Palaeontological Impact Assessment for the proposed Tshedza 1 Photovoltaic (PV) plant on Farm Witpoortje 117 IR with associated power lines, South of Brakpan, Gauteng Province

Desktop Study (Phase 1)

For

Heritage Contracts and Archaeological Consulting

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

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

A palaeontological Impact Assessment was requested for the proposed construction of the the Tshedza Phase 1 Photovoltaic Plant on a reclaimed mine dump. Two overhead power lines will feed into established substations, one to the north east and one to the south west.

In order 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 project.

For all three parts of the project the Significance for the Palaeontology is LOW as described below.

1. The proposed Photovoltaic Plant site lies on the reclaimed mine dump which is material transported from far below the surface and is too old and too weathered to preserve fossils. The SAHRIS palaeosensitivity map indicates the site is very highly sensitive (red) but this applies to the Vryheid Formation that overlies the Witwatersrand Group mined material and underlies the dumped material. There is no chance of fossils being affected.

2. The proposed power line to the northeast lies on the mine dump and Jurassic dolerite so there is no chance of fossils being affected.

3. The proposed power line to the southwest lies on a variety of rocks along the route. The Klipriviersberg Group andesite and tuff, and the Jurassic dolerite are non-fossiliferous. Fossil plants of the *Glossopteris* flora might occur in the Dwyka Group and Vryheid Formations but they are rare and the sites have been disturbed. Trace fossils (stromatolites) might occur in the Malmani Subgroup dolomites. Therefore, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no palaeontological site visit is required unless fossils are found once excavations have commenced.

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1. Background

TSHEDZA 1 PRE PROJECT DEVELOPMENT (Pty) Ltd proposes to construct a solar Photovoltaic (PV) plant (hereafter referred to as "Tshedza 1 PV plant") to supply power (embedded generation) to the existing Ergo Mining (Pty) Ltd Brakpan Plant. The identified site is situated on Ergo Mining owned land adjacent to the Withok Estates Agricultural Holdings and Witpoort Estates Agricultural Holdings areas of Brakpan within the City of Ekurhuleni Metropolitan Municipality, Gauteng Province.

The proposed development entails:

- A 10 MW PV facility, with battery energy storage, including ~11 km of 11 KV Overhead Power Line (OHL) which mainly follows an existing slurry pipe servitude/corridor.
- The OHL will link the PV facility to two (2) existing substations. The PV development will include up to 100 MWh containerized battery storage.

The vacant land earmarked for the PV facility itself, which was previously mined and subsequently rehabilitated to its current naturally vegetated condition, is owned by Ergo Mining and falls within the existing approved Mining Right Area (Figures 1, 2, 3).

The two mining facilities i.e., Ergo Mining Brakpan Plant and the Brakpan/Withok Tailings Dam facility, are currently supplied with electricity by Eskom via an existing grid infrastructure. The proposed PV facility will generate electricity with battery storage, to interface with the Eskom grid to supply the Ergo Mining Brakpan Plant and the Brakpan/Withok Tailings Facility. The generated electricity will be used when there is an interruption to Eskom's supply in energy.

A Palaeontological Impact Assessment was requested for the Tshedza PV plant project site and overhead cables to two existing substations. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed project.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (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, 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

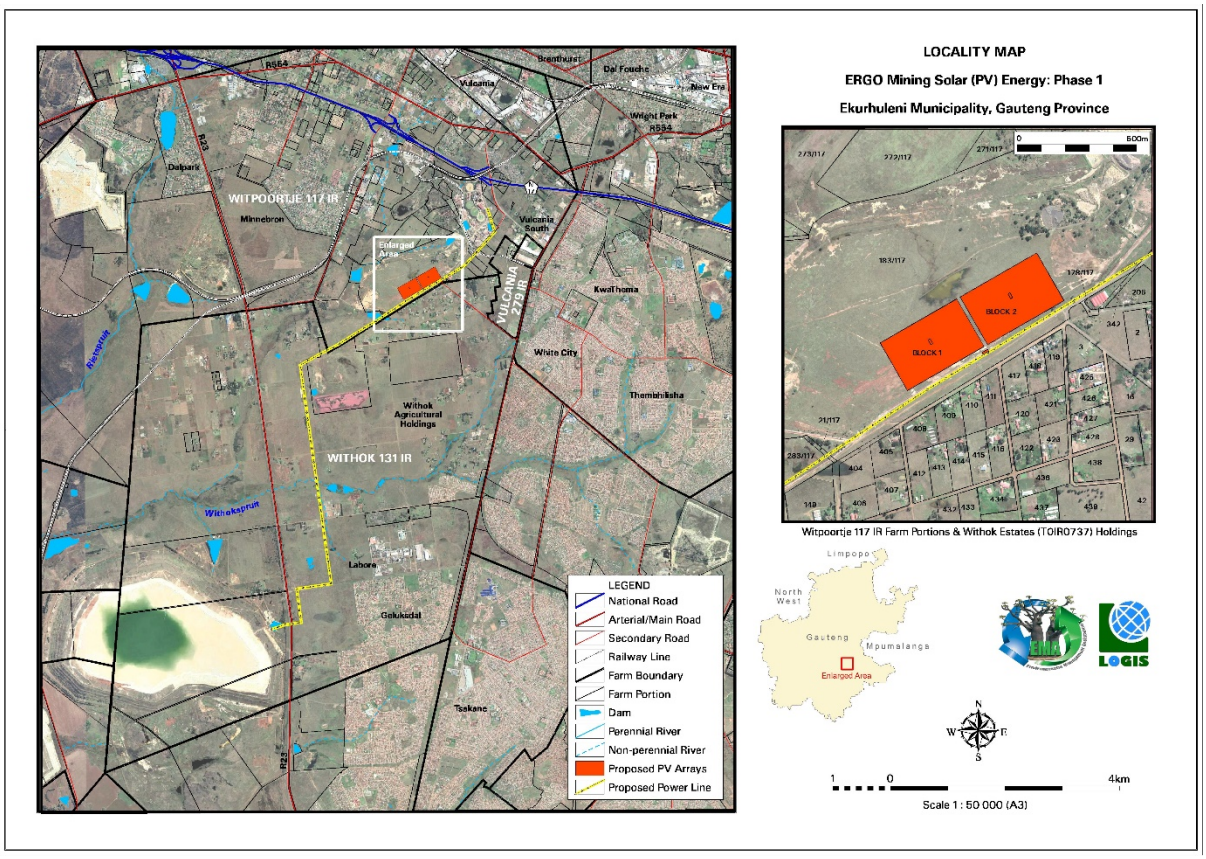

Figure 1: Topographic map of the area indicating the site for the Tshedza 1 PV plant (red blocks) and the power line routes to two substations (yellow line). Map supplied by LOGIS .

Figure 2: Google Earth map of the proposed Tshedza 1 PV plant site with the two sections shown by the red outline. Map supplied by HCAC.

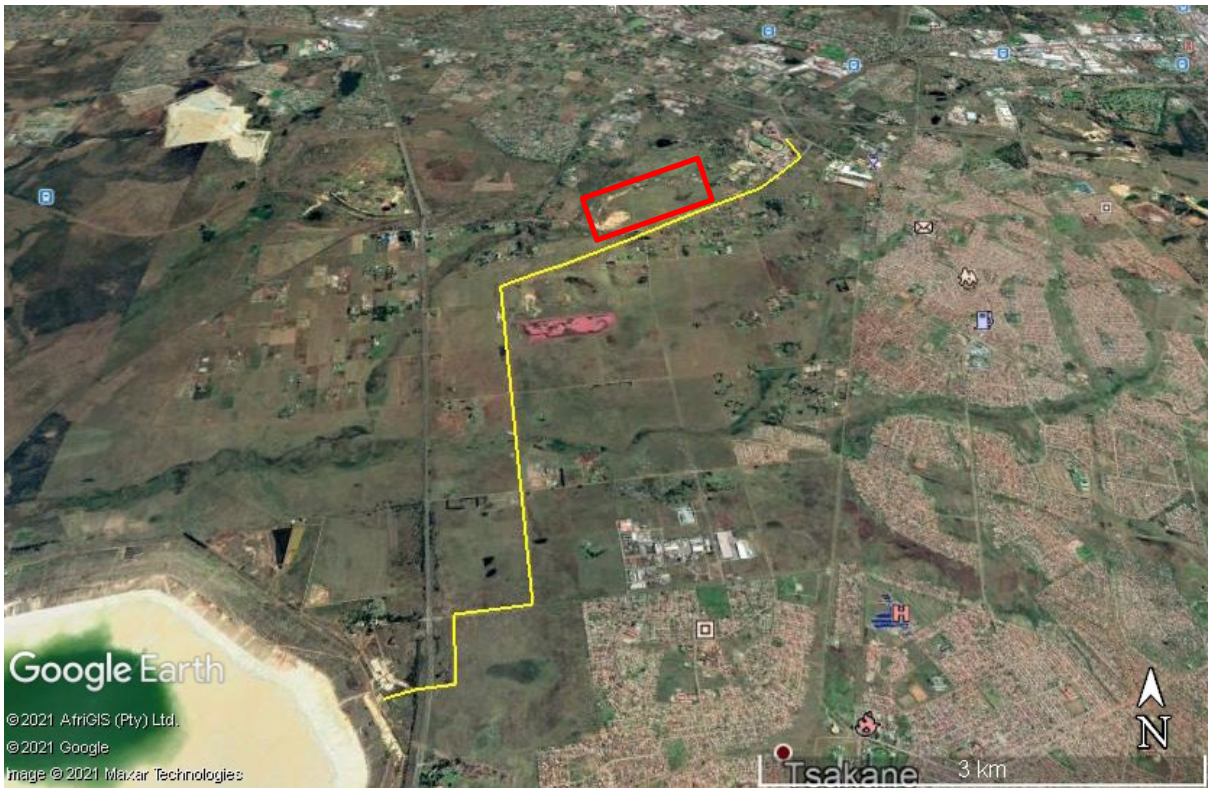

Figure 3: Google Earth map to show the proposed routes (yellow) for the overhead power lines for the Tshedza 1 PV plant.

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 area are the Klipriviersberg Group rocks that are all volcanic in origin with varying proportions of mafic lava, amygdaloidal and porphyritic tuffs and are older than 2417 million years (van der Westhuizen et al., 2006). Since they are of the wrong type and too old to contain any fossils they will not be considered any further.

The Late Archaean to early Proterozoic Transvaal Supergroup is preserved in three structural basins on the Kaapvaal Craton (Eriksson et al., 2006). In South Africa are the Transvaal and Griqualand West Basins, and the Kanye Basin is in southern Botswana. The Transvaal Supergroup comprises one of world's earliest carbonate platform successions (Beukes, 1987; Eriksson et al., 2006; Zeh et al., 2020). In some areas there are well preserved stromatolites that are evidence of the photosynthetic activity of blue green bacteria and green algae. These microbes formed colonies in warm, shallow seas.

In the Transvaal Basin the Transvaal Supergroup is divided into two Groups, the lower Chuniespoort Group and the upper Pretoria Group (with ten formations; Eriksson et al., 2006). The Chuniespoort Group is divided into the basal Malmani Subgroup that comprises dolomites and limestones and is divided into five formations based on chert content, stromatolitic morphology, intercalated shales and erosion surfaces. The top of the Chuniespoort Group has the Penge Formation and the Duitschland Formation.

The Hekpoort, Dwaalheuwel, Strubenkop and Daspoort Formations form a sequence as the middle part of the Pretoria Group, Transvaal Supergroup, and represent rocks that are over 2060 million years old.

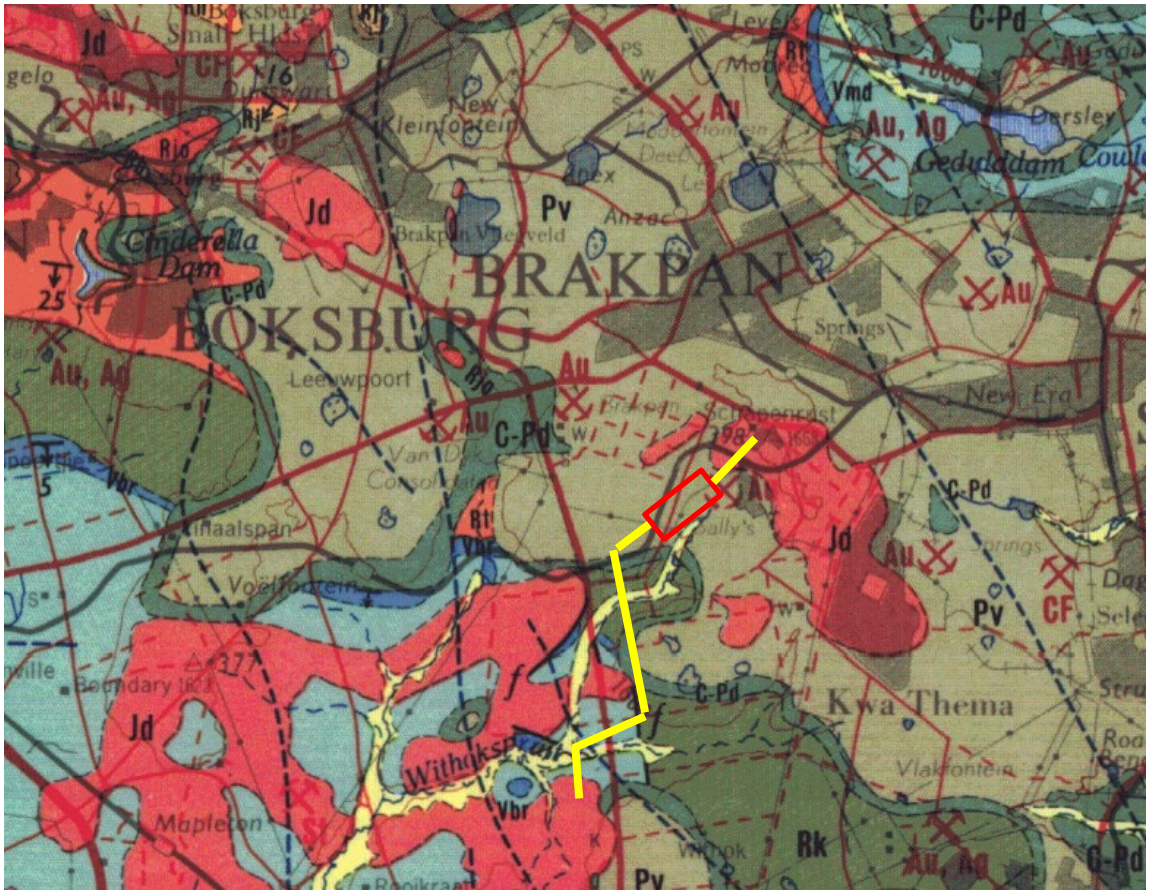

Figure 4: Geological map of the area around the south of Brakpan. The location of the proposed Tshedza 1 PV plant is indicated within the red rectangle and the powerline route is indicated by the yellow line. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2628 East Rand.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006. Johnson et al., 2006; McCarthy et al., 2006; Robb 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
Q	Quaternary	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pv	Vryheid Fm, Ecca Group, Karoo SG	Shales, sandstone, coal	Early Permian, Middle Ecca
Vt	Timeball Hill Fm Pretoria Group, Transvaal SG	Quartzite	< 2420 Ma
Vmd	Malmani Subgroup, Chuniespoort Group, Transvaal SG	Dolomite, chert	Ca 2750 – 2650 Ma
Vbr	Black Reef Fm, Transvaal SG	Quartzite, conglomerate, shale, basalt	Ca 2650 – 2640 Ma
Rk	Klipriviersberg Group, Ventersdorp SG	Andesite, tuff	Ca 2714 Ma

The Transvaal sequence has been interpreted as three major cycles of basin infill and tectonic activity with the first deep basin sediments forming the Chuniespoort Group, the second cycle deposited the lower Pretoria Group, and the upper part of the Pretoria Group was deposited in the third cycle. These sediments were deposited in shallow lacustrine, alluvial fan and braided stream environments (Eriksson et al., 2012).

Unconformably overlying the Transvaal Supergroup rocks are those of the Karoo Supergroup. These sediments fill in the large Karoo Basin as the Late Carboniferous glacial ice sheets retreated and melted. The basal diamictites and tillites of the Dwyka Group are overlain by the terrestrial Ecca Group shales, sandstones and mudstones. Coal seams formed by the compression and heat alteration of peats (accumulations of plant matter in water-logged anaerobic environments) occur in the Vryheid Formation. Younger Karoo rocks are not present in this area. Intrusive dolerite from the Jurassic volcanic activity has formed large sills of dolerite. This rock is volcanic in origin so does not preserve any fossils.

Considerably younger sands and alluvium of the Quaternary period have been deposited along the present water courses.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figures 5-7.

Photovoltaic Plant site

Indicated as very highly sensitive in the SAHRIS palaeosensitivity map is the PV plant site (Figure 5) and this applies to the Vryheid Formation that underlies the reclaimed mine dump, not the present day covering material. Fossil plants of the *Glossopteris* flora, namely Glossopteris leaves and reproductive structures, lycopods, sphenophytes, ferns and early gymnosperms can be found in the shales between the coal seams (Plumstead, 1969; Anderson and Anderson, 1985; Johnson et al., 2006). Fragments of these plants can sometimes be found in the Dwyka Group rocks (ibid).

Route for the overhead power lines

As indicated in Figure 6, the northern section of the powerline route is over the disturbed mine dump and then Jurassic dolerite which is non-fossiliferous. There is no chance of finding fossils along this section.

Figure 7 shows the southern route of the powerline that is mostly along the Klipriviersberg Group which is non-fossiliferous volcanic rock. Short sections are along the Dwyka Group (green in the map) so there is a small chance of finding fragments of *Glossopteris* flora plants. Dolerite does not preserve fossils. The short sections over the red background apply to the Malmani Group rocks where there is a small chance of finding the trace fossil, stromatolites.

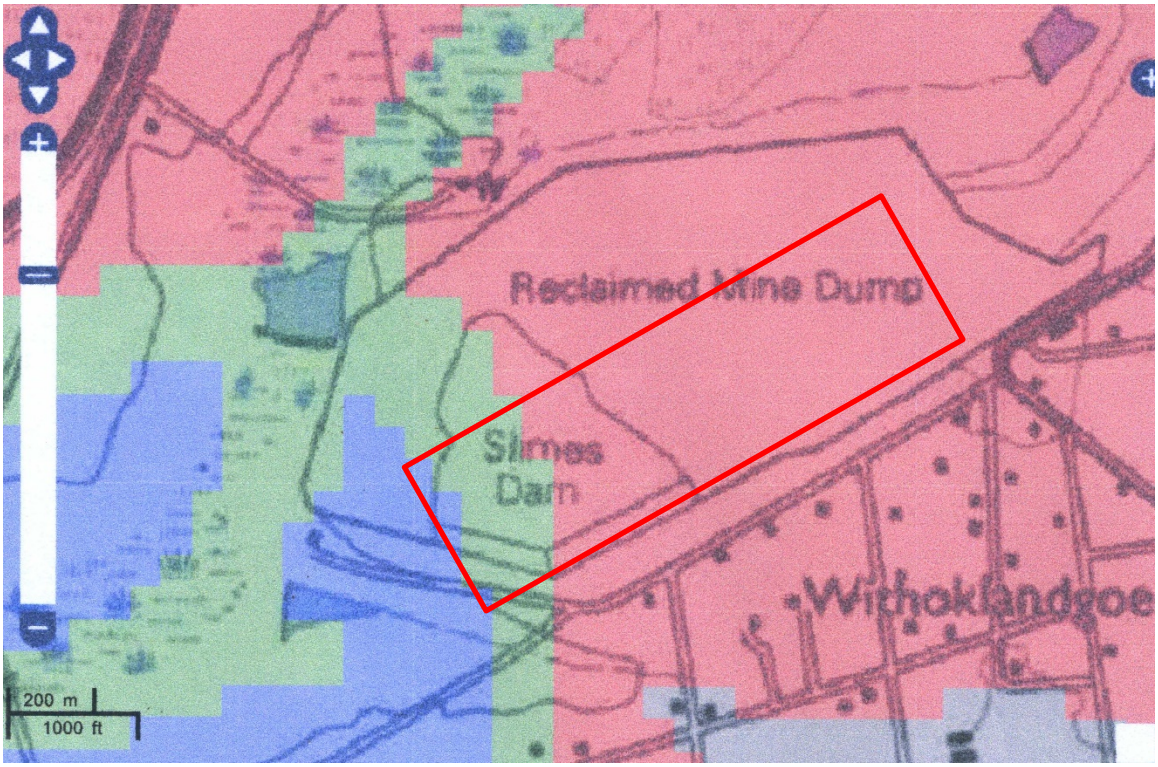

Figure 5: SAHRIS palaeosensitivity map for the site for the proposed Photovoltaic Plant shown within the red rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

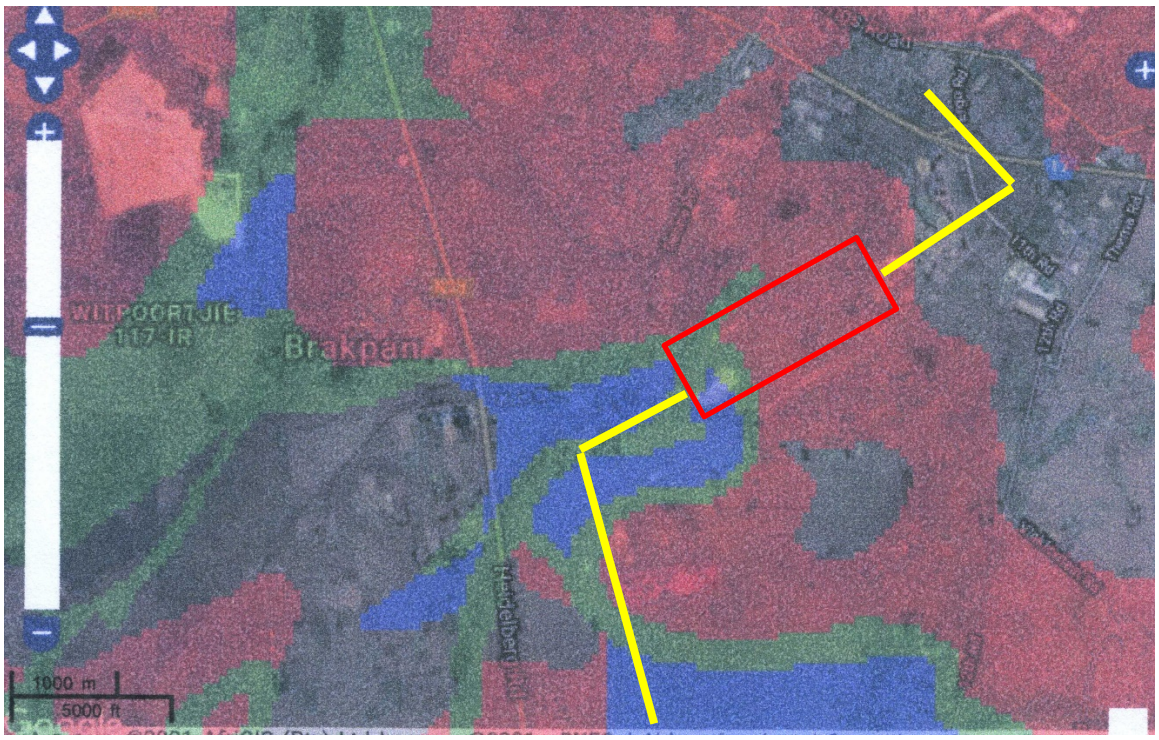

Figure 6: North section of the Tshedza 1 power line route - SAHRIS palaeosensitivity map (using the hybrid background because the 1:50 000 topographic layer used in figure 5 does not show the features. For background colours see Fig 5 caption.

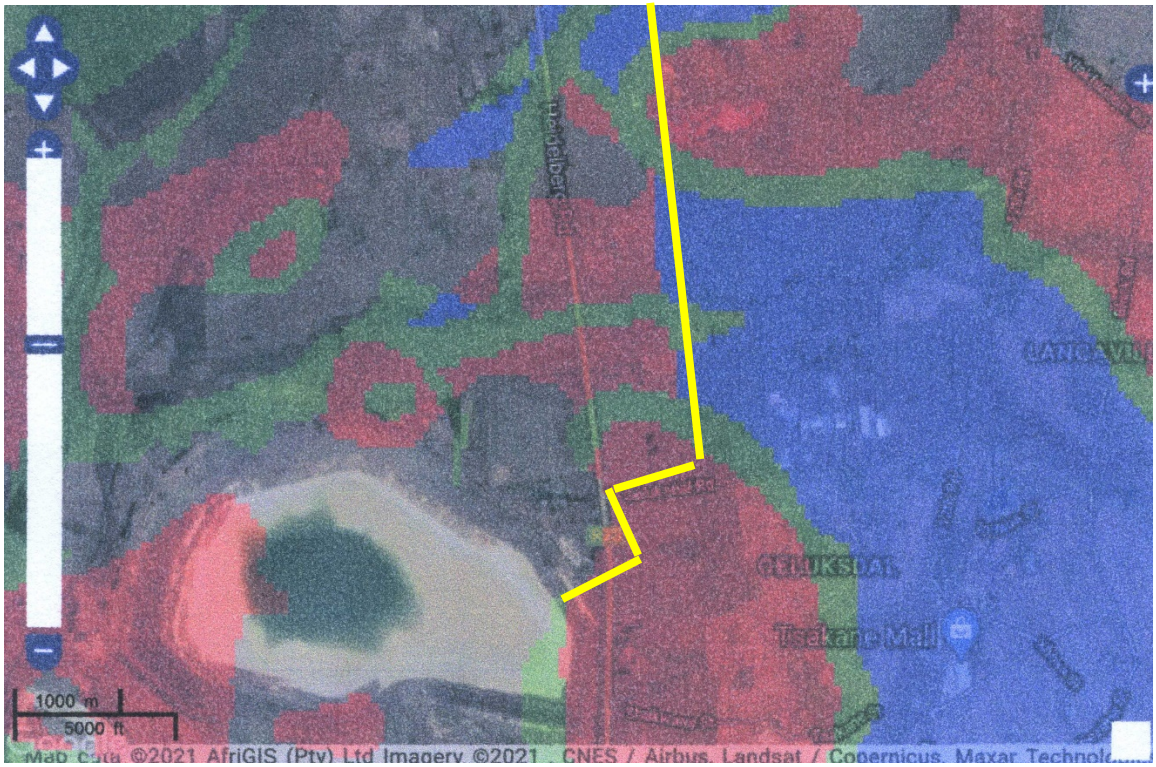

Figure 7: South section of the Tshedza 1 power line route - SAHRIS palaeosensitivity map (using the hybrid background because the 1:50 000 topographic layer used in figure 5 does not show the features. For background colours see Fig 5 caption.

Stromatolites are the fine layers of calcium carbonate, calcium sulphate, magnesium carbonate and magnesium sulphate that were deposited by the ancient colonies of cyanobacterial and green algae that grew in warm shallow seas. Their photosynthetic activity released oxygen which was rapidly absorbed by the reduced minerals on the earth's surface. The algal cells are very seldom preserved in the stromatolites so these structures are trace fossils. This area, however, is covered by soils and vegetation and has been greatly disturbed by urban and mining activities.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources is given in in Table 3 and has considered the criteria encapsulated after the table.

Significance colour coding:

- < 30 significance points = **LOW** environmental significance.
- 30- 60 significance points = **MODERATE** environmental significance
- >60 significance points = **HIGH** environmental significance

TABLE 3A AND B: IMPACT ASSESSMENTS

Activity:	Construction of the Photovoltaic Plant				
Impact:	NONE				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	1	0	0	0	**0**
Post-Mitigation	1	0	0	0	**0**
Is the Impact Reversible?	• No likelihood of fossils because the previous dump material is from a gold mine and far below the Vryheid Formation rocks; the material has been transported, sorted and the site reclaimed. • No impact				
Mitigation Measures:	• N/A				
Cumulative impacts:	• N/A				
Residual impacts:	• N/A				
Climate Change:	• N/A.				

Activity:	Construction of the Power lines to the west and south of the Photovoltaic Plant				
Impact:	LOW				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	5	1	0	2	**12**
Post-Mitigation	1	1	0	1	**0**
Is the Impact Reversible?	• YES – if fossils are found they can be removed				
Mitigation Measures:	• Removal of any fossils found – once the holes have been dug for the foundations for power line towers				
Cumulative impacts:	• None				

Residual impacts:	• None
Climate Change:	• N/A

Criteria for the Impact Assessment

The criteria below are used to establish the impact rating on sites:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0-1 years), assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years), assigned a score of 2;
  - medium-term (5-15 years), assigned a score of 3;
  - long term (> 15 years), assigned a score of 4; or
  - permanent, assigned a score of 5;
- The **magnitude**, quantified on a scale from 0-10 where; 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability of occurrence**, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1-5 where; 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- The **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be mitigated.

The **significance** is calculated by combining the criteria in the following formula:
S=(E+D+M) P
S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e., where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e., where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- 60 points: High (i.e., where the impact must have an influence on the decision process to develop in the area).

Impact Assessment

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 either much too old to contain fossils or of the wrong kind (e.g. volcanic).

Photovoltaic Plant on reclaimed mine dumps: No impact and the Signficance is Low
Power line to the North East: No Impact and the Significance is Low.
Power line to the west and South: Minor impact; Mitigation – When holes have been dug for the foundations for the power line towers, and if fossils are found (see Fossil Chance Find Protocol) then they should be removed and the project can proceed.

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 dolomites, sandstones, shales and sands are typical for the country and some could contain trace fossils such as stromatolites, fossil plant, insect, invertebrate and vertebrate material. The dolorites and volcanic rocks would not preserve fossils. There are no records of fossils from the proposed power line routes but it is unlikely that fossils occur there.

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 Klipriviersberg Group rocks or the Jurassic dykes. There is a very small chance that fossils may occur in the mudstones of the Dwyka Group or the shales of the early Permian Vryheid Formation. Stromatolites might occur on the Malmani Group dolomites, so a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once excavations have commenced for the towers of the overhead powerline along the southern route only ,(in the excavated holes), they should be rescued and a palaeontologist called to assess and collect a representative sample.

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.

Beukes, N.J., 1987. Facies relations, depositional environments, and diagenesis in a major early Proterozoic stromatolitic carbonate platform to basinal sequence, Campbell Rand Subgroup, Transvaal Supergroup, southern Africa. Sedimentary Geology 54, 1-46.

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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 (stromatolites, 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 8 - 10). 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 Malmani and Ecca Groups.

Figure 8: Surface view of stromatolites in the field (Malmani Subgroup).

Figure 9: Cross-sections and surface views of stromatolites (from MacRae, 1999).

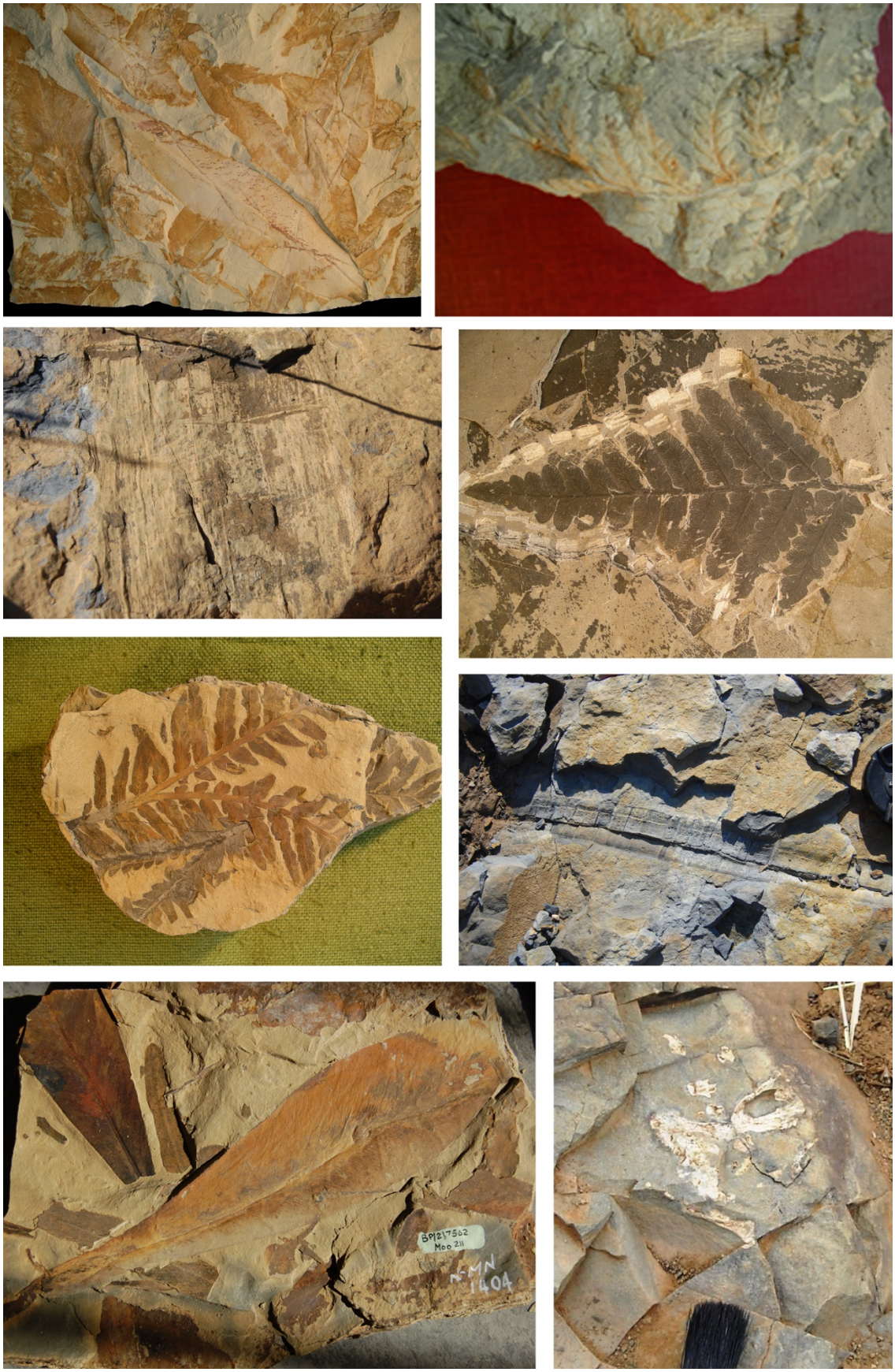

Figure 10: Selection of plants from the *Glossopteris* flora that could be found in the Dwyka Group or the Vryheid Formation (Ecca Group).

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)