

**Palaeontological Impact Assessment for the proposed  
Tshikota Ext 2 township, west of Machado  
(Louis Trichardt),  
Limpopo Province**

**Desktop Study (Phase 1)**

**For**

**Heritage Contracts and Archaeological Consulting**

**25 November 2020**

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Palaeobotanist

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## **Expertise of Specialist**

The Palaeontologist Consultant: Prof Marion Bamford  
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf  
Experience: 31 years research; 23 years PIA studies

## **Declaration of Independence**

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Heritage Contracts and Archaeological Consulting, Modimolle, 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 Makhado Local Municipality proposes to construct a township to the west of the town on Portion Remainder of Portion 1 of the Farm Naturelle Lokasie 272 LS. The development will comprise housing, business areas, retail, a crèche and open public spaces

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 project.

The township site lies on the soils, sands and alluvium of the Kalahari Group (Quaternary age). Rarely the sands will entrap more robust fossils, such as fragments of bones or wood, but these are not in situ. If palaeo-pans or palaeo-springs are in the area they might preserve fossils but no such feature is evident from the Google Earth imagery. There is an extremely small chance that fossils occur on the land surface, nonetheless a Fossil Chance Find Protocol should be added to the EMP. Based on this information it is recommended that no palaeontological site visit is required and the project may proceed.

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# 1. Background

The Makhado Local Municipality proposes to construct a township to the west of the town on Portion Remainder of Portion 1 of the Farm Naturelle Lokasie 272 LS. The development will comprise housing, business areas, retail, a crèche and open public spaces (Figures 1, 2).

As part of the EIA process, a Palaeontological Impact Assessment was requested for the project. 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 project and is reported herein.

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

|     | <b>A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:</b>   | <b>Relevant section in report</b> |
|-----|--|-----------------------------------|
| 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        |

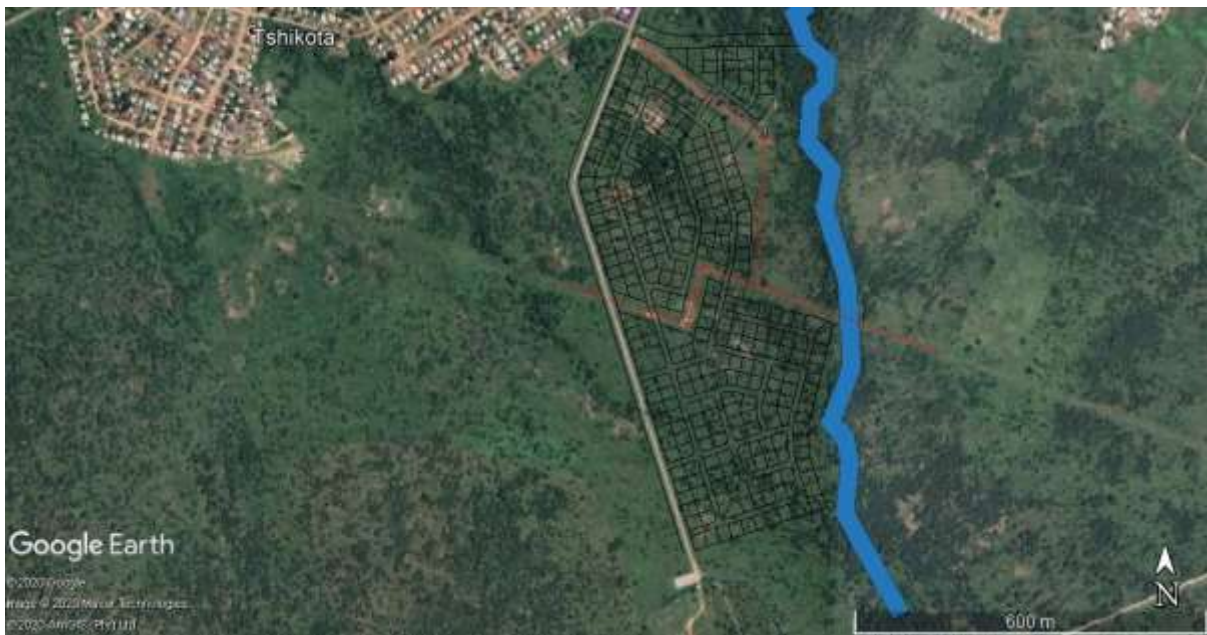


Figure 1: Locality map of the Tshikota Extension 2 township to the west of Makhado, Limpopo Province with the residential and business stands shown by the black lines. Map supplied by HCAC.

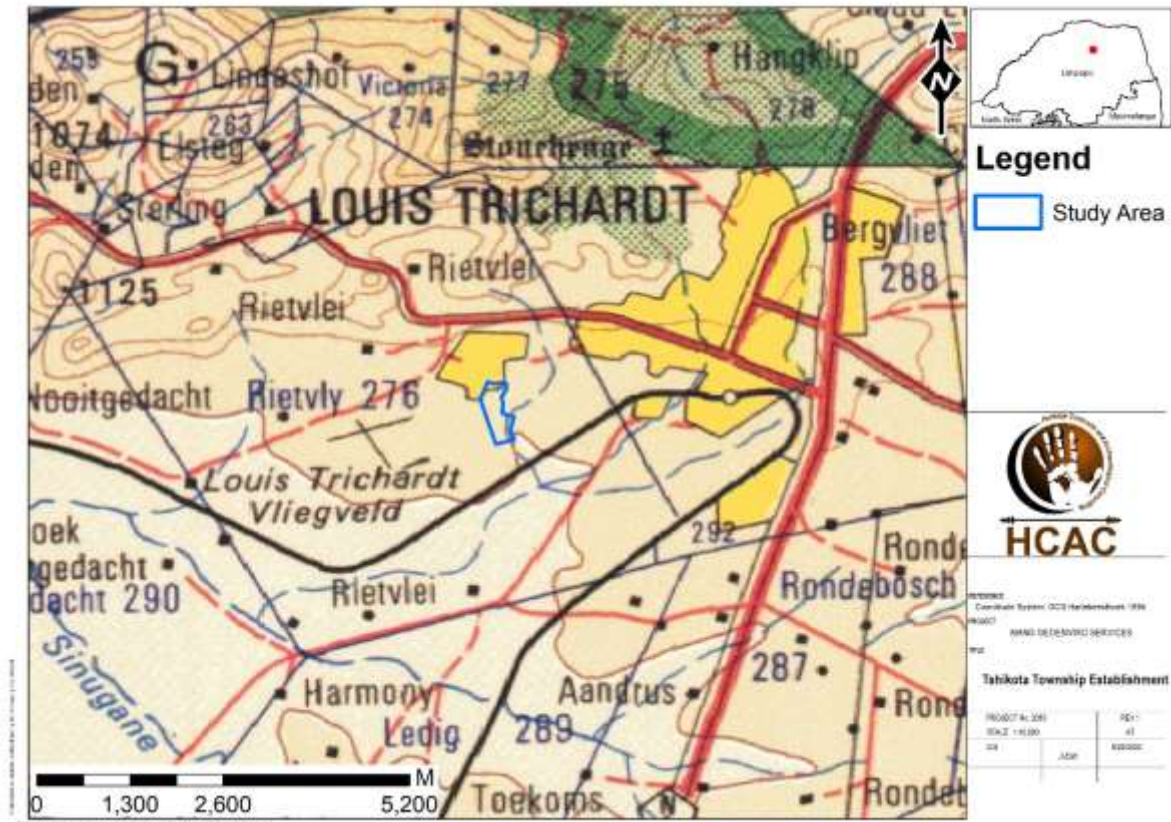


Figure 2: Topographic map showing the location of the Tshikota Ext 2 in the blue outline and other farms. Map supplied by HCAC.

## 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 Machado (Louis Trichardt). Limpopo Province. The location of the proposed project is indicated within the blue rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2328 Polokwane.

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

| Symbol | Group/Formation                          | Lithology   | Approximate Age                 |
|--------|--|---|---------------------------------|
| Q      | Kalahari Group                           | Soil, sand, alluvium                                      | Quaternary ca 2.5 Ma to present |
| Mw     | Wyllies Poort Fm,<br>Soutspansberg Group | Pink quartzite, minor conglomerate, shale and sandy shale | 2000 – 1700 Ma                  |



| Symbol | Group/Formation                   | Lithology | Approximate Age |
|--------|-----------------------------------|-----------|-----------------|
| Ms     | Sibasa Fm,<br>Soutspansberg Group | Basalt    | 2000 – 1700 Ma  |

Makhado lies in the southwestern part of the Soutspansberg Basin that is an intracratonic to mobile belt or near cratonic environment (Barker et al., 2006). The sediments that filled the basin are about 1700 to 2000 million year old are what are known as red beds. These Palaeoproterozoic red beds formed when there sufficient free atmospheric oxygen to produce oxides of the ferruginous materials, i.e. red beds (ibid). Just north of Makhado are exposures of the Sibasa Formation and the Wyllies Poort Formation basalts. They do not preserve any fossils and will not be discussed any further.

Overlying much of the area are the Kalahari Group sand and soils (Figure 3). This is the largest and most extensive palaeo-erg in the world (Partridge et al., 2006) and is composed of extensive aeolian and fluvial sands, sand dunes, calcrete, scree and colluvium. Periods of aridity have overprinted the sands, and calcrete and silcrete are common.

## ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for the township is covered by aeolian Kalahari sands that were derived from farther to the northwest (Goudie and Wells, 1995) and finally deposited in this region during the Quaternary. Since they are windblown the sands are not in primary context, nor do they preserve any fossils.

Fossils can only be preserved if there are palaeo-spring or palaeo-pan deposits where wood, plants or bones can be entrapped and preserved in the calcrete or silcrete that occasionally forms in such settings. No such deposits have been recorded from this site and it is not within the main pan belt of southern Africa which is west of the 26°E line (see Fig 1 in Goudie and Wells, 1995). Furthermore, the Google Earth imagery does not show any pans as the area is well vegetated and the rainfall relatively high.

Palaeo-spring deposits are more likely but such water sources are usually well known. Nothing is evident on the satellite imagery (Figure 1). possible or spring deposits. According to Goudie and Wells (1995) three factors are required for the formation of pans, namely a setting where the fluvial system is not fully integrated, and where salt weathering and aeolian deflation occur. The latter two conditions apply to this environmental setting, but the first does not as the site is on a slope and is far from any major river or drainage system. Therefore, it is extremely unlikely that there are any pans in the site or any fossils in the sands. Since most of the area has been disturbed by previous mining operations it is unlikely that any pan or spring features remain (Figure 1).



Figure 4: SAHRIS palaeosensitivity map for the site for the Tshikota Ext 2 township shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as moderately sensitive (green) and this applies to the Kalahari sands and soils.

#### 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   |           |  |
|---|-----------|--|
| <b>Criteria for ranking of the SEVERITY/NATURE of environmental impacts</b> | <b>H</b>  | Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.   |
|   | <b>M</b>  | Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.   |
|   | <b>L</b>  | Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. |
|   | <b>L+</b> | Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.                                     |
|   | <b>M+</b> | Moderate improvement. Will be within or better than the recommended level. No observed reaction.   |

|  |           |   |
|--|-----------|---|
|  | <b>H+</b> | Substantial improvement. Will be within or better than the recommended level. Favourable publicity. |
| <b>Criteria for ranking the DURATION of impacts</b>      | <b>L</b>  | Quickly reversible. Less than the project life. Short term  |
|  | <b>M</b>  | Reversible over time. Life of the project. Medium term  |
|  | <b>H</b>  | Permanent. Beyond closure. Long term.   |
| <b>Criteria for ranking the SPATIAL SCALE of impacts</b> | <b>L</b>  | Localised - Within the site boundary.   |
|  | <b>M</b>  | Fairly widespread – Beyond the site boundary. Local   |
|  | <b>H</b>  | Widespread – Far beyond site boundary. Regional/ national   |
| <b>PROBABILITY (of exposure to impacts)</b>              | <b>H</b>  | Definite/ Continuous  |
|  | <b>M</b>  | Possible/ frequent  |
|  | <b>L</b>  | Unlikely/ seldom  |

**TABLE 3B: IMPACT ASSESSMENT**

| <b>PART B: ASSESSMENT</b> |           |  |
|---------------------------|-----------|--|
| <b>SEVERITY/NATURE</b>    | <b>H</b>  | -  |
|                           | <b>M</b>  | -  |
|                           | <b>L</b>  | Aeolian sands do not preserve fossils; only palaeo-pan or palaeo-springs might preserve fossils. So far there are no records from the area nor are such features visible so it is very unlikely that fossils occur on the site. The impact would be very unlikely. |
|                           | <b>L+</b> | -  |
|                           | <b>M+</b> | -  |
|                           | <b>H+</b> | -  |
| <b>DURATION</b>           | <b>L</b>  | -  |
|                           | <b>M</b>  | -  |
|                           | <b>H</b>  | Where manifest, the impact will be permanent.  |
| <b>SPATIAL SCALE</b>      | <b>L</b>  | Since only the possible fossils within the area would be fossil wood or bone fragments in pan or spring deposits, the spatial scale will be localised within the site boundary.  |
|                           | <b>M</b>  | -  |
|                           | <b>H</b>  | -  |
| <b>PROBABILITY</b>        | <b>H</b>  | -  |
|                           | <b>M</b>  | -  |
|                           | <b>L</b>  | It is extremely unlikely that any fossils would be found in the loose sand that will be disturbed, nonetheless 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 below the surface are much too old to contain fossils and of the wrong kind, and aeolian sands do not preserve fossils. Only if there are palaeo-pans or palaeo-springs in the area, and none is visible from the Google Earth imagery, is there a very small chance of fossil wood or bone fragments occurring in the footprint. Since there is an extremely small chance that fossils from the Quaternary Kalahari sands may have entrapped fossils, 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 sands, soils and alluvium are typical for the country and do not contain fossil plant, insect, invertebrate and vertebrate material. Palaeopans so not occur in this area and only if there are any palaeo-springs might any fossils be trapped. The aeolian sands of the Quaternary period would not preserve 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 aeolian sands of the Quaternary. There is very small chance that fossils from pans or springs may have been entrapped in the sands of the Kalahari Group (Quaternary). Therefore, a Fossil Chance Find Protocol should be added to the EMP: if fossils are found once excavations have 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: Prodrum of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.
- 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.
- Goudie, A.S., Wells, G.L., 1995. The nature, distribution and formation of pans in arid zones. *Earth Science Reviews* 38, 1-69.
- 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.
- Partridge, T.C., Botha, G.A., Haddon, I.G., 2006. Cenozoic deposits of the interior. 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 585-604.

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.

## 8. Chance Find Protocol

**Monitoring Programme for Palaeontology – to commence once the excavations / drilling activities begin.**

1. The following procedure is only required if fossils are seen on the surface and when drilling/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 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 5-7). 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 fossils from the Quaternary aeolian sands



Figure 5: Fossil bone fragments from a Quaternary pan.



Figure 6: Silicified wood fragments from a fluvial deposit.



Figure 7: Example of a palaeo-spring deposit (from central Mozambique). Note the layered appearance of the deposits.

## Appendix B – Details of specialist

### Curriculum vitae (short) - Marion Bamford PhD July 2020

#### 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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#### 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 – 2019; Associate Editor: 2020 -

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
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for Enviropro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells

## **xi) Research Output**

Publications by M K Bamford up to December 2019 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 8 book chapters.

Scopus h-index = 29; Google scholar h-index = 36; -i10-index = 80

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)