

**Palaeontological Impact Assessment for the,
Rustenburg Platinum Mine, Amandelbult Complex's
proposed Tumela 15 East Dropdown and Dishaba 62
East Raise Bore projects,
Gauteng Province**

Desktop Study

For

SRK Consulting (Pty) Ltd

20 May 2018

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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 SRK Consulting South Africa, Johannesburg. 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

To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development of Rustenburg Platinum Mine, Amandelbult Complex's proposed Tumela 15 East Dropdown and Dishaba 62 East Raise Bore projects, Gauteng Province. The projects would occur on rocks of the Bushveld Complex Western Limb, in the northern part and therefore on the Bierskraal Magnetite Gabbro and the Pyramid Gabbro-norite. Since these rocks are over 2050 million years old they are too old to preserve body fossils. They are igneous in origin so would not preserve microfossils either. It is the opinion of the palaeontologist that this project may proceed as far as the palaeontology is concerned and no further assessments are required.

Table of Contents

Expertise of Specialist.....	1
Declaration of Independence	1
1. Background	3
2. Methods and Terms of Reference	6
3. Geology and Palaeontology	
i. Project location and geological context.....	7
ii. Palaeontological context	9
4. Impact assessment	10
5. Assumptions and uncertainties	11
6. Recommendation	11
7. References.....	11
Appendix A - CV of specialist	12.

1. Background

Anglo American Platinum, Rustenburg Platinum Mine's (RPM) Amandelbult Complex (Amandelbult) is situated within the Thabazimbi Local Municipality and Waterberg District Municipality and extends over some 20 km from west to east. The mine is approximately 15 km north northeast of the towns of Northam and 30 km south southwest of Thabazimbi on the northern part of the western limb of the Platinum Belt. The mine consists of four different operational units. The four units function as discreet business units, each headed by separate management teams.

- Tumela Mine consisting of a vertical shaft (Tumela shaft, previously known as No 1 Shaft) and a number of other incline and decline shafts, located north of the main vertical shaft;
- Dishaba Mine consisting of a vertical shaft (Dishaba shaft, previously known as No. 2 Shaft) and a number of other incline and decline shafts, located north of the main vertical shaft;
- The Concentrator and associated Tailings Storage Facility (TSF) complex; and
- Support services including offices, workshops, hospital, township, fridge plant, grouting plant and Game Park.

The main activity at Amandelbult is the mining of Platinum Group Metals (PGMs) from both the Merensky and UG2 reefs using underground and open cast mining methods. Mining at Dishaba during 2015 was at a rate of 174 kilo tonnes per month (ktpm), 324 ktpm at Tumela Mine and 43 ktpm for open cast mining (total of 541 ktpm). Anglo American Platinum estimates that adequate reserves remain for a life of mine (LOM) extending to at least 2050 with opencast mining scheduled to extend to 2024.

Opencast mining has recently been initiated at Tumela and was also undertaken in the past in the Dishaba and Tumela mining areas, with further opencast operations planned for Dishaba. The historical open cast mining ceased in 2005 and the land has been rehabilitated in accordance with the approved Environmental Management Plan (EMPr), dated 1995 and subsequent approved EMPr Addendums.

Ore mined from the reserves is processed at the Concentrator before being transported to off-site smelters for further refining. The main product is platinum with other products including gold and the PGMs rhodium, palladium, ruthenium, iridium, and osmium. By-products include copper, nickel and cobalt.

Amandelbult embarked on a concept study relating to the expansion of their underground mining operations which includes the following projects:

- Tumela 15 East Dropdown; and
- Dishaba 62 East Raise Bore.

Prior to the development of the proposed project, environmental authorisation is required by the Department of Mineral Resources (DMR) and a Water Use Licence (WUL) to be issued by the Department of Water and Sanitation (DWS). Anglo American Platinum appointed SRK Consulting South Africa (Pty) Ltd (SRK) as the independent Environmental Assessment

Practitioner (EAP) to manage and facilitate the environmental authorisation process and associated stakeholder engagement process.

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

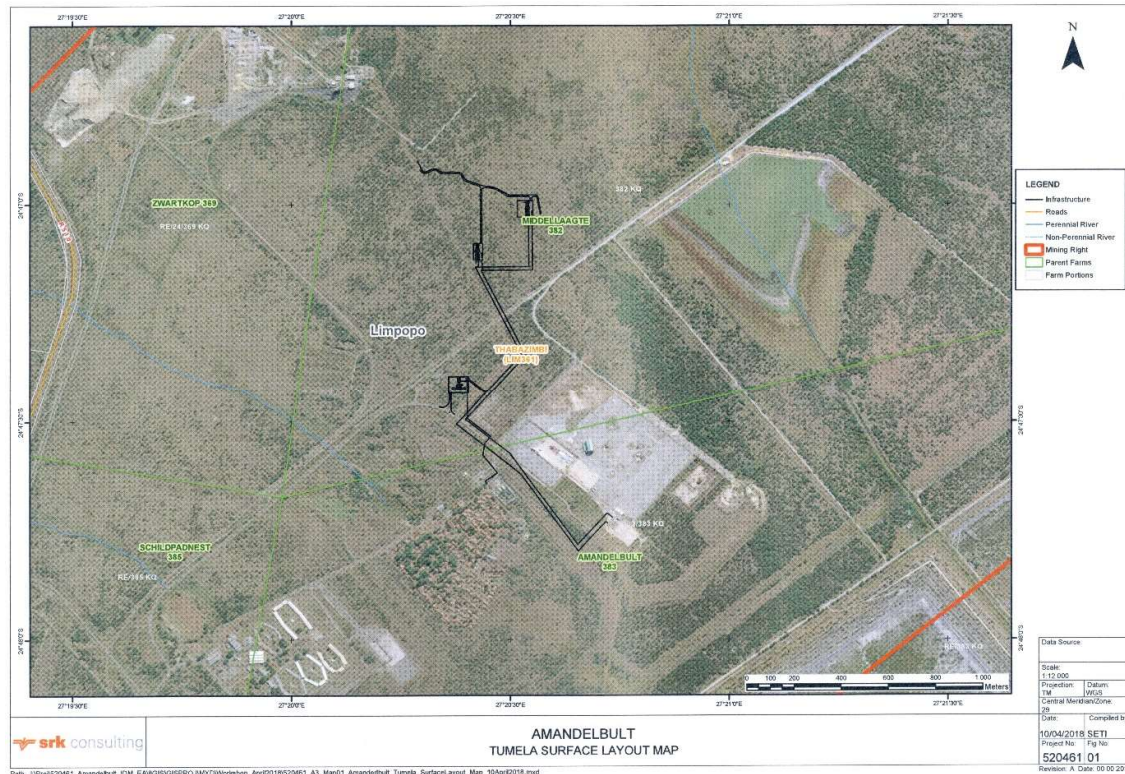


Figure 1: Detailed map of the proposed position for the Tumela 15 East Dropdown on Amandelbult, near Thabazimbi. Map supplied by SRK.

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*).

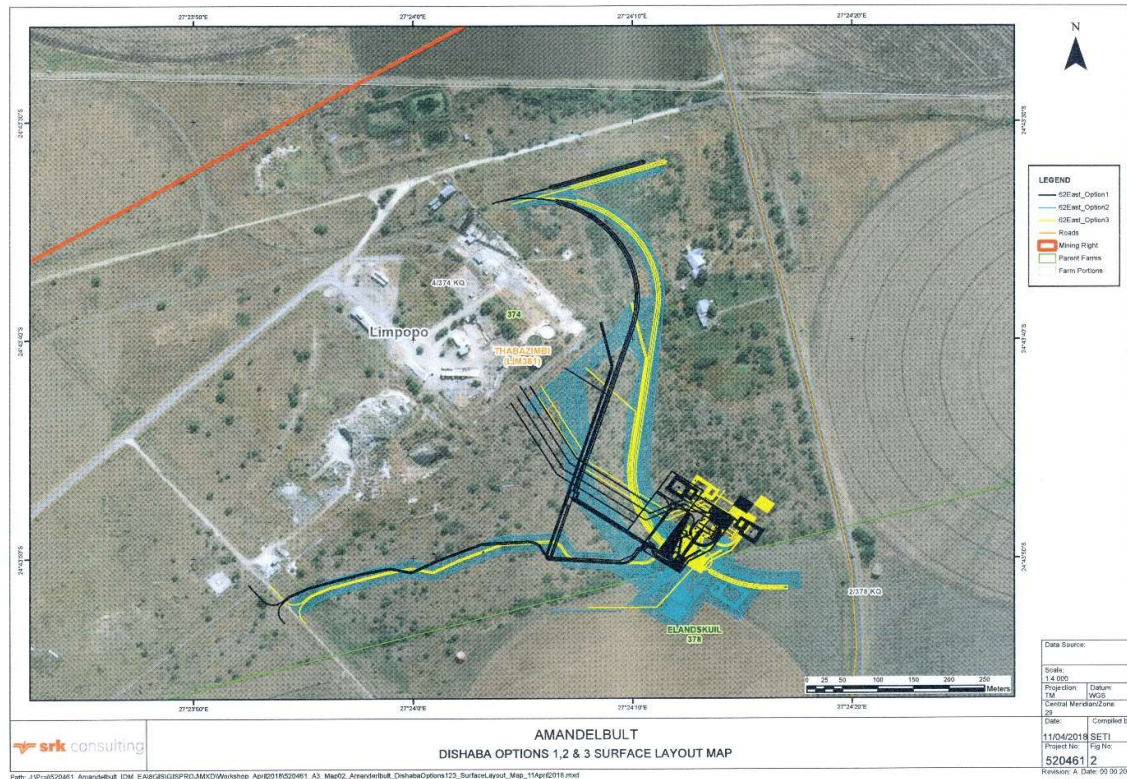


Figure 2: detailed map of Dishaba 62 East Raise Bore, on Amandelbult, near Thabazimbi. Map supplied by SRK.

3. Geology and Palaeontology

i. Project location and geological context

The project is located in the Western limb of the Bushveld Complex and in the Rustenburg Layered Suite that overlies the Rooiberg Group and is overlain by the Raseop Granophyre Suite and Lebowa Granite Suite. The Bushveld Complex is the largest mafic layered intrusion in the world and is composed of gabbro, norite and other volcanic rocks, and more importantly, the platinum group elements. Olivine-bearing pyroxenite occurs in the Amandelbult Mine. The volcanic rocks have been further metamorphosed over time.

The older rocks in the area are sedimentary rocks of the Chuniespoort and Pretoria Groups and these are exposed to the south of the proposed project in shales and sandstones of a gradually diminishing sea and shoreline facies, with sporadic regional volcanism (Erikssen et al., 2006).

Symbol	Group/Formation	Lithology	Approximate Age
Vmg	Magaliesberg Fm	Sandstone, mudrock	
Vsi	Silverton Fm, Pretoria Group	Shale, basalt, tuff	
Vs	Strubenkop Fm, Pretoria Group	shale	
Vh	Hekpoort Fm, Pretoria Group	Basaltic andesite, pyroclastic rocks	2222 Ma
Vt	Timeball Hill Fm Pretoria Group	Mudrock, diamictite, quartzite, lava	Ca 2420 Ma
Vm	Malmani Subgroup, Chuniespoort Group	Dolomite, limestone	>2500 Ma

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The site for development is in the Bierkraal Magnetite Gabbro and Pyramid Gabbro. The rocks here are volcanic and metamorphosed and are not conducive to the preservation of any fossils. (Gabbro is a coarse-grained intrusive mafic igneous rock and norite is similar but contains hypersthene (magnesium iron silicate)). Furthermore, they are over 2050 million years old, which is too old for body fossils. Dolomites occur in the Magaliesberg mountains but this is to the south. Stromatolitic dolomites can be classified as trace fossils because stromatolites are domes formed of calcium carbonate, magnesium sulphate and calcium sulphate by colonies of bluegreen green algae in warm, shallow seas or alkaline lakes. Only very few stromatolites contain evidence of the algae and these are microscopic. None has been reported from these rocks.

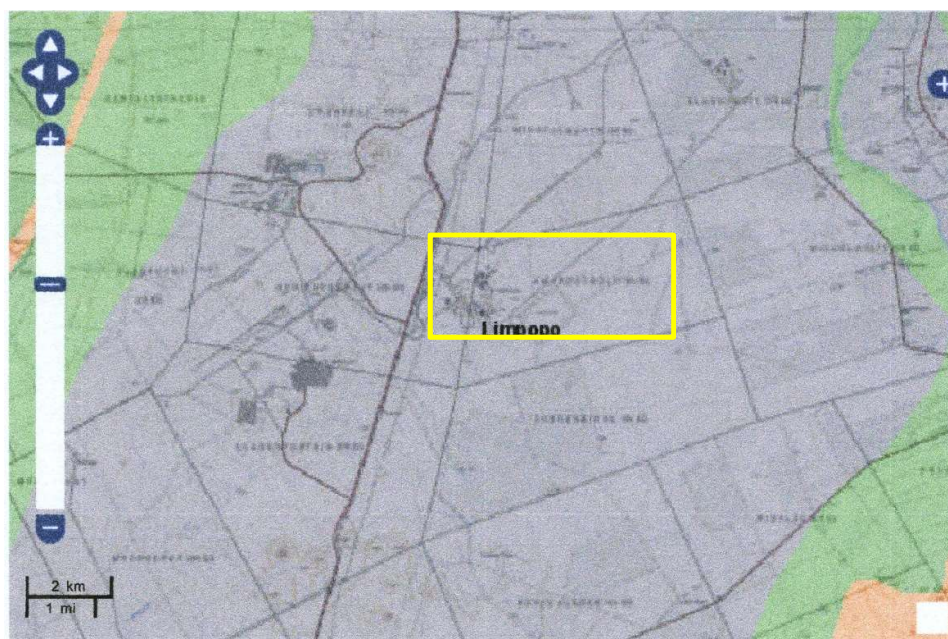


Figure 3: SAHRIS palaeosensitivity map for the region. The proposed Amandelbult project is shown within the yellow rectangular outline. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

Amandelbult, with the two projects to be developed, the Dishaba 62 East Raise Bore and Tumelo15 East Dropdown, fall within the low sensitivity area (blue).

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

TABLE 3A: CRITERIA FOR ASSESSING IMPACTS

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	H	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	L	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	L	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	H	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

TABLE 3B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	H	-
	M	-
	L	. No fossils occur in these rocks so there will be no impact
	L+	-
	M+	
	H+	-
DURATION	L	
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	L	Only if fossils occurred in the rocks

PART B: ASSESSMENT		
PROBABILITY	M	-
	H	-
	H	-
	M	-
	L	There is no chance of finding fossils as the rocks are igneous and too old

Based on the nature of the project, surface activities and underground activities would impact on the fossils if there were any present. The rocks are too old and volcanic/igneous in origin with some degree of metamorphism too, so do not preserve fossils. No fossils have been recorded from this site. Taking account of the defined criteria, the potential impact to fossil heritage resources is nil.

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 dolomites, sandstones, shales, gabbros, norites, granites, pyroxenites and magnetite gabbros are typical for the country and do not contain fossil plant, insect, invertebrate and vertebrate material.

6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils will be identified in the proposed sites at Amandelbult to expand their underground mining operations that includes the following projects: the Tumela 15 East Dropdown and the Dishaba 62 East Raise Bore. The SAHRIS palaeosensitivity map indicates that there is a low sensitivity and the desktop study shows that there is no potential for finding fossils. Taking these criteria into account, as far as the palaeontology is concerned the projects may go ahead and no further palaeontological impact assessment is required.

7. References

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.

Erikssen, 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.

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.

Appendix A – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD May 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
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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	5	2
Masters	8	1
PhD	10	2
Postdoctoral fellows	7	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
- 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 January 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)