

**Palaeontological Impact Assessment for the Mining  
Rights Application for sand on Farm  
Bezemfontein 213, Laingsburg District,  
Western Cape Province**

**Desktop Study**

**For**

**Archaeological and Heritage Services Africa (Pty) Ltd**

**29 November 2019**

**Prof Marion Bamford**

Palaeobotanist

P Bag 652, WITS 2050

Johannesburg, South Africa

[Marion.bamford@wits.ac.za](mailto:Marion.bamford@wits.ac.za)

## Expertise of Specialist

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

## Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Archaeological and Heritage Services (Pty) Ltd, 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**

A palaeontological Impact Assessment was requested for the Mining Rigts Application for sand on portion Waterval on farm Bezemfontein 213, Laingsburg District. In order 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 project.

The proposed site lies on the shales and sandstones of the Waboomberg Formation (Bidouw Subgroup, Bokkeveld Group, Cape Supergroup) and there is a small chance that invertebrate fossils, such as trilobites, could occur here because they have been reported from the same formation in the Ceres area. However, it is unlikely that any fossils will occur in the loose that this is to be mined. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no palaeontological site visit is required and as far as the palaeontology is concerned the mining for sand and rehabilitation of the land may proceed.

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# 1. Background

The applicant Blou Berg Eiendom (Pty) Ltd has applied for a Mining Permit on “A Portion of Portion 5 (a portion of Portion 2 – Waterval) of the Farm Bezemfontein 213. The area, 4.99 HA is located in the Laingsburg District (Figures 1, 2).

Sand will be excavated using a TLB and Front-end loader and loaded onto Tipper Trucks as a marketable product. On completion of the mining operation, the various surfaces, including the access road, the office area, storage areas and the mining area, will finally be rehabilitated as follows: All material on the surface will be removed to the original topsoil level where possible, and excavations sloped and made safe. All infrastructures, equipment, and other items used during the operational period will be removed from the site.

On completion of operations, all buildings, structures or objects on the office site will be dealt with in accordance with regulation 44 of the Minerals and Petroleum Resources Development Act, 2002.

A Palaeontological Impact Assessment was requested for the mining rights application. 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 and is presented herein

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

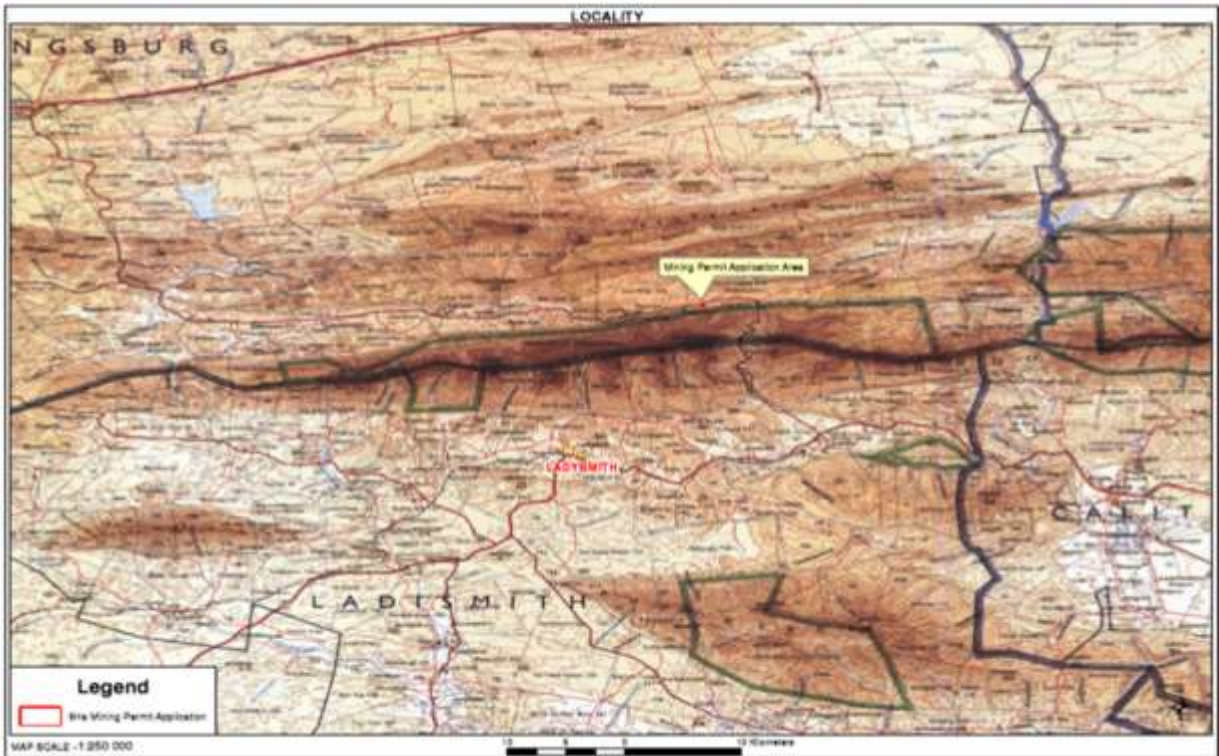


Figure 1: Topographic map of the site for the Mining Rights Application on the portion Waterval on Farm Bezemfontein 213. Map supplied by Blouberg Eiendomme (Pty) Ltd via Dr Matenga.

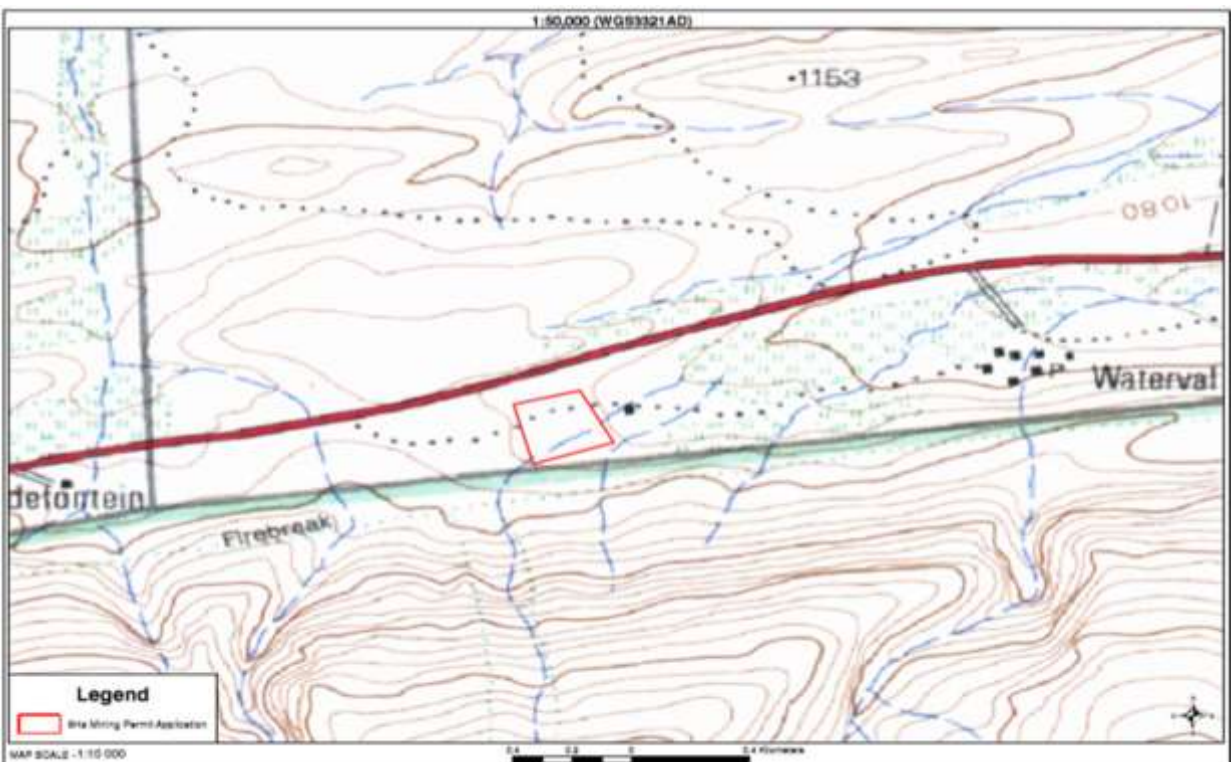


Figure 2: Detailed topographic map showing the site for sand mining on portion Waterval of Farm Bezemfontein 213, in the red rectangle.

## 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

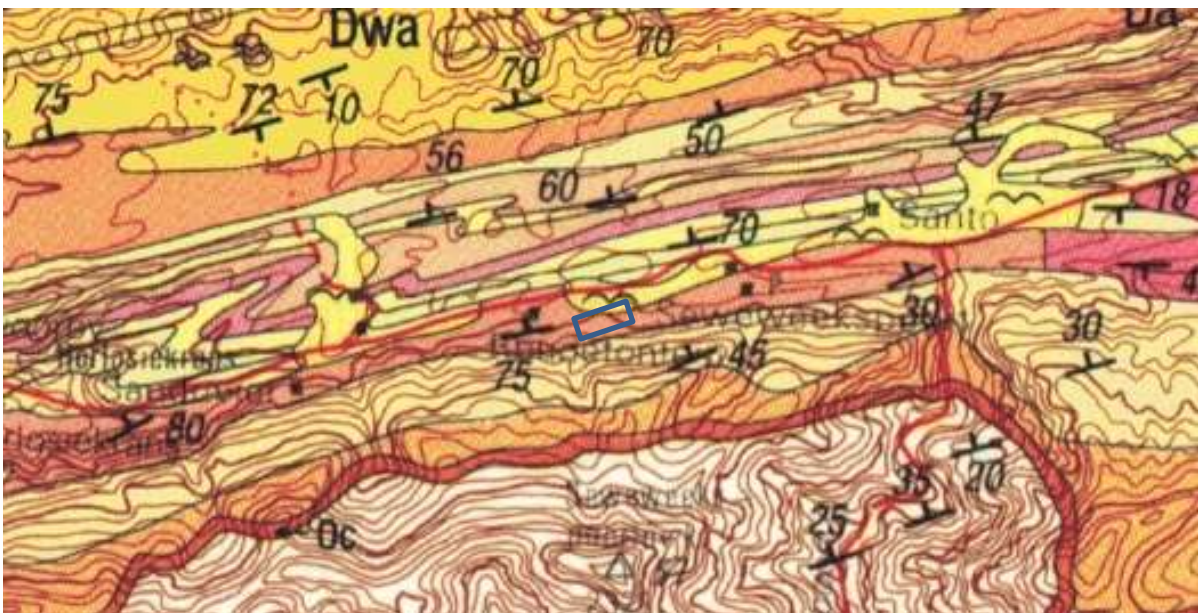


Figure 3: Geological map of the area around Farm Bezemfontein 213, north of the town of Ladismith. The location of the proposed project is indicated within the blue rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 3320 Ladismith.



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

Symbol	Group/Formation	Lithology	Approximate Age
Da	Adolphspoort Fm, Traka Subgroup, Bokkevekd Group, Cape SG	Siltstone, shale, argillaceous sandstone	Devonian
Dw	Waboomberg Fm, Bidouw Subgroup, Bokkeveld Group, Cape SG	Mudrock, siltstone, sandstone	Devonian
Dh	Hex River Fm, Ceres Subgroup, Bokkeveld Group, Cape SG	Protosandstone, siltstone	Devonian
Db	Baviaanskloof Fm, Nardouw Subgroup, Table Mountain Group, Cape SG	Micaceous sandstone	Devonian
Ss	Skurweberg Fm, Nardouw Subgroup, Table Mountain Group, Cape SG	sandstone	Silurian
Sg	Goudini Fm, Nardouw Subgroup, Table Mountain Group, Cape SG	Sandstone	Silurian
Os	Skiereiland Peninsular Fm, Table Mountain Group, Cape SG	Quartzitic sandstone, shale and conglomerate	Ordovician

The portion Waterval, farm Bezemfontein 213 lies in the Cape Supergroup on a steep slope so rocks of the Ordovician, Silurian and Devonian are in close proximity (Figure 3). Representing a passive margin basin, the Cape Supergroup represents about 170 million years of deposition that was then deformed in the Cape Orogeny (mountain-building) (Thamm and Johnson, 2006). All the sediments are sandstone dominated and the depositional environments range from shallow marine to fluvial with a glacial interlude towards the middle (ibid). Penn-Clarke et al. (2018) have measured many sections in detail and shown the presence of a number of fining upwards sequences.

## ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for sand mining in portion Waterval is in the Waboomberg Formation (Bidouw Subgroup, Bokkeveld Group, Cape Supergroup) and is composed of mudrock, siltstone and sandstone that were deposited on and offshore shelf, prodelta slope (Thamm and Johnson, 2006). Some fossil invertebrates have been recorded from the Waboomberg Formation but in the Ceres

area, quite some distance from this site. The phacopid trilobite, *Pennaia*, was photographed by Almond (in Thamm and Johnson, 2006). There is also a small chance of trace fossils of invertebrate burrows occurring in the finer-grained siltstones.

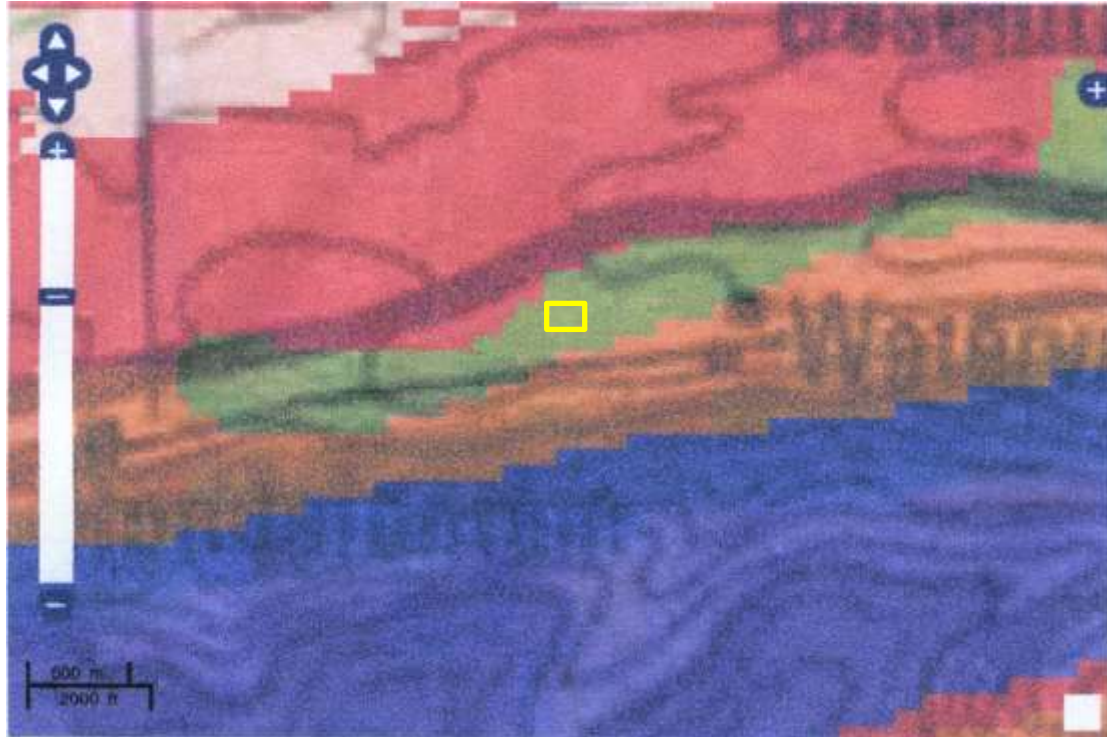


Figure 4: SAHRIS palaeosensitivity maps for the site for the proposed mining rights application on portion Waterval of Farm Bezemfontein 213 shown within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as moderately sensitive (green) so a desktop PIA has been completed.

#### 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.

	<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>	Loose sands do not preserve plant or invertebrate fossils; so far there are no records from this site but there are records from near Ceres 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 very fragmentary fossil plants, trilobites or invertebrate burrows from the Waboomberg Fm hard shales, 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 mined, 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 the right age to contain fossils but in the finer-grained material that has not weathered to form loose sand. Furthermore, the material to be mined is loose sand and this does not preserve fossils. Since there is an extremely small chance that fossils from the Waboomberg Formation may be disturbed, although none has been reported from this site, 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 sandstones, shales and sands are typical for the country and could contain fossil, invertebrates and invertebrate burrows. The loose sands 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 loose sands of the Waboomberg Formation of the Devonian. There is a very small chance that fossil may occur in the adjacent hard shales and sandstones so a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once mining has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

## 7. References

Penn-Clarke, C.R., Rubidge, B.S., Jinnah, Z.A., 2018. High palaeolatitude environmental change during the early to middle Devonian: insights from Emsian-Eifelian (lower-middle Devonian) siliciclastic depositional systems of the Ceres Subgroup (Bokkeveld Group) of South Africa. *Journal of Sedimentary Research*, 88, 1040–1075.

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.

Thamm, A.G., Johnson, M.R., 2006. The Cape 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 443 – 460.

## 8. Chance Find Protocol

### **Monitoring Programme for Palaeontology – to commence once the mining begins.**

1. The following procedure is only required if fossils are seen on the surface and when 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) should be put aside in a suitably protected place. This way the mining 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 1.5). 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/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 mining and rehabilitation have finished then no further monitoring is required.

## Appendix A – Examples of fossils from the Cape Supergroup.

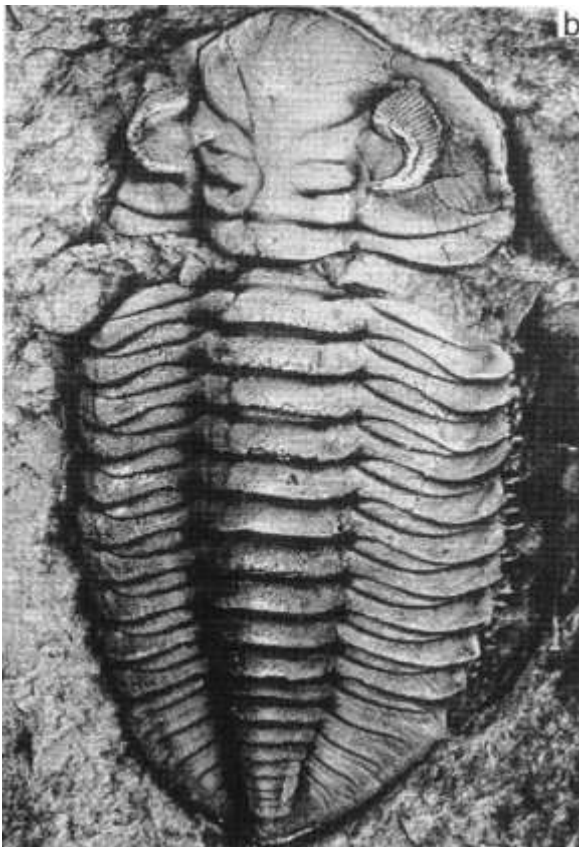


Figure 5: trilobite from the Waboomberg Formation at Ceres. Photograph from Thamm and Johnson, 2006, page 451.

## Appendix B – Details of specialist

### Curriculum vitae (short) - Marion Bamford PhD September 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, Johannesburg, South Africa-  
Telephone : +27 11 717 6690  
Fax : +27 11 717 6694  
Cell : 082 555 6937  
E-mail : [marion.bamford@wits.ac.za](mailto:marion.bamford@wits.ac.za) ; [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.

#### 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 -

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

## **xi) Research Output**

Publications by M K Bamford up to June 2018 peer-reviewed journals or scholarly books: over 140 articles published; 5 submitted/in press; 8 book chapters.

Scopus h index = 27; Google scholar h index = 32;

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)