

# Palaeontological Impact Assessment for the proposed Kamkuip Mining Permit Application, Farm Gemsbokbult 120, NE of Kenhardt, Northern Cape Province

## Desktop Study (Phase 1)

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Prepared for



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## **Expertise of Specialist**

The Palaeontologist Consultant: Prof Marion Bamford  
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf  
Experience: 33 years research and lecturing in Palaeontology  
25 years PIA studies and over 300 projects completed

## **Declaration of Independence**

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Beyond Heritage, 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:

A handwritten signature in blue ink, appearing to read 'MK Bamford', with a horizontal line underneath it.

## **Executive Summary**

A Palaeontological Impact Assessment was requested for the Mining Permit Application on a Portion of the Remaining Extent of Portion 3 (Rooidam) of the farm Gemsbok Bult no. 120 HE near Kenhardt, within the Kai !Garib Local Municipality, Northern Cape, hereafter called Rooidam.

To comply with the regulations of 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 material to be targeted is likely to be non-fossiliferous granites but the site lies very close to moderately fossiliferous aeolian sands of the Gordonina Formation (Kalahari Group, Quaternary age). Aeolian sands do not preserve fossils but might cover traps such as palaeo-pans and palaeo-springs. No such feature is visible from the satellite imagery. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the miners, environmental officer or any other designated responsible person once mining or drilling activities have commenced. Since the impact is low, as far as the palaeontology is concerned, the project should be authorised.

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# 1. Background

There is a proposed application for a Mining Permit Application on a Remaining Extent of Portion 3 (Rooidam) of the farm Gemsbok Bult no. 120 HE near Kenhardt, within the Kai !Garib Local Municipality, Northern Cape. The application is for the mining of Construction Aggregate. The site are west of the road, about 30km to the northeast of Kenhardt and comprise one areas. For this report the project will be referred to as the Rooidam mine.

A Palaeontological Impact Assessment was requested for the Rooidam mining project. To comply with the regulations of 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 reported herein.

Table 1: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6).

|     | <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 2                            |
| 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                               |

|     | <b>A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:</b>   | <b>Relevant section in report</b> |
|-----|--|-----------------------------------|
| 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  | Section 8, 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   | Section 8, Appendix A             |
| ni  | A reasoned opinion as to whether the proposed activity or portions thereof should be authorised  | Section 6                         |
| 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 | Sections 6, 8                     |
| 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 of any comments that were received during any consultation process  | N/A                               |
| q   | Any other information requested by the competent authority.  | N/A                               |
| 2   | Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.       | N/A                               |



**Figure 1: Google Earth map of the general area to show the relative land marks and the Rooidam MRA area (Yellow) is indicated with the arrow.**



**Figure 2: Google Earth Map of the proposed Rooidam mine adjacent to the road and railway line. Note previous mining impact.**



## 2. Methods and Terms of Reference

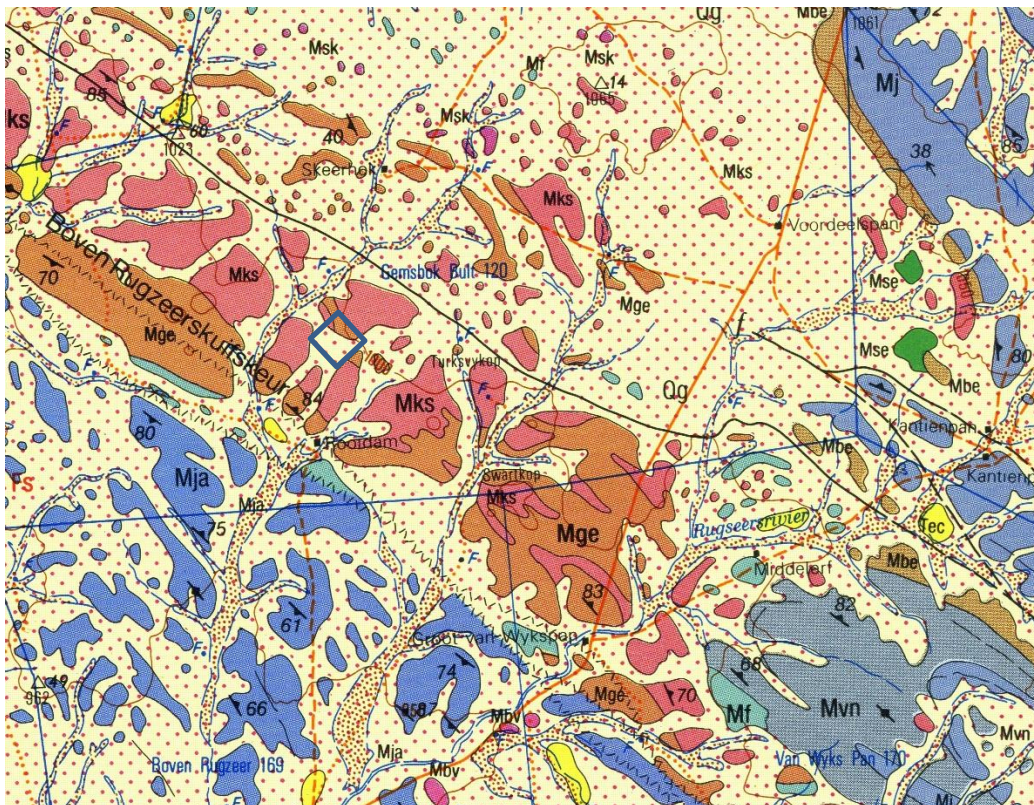
The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.

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 Rooidam mining area 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 2920 Kenhardt.**



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

| Symbol | Group/Formation                                     | Lithology                                     | Approximate Age                  |
|--------|---|---|----------------------------------|
| Qg     | Gordonia Fm, Kalahari Group                         | Red-brown wind-blown sand and sand dunes      | Quaternary, ca 2.5 Ma to present |
| T      | Tertiary  | Calcrete                                      | Neogene, last 25 Ma              |
| Mge    | Gemsbokbult Granite, Keimos Group                   | Granite with blue quartz and large xenocrysts | 1200 - 1000 Ma                   |
| Mks    | Klip Koppies Granite, Keimos Suite                  | Porphyritic granite                           | 1200 - 1000 Ma                   |
| Msc    | Unnamed mafic and ultra-mafic granite, Keimos Suite | Mafic and ultra-mafic granite                 | 1200 - 1000 Ma                   |
| Mja    | Jannelspan Granite, Areachap Group                  | amphibolite                                   | 1200 - 1000 Ma                   |

The Farm Gemsbokbult project lies in the Namaqua-Natal Province in the Namaqua section (Figure 3, Table 2). The Namaqua-Natal Province is a tectono-stratigraphic province and forms the southern and western boundary of the ancient Kaapvaal Craton, and extends below the Karoo Basin sediments to the south (Cornell et al., 2006). It comprises rocks that were formed during the Namaqua Orogeny (mountain-building) some 1200 – 1000 million years ago. It has been divided by geologists into a number of terranes (similar lithology and bounded by shear zones). There are three main lithologic units used to separate the terranes as well as the shear zones but still there is some debate about the terranes (ibid). Very simply, the lithologic units are older reworked rocks, juvenile rocks formed during tectonic activities and metamorphosed, and intrusive granitoids.

According to Cornell et al. (2006) the five terranes are:

A - Richtersveld Subprovince (undifferentiated terranes)

B – Bushmanland Terrane (granites)

C – Kakamas Terrane (supracrustal metapelite ca 2000 Ma

D – Areachap Terrane (supracrustal rocks and granitoids), includes Keimos Suite

E – Kaaien Terrane (Keisian aged metaquartzites and deformed volcanic rocks).

The farm lies in the Areachap Terrane and it has a more or less northwest-southeast extent, bounded on the western side by the Boven-Ruzgeer Shear zone and on the eastern side by a Transcurrent Shear Zone. The Namaqua-Natal Province rocks are volcanic in origin and frequently metamorphosed. (Cornell et al., 2006).

Overlying many of these rocks are loose sands and sand dunes of the Gordonia Formation, Kalahari Group of Neogene Age. The Gordonia Formation is the youngest of six formations and is the most extensive, stretching from the northern Karoo, Botswana, Namibia to the Congo River (Partridge et al., 2006). It is considered to be the biggest palaeo-erg in the world (ibid). The sands have been derived from local sources with some additional material transported into the basin (Partridge et al., 2006). Much of the Gordonia

Formation comprises linear dunes that were reworked a number of times before being stabilised by vegetation (ibid).

## ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for development lies on volcanic and metamorphic rocks of the Kakamas Terrane, Namaqua-Natal Province that are dated between 1200 to 1000 Ma. This predates any body fossils, and because of their volcanic origin, they do not preserve any fossils. There are only small outcrops of the rocks in the area but not in the project footprint. Nonetheless, they would not preserve fossils.

The aeolian sands of the Gordonia Formation do not preserve fossils because they have been transported and reworked. Such oxic environments as loose sands are not conducive to reservation because the oxygen enables fungi and invertebrates to breakdown organic matter (Cowan, 1995). However, in some regions the sands may have covered palaeo-pan or palaeo-spring deposits and these can trap fossils, and more frequently archaeological artefacts (Goudie and Wells, 1995). Usually these geomorphological features can be detected using satellite imagery. No such features are visible.



**Figure 4: SAHRIS palaeosensitivity map for the site for the proposed Rooidam mine on Farm Gemsbokbult, 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 Gordonia Formation aeolian sands, so a desktop study is required.

#### 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**

| <b>PART A: DEFINITION AND CRITERIA</b>                                      |           |  |
|---|-----------|--|
| <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; so far there are no records from the Gordonia Fm of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be negligible            |
|                           | <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 the only possible fossils within the area would be fossils trapped in palaeo-pans or palaeo-springs beneath the sands, 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 soils and sands that cover the area as no pan or spring feature is evident. 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 are either much too old to contain fossils or the wrong types, namely aeolian sand. No traps for fossils are evident from the satellite imagery. Since there is an extremely small chance that fossils from buried pans or springs may be disturbed 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 granites, gneisses, sandstones, shales and sands are typical for the country and do contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Gordonia Formation would not preserve fossils but might have buried traps such as palaeo-pans or palaeo-springs. No such feature is evident in the satellite imagery.

## 6. Recommendation

The target of the rock for aggregate is likely to be granite and not the overlying sands. 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 Gordonia Formation, Kalahari Group (Quaternary). There is a very small chance that fossils may have been trapped in features such as palaeo-pans or palaeo-springs, and buried by the aeolian sands, but no such feature is visible in the satellite imagery. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once mining activities have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. Since the impact on the palaeontological heritage would be very low, as far as the palaeontology is concerned, the project should be authorised.

## 7. References

Cornell, D.H., Thomas, R.J., Moen, H.F.G., Reid, D.L., Moore, J.M., Gibson, R.L., 2006. The Namaqua-Natal Province. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 325-379.

Goudie, A.S., Wells, G.L., 1995. The nature, distribution and formation of pans in arid zones. *Earth Science Reviews* 38, 1-69.

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 mining / drilling activities begin.**

1. The following procedure is only required if fossils are seen on the surface and when drilling/mining commences.
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 fossils must be provided to the developer to assist in recognizing the fossil plants, vertebrates, invertebrates or trace fossils 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 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 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.



9. Appendix A – Examples of fossils from the Quaternary fluvial and pan settings



**Figure 6: Photographs of fragmented and transported fossils from Quaternary deposits.**

## 10. Appendix B – Details of specialist

### **Curriculum vitae (short) - Marion Bamford PhD January 2022**

#### **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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[marionbamford12@gmail.com](mailto: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.  
NRF Rating: C-2 (1999-2004); B-3 (2005-2015); B-2 (2016-2020); B-1 (2021-2026)

#### **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              | 13                  | 0       |
| Masters              | 11                  | 3       |
| PhD                  | 11                  | 6       |
| Postdoctoral fellows | 15                  | 1       |

### **viii) Undergraduate teaching**

Geology II – Palaeobotany GEOL2008 – average 65 students per year  
Biology III – Palaeobotany APES3029 – average 45 students per year  
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology;  
Micropalaeontology – average 12-20 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 –  
Associate Editor *Open Science UK*: 2021 -  
Review of manuscripts for ISI-listed journals: 30 local and international journals  
Reviewing of funding applications for NRF, PAST, NWO, SIDA, National Geographic,  
Leakey Foundation

### **x) Palaeontological Impact Assessments**

Selected from the past five years only – list not complete:

- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klippoortjie 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
- Lielifontein 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
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for EnviroPro
- Frankfort-Windfield Eskom Powerline 2020 for 1World
- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage
- Smithfield-Rouxville-Zastron PL 2021 for TheroServe

### **xi) Research Output**

Publications by M K Bamford up to January 2022 peer-reviewed journals or scholarly books: over 160 articles published; 5 submitted/in press; 10 book chapters.

Scopus h-index = 30; Google scholar h-index = 35; -i10-index = 92

Conferences: numerous presentations at local and international conferences.