a minimum of 12m below the surface. It should be noted that the distribution and abundance of fossil leaf impressions are unpredictable and variable; frequently being very sporadic and rare, respectively.

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.
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

TABLE 3B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	H	-
	M	-
	L	It is possible that leaf impressions of the *Glossopteris* flora occur well below ground and associated with coal seams BUT since the proposed project will be constructed on the land surface with standard building foundations and excavations (no more than 2m).
	L+	-
	M+	-
	H+	-
DURATION	L	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	L	Since only the possible fossils within the area would be fossil plants from the *Glossopteris* flora in the shales, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	It is extremely unlikely that any fossils would be found in the surface soils that would be affected by the removal of vegetation and excavation of building foundations. Nonetheless a chance find protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are potentially fossiliferous because coals occur in the region, Vryheid Formation. However the surface soils would not contain fossils and the excavations for the buildings and infrastructure are most unlikely to extend beyond the depth of standard building foundations, i.e. no more than 2m, whereas the uppermost recoded coal seam is 12m below the surface. Since there is a very small chance of finding fossils when building operation commence, a Chance Find protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely 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 dolomites, sandstones, shales, coals and sands are typical for the country and could contain fossil plant impressions but none has been reported from this area. The older rocks of the Pretoria Group are not in the immediate area and are too old to contain fossils.

6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the surface soils that would be affected by the removal of vegetation and excavation for building foundations. Nonetheless, since there is a very small chance that fossils may occur in the project area, the Permian Vryheid Formation, a Chance Find Protocol should be added to the EMPr: if fossils are found once clearing or building has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

7. References

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

Erikssen, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its pre-cursors. 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 237-260.

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.

8. Chance Find Protocol

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

1. The following procedure is only required if fossils are seen on the surface and when clearing and 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 5). 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. If there is any possible fossil material found by the developer/environmental officer/responsible person then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
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 will not be necessary. An annual report or final report 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.

Figure 5 below – examples of fossil leaf impressions, *Glossopteris* and *Noeggerathiopsis*, that occur in the Vryheid Formation
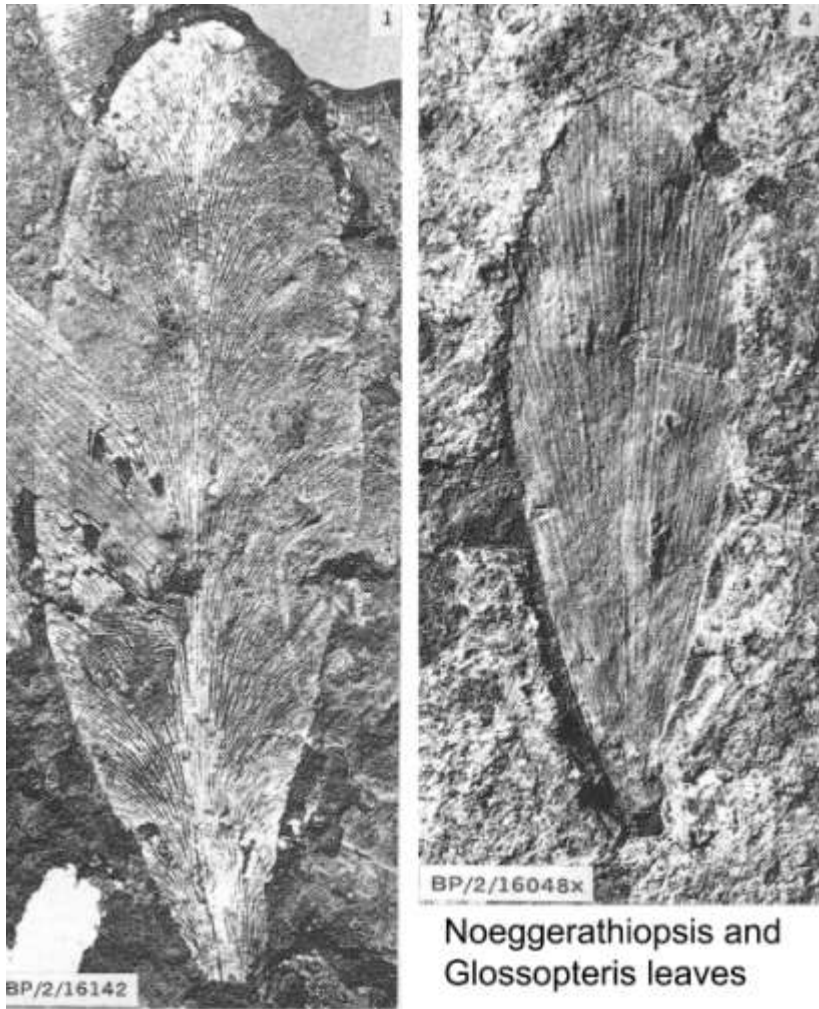
Noeggerathiopsis and
Glossopteris leaves

Fig 5

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Curriculum vitae (short) - Marion Bamford PhD
June 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-
Telephone   :   +27 11 717 6690
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	6	1
Masters	8	1
PhD	10	2
Postdoctoral fellows	9	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
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
-

xi) Research Output

Publications by M K Bamford up to June 2018 peer-reviewed journals or scholarly books: over 120 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 26; Google scholar h index = 28;
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)