Palaeontological Impact Assessment for the Rooidam 101 MR application, near Windsorton, Barkly West District, Northern Cape Province

Desktop Study (Phase 1)

For

Archaeological and Heritage Services (Pty) Ltd

29 November 2020

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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 31 years research; 23 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, Pretoria, 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 Rights (MR) application on the Remaining Extent of Farm Rooidam 101 and Portion 101/1, near Windsorton, Barkly West District, Northern Cape 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 project.

The prospecting area lies on the non-fossiliferous volcanic rocks (lava, andesite, porphyritic basalt) of the Neoarchaean Allanridge Formation, Pniel Group, Ventersdorp Supergroup. There is a very small chance that fragments of transported fossils may occur along the Vaal River but they would not be of any scientific interest. Nonetheless, if fossils are found by the miners then they should be rescued and a palaeontologist called to assess their scientific value. As far as the palaeontology is concerned, the mining right should be granted and no further PIA is required.

Table of Contents

1. Background

Rooidam Plaas (Pty) Ltd has requested for a Mining Rights (MR) application on the Remaining Extent of Farm Rooidam 101 and Portion 101/1, near Windsorton, Barkly West District, Northern Cape Province (Figures 1-3). The south east border of the farm is on the west bank of the Vaal River.

A Palaeontological Impact Assessment was requested for the MR 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 reported herein.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (amended 2017)

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
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	Section 7, 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 7, 8 Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 7
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

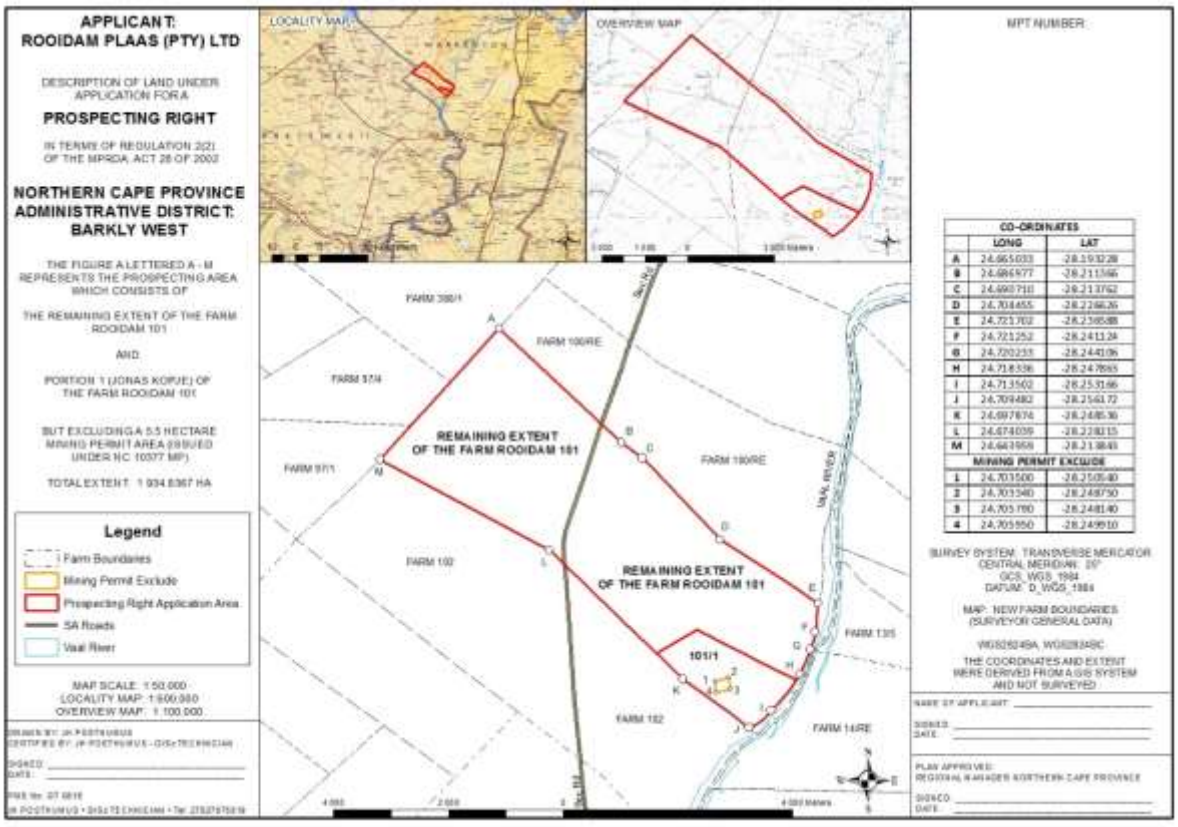

Figure 1: Map showing the region and location of the Farm Rooidam for a Mining Right application is under review. Map supplied by EM.

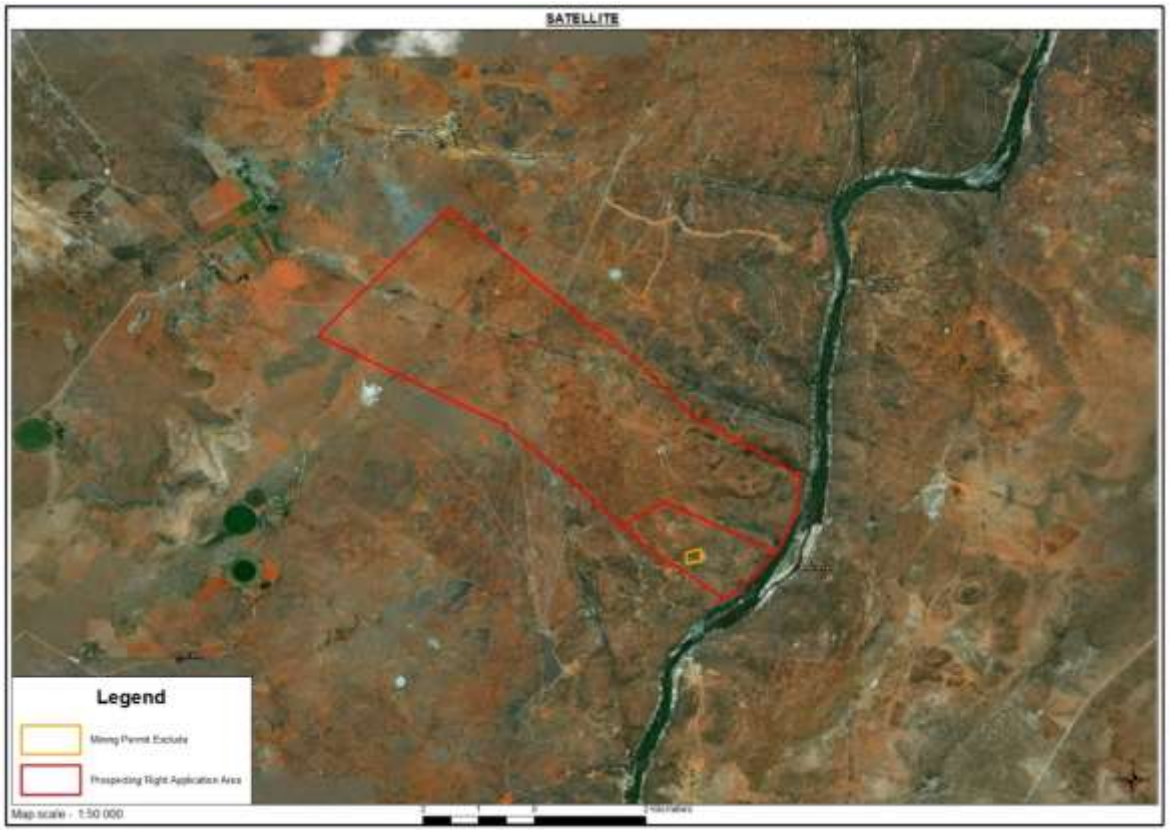

Figure 2: Google Earth map with the boundary of Farm Rooidam 101 shown in red.

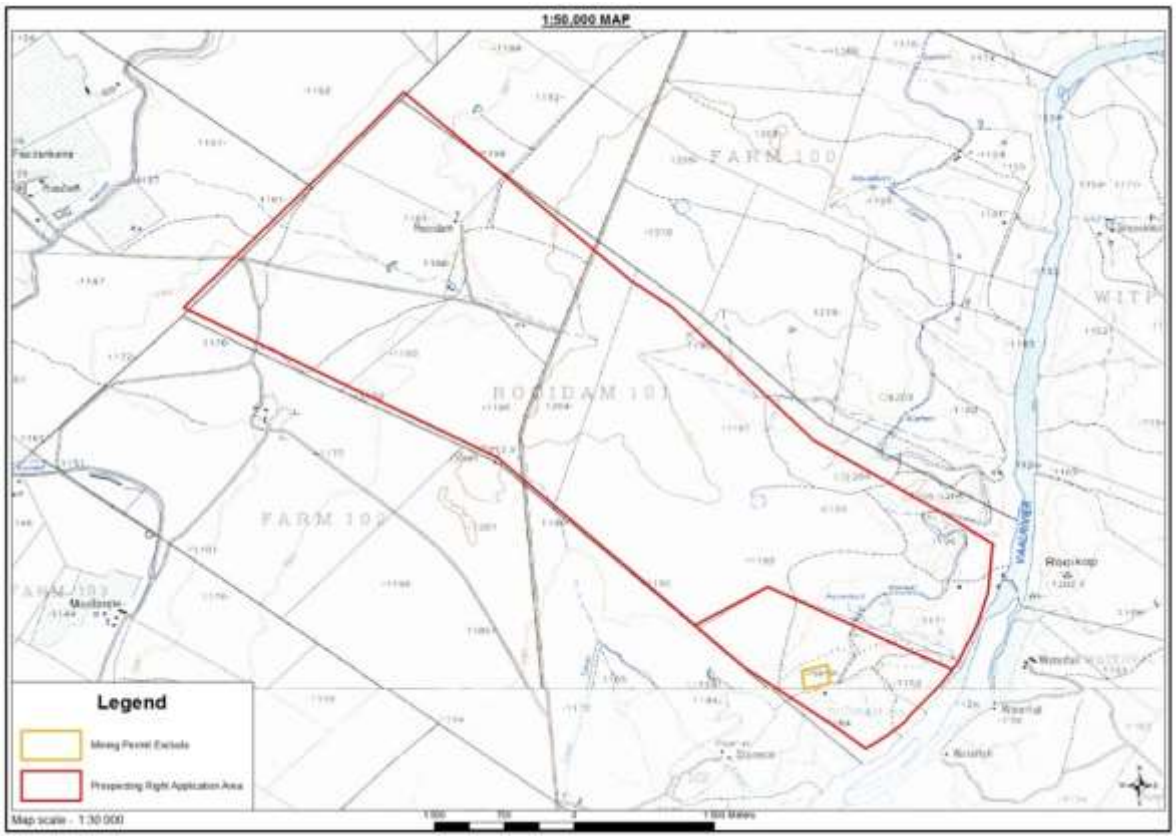

Figure 3: Detailed topographic map showing the outlines of the Farm Rooidam 101.

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 oldest rocks in the region are the lavas, andesites and porphyritic rocks of the Allanridge Formation (Pniel Group, Ventersdorp Supergroup; Figure 4, Table 2). The Ventersdorp Supergroup is underlain by the Witwatersrand Supergroup and overlain by the Transvaal Supergroup. It occupies a huge elliptical basin and is the largest and most widespread sequence of volcanic rocks on the Kaapvaal Craton (van der Westhuizen et al., 2006). There are thre groups in this Supergroup, the basal Klipriviersberg Group (with seven formations), the middle Platberg Group (with four formations) and the upper Pniel Group with two formations. Placed at the top of the sequence, the Allanridge Formation directly underlies the Transvaal Supergroup.

More recent research by Gumsley et al (2020) has shown that the Ventersdorp Supergroup has the initiation and termination of with two large igneous provinces (LIPs), the Klipriviersberg and Allanridge, that are separated by Platberg volcanism and sedimentation. The Allanridge LIP occurred between 2709–2683 Ma (ibid).

Since the Transvaal Supergroup is absent in this particular region, unconformably overlying the Allanridge Formation on the farm are the basal sequences of the Karoo Supergroup, namely the Prince Albert Formation of the Ecca Group. And unconformably overlying these sediments are the much younger sands, calcretes and limestones of the Kalahari Group Sands. Along the Vaal River there might be transported sands.

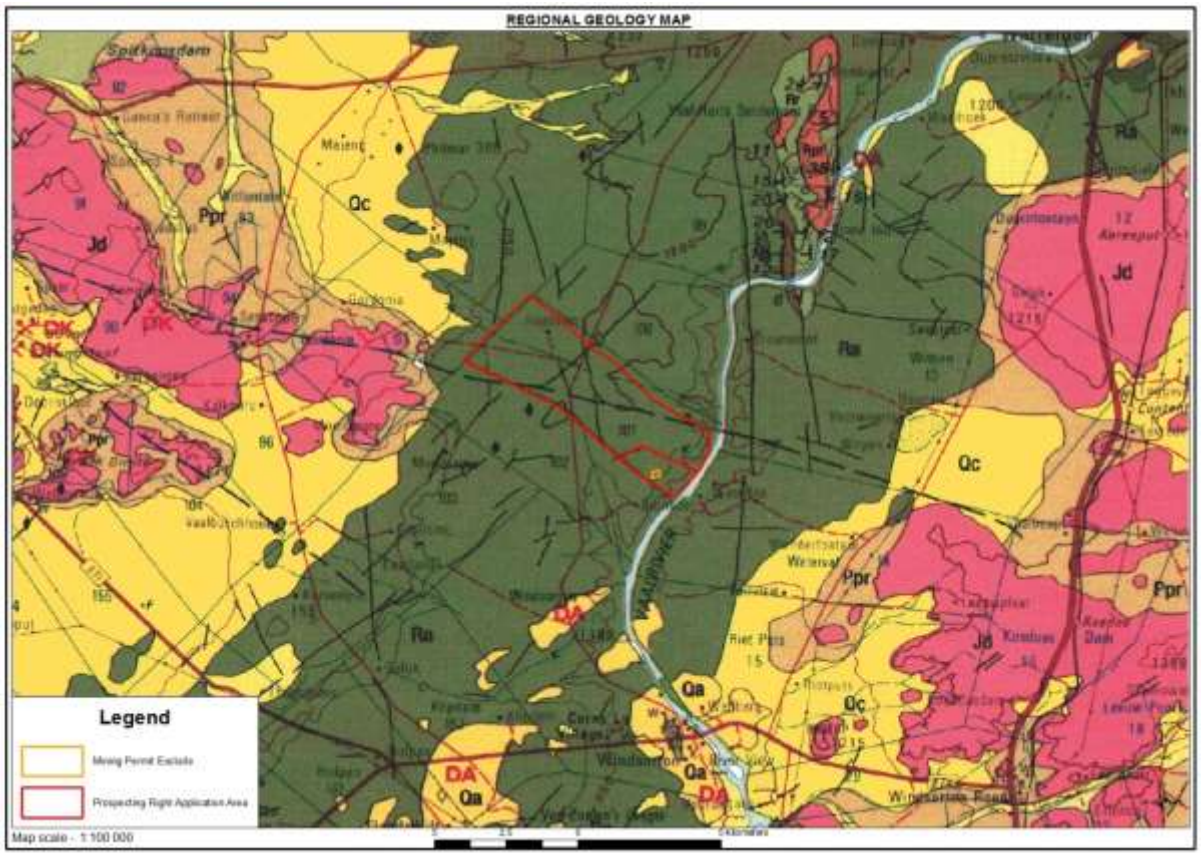

Figure 2: Geological map of the area around the Farm Rooidam. The location of the proposed project is indicated within the red outline. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2824 Kimberley.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006. Gumsley et al., 2020; Johnson et al., 2006; van der Westhuizen et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Qc	Quaternary Kalahari SAnds	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Ppr	Prince Albert Fm, Ecca Group, Karoo SG	Shales	Early Permian, Early Ecca Ca 290 – 284 Ma
Ra	Allanridge Fm, Pniel Group, uppermost Ventersdorp SG	Andesite, amygdaloidal and calcified in places, porphyritic	2709–2683 Ma

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 6. The site for development is in the Allanridge Formation with Quaternary Kalahari sands and calcretes very close to the north western margin. Since the Allanridge Formation rocks are all

volcanic in origin with varying proportions of mafic lava, amygdaloidal and prophyritic tuffs and are older than 2683 million years (Gumsley et al., 2020; van der Westhuizen et al., 2006) they are of the wrong type and too old to contain any fossils. Although the Prince Albert Formation shales are in close proximity to the site they are unlikely to contain fossils because this is at the extreme margin of the Karoo sediments and no fossils have been reported. More significantly the proposed operation will prospect for the target minerals using borehole cores and possible minor excavations. Alluvium and sands have been naturally transported here recently, from a distance by the river or would be from the weathering of local sandstones. Very rarely are fossils transported by river action and then they would be very fragments and out of context, i.e. far away from their origin, so would be of no scientific value.

Figure 5: SAHRIS palaeosensitivity map for the site for the Mining Rights Application on Farm Rooidam 101 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 having zero or insignificant sensitivity (blue) so no palaeontological impact assessment is required, for the mining activities. The geology and recent research confirms this conclusion. Although not indicated on the maps, it is possible that transported fossils might be associated with the river alluvium and gravels. These might include fragments of bone or silicified wood that have been transported by the River from higher upstream. This is unlikely as the river is fairly straight here and sands and gravels (and fossil fragments) would be re-transported every time the river floods. Note: the Pniel Group for the Allanridge Formation should not be confused with the Pniel archaeological site near Kimberley in a loop and palaeo-channel of the Vaal River.

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	Lavas and volcanic rocks do not preserve any fossils; so far there are no records from the region so it is very unlikely that fossils occur on the site. The impact would be very unlikely.
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	There is no chance of fossils occurring on the farm Rooidam. The spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	It is extremely unlikely that any fossils would be found in the loose sand that may cover the volcanic rocks. There are no loops or traps in the river so no gravels and sands (or fossil fragments) are likely to remain beyond one flood event.

Based on the nature of the project, surface activities may impact upon the fossil heritage if any fossils have been transported by the river from other sites but they would be very fragmented and out of context. The geological structures suggest that the rocks are much too old to contain fossils and also they are of the wrong kind (volcanic, not sedimentary). 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 lavas, andesites, basalts and alluvium/sand are typical for the country and do NOT contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period would not preserve fossils but there might be transported fossils in the river sands and gravels although the chance is very small because there are no loops and channels along this straight stretch of river.

6. Recommendation

Based on the geology and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the prospecting area. If transported fossils are found once mining activities have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample (see Section 8 and Appendix A). Since the palaeontological impact is very low, as far as the palaeontology is concerned, the mining right should be granted.

7. References

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

Gumsley, A., Stamsnijder, J., Larsson, E., Söderlund, U., Naeraa, T., de Kock, M., Sałacińska, A., Gawęda, A., Humbert, F., Ernst, R., 2020. Neoarchean large igneous provinces on the Kaapvaal Craton in southern Africa re-define the formation of the Ventersdorp Supergroup and its temporal equivalents. GSA Bulletin 132, 1829–1844. https://doi.org/10.1130/B35237.1

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.

Van der Westhuizen, W.A., de Bruiyn, H., Meintjes, P.G., 2006. The Ventersdorp 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 187-208.

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations / drilling / mining activities begin.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations/mining commence.
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 or wood) 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/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 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.

Appendix A – Examples of fossils from the Quaternary fluvial deposits.

Figure 5: Photographs of fragmentary fossils that might occur in trapped river gravels or palaeo-channels

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD November 2020

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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Cell : 082 555 6937
E-mail : marion.bamford@wits.ac.za ; 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	9	2
Masters	9	5
PhD	11	5
Postdoctoral fellows	10	4

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 –
Journal of African Earth Sciences: 2020 -

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
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein 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
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xi) Research Output

Publications by M K Bamford up to November 2020 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 8 book chapters.
Scopus h-index = 29; Google scholar h-index = 36; -i10-index = 80
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)