Palaeontological Impact Assessment for the proposed Prospecting Rights Application on Farm Eyerdop Pan 58, Prieska area, Northern Cape Province

Desktop Study (Phase 1)

For

Archaeological and Heritage Services (Pty) Ltd

02 March 2021

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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 32 years research; 24 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 Prospecting Rights Application of Farm Eyerdop Pan 58, south southwest of Marydale in the Prieska district.

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 proposed site lies mostly on the sands of the Gordonia Formation (Kalahari Group) and partially on non-fossiliferous metamorphic rocks of the Areachap Terrane (Natal-Namaqua Province). Fossils are only likely to be preserved in palaeo-pans or palaeo-springs in the Kalahari sands, not in the aeolian sands. There is also a chance that there are buried kimberlite pipes in the farm, like the nearby Stompoor pipe. Often these pipes have sediments preserved in the depression formed after the explosion of the pipe. Diamonds can also be retained in the kimberlite material below the lake sediments. Fossil fish, shells, plants and dinosaurs can be preserved in these sediments. Therefore, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that the drill core and excavated materials be carefully scanned for any fossil material and photographs of potential fossils sent to a palaeontologist for assessment. Any fossils would have to be removed and housed in a recognised institution for further study.

Table of Contents

1. Background

Orion Exploration No 4 (Pty) Ltd is applying for a Prospecting Right in terms of Regulation 2(2) of the MPRDA, Act 28 of 2002 in the Prieska Administrative District, Northern Cape Province. The area is 20 956.8 Ha on Farm Eyerdop Pan 58, south of Marydale.

In particular, the land parcels are Portion 1 (Neeldale) of the Farm Eyerdop Pan 58, the Remaining extent of Portion 2 (Witkop) of the Farm Eyerdop Pan 58, Portion 2 (Eijerdop Put) (a portion of Portion 2) of the Farm Eyerdon Pan 58, and Portion 4 (Rooipan) (a portion of Portion 2) of the Farm Eyerdop Pan 58 (Figure 1).

A Palaeontological Impact Assessment was requested for the project. To comply with the regulations of 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 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	N/A

	buffers;	
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, 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

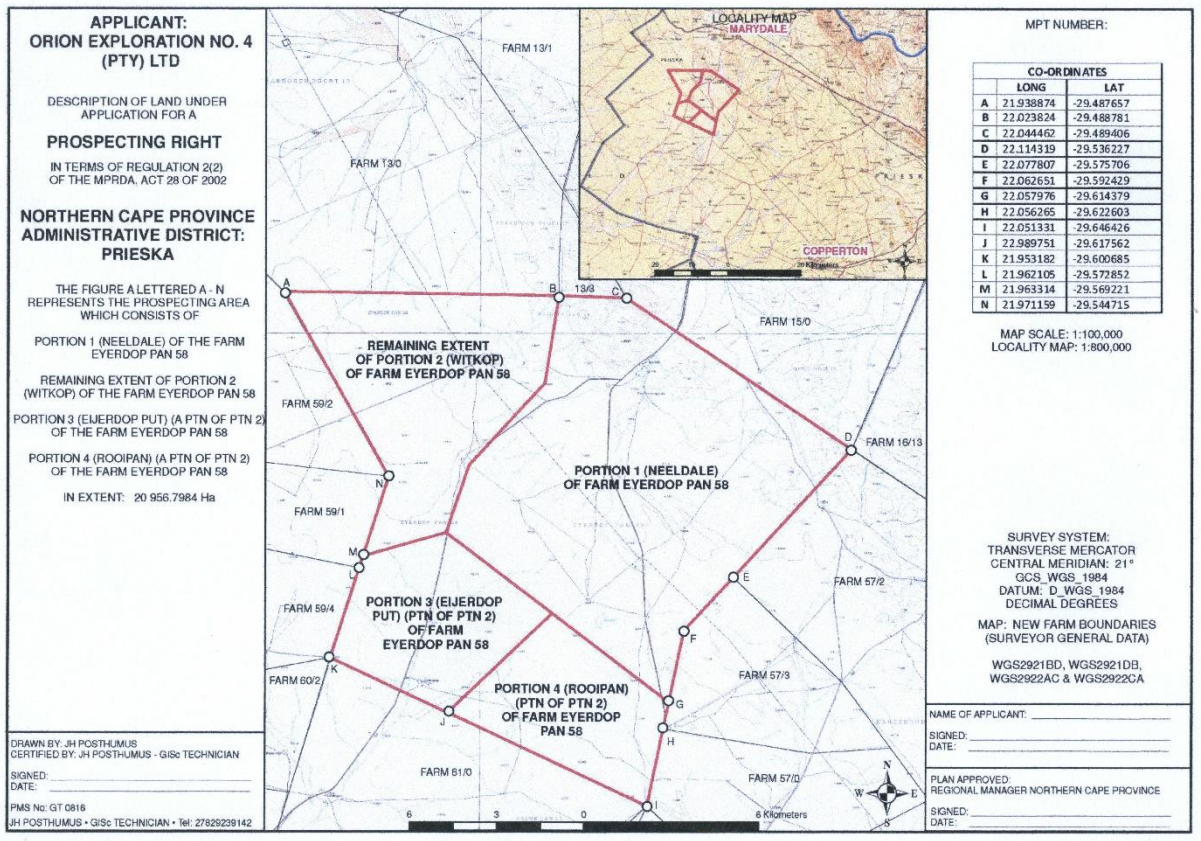

Figure 1: Map of the Eyerdop Pan 58 Prospecting Rights area shown within the red outline. Map supplied by EM.

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

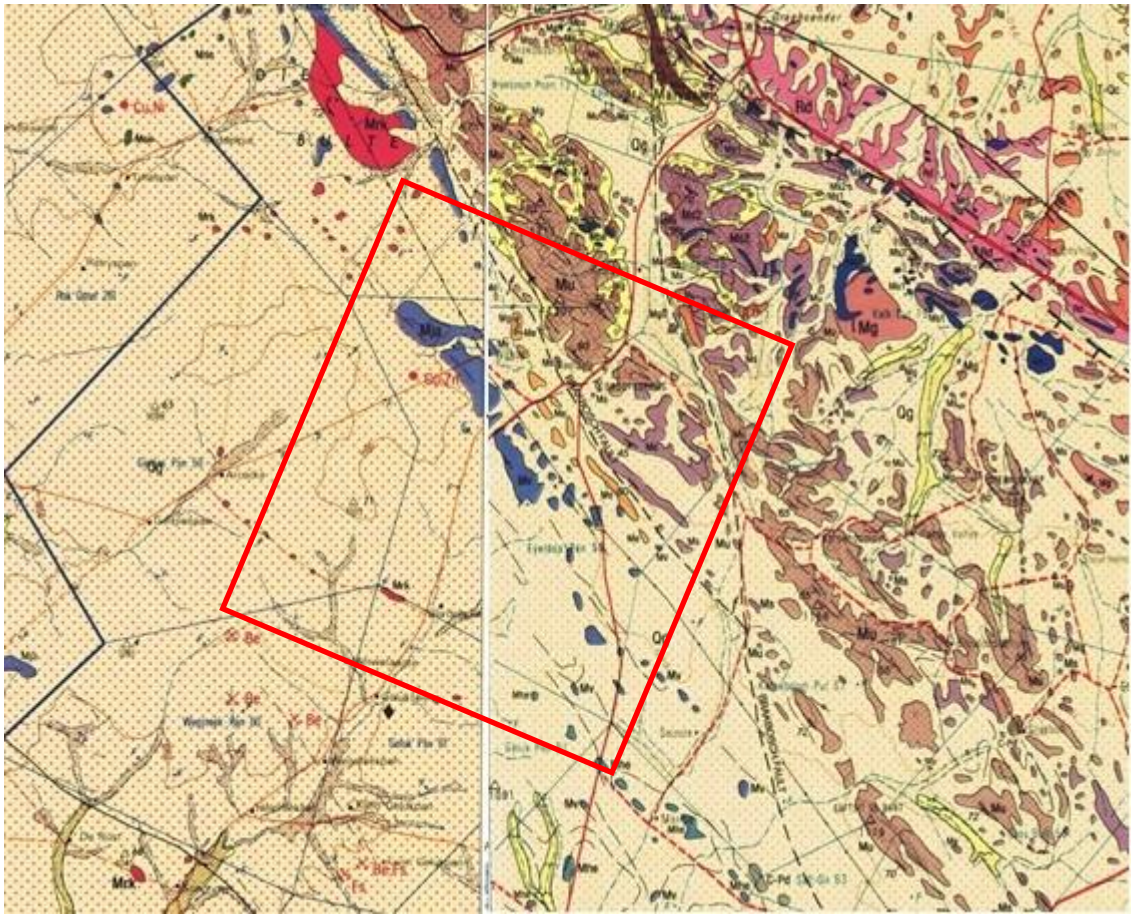

Figure 2: Geological map of the area around the Farm Eyerdop Pan 58, south of Marydale. The location of the proposed project is indicated within the red rectangle. Abbreviations of the rock types are explained in Table 2. West side of map enlarged from the Geological Survey 1: 250 000 map 2920 Kenhardt and East side from map 2922 Prieska.

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

Symbol	Group/Formation	Lithology	Approximate Age
Qg	Gordonia Fm, Kalahari Group	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
Me	Eyerdop Pan Fm, Areachap Group, Areachap Terrane, Namaqua- Natal Province	Grey medium-grained, well-foliated granite	Ca 1300 Ma
Mgh	Groblershoop Fm, Brulpan Group, Areachap	Quartz sericate schist	Ca 1300 Ma

Symbol	Group/Formation	Lithology	Approximate Age
	Terrane, Namaqua- Natal Province		
Mu	Uitdraai Fm, Brulpan Group, Areachap Terrane, Namaqua- Natal Province	Banded to massive quartzite	Ca 1300 Ma
Mhe	Hedley Plains Fm, Jacopmyns Pan Group, Areachap Terrane, Namaqua- Natal Province	Calc-silicate rocks	Ca 1300 Ma
Mv	Vogelstruisbult Fm, Jacopmyns Pan Group, Areachap Terrane, Namaqua- Natal Province	Garnet and sillimanite-bearing schist and gneiss	Ca 1300 Ma
Mk	Kaboom Fm, Areachap Terrane, Namaqua- Natal Province	Carbonatitie	Ca 1300 Ma
Ms, Ms1, Ms2	Spionkop Fm, Areachap Terrane, Namaqua- Natal Province	Fine-grained quartz; Quartz muscovite schist; Grey micaceous quartzite	Ca 1300 Ma

The site lies in the Namaqua Sector of the Namaqua-Natal Province that is subdivided into a number of tectonostratigraphic subprovinces and terranes which are distinguished by marked changes in the lithostratigraphy across structural discontinuities (Cornell et al., 2006). Of the five domains within this sector, the Areachap Terrane is the one underlying the Eyerdop Pan farm. It comprises approximately 1300 million years old arc-related supra-crustal rocks and some 1000 Ma granitoids. From the geological map (Figure 2) the numerous small outcrops of the different component formations can be seen in the north eastern part of the farm and beyond. These rocks are extrusive and highly metamorphosed so do not preserved fossils. They will not be considered further.

Overlying much of the area are the Kalahari Group sands, the Gordonia Formation. This is the largest and most extensive palaeo-erg in the world (Partridge et al., 2006) and is composed of extensive aeolian and fluvial sands, sand dunes, calcrete, scree and colluvium. Periods of aridity have overprinted the sands, and calcrete and silcrete are common.

The Kalahari sands, however, have covered kimberlite pipes in this region. Such pipes are the vents formed by gasses escaping from below the earth's crust, where it is relatively thin, and the action brought rocks and sediments up to the top, then collapsed and formed a depression. Crater lake facies often fill in these depressions and they preserve fossils, and more significantly diamonds, and so are well studied (Skinner and Truswell, 2006; de Wit et al., 2016). Kimberlite pipes range in size at the present ground level from a few metres to 5 or more kilometres, depending on the initial diameter of the pipe and down to what level it has been eroded. Not all have preserved crater lake facies but there are examples such as the Stompoor pipe (Smith, 1989), Arnot pipe on farm Banke (Scholtz, 1985), A-A pipe, House pipe (ESI herbarium), Orapa (Bamford, 1990, 2000; Rayner et al., 1997).

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The site for prospecting is covered by aeolian Kalahari sands that were derived from farther to the northwest (Goudie and Wells, 1995) and finally deposited in this region during the Quaternary. Since they are windblown the sands are not in primary context, nor do they preserve any fossils.

Fossils can only be preserved if there are spring or palaeopan deposits where wood, plants or bones can be entrapped and preserved in the calcrete or silcrete that occasionally forms in such settings. There are numerous pans in the region and most farm names indicate this.. According to Goudie and Wells (1995) three factors are required for the formation of pans, namely a setting where the fluvial system is not fully integrated, salt weathering and aeolian deflation occur. These conditions apply to this environmental setting, and there are numerous pans. Therefore, it is possible than some pans will be prospected by drilling or excavations.

To the southwest of Eyerdop Pan Farm is the Farm Stompoor 109 that has a kimberlite pipe with crater-lake facies dated to the Late Cretaceous based on the dinosaur bone mould, fossil frogs, fish, araucarian cone and pollen (Smith, 1986; Trueb et al., 2005; pers obvn).

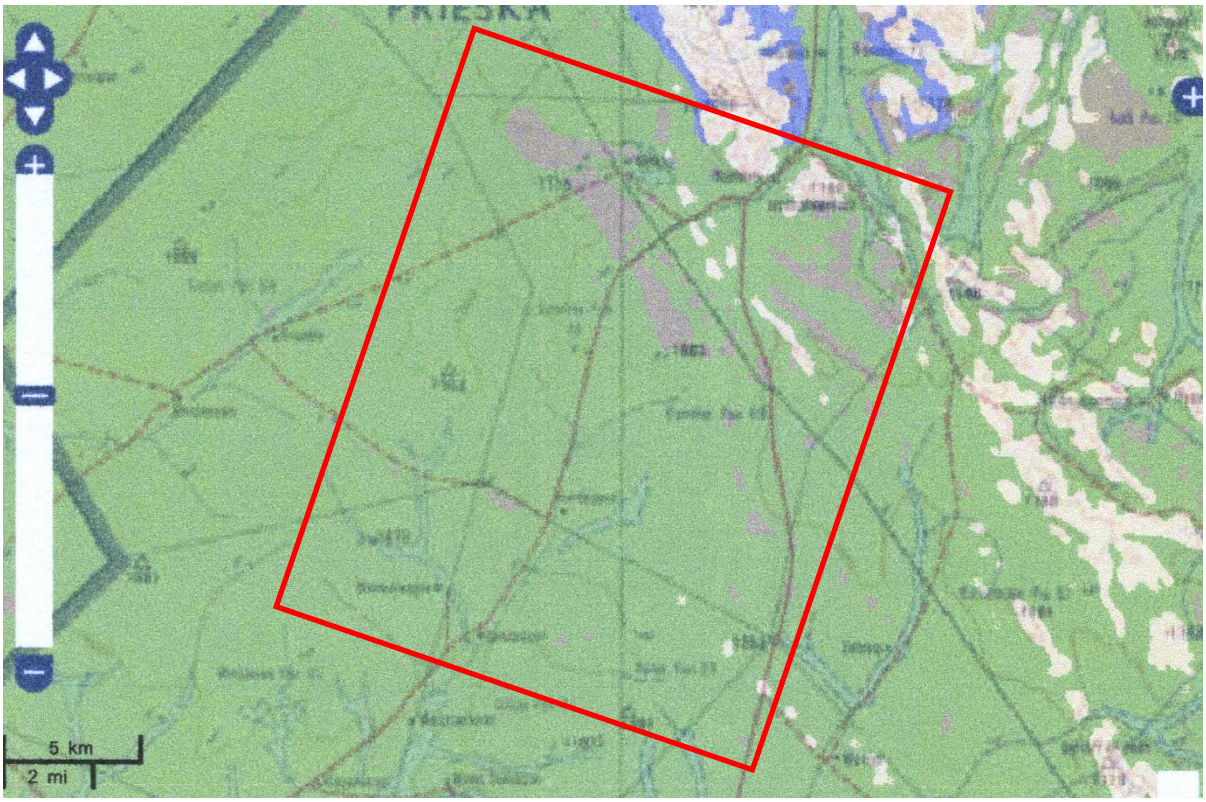

Figure 3: SAHRIS palaeosensitivity map for the site for the proposed Eyerdop Pan 58 Prospecting rights application shown within the red rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as moderately sensitive (green) and this applies to the Gordonia Formation (Kalahari Group, Quaternary) and to the upper Cretaceous kimberlite pipes. The latter are only found using magnetic surveys and drilling.

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	Sands do not preserve fossils but pans ad springs might; so far there are no records from the area; kimberlite pipes might also preserve crater lake facies with fossils such as has been recorded fro a nearby farm, Stompoor. None has been reported from this farm so it is 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.

PART B: ASSESSMENT		
SPATIAL SCALE	L	Since only the possible fossils within the area would be Quaternary fossil bones and plants from pans or springs, or upper Cretaceous dinosaurs, frogs, invertebrates and plants from a kimberlite pipe, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	It is unlikely that any fossils would be found in the loose sand unless there are pans or springs; if any kimbrlite ppes exisit on the farm they might have sediments with fossils. Therefore, 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. Since there is a small chance that there might be Quaternary pans or springs with fossil bones or wood, or upper Cretaceous kimberlite pipes with crater lake facies and preserved, 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 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 granites, sandstones, shales and sands are typical for the country and could contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period would not preserve fossils unless there are features such as palaeo-springs or palaeo-pans. If there are any kimberlite pipes on the farm with preserved crater lake facies, there might be fossils in these sediments.

6. Recommendation

Based on experience, the presence of pans in the region, and the possibility that there might be kimberlite pipes with lake sediments and fossils buried beneath the sands, there is a small chance that the drilling and/or excavations for the prospecting activities might disturb fossils. Therefore, a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once prospecting activities have commenced then they should be rescued and a palaeontologist called to assess their scientific value, and collect a representative sample.

7. References

Bamford, M.K., 1990. The Angiosperm Palaeoflora from Orapa Pipe, Botswana. Unpublished PhD thesis, University of the Witwatersrand, Johannesburg; 2 vols.
Bamford, M.K. 2000. Cenozoic macro-plants. In Partridge, T.C. and Maud, R.R. (Eds) Cenozoic of Southern Africa. Oxford Monographs on Geology and Geophysics No. 40. Oxford University Press. pp. 351-356.

Cornell, D.H., Thomas, R.J., Moen, H.F.G., Reid, D.L., Moore, J.M., Gibson, R.L., 2006. The Namaqua-Natal Province. 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 325-379.

de Wit, M., Bhebhe, Z., Davidson, J., Haggerty, S.E., Hundt, P., Jacob, J., Lynn, M., Marshall, T.R., Skinner, C., Smithson, K., Stiefenhofer, J., Robert, M., Revitt, A., Spaggiari, R., Ward, J. 2016. Overview of Diamond Resources in Africa. Episodes 39, 199-237.

Goudie, A.S., Wells, G.L., 1995. The nature, distribution and formation of pans in arid zones. Earth Science Reviews 38, 1-69.

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.

Scholtz, A., 1985. The palynology of the upper lacustrine sediments of the Arnot Pipe, Banke, Namaqualand, South Africa. Annals of the South African Museum 95, 1-109.

Skinner, E.M.W., Truswell, J.F., 2006. Kimberlites. 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 651-660.

Smith, R. M. H. 1986. Sedimentation and palaeoenvironments of Late Cretaceous crater-lake deposits in Bushmanland, South Africa. Sedimentology 33, 369-386.

Trueb, L., Ross, C.F., Smith, R., 2005. A new pipoid anuran from the Late Cretaceous of South Africa. Journal of Vertebrate Paleontology 25(3), 533-547.

8. Chance Find Protocol

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

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations 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, coal) should be put aside in a suitably protected place. This way the project 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 4-6). 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 kimberlite pipes and Gordonia Fm.

Figure 4: Angiosperm leaf from the Orapa kimberlite pipe in Botswana.

Figure 5: fragments of bones from a Quaternary pan deposit.

Figure 6: silicified wood pieces from a Pleistocene site – similar pieces might be found in a pan setting.

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
January 2021

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 ; 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	11	0
Masters	10	4
PhD	11	4
Postdoctoral fellows	10	5

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 –

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
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for EnviroPro

xi) Research Output

Publications by M K Bamford up to December 2019 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 10 book chapters.
Scopus h-index = 29; Google scholar h-index = 35; -i10-index = 92
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)