Palaeontological Impact Assessment for the proposed Khanyazwe Flexpower 1GW Gas to Power Project, Malelane, Mpumalanga Province

Desktop Study (Phase 1)

For

Nsovo Environmental (Pty) Ltd

22 February 2024; Rev 11 June 2024

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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf, PSSA
Experience: 35 years research and lecturing in Palaeontology
27 years PIA studies and over 350 projects completed

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Nsovo Environmental, 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: MKBamford

Executive Summary

A Palaeontological Impact Assessment was requested for the Khanyazwe Flexpower Gas to Power Project, Malelane, Mpumalanga Province. The proposal is by Flexpower to construct a 1GW Gas to Power facility adjacent to the existing Eskom Khanyazwe Sub Station on portions of Farms Malelane 389 and 390. There is only one option under consideration for the facility and related infrastructure.

To comply with the regulations of 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.

The entire project area lies on the Tjakastad Subgroup (Onverwacht Group, Barberton Supergroup). The BGB succession is composed of the ca. 3.55-3.22 Ga Swaziland (or Barberton) Supergroup has three groups, from the base upwards, the Onverwacht, Fig Tree and Moodies Groups. The basal Onverwacht Group is dominated by pillow and massive basalt and komatiite, mafic-ultramafic intrusions, felsic volcanic rocks and chert, so is unsuitable for the preservation of fossils. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, environmental officer or other designated responsible person once excavations or drilling activities have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Moderate/ Low	Very Low	Paleontological Impact Assessment	Section 7.2. SAHRA Requirements

Table of Contents

1. Background

A Palaeontological Impact Assessment was requested for the Khanyazwe Flexpower Gas to Power Project, Malelane, Mpumalanga Province. The proposal is by Flexpower to construct a Gas to Power facility that will produce up to 1GW of power adjacent to the existing Eskom Khanyazwe Sub Station on portions of Farms Malelane 389 and 390. After four options were considered the preferred site is reported upon here for the facility and related infrastructure (Figures 1-2).

The existing Khanyazwe Eskom Substation will receive power via powerlines from the Gas to Power facility. The preferred site is located just to the east of the existing substation (Figure 2).

A Palaeontological Impact Assessment was requested for the Khanyazwe Flexpower project. To comply with the regulations of 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: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6).

	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

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
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 8, 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 8, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6
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	Sections 6, 8
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 of any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A
2	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

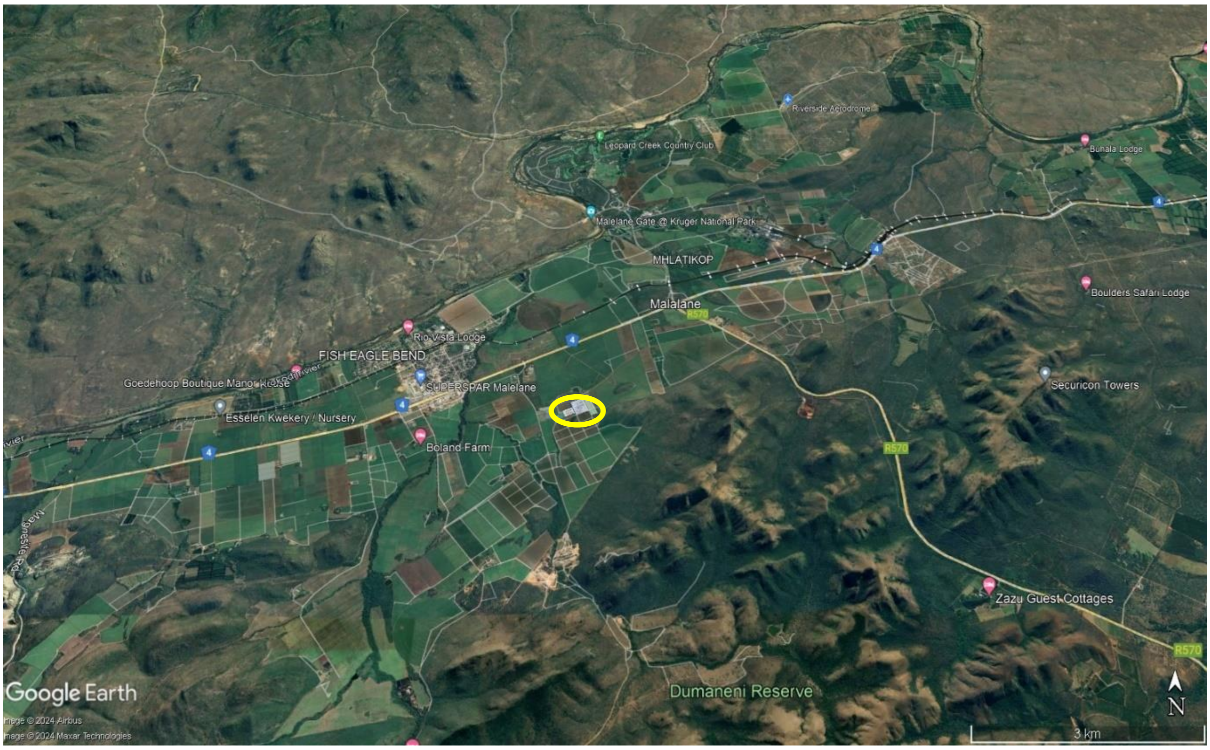

Figure 1: Google Earth map of the general area around Malelane to show the relative land marks. The Khanyazwe Flexpower project site is shown by the yellow outline.

Figure 2: Google Earth Map of the proposed development of Khanyazwe Flexpower project with the site closest to the existing substation being the preferred option.

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 include records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases; eg https://sahris.sahra.org.za/map/palaeo
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' representativity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

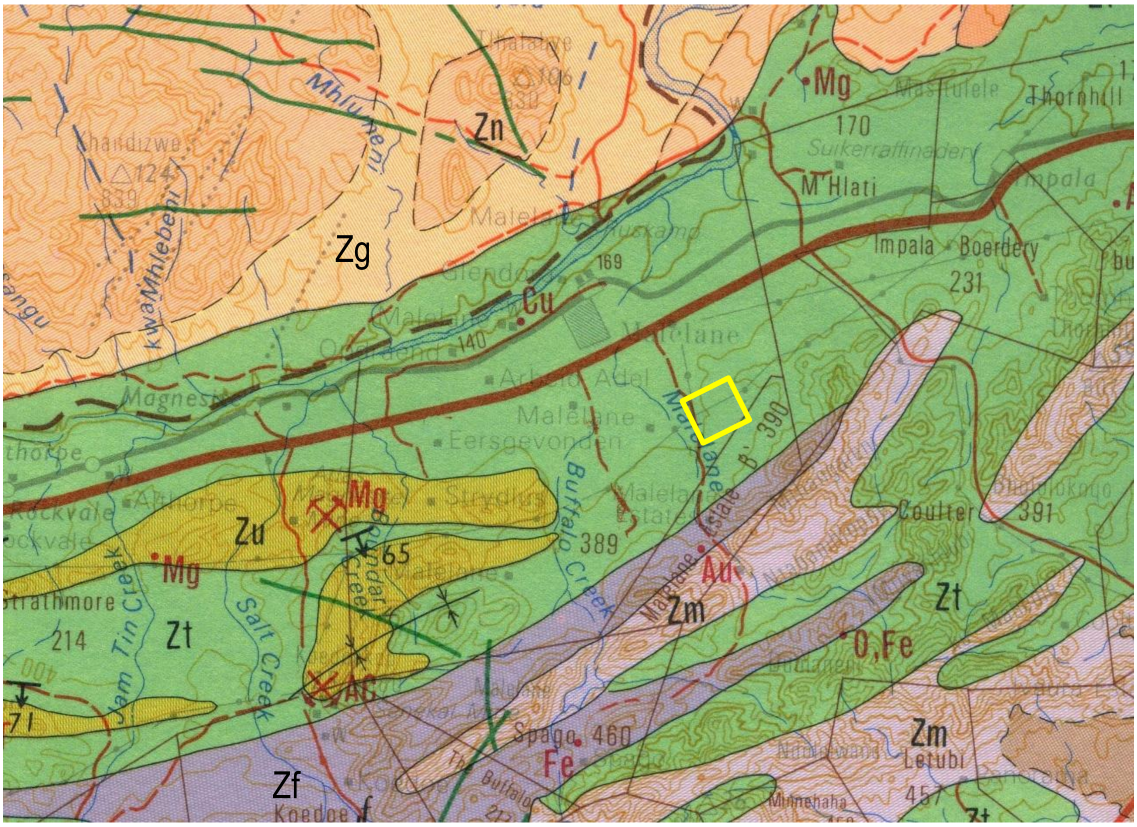

Figure 3: Geological map of the area around the Khanyazwe Gas to Power project indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2530 Barberton.

Table 2: Explanation of symbols for the geological map and approximate ages (Aganji et al., 2018; Brandl et al., 2006; Robb et al., 2006;). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Zn	Nelspruit Suite	Grey-white coarse-grained biotite granite	Mesoarchaean Ca 3104 Ma
Zg	Intrusive rocks	Biotite-trondhjemite gneiss	Mesoarchaean
Zu	Undifferentiated	Serpentenised dunite. Harzbergite, orthopyroxenite	Palaeoarchaean
Zm	Moodies Group, Barberton SG	conglomeratic quartzose sandstone; upper unit of finer-grained quartzose sandstone, siltstone and shale	Palaeoarchaean Ca 3220 Ma
Zf	Fig Tree Group, Barberton SG	Sandstone, grit, conglomerate, shale, phyllite	Palaeoarchaean
Zt	Tjakastad Subgroup, Onverwacht Group, Barberton SG	Undifferentiated basalts, komatiite, schists	Palaeoarchaean
Ztk	Komati Fm, Tjakastad Subgroup, Onverwacht Group, Barberton SG	Basaltic and peridotitic komatiite, theoliite	Palaeoarchaean
Ztt	Theespruit Fm, Tjakastad Subgroup, Onverwacht Group, Barberton SG	Various mafic and ultramafic schists	Palaeoarchaean

The project lies in an eastern greenstone belt, the Barberton Greenstone belt (Figure 3).

The Barberton Greenstone Belt (BGB) is the largest and best studied of a number of greenstone belts on the Kaapvaal Craton. Greenstone Belts represent the oldest crustal rocks on the earth so are of major geological interest, as well as the fact they contain economic reserves of heavy minerals such as gold and nickel. The BGB succession is composed of the ca. 3.55-3.22 Ga Swaziland (or Barberton) Supergroup, which is preserved as a folded southwest to northeast-trending belt (Agangi et al., 2018). It has been subdivided into three groups, from the base upwards, the Onverwacht, Fig Tree and Moodies Groups. The basal ca. 3550-3300 Ma Onverwacht Group is dominated by pillow and massive basalt and komatiite, mafic-ultramafic intrusions, felsic volcanic rocks and chert. In contrast, the Fig Tree and Moodies Groups consist of sandstone, shale, chert, banded iron formation and felsic volcanic rocks ranging in age from ca. 3260-3216 Ma

The southwest to northeast-trending Inyoka-Saddleback Fault System separates a northern and a southern terrane of different age and geochemical characteristics (Brandl et al., 2006; Agangi et al., 2018). The Supergroup has undergone multiple deformation events (D1-D4), and has been metamorphosed under conditions of greenschist to amphibolite facies, and the final phase of deformation formed the gold deposits.

Felsic volcanic rocks in the Onverwacht Group are mostly preserved in the Theespruit, Sandspruit and Hooggenoeg Formations. The lowermost portion is the Theespruit and Sandspruit Formations, dated at ca. 3552-3521 Ma. They are composed of strongly foliated mafic-ultramafic to felsic volcanic rocks and shallow intrusions metamorphosed at amphibolite facies conditions. These two formations are separated from the overlying mafic ultramafic volcanic rocks of the Komati Formation by the Komati fault (de Ronde and de Wit, 1994; Lana et al., 2010a). The Hooggenoeg Formation, includes felsic volcanic and intrusive rocks, volcaniclastic conglomerates, sandstone and tuffs.

The Fig Tree Group is also known to contain dacitic volcanic and volcaniclastic rocks (tuffs and agglomerates), dated between 3259 Ma and 3225 Ma, although little information on the chemical composition of these rocks is available in the literature (Agangi et al., 2018). These ages overlap at least in part with the intrusions to the north-west of the Barberton Greenstone Belt, such as the 3229-3223 Ma Kaap Valley tonalite.

According to the review by Agangi et al. (2018), the base of the Moodies Group in the vicinity of the Eureka Syncline contains prominent pebble to cobble conglomerate beds intercalated with sandstone. The clasts consist mainly of black chert and felsic igneous clasts. Igneous clasts have variable textures, from porphyritic to granophyric, indicative of a volcanic or shallow intrusive origin. Some clasts contain predominant quartz, K-feldspar and biotite, and accessory zircon, apatite and monazite and their dating clusters into three groups that indicate the presence of shallowly-emplaced K-rich intrusive rocks with ages pre-dating the emplacement of mafic intrusions (mostly <3.2 Ga).

There are several areas of Archaean Granitoid intrusions through the Kaapvaal Craton in South Africa ranging in age from >3 600 Ma to 2500 Ma (Robb et al., 2006).
The four areas are

1. Eastern and southeastern Kaapvaal Craton (south of 25°S)
2. Northeastern Kaapvaal Craton (north of 25°S)
3. The central Kaapvaal Craton (Makoppa, Johannesburg, Vredefort, Westerdam and Colgny Domes, the Amalia-Kraaipan area, and the Gaborone Granite Suite)
4. Southwestern Kaapvaal Craton (Prieska-Marydale area)

This project lies in the Eastern and Southeastern Kaapvaal Craton. To the north of the project area is the Nelspruit Batholith or Suite that is a Mesoarchaean intrusion dated to around 3200-2800 Ma (Robb et al., 2006). These are ancient volcanic rocks and do not preserve any fossils.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figures 4-9. The site for development is in the Tjakastad Subgroup.

There are two strata in the BGB that have strong evidence of the earliest microbial life forms, namely the deposits of the 3.416 Ga Buck Reef Chert (in the Onverwacht Anticline and Kromberg Syncline, central part) and the sandstones of the 3.22 Ga Moodies Group (see recent review by Homan (2019)). These strata have a wealth of remarkably preserved microbial mats and microfossils, consistent lateral exposure for several tens of kilometres and thick stratigraphy. Based on its universal and outstanding geological and palaeobiological value the Barberton-Makhonjwa Mountains were inscribed in the UNESCO World Heritage Site register in 2018. These fossils will ultimately help to protect these exceptional outcrops for future studies of Earth's early evolution.

Microbialites (sensu Burne and Moore, 1987) are organo-sedimentary deposits formed from interaction between benthic microbial communities (BMCs) and detrital or chemical sediments. In addition, microbialites contrast with other biological sediments in that they are generally not composed of skeletal remains. Archean carbonates mostly consist of stromatolites. These platforms could have been the site of early O_2 production on our planet. Stromatolites are the laminated, organo-sedimentary, non-skeletal products of microbial communities, which may have included cyanobacteria, the first photosynthetic organisms to produce oxygen. Another type of trace fossil has been termed Microbially-induced sedimentary structures (MISS sensu Noffke et al., 2001) or simply 'fossil mats' (sensu Tice et al., 2011). These include swirls, rip-ups, crinkled surfaces and wrinkles that were formed by the mucus extruded by littoral algae or microbes and bound together sand particles. Davies et al. (2016) caution against the assumption that all such structures are microbially induced unless there is additional evidence for microbes in the palaeoenvironment.

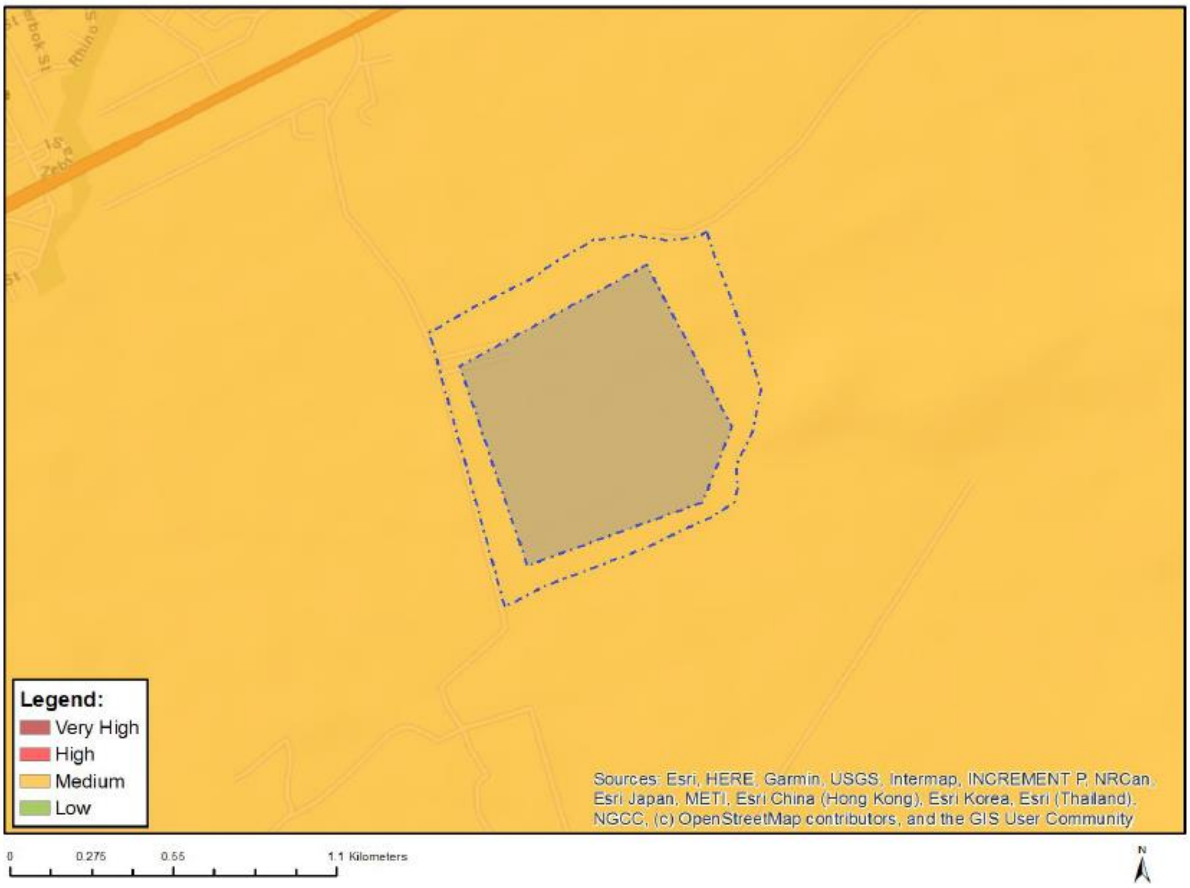

Figure 4: DFFE Screening map for Palaeosensitivity for Khanyazwe Gas to Power site preferred option 1.

Figure 5: SAHRIS palaeosensitivity map for the site for the proposed Khanyazwe Flexpower project 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 DFFE palaeosensitivity maps (Figure 4) the site is indicated as moderately sensitive (yellow) while the SAHRIS palaeosensitivity map above the area is indicated as having a low sensitivity (blue). The SAHRIS map is the more accurate one because it is based on the geology as well as the palaeotechnical reports compiled for SAHRA by palaeontologists.

The project is on the ancient metamorphosed volcanic rocks of the Tjakastad Subgroup (Onverwacht Group). They predate the sedimentary rocks Figtree and Moodies Groups from where there are rare trace fossils of microbes. Based on the older age and the type of rock that does not preserve fossils (volcanic), it is extremely unlikely that fossils occur in the Tjakastad Subgroup.

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	Volcanic do not preserve fossils; so far there are no records from the Tjakastad Subgroup of trace, plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be negligible
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.

PART B: Assessment		
SPATIAL SCALE	**L**	Since the only possible fossils within the area would be trace fossils in any shales, 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 soils and sands that cover the area or in the Tjakastad Subgroup. Nonetheless, a Fossil Chance Find Protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are much too old and of the wrong type to contain fossils. Furthermore, the material to be excavated is soil and this does not preserve fossils. Since there is an extremely small chance that fossils from the nearby Moodies or Figtree Subgroups may be disturbed a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the basalts, lavas, sandstones, shales and sands are typical for the country and do not contain any trace fossils, fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period 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 overlying soils of the Quaternary. There is almost no chance that fossils may occur in the volcanic rocks of the Tjakastad Subgroup so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations for foundations and infrastructure have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. The impact on the palaeontological heritage would be very low, as far as the palaeontology is concerned, so the project should be authorised.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Moderate / Low	Very low	Paleontological Impact Assessment	Section 7.2. SAHRA Requirements

7. References

Agangi, A., Hofmann, A., Elburg, M.A., 2018. A review of Palaeoarchaean felsic volcanism in the eastern Kaapvaal craton: Linking plutonic and volcanic records. Geoscience Frontiers 9, 667-688.

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.

Homann, M., 2019. Earliest life on earth: evidence from the Barberton Greenstone Belt, South Africa. Earth-Science Reviews 196, p.102888.

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.

Noffke, N., Gerdes, G., Klenke, T. and Krumbein, W.E., 2001. Microbially induced sedimentary structures – a new category within the classification of primary sedimentary structures. Journal of Sedimentary Research, A71, 649-656.

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.

Tice, M.M., Thornton, D.C.O., Pope, M.C., Olszewski, T.D., Gong, J., 2011. Archean Microbial Mat Communities. Annual Review of Earth and Planetary Sciences 39, 297–319.

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 discard must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone or coal) 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 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 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. Traces, 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.

9. Appendix A – Examples of fossils from the Moodies Group

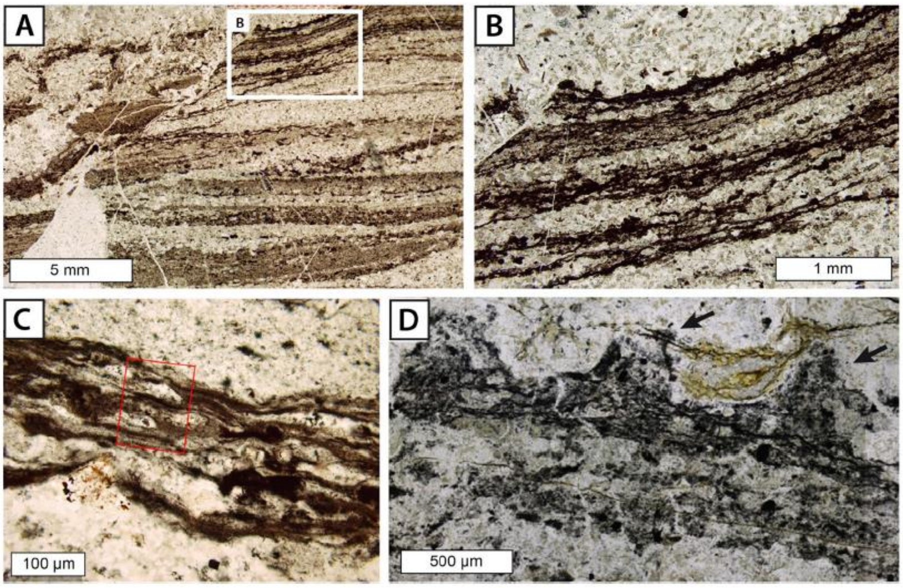

Fig. 3. Photomicrographs of carbonaceous laminations from silicified volcaniclastic sediments of the 3.47 Ga Middle Marker interpreted as remnants of microbial mats. A) Multi-layered mats on horizontally-laminated and cross-bedded sediments, disrupted by secondary fracture. B and C) Close-up view of crinkly laminations of carbonaceous composition. D) Laminations with 'pseudo-tufted' morphology (arrows), which formed secondary as the result of plastic deformation. *Images (A-D) from* Hickman-Lewis et al. *(2018).*

Figure 6: Photomicrographs of traces of microbial activity that have been found in thin sections from the Moodies Group.

10. Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
January 2024

Present employment:	Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DSI 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
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

v) **Supervision of Higher Degrees**

All at Wits University

Degree	Graduated/completed	Current
Honours	13	0
Masters	13	3
PhD	13	7
Postdoctoral fellows	14	4

vi) **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 12 - 20 students per year.

vii) **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 –
Associate Editor: Cretaceous Research: 2018-2020
Associate Editor: Royal Society Open: 2021 -
Review of manuscripts for ISI-listed journals: 30 local and international journals

viii) **Palaeontological Impact Assessments**
27 years' experience in PIA site and desktop projects
Selected from recent projects only – list not complete:

- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage

- Smithfield-Rouxville-Zastron PL 2021 for TheroServe
- Glosam Mine 2022 for AHSA
- Wolf-Skilpad-Grassridge OHPL 2022 for Zutari
- Iziduli and Msenge WEFs 2022 for CTS Heritage
- Hendrina North and South WEFs & SEFs 2022 for Cabanga
- Dealesville-Springhaas SEFs 2022 for GIBB Environmental
- Vhuvhili and Mukondeleli SEFs 2022 for CSIR
- Chemwes & Stilfontein SEFs 2022 for CTS Heritage
- Equestria Exts housing 2022 for Beyond Heritage
- Zeerust Salene boreholes 2022 for Prescali
- Tsakane Sewer upgrade 2022 for Tsimba
- Transnet MPP inland and coastal 2022 for ENVASS
- Ruighoek PRA 2022 for SLR Consulting (Africa)
- Namli MRA Steinkopf 2022 for Beyond Heritage
- Adara 2 SEF 2023 for CTS Heritage
- Buffalo & Lyra SEFs 2023 for Nextec
- Camel Thorn Group Prospecting Rights 2023 for AHSA
- Dalmanutha SEFs 2023 for Beyond Heritage
- Elandsfontein Residential 2023 for Beyond Heritage
- Waterkloof Samancor 2023 for Elemental Sustainability
- Zonnebloem WTP 2023 for WSP
- Elders Irrigation 2023 for SRK
- Leghoya WEFS 2023 for Red Cap & SLR

ix) **Research Output**
Publications by M K Bamford up to January 2024 peer-reviewed journals or scholarly books: over 175 articles published; 5 submitted/in press; 14 book chapters.
Scopus h-index = 32; Google Scholar h-index = 40; -i10-index = 121 based on 7261 citations.
Conferences: numerous presentations at local and international conferences.