

**Palaeontological Impact Assessment for the proposed
extension to the runway at Lapalala Wilderness
Reserve,
Limpopo 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, 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 proposed extension to the runway at Lapalala Wilderness Reserve, plus associated roads and access, in Limpopo Province. In order 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 fluviially deposited sandstones and conglomerates of the Mokalakwena Formation, Waterberg Group, some 2000-1800 million years. No fossils have been recorded from this Formation, and confirmed in the Limpopo Palaeotechnical Report, however the SAHRIS Palaeosensitivity map indicates that the area is moderately sensitive. Trace fossils of microbial structures have been reported from the underlying Makgabeng Formation but that formation does not occur here. Only because of the indication by the SAHRIS map a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no palaeontological site visit is required and the project can proceed.

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1. Background

The affected property, Game 1014 LR, is situated within Lapalala Wilderness Reserve in the Lephalale Local Municipality, approximately 60 Km south east of Lephalale. The proposed expansion will entail the addition of a 100m stop way and a 600m clearway to the existing runway within Lapalala Wilderness Reserve. The stop way is an extension to the runway and will need to be completely cleared and levelled in order for it to support the landing of aircraft without causing any structural damage. The clearway is an extension to the runway that acts as a safety net in the event that a plane's climb rate is reduced due to an unforeseen problem. The clearway will only need to be cleared of vegetation/obstacles of a significant height (i.e. anything with a height greater than 1m).

The motivation and reasoning behind the expansion of the runway is mainly due to safety reasons but will also play a role in furthering development of the growing tourism industry and possible tourism linkages within the area. The current runway within Lapalala Wilderness Reserve does not have any provisions for a stop way or clear way. A stop way and clear way are essential when it comes to safety requirements as they provide support to the airplane during an aborted take-off and increase the allowable aircraft operating takeoff respectively. The proposed expansion of the runway will also mean guests will be able to fly safely straight into Lapalala Wilderness Reserve. Due to its distance from major cities, this may be a preferred option for many guests and so will lead to an increase in tourism to the area.

For the project the clearance of an area of 300 square meters or more of indigenous vegetation will be required. The total cleared footprint will be approximately 28 368 square meters. The expansion of runways or aircraft landing strips where the expanded runways or aircraft landing strips will be longer than 1.4 kilometres in length.

A Palaeontological Impact Assessment was requested for the proposed project in order 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 and is presented here.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2017)

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
ai	Details of the specialist who prepared the report	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1

ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
h	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
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j	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
k	Any mitigation measures for inclusion in the EMPr	Appendix A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	N/A
nii	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
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies if any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A

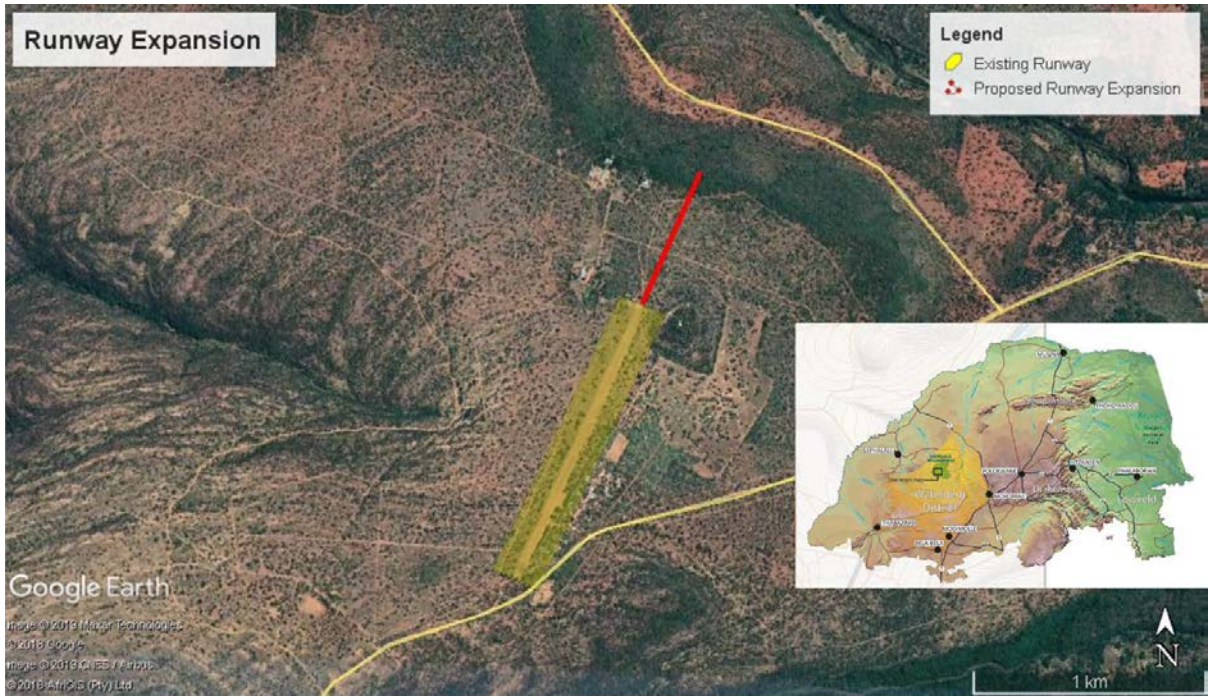


Figure 1: Google Earth map of the proposed extension tot eh runway at Lapalala Wilderness Reserve, Limpopo Province with the section shown by the red outline. Map supplied by NuLeaf.

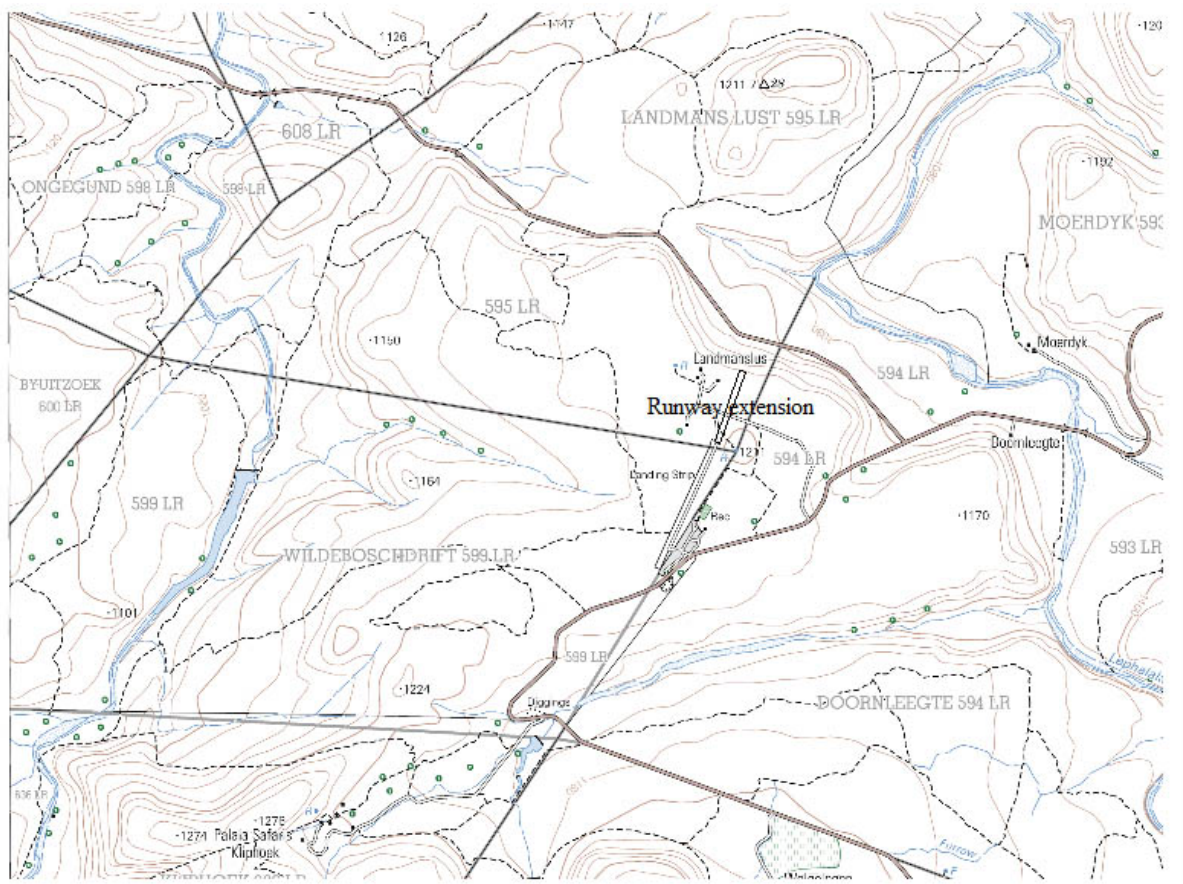


Figure 2: Topographic map of the proposed extension to the Lapalala Runway.

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 (*not applicable to this assessment*);
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 (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

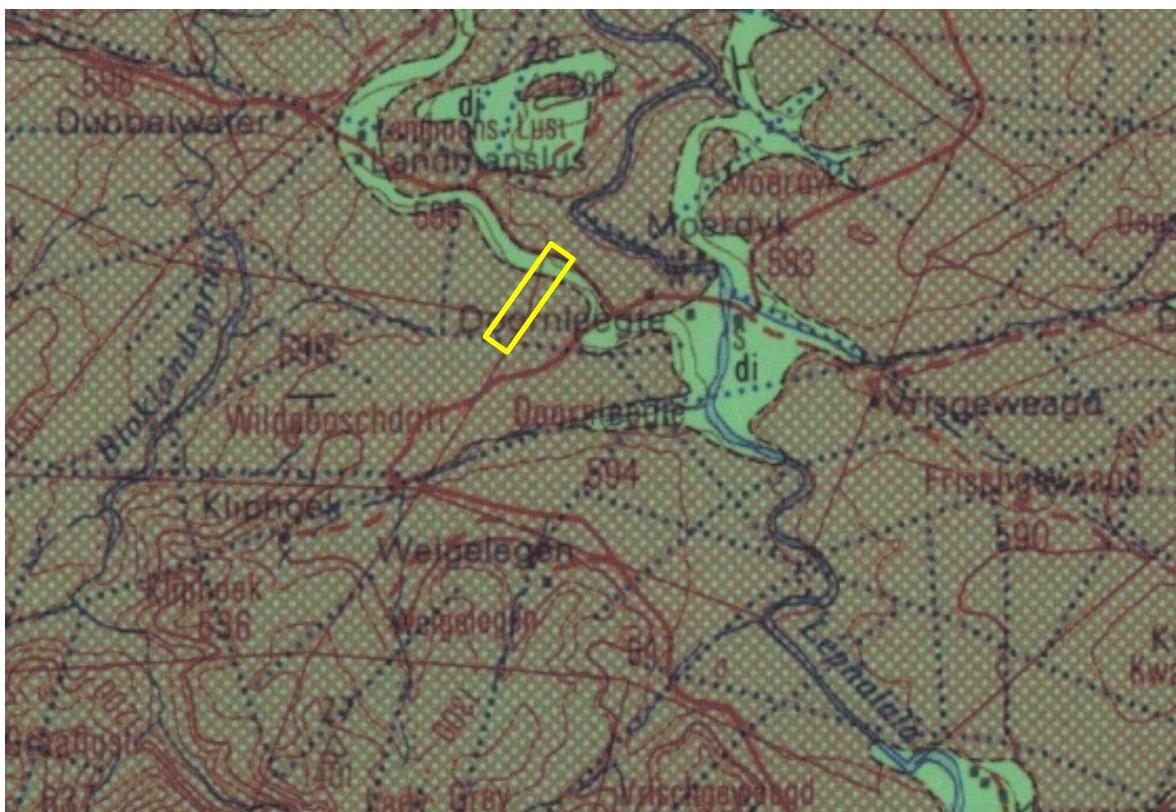


Figure 3: Geological map of the area around the Lapalala Runway. The location of the proposed project is indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
di	Diabase	Intrusive volcanic rocks	
Mm	Mogalakwena Fm, Waterberg Group	Coarse-grained purplish-brown sandstone with conglomerate	2000 – 1800 Ma
Mma	Makgabeng Fm, Waterberg Group	Medium-grained yellowish sandstone	2000 – 1800 Ma

The only rocks in the whole region are the coarse-grained purplish-brown sandstones and conglomerates of the Mogalakwena Formation, Waterberg Group. There is a narrow exposure of diabase that is post-Waterberg volcanic intrusive rocks and these rocks do not preserve fossils.

The Waterberg Group is extensive in Limpopo Province and comprises several Formations in the Middelburg Basin. In this project area the Blouberg Formation is at the base, and is overlain successively by the Setloale Formation, Makgabeng Formation and the Mogalakwena Formation (Barker et al., 2006; Eriksson et al., 2008; Simpson et al., 2004, 2013). According to Eriksson et al. (2008) the Waterberg Group sediments were derived from typical braided fluvial deposits, combined with some subordinate occurrences of sediment gravity-flow and sheetflood deposits, and therefore support the presence of raised palaeoslopes (possibly restricted in time and space) for these Palaeoproterozoic fluvial systems. An abundance of fine, argillaceous material within such river systems likely resulted from warm and humid palaeoclimatic conditions, thus enabling localized debris-flow and hyperconcentrated flow processes. Furthermore, the Waterberg sandstones had highly variable mud contents (ibid).

ii. Palaeontological context

Much research has been done by a group of geologists on the Makgabeng Formation of the Waterberg Group because they have found trace fossils such as microbial mats, mudcracks, curl structures, etc (Simpson et al., 2004, 2013; Eriksson et al., 2008). The older Makgabeng Formation is medium grained sandstones whereas the overlying Mogalakwena Formation has coarse-grained sandstones so would not be able to preserve, as convincingly, any trace fossils.

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for development is in the Mogalakwena Formation that has no published fossil record, yet is indicated as moderately sensitive in the SAHRIS Palaeosensitivity map. The compilers of the Palaeotechnical report for Limpopo (Groenewald et al., 2014) also indicate that the Mogalakwena Formation has no fossils. Therefore, it has to be assumed that the SAHRIS map needs to be corrected.



Figure 4: SAHRIS palaeosensitivity maps for the site for the proposed Lapalala Runway extension shown 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.

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	Ancient sandstones of the Mogalakwena Fm do not preserve fossils. The impact would be very unlikely.
	L+	-
	M+	-
	H+	-
DURATION	L	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	L	Since only the formation in the area is non-fossiliferous, 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 ancient fluvial sandstones. Only because the SAHRIS map indicates moderate sensitivity a Fossil 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 much too old to contain fossils and too coarse. Neither the geological formation nor the Limpopo Palaeotechnical Report indicate any chance of fossils occurring in this footprint, the

Mogalakwena Formation. Only based on the SAHRIS map a Fossil 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 conglomerates, sandstones, shales and sands are typical for the country and do not contain any fossils. It is assumed that there is an error in the SAHRIS map and this should be rectified. Until such time, and to err on the side of caution, a Fossil Chance Find Protocol has been added to this report.

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 ancient fluvial sands of the Mogalakwena Formation (Waterberg Group). Until the SAHRIS map is corrected a Fossil Chance Find Protocol should be added to the EMP: if fossils are found once clearing and excavations have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

7. References

Barker, O B., Brandl, G., Callaghan, C.C., Erikssen, P.G., van der Neut, M., 2006. The Soutspanberg and Waterberg Groups and the Blouberg Formation. 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 301-318.

Eriksson, P., Long, D., Bumby, A., Eriksson, K., Simpson, E., Catuneanu, O., Claassen, M., Mtimkulu, M., Mudziri, K., Brumer, J., van der Neut, M., 2008. Palaeohydrological data from the c. 2.0 to 1.8 Ga Waterberg Group, South Africa: discussion of a possibly unique Palaeoproterozoic fluvial style. *South African Journal of Geology* 111, 281-304.

Groenewald, G., Groenewald, D., Groenewald, S., 2014. SAHRA Palaeotechnical Report. Palaeontological Heritage of Limpopo. 22 pages.

Simpson, E.L., Eriksson, K.A., Kuklisa, C.A., Eriksson, P.G., Bumby, A.J., van Jaarsveld, C.F., 2004. Saline pan deposits from the 1.8 Ga Makgabeng Formation, Waterberg Group, South Africa. *Sedimentary Geology* 163, 279–292.

Simpson, E.L., Heness, E., Bumby, A., Eriksson, P.G., Eriksson, K.A, Hilbert-Wolf, H.L., Linnevelt, S., Malenda, H.F., Modungwa, T., Okaforba, O.J., 2013. Evidence for 2.0 Ga continental microbial mats in a paleodesert setting. *Precambrian Research* 327, 36-50

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the clearing of vegetation and obstacles for the runway extension and access roads begin.

1. The following procedure is only required if fossils are seen on the surface and when excavations/clearing commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (mudcracks, curls, etc.) should be put aside in a suitably protected place. This way the project 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/miners 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 no site inspections by the palaeontologist will not be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Appendix A – examples of microbially induced structures from the Makgabeng Formation

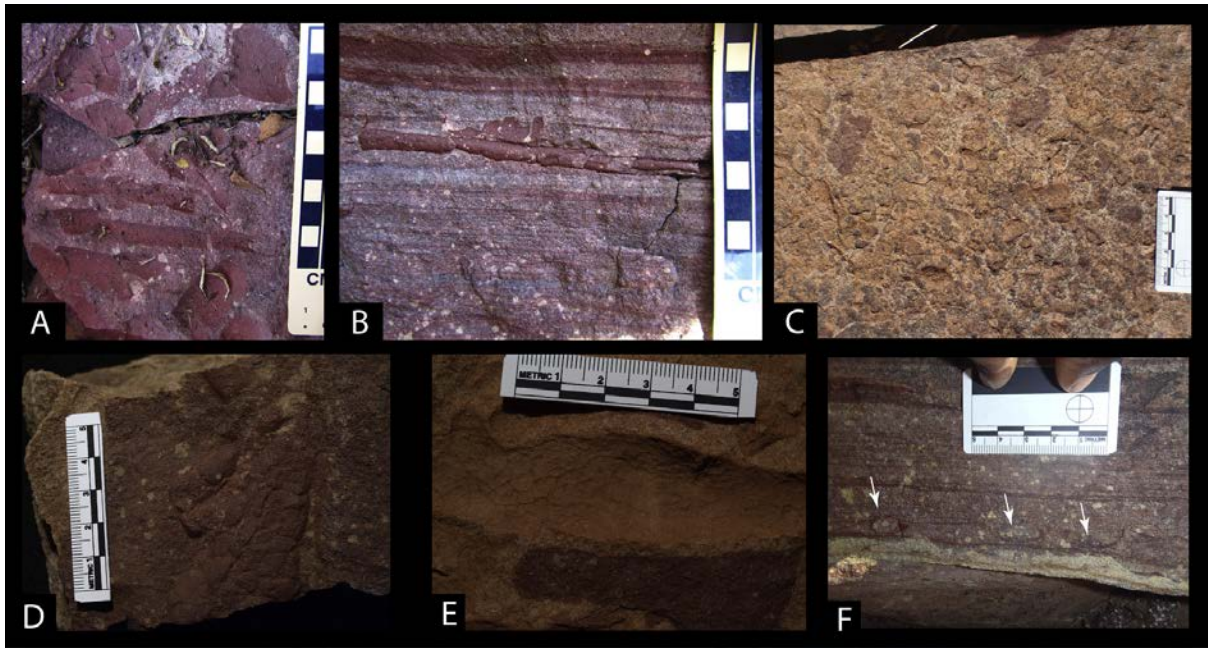


Figure 5: Microbial mats and sedimentary structures from the Makgabeng Formation (Figure 6. Page 4, Simpson et al., 2013).

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD September 2019

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	7	0
Masters	10	4
PhD	12	5
Postdoctoral fellows	10	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
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala

- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO

xi) Research Output

Publications by M K Bamford up to June 2018 peer-reviewed journals or scholarly books: over 140 articles published; 5 submitted/in press; 8 book chapters.

Scopus h index = 27; Google scholar h index = 32;

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)