Palaeontological Impact Assessment for the proposed mine prospecting application for Farm Schmidtsdrif 248 portion 1, Herbert District, Northern Cape Province,

Site visit (Phase 2)

For

Nyezi Holdings (Pty) Ltd

05 September 2019

Prof Marion Bamford
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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 Nyezi Holdings (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 mine prospecting rights for diamonds by Nyezi Holdings (Pty) Ltd on Farm Schmidtsdrif 248, Portion 1, just west of the town of Schmidtsdrif, Herbert 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 site visit, requested by SAHRA (Case ID:13238), was completed on 03 September 2019 and is reported here.

The proposed site lies predominantly on Kalahari Group sands of Quaternary age, and on a narrow outcrop of the Vryburg Formation (base of the Transvaal Supergroup), and forming the hills to the NE-SW are the dolomites of the Boomplaas Formation (Schmidtsdrift Subgroup, Ghaap Group, Transvaal Supergroup). No fossils were found in the aeolian Kalahari Sands and no fossils occur in the Vryburg Formation. The Boomplaas Formation has stromatolites and oolites. Stromatolites were formed by ancient algal colonies that deposited layers of minerals, but NO fossils are preserved, so they of interest to geologists only, but not to palaeontologists.

Based on this information it is recommended that no further palaeontological site visit is required and a prospecting and a mining right be granted.

Table of Contents

1. Background

A palaeontological Impact Assessment site visit (SAHRA Case ID:13238) because the findings of stromatolites was questioned. A prospecting rights application is in progress for diamonds by Nyezi Holdings (Pty) Ltd on the Farm Schmidtsdrif 248, Portion 1, in the Herbert, Northern Cape Province (Fig 1). 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 site visit was completed by Prof Bamford and Dr House on 03 September 2019, and is reported here.

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
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	Section 8

A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	N/A
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	N/A
A description of any consultation process that was undertaken during the course of carrying out the study	N/A
A summary and copies if any comments that were received during any consultation process	N/A
Any other information requested by the competent authority.	N/A

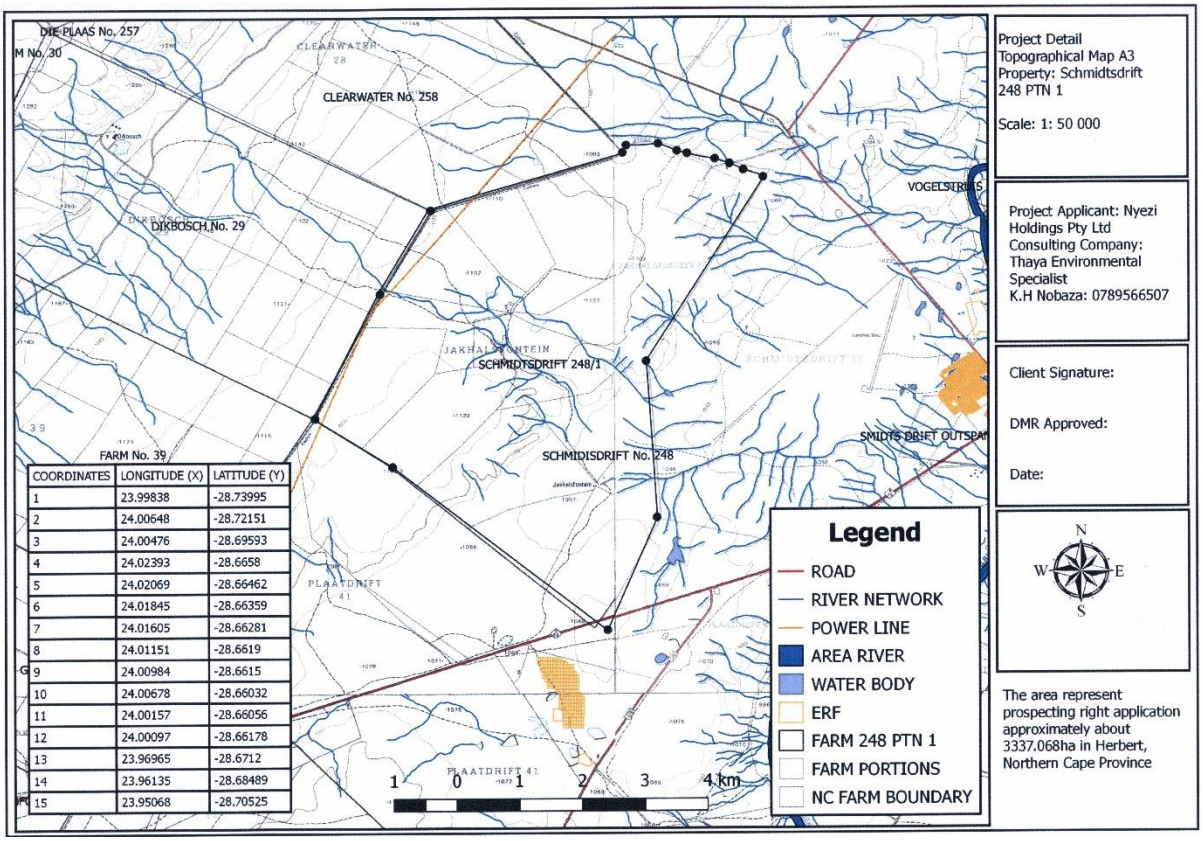

Figure 1: Map of the proposed site for the mine prospecting application, Schmidtsdrift 248, Portion 1, with farm boundary shown in black (centre). Map supplied by Thaya Environmental Specialist for Nyezi Holdings (Pty) Ltd.

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;
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 project footprint are those of the Vryburg Formation that comprises a basal transgressive conglomerate, quartzites, shales and some stromatolitic carbonates, capped in some places by basaltic or andesitic lavas. The environment has been interpreted as a fluvial to marginal marine setting (van der Westhiuzen et al., 2006). Above the Vryburg Formation in the Prieska and Ghaap Plateau sub-basins is the Schmidtsdrift Subgroup comprising the lower Boomplaas Formation (limestone, stromatolitic and oolitic carbonates) and upper Clearwater formation (shales, tuffites and banded ironstone-like cherts). Most of the northwestern part lies on the rocks of the Boomplaas Formation with a narrow strip of Vryburg quartzites adjacent to these rocks and along the southeastern exposure.

Kalahari Group sands cover the rest of the project area and these are deep and of aeolian origin. Concentrated in the south and eastern part of the area are calcretes within and overlying the sands. They indicate periods of wet and dry conditions during the past 2.5 million years, and have covered large areas of the north-western Cape.

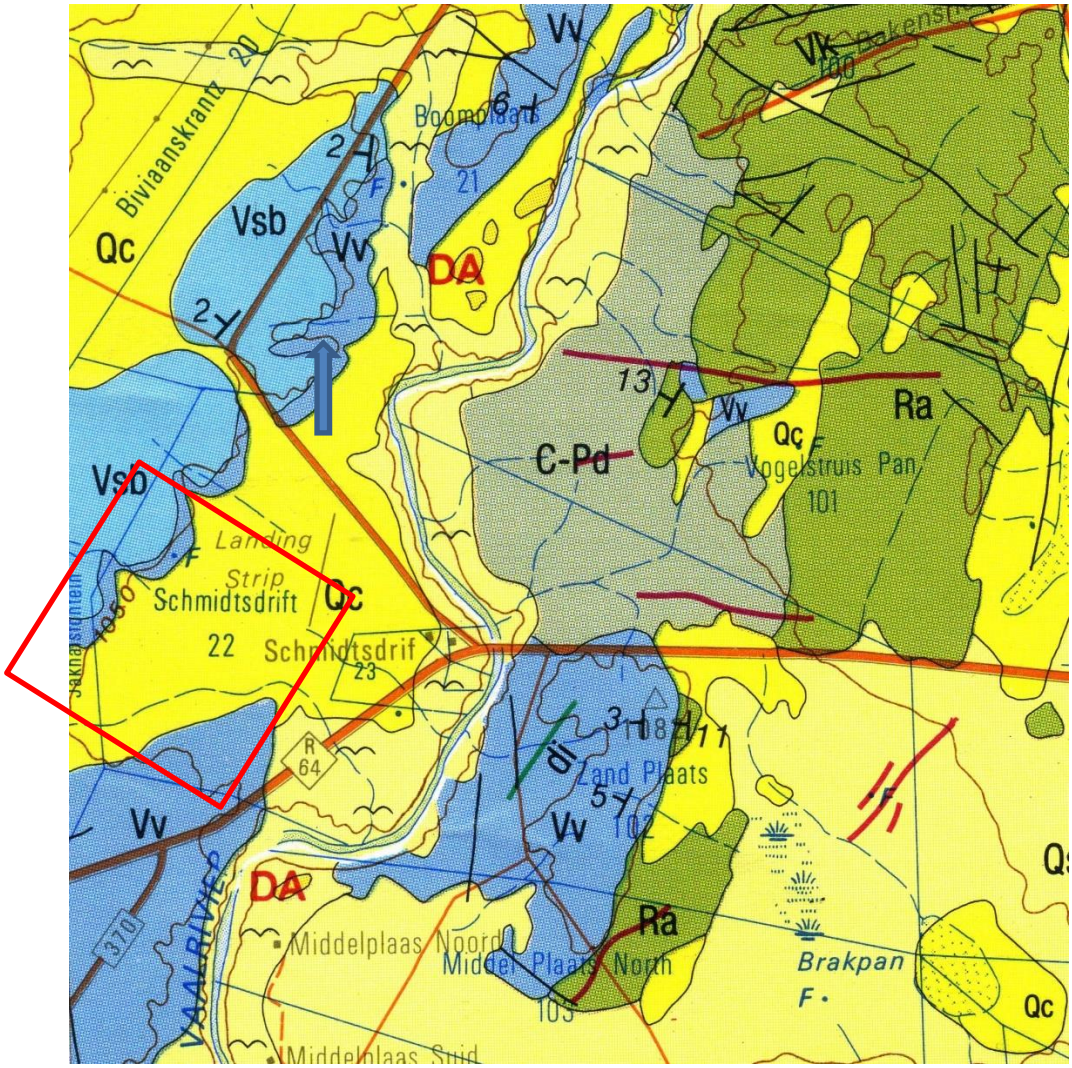

Figure 2: Geological map of the area around Schmidtsdrif town. The location of the proposed project is indicated within the red rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2824 Kimberley. See Fig 3 for the geological map to the west.

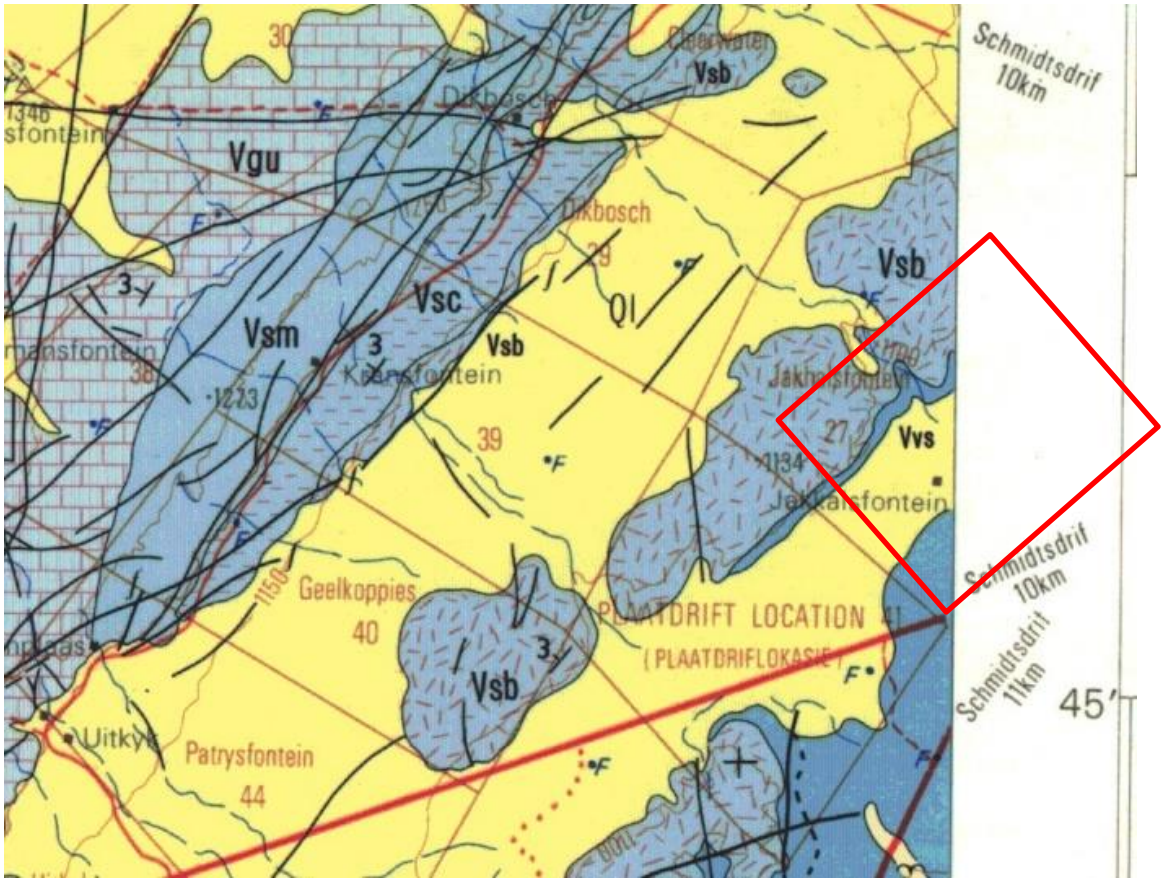

Figure 3: Geological map of the area around Schmidtsdrif town. The location of the proposed project is indicated within the red rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2824 Postmasburg. See fig 2 for the geological map to the east of this map

Table 2: Explanation of symbols for the geological map and approximate ages (Johnson et al., 2006; van der Westhuizen et al., 2006). SG = Supergroup; Fm = Formation. Ma = million years. Shaded areas/formations are those impacted by the proposed project.

Symbol	Group/Formation	Lithology	Approximate Age
Qc	Kalahari Group	Alluvium, sand, calcrete, calcified pandune and surface limestone	Quaternary, ca 2,5 Ma to present
C-Pd	Dwyka Group, Karoo SG	Diamictites, tillites, sandstones, shales	Late Carboniferous-Early Permian; Ca 300 Ma
Vsb	Boomplaas Fm, Schmidtsdrif Subgroup, Ghaap Group, Transvaal SG	Oolitic, pisolitic and stromatolitic dolomite, limestone, interbedded with siltstone	Ca 2640 – 2630 Ma
Vv / Vvs	Vryburg Fm, Transvaal SG	Shale, quartzitic grit, conglomerate	<2650 Ma

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for prospecting and mining is in three lithologies, namely the Vryburg Formation (green) that is indicated as moderately sensitive, Boomplaas Formation (red) that indicated as very highly sensitive, and the Kalahari group sands that are highly sensitive (orange).

In the northern section are the Vryburg Formation shales, quartzitic grit and conglomerates as interpreted in the more recent geological maps and literature (van der Westhuizen et al.) and NOT stromatolitic carbonates from the older literature. The Vryburg Formation should not be indicated as highly sensitive on the palaeosensitivity map (see Fairey et al., 2013). Stromatolites do occur in the Boomplaas Formation and they are trace fossils of ancient algal colonies that formed in shallow marine settings. Although some stromatolites preserve the cells of the microscopic algae, these are rare and can only be seen under the microscope from petrographic thin sections. The limestones of the Boomplaas Formation, Schmidtsdrif Subgroup, are stromatolitic and oolitic platform carbonates and were also formed by algal colonies so there is an extremely small chance that the microscopic algae have been preserved in some facies. Most oolites, however, are limestones, whereas ooids are made of calcium carbonate (minerals aragonite or calcite). Ooids are spheroidal grains with a nucleus and mineral cortex accreted around it that increases in sphericity with distance from the nucleus. The term “ooid” is applied to grains less than 2 mm in diameter. The oolites from the Boomplaas Formation are, therefore, of chemical and not biological origin.

Much research has been done on the geochemistry of the stromatolites, for example Fairey et al. (2013 and references therein), but no publications could be found on the palaeontology of the stromatolites). Beukes and Lowe (1989) have described the morphology of stromatolites and emphasised their palaeoenvironmental context (not the biological importance).

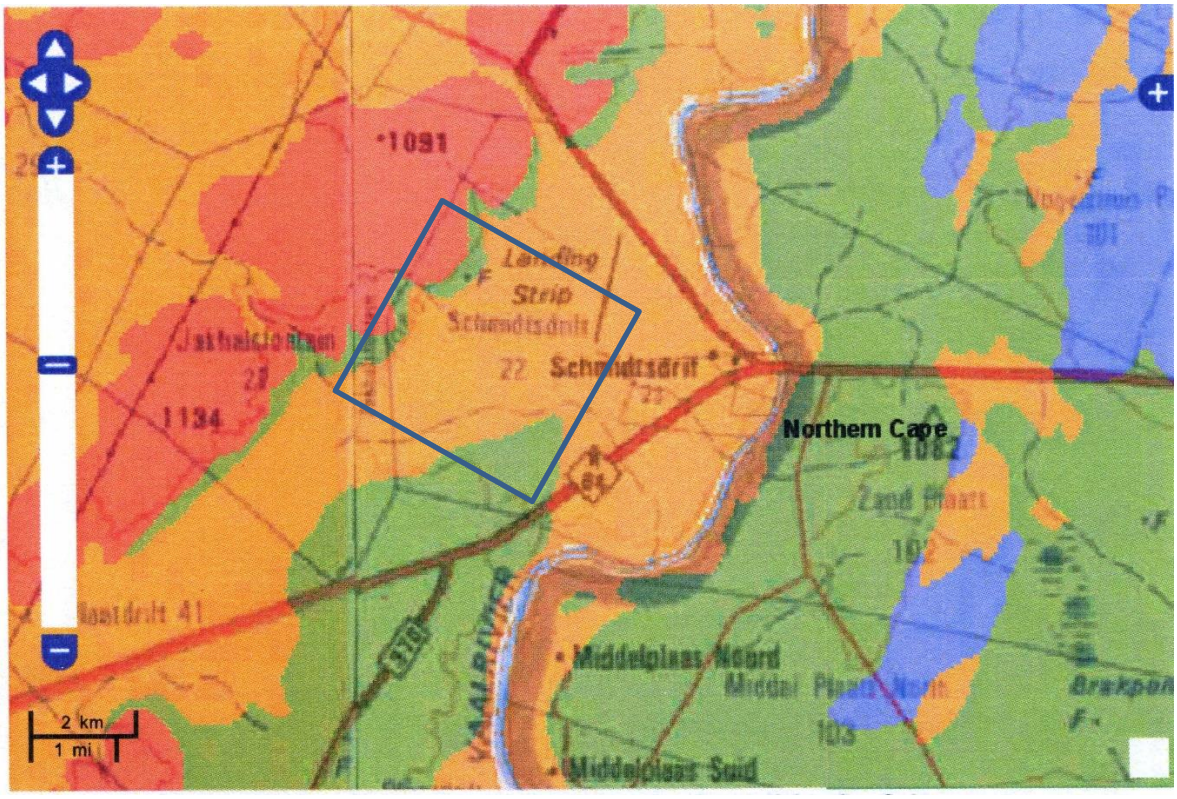

Figure 4: SAHRIS palaeosensitivity map for the site for the proposed mine prospecting shown within the red square. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

iii Results from Site Visit

The site was visited on 03 September by a professional palaeontologist and palaeontological assistant and the observations, with field photographs, are provided below. The whole area is very dry and sparsely vegetated so it was easy to see the soils and rocks. Dominant vegetation is a thin covering of short grasses (*Aristida* spp., *Eragrostis* spp, *Centropodia glauca*, *Setaria* spp.) and thorny trees and bushes (*Acacia mellifera, Acacia karoo, Boscia albitrunca, Tarchonanthus camphoratus, Ziziphus mucronata*).

Table 3: Locations and observations at selected sites surveyed on 03 September.

GPS co-ordinates	Observations	Figure
Point 1 – near gate on N8 28° 44,496' S	Calcrete covered road; red aeolian Kalahari sand and low bushes of *Acacia mellifera* and *Tarchonanthus camphoratus*; calcrete fragments	5

23° 59,142’ E		
Point 2 28° 44,043’ S 23° 58,566’ E	Heading towards the hills – red aeolian Kalahari sand and calcrete fragments and expanses. Vegetation as before but with taller trees of *Boscia albitrunca* and *Acacia karoo*	6, 7
Point 3 28° 44,003’ S 23° 58,435’ E	Red aeolian Kalahari sand; calcrete expanses and limestone fragments	8
Point 4 28° 43,699’ S 23° 58,345’ E	Red aeolian Kalahari sand; calcrete expanses and limestone fragments	9
Point 5 28° 43,440’ S 23° 58,235’ E	Dolerite scatter where stream has eroded the red aeolian Kalahari sand; no calcrete	10
Point 6 28° 43,247’ S 23° 58,343’ E	Central point along hillslopes. Hill comprises dolerite and shale at the base (Vryburg Fm) and is overlain by dolomite with large, very fine –grained stromatolites, oolites, elephant skin weathering and rare lenses of chert (Boomplaas Fm).	11 - 15
Point 7 28° 43,822’ S 23° 59,090’ E	Stream bed and open area with hard Kalahari sand and scatters of dolerite flakes and fragments	16

Figure 5: Red aeolian Kalahari sand and low bushes of *Acacia mellifera* and *Tarchonanthus camphoratus*; calcrete fragments.

Figure 6: Heading towards the hills – red aeolian Kalahari sand and calcrete fragments and expanses. Vegetation as before but with taller trees of *Boscia albitrunca* and *Acacia karoo.*

Figure 7: Calcrete fragments on red Aeolian sands with a thin covering of short grasses.

Figure 8: Red aeolian Kalahari sand; calcrete expanses and limestone fragments.

Figure 9: Red aeolian Kalahari sand; calcrete expanses and limestone fragments.

Figure 10: Dolerite scatter where stream has eroded the red aeolian Kalahari sand; no calcrete.

Figure 11: Central point along hillslopes. Hill comprises dolerite and shale at the base (Vryburg Fm) and is overlain by dolomite with large, very fine –grained stromatolites, oolites, elephant skin weathering and rare lenses of chert (Boomplaas Fm).

Figure 12: Close-up of oolites – chemical accumulations around sand grains.

Figure 13: Dolomite of the Boomplaas Fm with typical weathering pattern

Figure 14: a large stromatolite (concentric circles) in the Boomplaas Fm dolomite.

Figure 15: another example of a stromatolite in the Boomplaas Fm. Shoe for scale.

Figure 16: open area with red aeolian sands and scatter of shales and dolorite.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 4:

TABLE 4A: 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	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local

impacts	**H**	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

TABLE 4B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	**H**	-
	M	-
	L	The stromatolites (Boomplaas Fm) are trace fossils and rarely preserve fossil algae; Loose sands (aeolian Kalahari Group, Quaternary) do not preserve plant fossils; so far there are no records of fossils from this area so the impact would be very unlikely.
	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 but no animals or plants, 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 stromatolites as they are very fine-grained. Hans lens examination showed no internal structure.

The geological structures suggest that the rocks are mostly too old or volcanic to contain fossils. Stromatolites are trace fossils and there was no hint of any microscopic forms being preserved. The red Kalahari sands are aeolian (wind transported) and do not contain any fossils. No fossils have been reported from this site. Both the desktop study and the site visit confirm that there are no fossils in the project footprint so the prospecting and mining activities will have no impact on the palaeontological heritage.

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 and dolerite dykes do not contain fossils. The sands and calcrete do not contain fossils either. The only fossils in the area are trace fossils, i.e. stromatolites but these are very fine-grained and show no hints of internal structure as seem with a 10x hand lens. Representative areas of different rock formations were surveyed during the site visit, and confirmed that there are no fossils.

6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, and on the findings of the site visit, it can be confirmed that there are no fossils in the project footprint. It is the opinion of the professional palaeontologist that, as far as the palaeontology is concerned, the prospecting and mining rights applications should be granted.

7. References

Beukes, N.J., Lowe, D.R., 1989. Environmental control on diverse stromatolite morphologies in the 3000 Myr Pongola Supergroup, South Africa Sedimentology 36, 383-397.

Eriksson, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its pre-cursors. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. pp 237-260.

Fairey, B., Tsikos, H., Corfu, F., Polteau, S., 2013. U–Pb systematics in carbonates of the Postmasburg Group, Transvaal Supergroup, South Africa: Primary versus metasomatic controls. Precambrian Research 231, 194– 205.

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.

Appendix A – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
June 2018

I) Personal details

Surname	:	**Bamford**
First names	:	**Marion Kathleen**
Present employment	:	Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa-
Telephone	:	+27 11 717 6690
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	6	1
Masters	8	1
PhD	10	2
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 – 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
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xi) Research Output

Publications by M K Bamford up to June 2018 peer-reviewed journals or scholarly books: over 120 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 26; 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)