Palaeontological Impact Assessment for the proposed Olienhout Dam, east of Nelspruit, Mpumalanga Province

Desktop Study

For

Enpact Environmental

25 April 2018

Prof Marion Bamford
Palaeobotanist
P Bag 652, WITS 2050
Johannesburg, South Africa
Marion.bamford@wits.ac.za

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 Kudzala Environmental, Nelspruit, 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

Enpact Environmental has been contracted to carry out an EMPr for the proposed construction of a dam on the Farm Boblands 247JU, 25 km east of Nelspruit, just south of Malelane, Mpumalanga Province. The site lies on ancient rocks of the Nelspruit Batholith which are granites and gneisses. These are volcanic in origin and do not contain fossils of any kind. As far as the palaeontological heritage is concerned the project can continue and no further assessment is required.

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1. Background

Enpact Environmental has been appointed to carry out the EIA and WULA for a proposed dam 25 km east of Nelspruit, on the Farm Boblands 274JU. 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.

Figure 1: Detailed map from Google Earth of the proposed Olienhout Dam, 25km east of Nelspruit, Mpumalanga Province, on the Farm Boblands 247JU.

This report 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 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	n/a
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

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

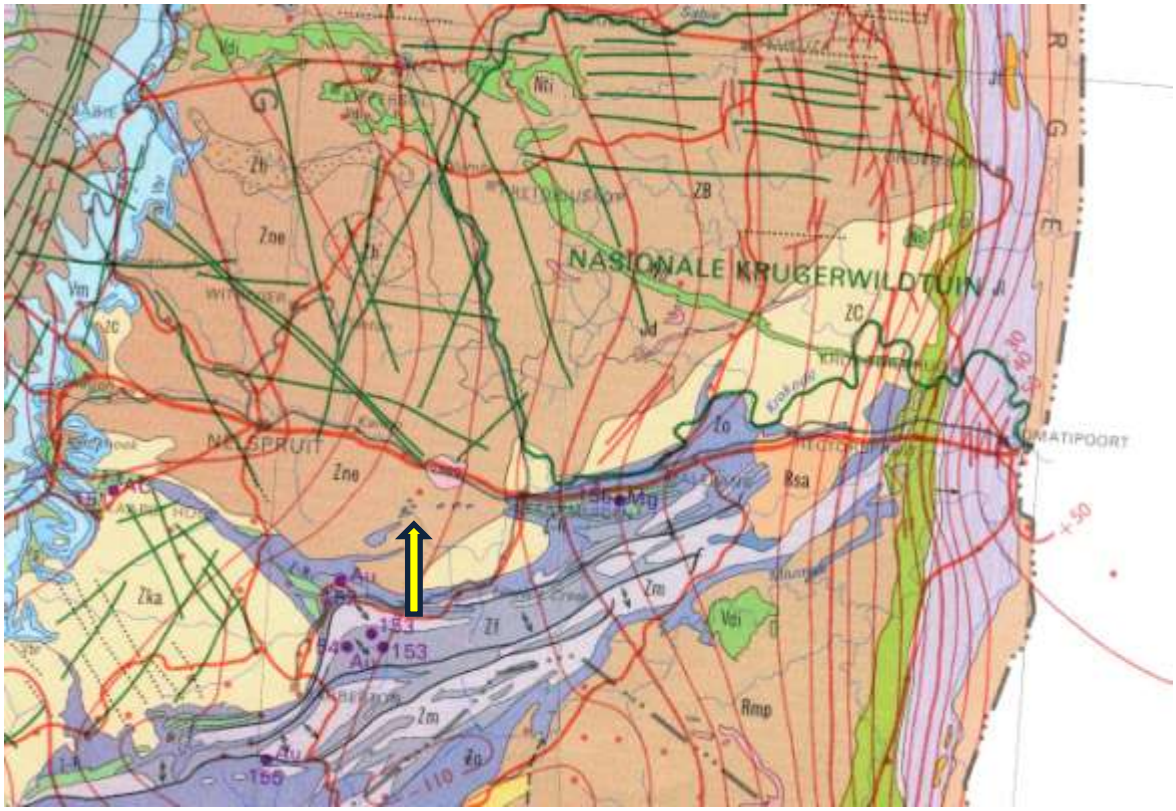

Figure 2: Geological map of the area around Boblands, Mpumalanga Province, where the proposed Olienhout Dam will be constructed. The proposed site is indicated by the yellow arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

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,	Ca 300 – 180 Ma

Symbol	Group/Formation	Lithology	Approximate Age
		sandstone, mudstone	
Jl	Letaba Fm, Lebombo Group	Picritic basalt	Ca 183 Ma
Jt	Tshokwane granophyre	Granophyre	Ca 140 Ma
Rmp	Mpuluzi Granite	Quartz monzonite	
Zne	Nelspruit Suite/batholith	Biotite granite, migmatite	3106 Ma
ZC	Unnamed	Trondhjemitic and tonalitic gneisses, migmatite	
ZB	Unnamed	Potassic granite and granodiorite	
Z-R	Unnamed ultrabasic rock	granites	
Zm	Moodies Group, Barberton Sequence	Sandstone, shale, conglomerate	>3300 Ma
Zf	Figtree Group, Barberton Sequence	Greywacke, shale, chert, dacitic volcanic rocks	>3300 Ma
Zo	Onverwacht Group, Barberton Sequence	Lava, pyroclastic rocks	>3300 Ma

The proposed site lies on rocks of the Nelspruit Suite or Batholith and possibly on a small outcrop of ultrabasic rocks of a similar age (Fig 2). These rocks include gneisses and porphyritic granites. According to Robb et al. (2006) the large volume of magma required to form the Nelspruit Suite is thought to have derived from a partial melting of a pre-existing tonalitic-trondhjemitic basement.

Most research has been done on the southern part of the Barberton Greenstone Belt and little on the northern part, where the Olienhout Dam is situated. (Brandl et al., 2006).

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 parallel Karoo rocks are far to the east of the proposed dam site and will not be discussed further.

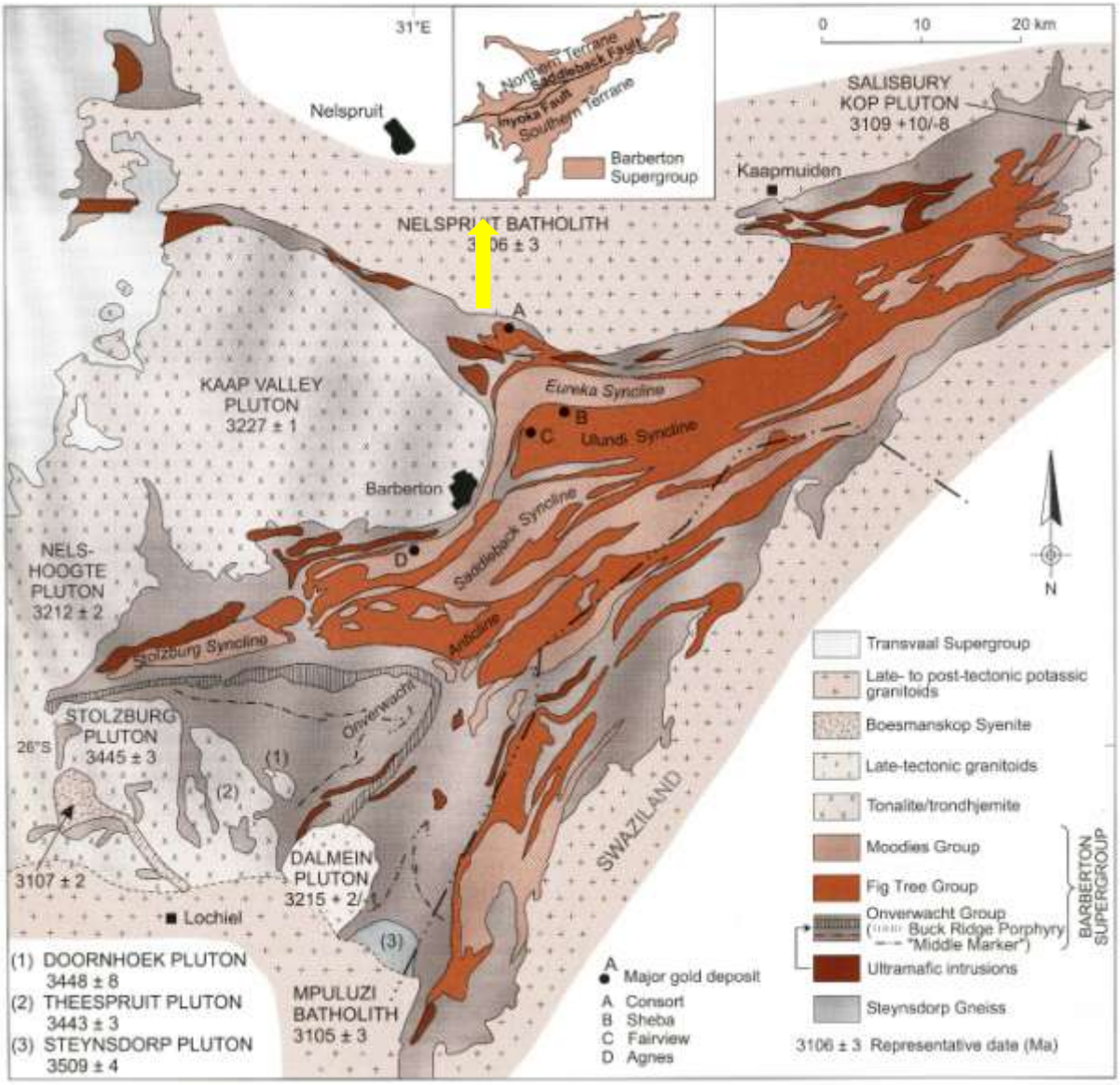

Figure 3: Map showing the updated geological groups in the Barberton Greenstone Belt (from Brandl et al., 2006, figure 2, page 11) with a focus on the three main stratigraphic divisions and the volcanic rock types. Boblands, arrow, is in the north central part.

ii. Palaeontological context

The ancient and igneous rocks (gneisses, granite) are too old and of the wrong type to contain fossils as they are volcanic in origin. Although the SAHRIS palaeosensitivity map shows the area as blue (i.e. low sensitivity; Fig 3) the geology and the palaeontological record as we know it, do not support this interpretation. Even the scattered exposures of Unnamed ultrabasic rocks would not contain fossils as they are also igneous in origin.

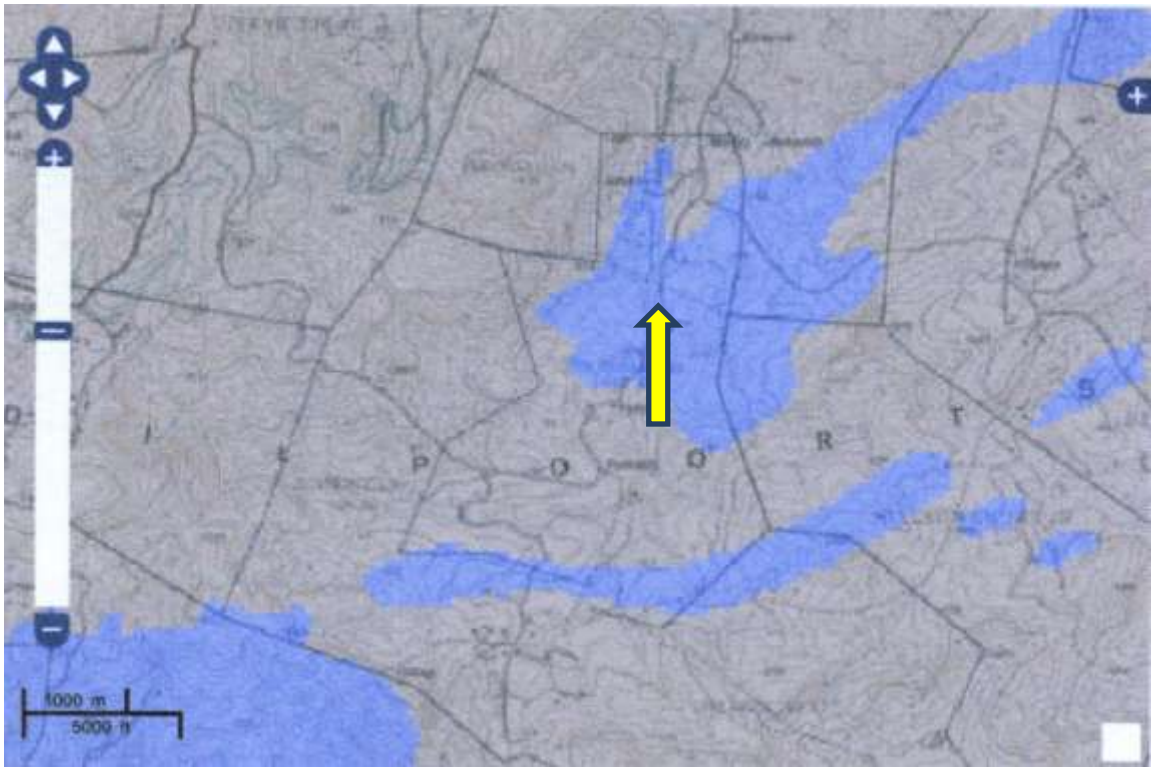

Figure 3: SAHRIS palaeosensitivity map of the region around Olienhout Dam. The site in the blue area (arrow). Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

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	**L**	Quickly reversible. Less than the project life. Short term

DURATION of impacts	**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	There is a very 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 no chance of finding fossils in the granites, gneisses and ultrabasic rocks.

Based on the nature of the project, the surface soils will be excavated to a depth of several metres and will be used to form the dam wall. Associated structures are also planned to be constructed from the local soil. If rocks are encountered they will be the granites and gneisses of the Nelspruit batholith or some unnamed ultrabasic rocks. Since there is no chance of finding fossils in the soils and granites there would be no impact on the fossil heritage. Taking account of the defined criteria, the potential impact to fossil heritage resources is negligible.

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, granites and basalts are typical for the country and do not contain any fossil plant, insect, invertebrate and vertebrate material. Furthermore, no fossils have been reported from this region.

6. Recommendation

Based on the age of the sediments and occurrence of fossils in this formation, no fossils have been recorded from this area. No further palaeontological assessment is required. As far as the palaeontological heritage is concerned the proposed dam construction can proceed.

7. References

Brandl., G., Cloete, M., Anhauaeusser, C.R., 2006. Archaean Greenstone belts. 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 9-56.

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.

Knoll, A.H., Bergmann, K.D., Strauss, J.V., 2016. Life: the first two billion years. Philosophical Transactions of the Royal Society B 371, 20150493.

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.

Robb, L.J., Brandl, G., Anhaeusser, C.R., Poujol, M., 2006. Archaean Granitoid Intrusions. 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 57-94.

Appendix A – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
April 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	5	2
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 – current Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 – current
Cretaceous Research: 2014 - current

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
- 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 April 2018 peer-reviewed journals or scholarly books: over 120 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 24; Google scholar h index = 26;
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)