

**Palaeontological Impact Assessment for the proposed  
Construction of the Bospoort pipeline, northeast of  
Rustenburg, Gauteng Province**

**Desktop Study**

**For**

**Ecoleges Environmental Consultants**

**31 March 2019**

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## **Expertise of Specialist**

The Palaeontologist Consultant is: Prof Marion Bamford  
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf  
Experience: 30 years research; 22 years PIA studies

## **Declaration of Independence**

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Ecoleges Environmental Consultants, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature:

A handwritten signature in blue ink, appearing to read 'M. Bamford', is written over a horizontal line.

## **Executive Summary**

A Palaeontological Impact Assessment was requested for the proposed construction of a pipeline from Bospoort dam, through Kana towards Rustenburg, Gauteng Province. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed project.

The site is on ancient intrusive rocks of the Pyramid Gabbro-norite, Rustenburg Layered Suite, Bushveld Complex. These rocks are igneous in origin and have been metamorphosed so there NO chance of fossils being preserved in these rocks. As far as the palaeontology is concerned the project may proceed.

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# 1. Background

A Palaeontological Impact Assessment was requested for the proposed construction of a water pipeline from Bospoort Dam, south-westwards through the town of Kana towards Rustenburg.

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 presented here.

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 <b>Error! Reference source not found.</b>
An identification of any areas to be avoided, including buffers	N/A
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
Any mitigation measures for inclusion in the EMPr	N/A
Any conditions for inclusion in the environmental authorisation	N/A
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8

A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	N/A
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	N/A
A description of any consultation process that was undertaken during the course of carrying out the study	N/A
A summary and copies if any comments that were received during any consultation process	N/A
Any other information requested by the competent authority.	N/A

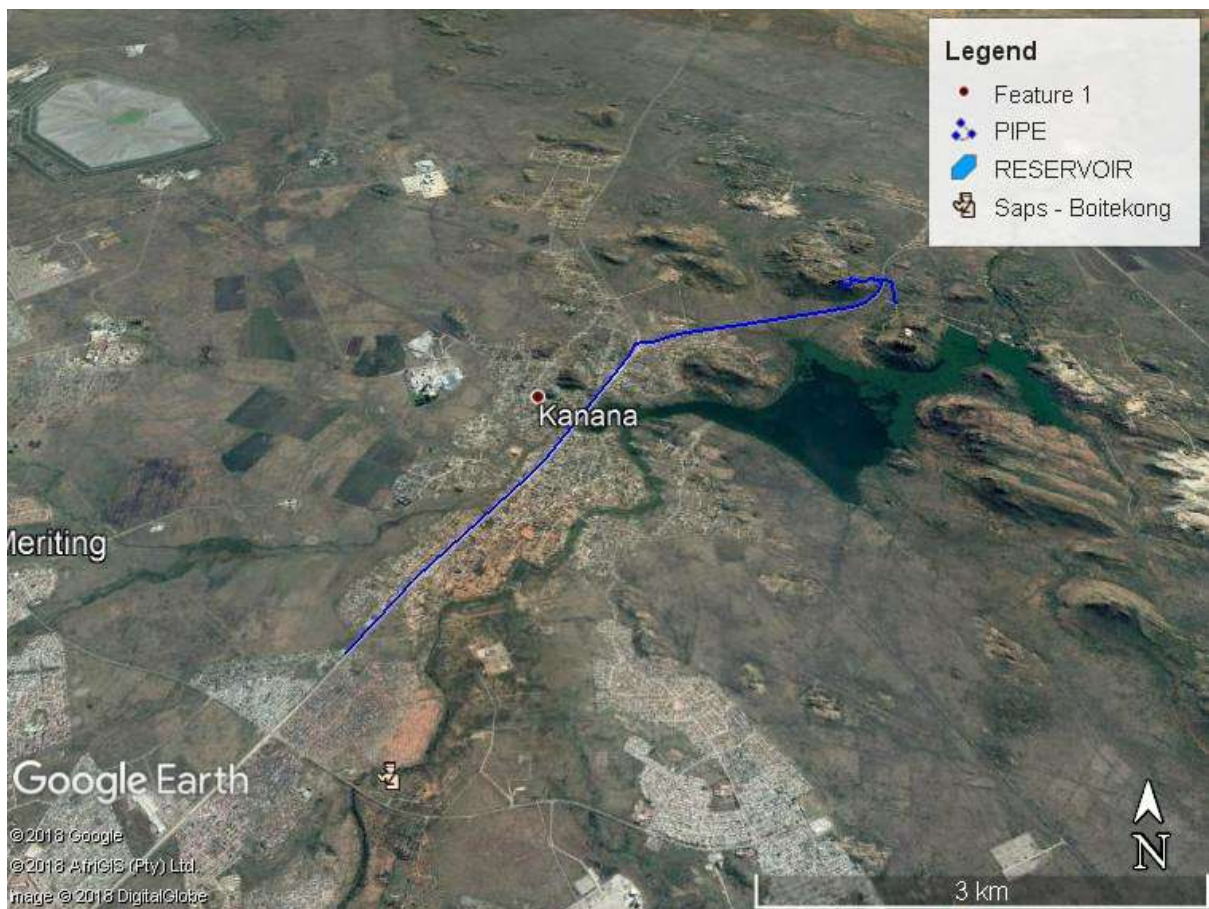


Figure 1: Google Earth map of the proposed route of the Bospoort pipeline, northeast of Rustenburg. Map supplied by Ecoleges Environmental Consultants.

## 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 2: Geological map of the area northeast of Rustenburg and Kana/Kanana. The location of the proposed pipeline routes is within the blue rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey map 1: 250 000 2526 Rustenburg, 1981.

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

Symbol	Group/Formation	Lithology	Approximate Age
Vvi	Villa Nora Gabbro	Gabbro, anorthosite	>2050 Ma
Vpy	Pyramid Gabbronorite, main zone, Rustenburg Layered Suite, Bushveld Complex	gabbronorite	>2050 Ma
Vn	Kolobeng Norite, marginal zone, Rustenburg Layered Suite	norite	>2050 Ma
Vsl	Schilpadnest Subsuite, Rustenburg Layered Suite, Bushveld Complex	Norite, pyroxenite, anorthosite	>2050 Ma
Vvl	Vlakfontein Subsuite, Rustenburg Layered Suite, Bushveld Complex	Bronzitie, harzburgite, norite	>2050 Ma
Vmg	Magaliesberg Fm, Pretoria Group, Transvaal SG	Sandstone with mudrock lenses and interbeds	Ca 2100 Ma
Vsi	Silverton Fm, Pretoria Group, Transvaal SG	Shale, basalt, tuff	Ca 2222 Ma

The site is in the heart of the Bushveld Complex, in the western limb of the Rustenburg Layered Suite. The Bushveld Complex is the largest mafic layered intrusion in the world and the ore reserves of the platinum group elements, namely platinum, chromium and vanadium are exploited on a large scale (Cawthorn et al., 2006). These volcanic rocks have intruded between and through the Pretoria Group rocks (Transvaal Supergroup), the Rooiberg Group, Lebowa Granite Suite and the Rashoop Granophyre (ibid). In the Transvaal Basin the Transvaal Supergroup is divided into two Groups, the lower Chuniespoort Group and the upper Pretoria Group (with ten formations; Erikssen et al., 2006). The Malmani Subgroup comprises dolomites and limestones and is divided into five formations based on chert content, stromatolitic morphology, intercalated shales and erosion surfaces; it is the lower part of the Chuniespoort. The proposed route for the Bospoort pipeline is entirely over the Pyramid Gabbronorite

## ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figures 3-4. The site for development is in the Pyramid Gabbronorite. Gabbro is defined as a coarse-grained, black or dark green-coloured, intrusive igneous rock. It is composed mainly of the minerals plagioclase and augite. It is the most abundant rock in the deep oceanic crust. Gabbronorite has norite included within the structure. These rocks are brittle.



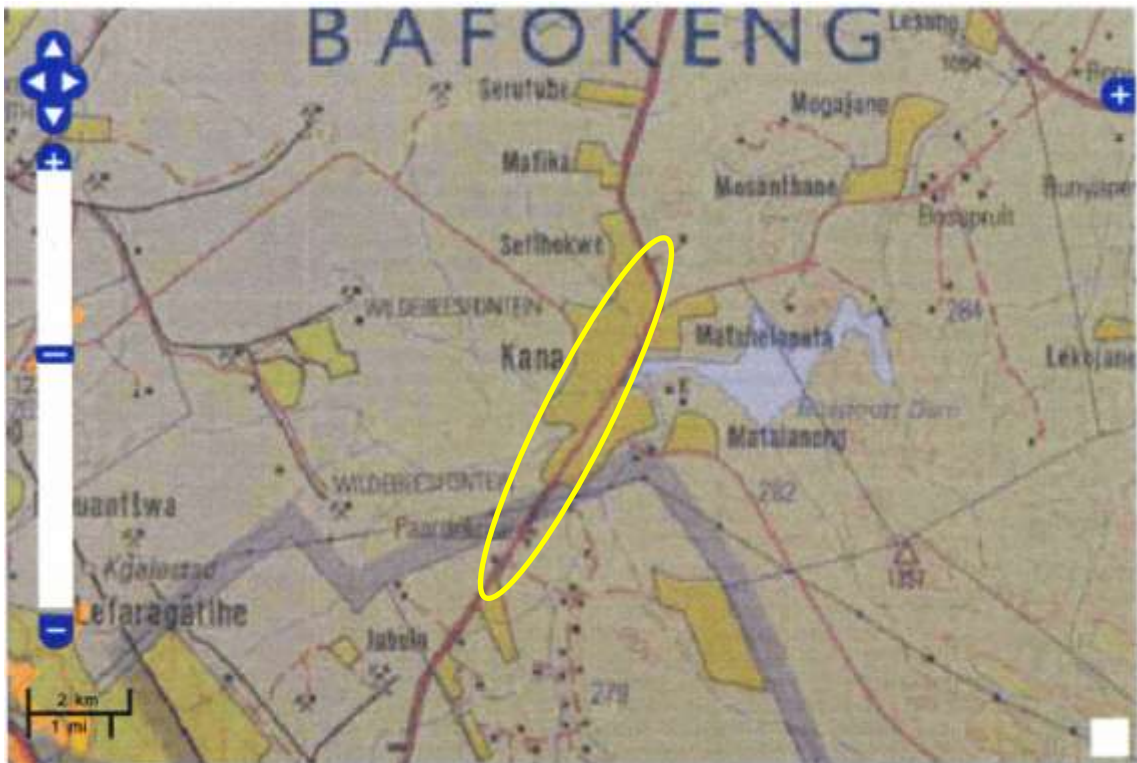


Figure 3: SAHRIS palaeosensitivity maps for the site for the route for the propose pipeline northeast of Rustenburg. Project area is within the yellow oval. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

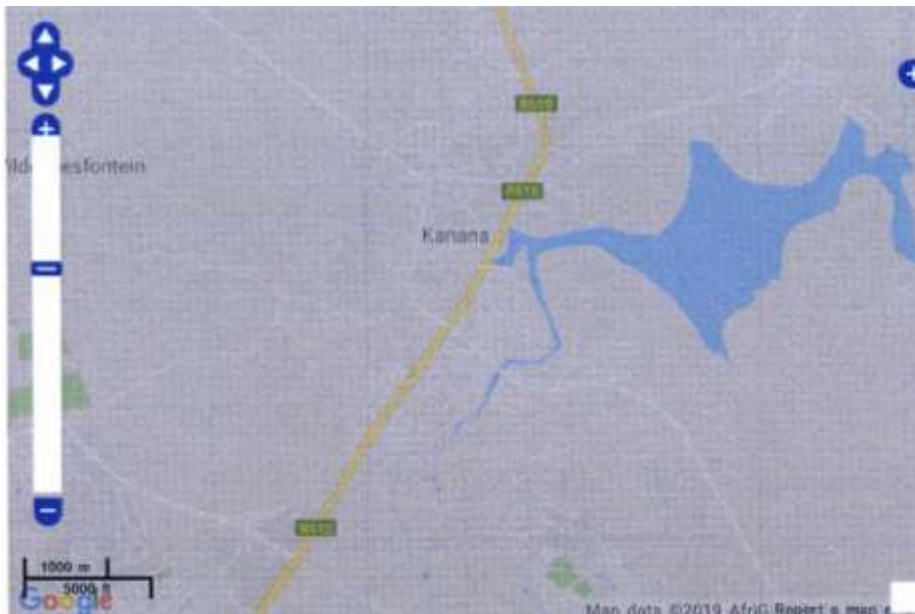


Figure 4: SAHRIS palaeosensitivity map without the infrastructure layer to confirm the “grey” colour that was obscured in Figure 3 – with infrastructure.

From the SAHRIS map above (Figures 3, 4) the area is indicated as very insignificant to zero sensitivity (grey) meaning that there is NO chance of finding fossils. The rocks are volcanic in origin and have been metamorphosed.

## 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>	No chance of fossils occurring in gabbro-norite of the Pyramid layers of the Rustenburg Layered Suite
	<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>	Fossils do not occur in gabbro-norite.
	<b>M</b>	-
	<b>H</b>	-

<b>PART B: ASSESSMENT</b>		
<b>PROBABILITY</b>	<b>H</b>	-
	<b>M</b>	-
	<b>L</b>	Zero probability of finding fossils

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 mostly much too old to contain fossils and they are of igneous origin and metamorphosed. Furthermore, no body fossils had evolved by this time. There is No chance that fossils occur in the Pyramid Gabbonorite of the Rustenburg Layered Suite, Bushveld Complex. Taking account of the defined criteria, the potential impact to fossil heritage resources is zero.

## 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 intrusive rocks of the Rustenburg Layered Suite, Bushveld Complex, in the area to the north east of the town of Rustenburg, to the Bospoort Dam does not contain any fossils. There is no evidence to the contrary. The South African Palaeontological Heritage, therefore, will not be impacted upon.

## 6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, there is no chance that any fossils would be preserved in the loose soils or the rocks below. No fossils are preserved in the igneous rocks. As far as the palaeontology is concerned the project can proceed.

## 7. References

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

Anhaeusser, C.R., 2006. Ultramafic and Mafic Intrusions and the Kaapvaal Craton. 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 95-134.

Cawthorn, R.G., Eales, H.V., Walraven, F., Uken, R., Watkeys, M.K., 2006. The Bushveld Complex. 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 261-281.

Eriksson, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its precursors. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. pp 237-260.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

## Appendix A – Details of specialist

### Curriculum vitae (short) - Marion Bamford PhD January 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,

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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 – 1984 to present  
 Royal Society of Southern Africa - Fellow: 2006 onwards  
 Academy of Sciences of South Africa - Member: Oct 2014 onwards  
 International Association of Wood Anatomists - First enrolled: January 1991  
 International Organization of Palaeobotany – 1993+  
 Botanical Society of South Africa  
 South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016  
 SASQUA (South African Society for Quaternary Research) – 1997+  
 PAGES - 2008 –onwards: South African representative  
 ROCEEH / WAVE – 2008+  
 INQUA – PALCOMM – 2011+onwards

## vii) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	6	1

Masters	8	1
PhD	10	3
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 onwards – 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
- Amandelbult 2018 for SRK
- 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
- SARA0 2018 for Digby Wells
- Ventersburg B 2018 for NGT
- Hanglip Service Station 2018 for HCAC
- 

## **xi) Research Output**

Publications by M K Bamford up to January 2019 peer-reviewed journals or scholarly books: over 125 articles published; 5 submitted/in press; 8 book chapters.

Scopus h index = 27; Google scholar h index = 29;

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)