

**Palaeontological Impact Assessment for the proposed
construction of pipelines around Polokwane,
Limpopo Province.**

Desktop Study

For

Heritage Contracts and Archaeological Consulting

09 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 Heritage Contracts and Archaeological Consulting, Modimolle, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

A Palaeontological Impact Assessment was requested for the proposed construction of pipelines around Polokwane in three phases, Limpopo 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 routes are mostly on ancient igneous rocks, granites and granodiorites of the Cleremont Formation, Waterberg Group and these do not have fossils. The pipelines may cross the Sand and Bloed Rivers where Quaternary Kalahari sands are present. These sands however, are fluviially deposited and the rivers are still active so it is extremely unlikely that trace fossils of roots and burrows would be preserved. Since the impact on the fossil heritage is extremely unlikely, the project may proceed as far as the palaeontology is concerned and no site visit is necessary.

Table of Contents

Expertise of Specialist.....	1
Declaration of Independence.....	1
1. Background.....	4
2. Methods and Terms of Reference	6
i. Project location and geological context.....	6
ii. Palaeontological context	8
4. Impact assessment.....	9
5. Assumptions and uncertainties.....	10
6. Recommendation.....	10
7. References.....	10
Appendix A (short CV of specialist)	11

1. Background

A proposed project to construct pipelines around the city of Polokwane has been planned for three phases and all the sections and routes are included in this palaeontology report.

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.

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 EMP, 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: Composite Google Earth map showing the proposed routes of the pipelines around Polokwane, Limpopo Province. Three phase have been planned: Phase 1 - light blue and dark blue lines; Phase 2 - red, orange and green lines; Phase 3 - red and yellow lines. Map supplied by HCAC.

2. Methods and Terms of Reference

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

The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

The Pieterburg Group represents a lithotectonic sequence produced by tectonic stacking of lithological packages (Brandl et al., 2006) and is divided into five formations: Mothiba, Ysterberg, Eersteling, Zandriverspoort and Vrischgewaagd Formations. This greenstone belt is believed to represent an intrusive-extrusive igneous complex that may have formed in shallow oceanic environment (ibid).

The Mothiba Formation comprises granodiorites and tonalitic gneisses and is Archaean in age (ca 3455 million years old).

The Turfloop Granite is one of the Neoproterozoic intrusions (2800-2500 Ma; Robb et al., 2006) in the Polokwane (Pietersburg) area.

The dominant rocks in the area are the Cleremont Formation arenites, sandstones and quartzites that were probably laid down in a relatively high energy, tidally influenced, distal subaqueous setting, along a shoreline (Barker et al., 2006).

Small exposures of Quaternary Kalahari sands are present to the north along the Sand River and to the west along the Bloed Rivier (Figure 2), with a larger expanse occurring to the southeast of Polokwane. The Kalahari Group is divided into six formations: Wessels, Budin, Eden, Mokalanen, Obogorop and Gordonia Formations (base to top; Partridge et al., 2006) distinguished by differing proportions and sizes of gravels and sands.

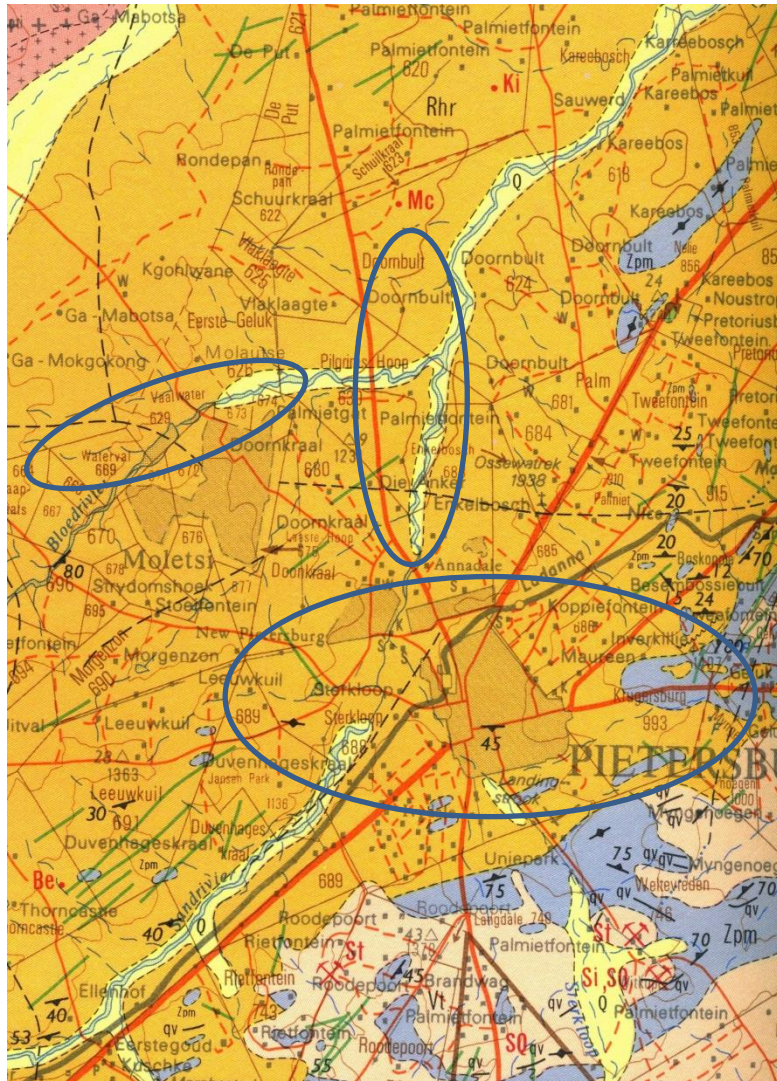


Figure 2: Geological map of the area around Polokwane, Limpopo Province. The proposed pipeline routes are within the blue oval outlines.. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 Pietersburg 2328, 1996.

Table 2: Explanation of symbols for the geological map and approximate ages (Barker et al., 2006; Brandl et al., 2006; Johnson et al., 2006; Partridge et al., 2006; Robb et al., 2006). SG = Supergroup; Fm = Formation.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary Group Kalahari sands	Sands	Last 2.5 Ma
Mc	Cleremont Fm, Kransberg Subgroup, Waterberg Group	Arenite, sandstone, quartzite	2060-1700 Ma
Vt	Turfloop Granite, Pietersburg Greenstone Belt	Granodiorite, monzogranite	2777 – 2674 Ma
Zmp	Mothiba Fm, Pietersburg	Granodiorite, tonalitic	Ca 3455 Ma

Symbol	Group/Formation	Lithology	Approximate Age
	Group	gneiss, massive unfoliated granitoids	

ii. Palaeontological context

No fossils occur in the igneous Mothiba Formation. The routes for the proposed pipelines fall mostly on the arenites of the Cleremont Formation that, because of their great age and high energy depositional environment, do not preserve any fossils.

The pipeline crosses the Sand River and the Bloed River where there are Kalahari sands of Quaternary age. These much younger sediments are the correct age for fossils but, because of their nature, windblown or fluviially transported sands, do not preserve fossils, or only rarely where there are springs or pans (Partridge et al., 2006). These two rivers, although seasonally dry today, appear to have been more substantial in the past judging by the width of the valleys they occupy (Google Earth imagery). There are no pans or springs in this area.

The palaeontological sensitivity of the area under consideration is presented in Figure 3. Most of the area has insignificant to no paleontologically sensitivity (grey on SAHRIS map) but there are small sections of moderately sensitive areas and this applies to the Quaternary Kalahari sands. It is extremely unlikely, however, that any fossils will be preserved in these fluvial or Aeolian deposits. To date no fossils have been reported from the area.

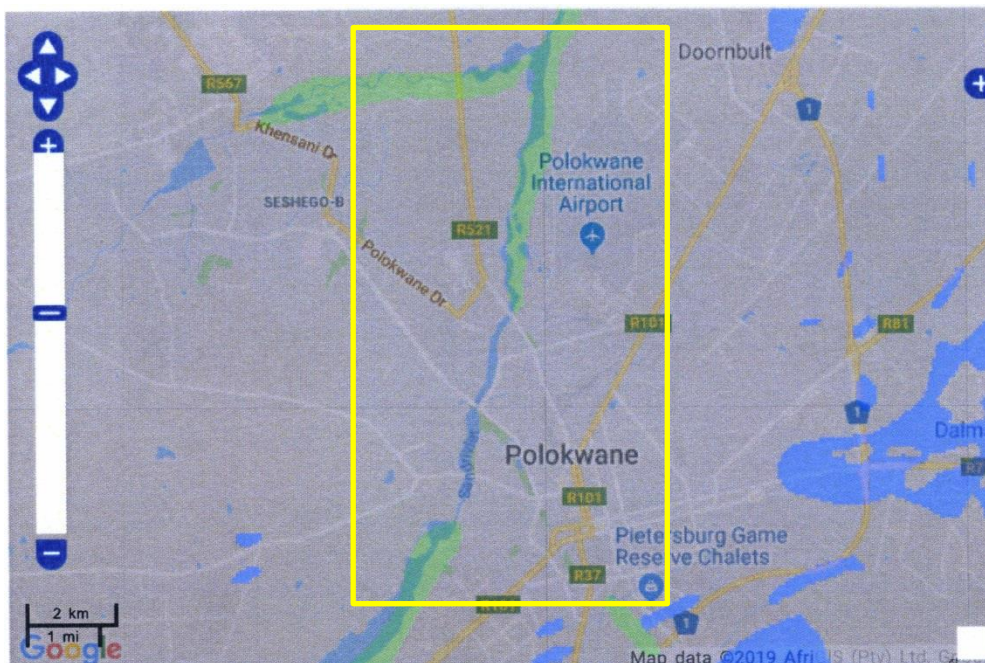


Figure 3: SAHRIS palaeosensitivity maps for the site for the proposed development around Polokwane, Limpopo Province. Project area is within the yellow rectangle. Colours indicate

the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

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 have been reported from Quaternary Kalahari sands in this area.
	L+	-
	M+	-
	H+	-
DURATION	L	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	L	Since the only possible fossils within the area would be trace fossils of root casts and burrows in consolidated sands of the Quaternary Kalahari sands, the spatial scale will be localised within the site boundary.
	M	-
	H	-

PART B: ASSESSMENT		
PROBABILITY	H	-
	M	-
	L	It is extremely unlikely that any trace fossils would be found in the sands and river beds.

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. Furthermore, no body fossils had evolved by this time to be preserved in the Cleremont Formation, Kransberg Group of the Pietersburg Group. There is only an extremely small chance that trace fossils from the Quaternary Kalahari sands may occur along the Sand and Bloed Rivers because they are fluviially deposited high energy environments. None has been recorded. 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 igneous rocks do not contain any fossils. The Quaternary Kalahari arenites, sandstones, quartzites and sands are typical for the country and might contain trace fossils of roots or burrows. The overlying modern soils 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. No fossils are preserved in the igneous rocks. Based on these criteria and as far as the palaeontology is concerned, the project can proceed.

7. References

Barker, O B., Brandl, G., Callaghan, C.C., Erikssen, P.G., van der Neut, M., 2006. The Soutspanberg and Waterberg Groups and the Blouberg Formation. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 301-318.

Brandl, G., Cloete, M., Anhaeusser, C.R., 2006. Archaean Greenstone belts. 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 9-56.

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.

Robb, L.J., Brandl, G., Anhaeusser, C.R., Poujol, M., 2006. Archaean Granitoid Intrusions. 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 57-94.

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, Johannesburg, South Africa-
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ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) Professional qualifications

Wood Anatomy Training (overseas as nothing was available in South Africa):

1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps

1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer

1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa – 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
- Klipootjie 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
- SRAO 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 = 30

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)