

Palaeontological Impact Assessment for the proposed Ergo Mining Solar PV Phase 2 (40MW), Brakpan, Gauteng Province

Desktop Study (Phase 2)

For

Beyond Heritage

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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford

Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf

Experience: 33 years research and lecturing in Palaeontology

25 years PIA studies and over 300 projects completed

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Beyond Heritage, 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 Ergo Mining Solar Phase 2 development on Ergo Mining land, south of Brakpan, Gauteng.

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 three proposed project areas lie on the potentially fossiliferous Vryheid Formation (Ecca Group, Karoo Supergroup) that could preserve fossils of the *Glossopteris* flora. A site visit was not completed because the site is already highly disturbed from the past mining activities and subsequent rehabilitation and re-vegetation. Both factors would have destroyed any surface or near surface fossils, if ever present. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr in case there are fossils well below the ground surface. 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 have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised. Significance for the Palaeontology is **LOW**

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1. Background

The existing Ergo Mining (Pty) Ltd Brakpan Plant is proposing to develop the Phase 2 Ergo Mining Solar facility on their property. The proposed project is an ~120 hectare Solar PV development located on Ergo Mining owned land adjacent to the Withok Estates Agricultural Holdings in the area of Brakpan within the City of Ekurhuleni Metropolitan Municipality, Gauteng Province. The site is located approximately 6km south of the Brakpan central business district. Farms included in scoping assessment totalling about 557ha include: Portion 9 of Farm Withok 131 IR; Portion 183; 272 and 283 of Farm Witpoortje 117 IR; Holdings 203 - 208; 240-245; 296-303; 348-355 of Withok Estates Agricultural Holdings. Land assessed for the Impact Assessment Phase included the Preferred Layout Area (total ~116ha), on Farm Witpoortje 117 IR Portion 183 and Farm Witpoortje 117 IR Portion 272; and an alternate Layout Area (~total of ~122ha) on Farm Witpoortje 117 IR Portion 183 (this area is the same for both the preferred and alternate layout areas), and Farm Withok 131 IR Portion 9 (Figures 1-2).

All earmarked land for the PV facility is currently vacant and owned by Ergo Mining and falls within the existing approved Mining Right Area. Most of the land proposed for the development was historically impacted on by mining activities (i.e. Farm Witpoortje 117 IR Portion 183 and Farm Withok 131 IR Portion 9) or cultivated (i.e. Farm Witpoortje 117 IR Portion 272). Previously mined land has subsequently been rehabilitated to its current naturally vegetated condition.

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 by SAHRA (Case ID: 18418) for the Phase 2 Ergo Mining Solar facility plant project. 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: 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
a ii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
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 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

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
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

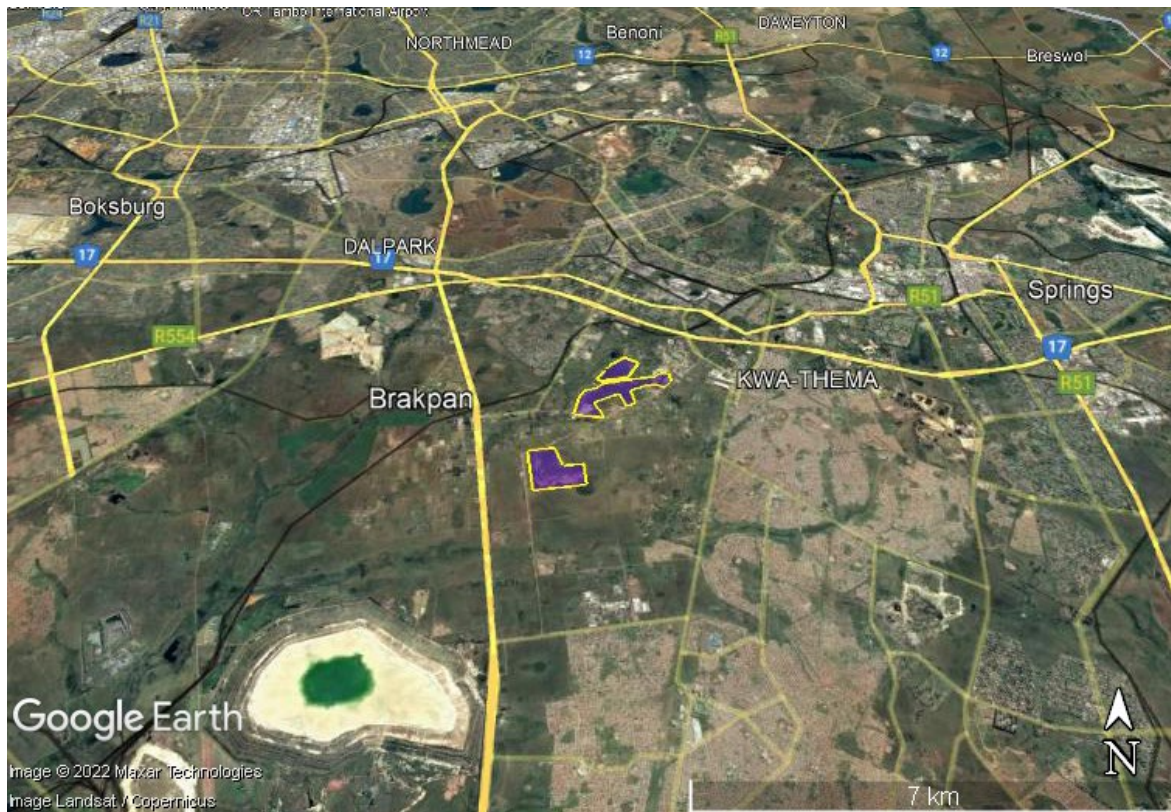


Figure 1: Google Earth map of the general area to show the relative land marks. The proposed Solar project is shown by the purple polygons.

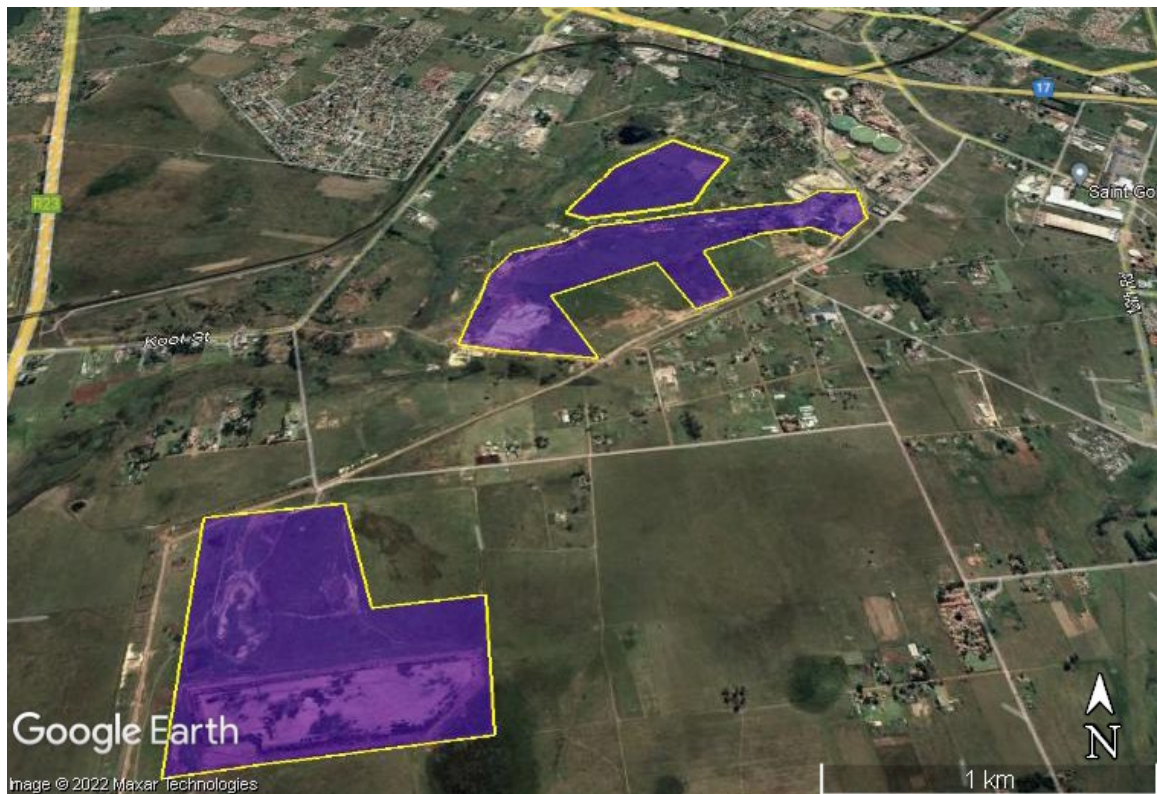


Figure 2: Google Earth Map of the proposed Phase 2 Solar project on three sites, two in the northeast and one in the southwest (purple polygons).

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;
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

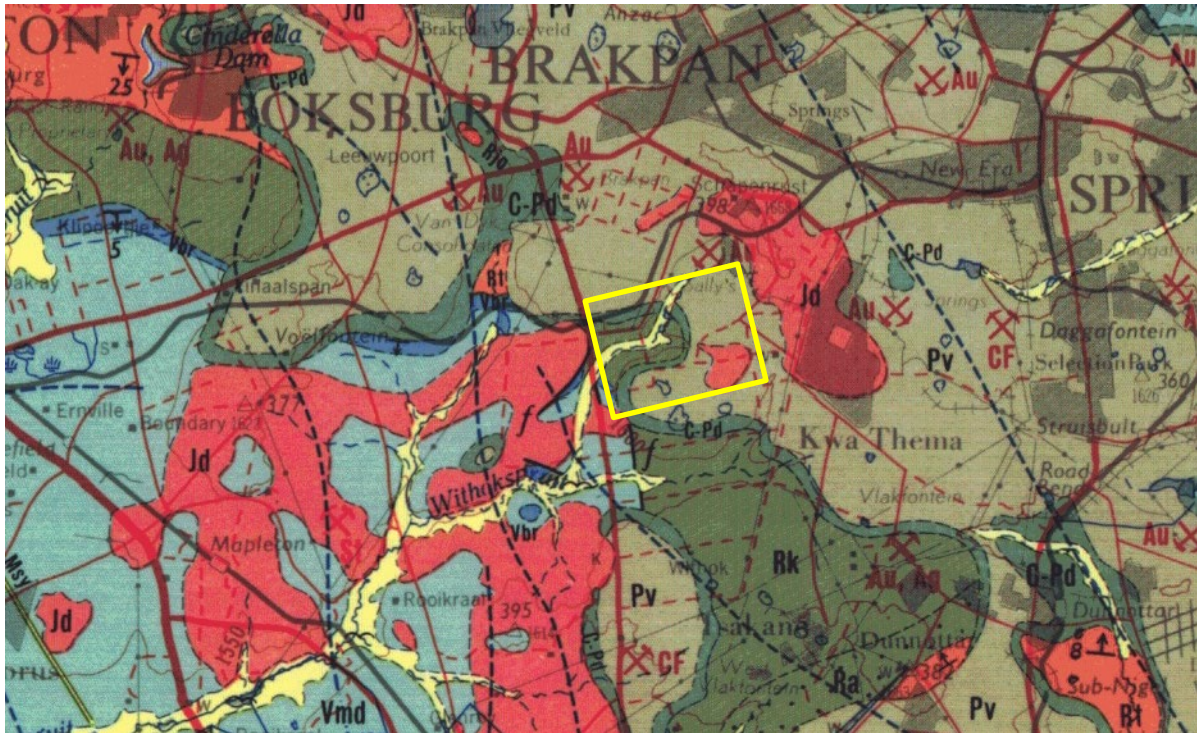


Figure 3: Geological map of the area around the proposed Phase 2 sites, south of Brakpan. The location of the proposed project is indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2428 East Rand.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006. Johnson et al., 2006; McCarthy et al., 2006). 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, Eccca Group, Karoo SG	Shales, sandstone, coal	Early Permian, Middle Eccca
C-Pd	Dwyka Group, Karoo SG	Tillites, diamictite, sandstone, mudstone	Late Carboniferous to Early Permian
Vbr	Black Reef Fm, Transvaal SG	Quartzite, conglomerate, shale, basalt	Ca 2650 – 2640 Ma
Vmd	Malmani Subgroup, Chuniespoort Group, Transvaal SG	Dolomite, chert	Ca 2750 – 2650 Ma
Rk	Klipriviersberg Group, Ventersdorp SG	Andesite, tuff	Ca 2714 Ma

The site lies in the central Transvaal Basin that has exposures of the basal members of the Transvaal Supergroup, and overlies the older rocks of the Witwatersrand Supergroup. Unconformably overlying the Transvaal Supergroup rocks are the much

younger basal members of the Karoo Supergroup as this is the northern margin of the Main Karoo Basin. Along the rivers and watercourses are recent deposits of sand and alluvium, of late Quaternary age (Figure 3).

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 Griqualand West Basin is divided into the Ghaap Plateau sub-basin and the Prieska sub-basin. Sediments in the lower parts of the basins are very similar but they differ somewhat higher up the sequences. Several tectonic events have greatly deformed the south western portion of the Griqualand West Basin between the two sub-basins

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 Deutschland Formation. The Karoo Supergroup rocks cover a very large proportion of South Africa and extend from the northeast (east of Pretoria) to the southwest and across to almost the KwaZulu Natal south coast. It is bounded along the southern margin by the Cape Fold Belt and along the northern margin by the much older Transvaal Supergroup rocks. Representing some 120 million years (300 – 183Ma), the Karoo Supergroup rocks have preserved a diversity of fossil plants, insects, vertebrates and invertebrates.

During the Carboniferous Period South Africa was part of the huge continental landmass known as Gondwanaland and it was positioned over the South Pole. As a result, there were several ice sheets that formed and melted, and covered most of South Africa (Visser, 1986, 1989). Gradual melting of the ice as the continental mass moved northwards and the earth warmed, formed fine-grained sediments in the large inland sea. These are the oldest rocks in the system and are exposed around the outer part of the ancient Karoo Basin, and are known as the Dwyka Group. They comprise tillites, diamictites, mudstones, siltstones and sandstones that were deposited as the basin filled. This group has been divided into two formations with Elandsvlei Formation occurring throughout the basin and the upper Mbizane Formation occurring only in the Free State and KwaZulu Natal (Johnson et al., 2006).

Overlying the Dwyka Group rocks are rocks of the Ecca Group that are Early Permian in age. There are eleven formations recognised in this group but they do not all extend throughout the Karoo Basin. In Gauteng, the Free State, Mpumalanga and KwaZulu Natal, from the base upwards are the Pietermaritzburg Formation, **Vryheid Formation** and the Volksrust Formation. All of these sediments have varying proportions of

sandstones, mudstones, shales and siltstones and represent shallow to deep water settings, deltas, rivers, streams and overbank depositional environments.

Overlying the Ecca Group are the rocks of the Beaufort Group that has been divided into the lower Adelaide Subgroup for the Upper Permian strata, and the Tarkastad Subgroup for the Early to Middle Triassic strata. As with the older Karoo sediments, the formations vary across the Karoo Basin. The Stormberg Group forms the upper part of the Karoo sediments. Large exposures of Jurassic dolerite dykes occur throughout the area. These intruded through the Karoo sediments around 183 million years ago at about the same time as the Drakensberg basaltic eruption.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4 for the two northeast sites, and Figure 5 for the Southwest site. Most of the footprint is in the Vryheid Formation (red in the SAHRIS map) that is very highly sensitive for palaeontology. The green colour indicates moderate sensitivity for Quaternary alluvium along the rivers and for the moderately sensitive Dwyka Group rocks.

The **Dwyka Group** could preserve transported and usually fragmented fossils of the *Glossopteris* flora, and some invertebrates, but these are rare and have not been recorded from the Transvaal.

The **Vryheid Formation** has extensive coal seams of Early Permian age. Although coal is formed from buried peat that is altered over time by high temperatures and pressures, the original plants that made the peat are not recognisable. The carbonaceous shale bands and lenses between the coal seams are more likely to preserve impressions of the plants. They are typical plants of the *Glossopteris* flora that includes leaves, seeds, reproductive structures and wood of *Glossopteris*, as well as other plants such as lycopods, sphenophytes, ferns and early gymnosperms.

In the Highveld and Witbank coal fields there are five to six coal seams, with No 4 being made up of two seams close together. The uppermost seam, No 5, is on average more than 10m below the ground surface. It is overlain by soils then shales and siltstone or interbedded shale and sandstone (Snyman, 1998). There are no coal mines in this part of the Vryheid Formation but the sediments overlie the much deeper gold reserves in underlying Witwatersrand Supergroup that is non-fossiliferous because it is too old and has been metamorphosed (McCarthy, 2006).

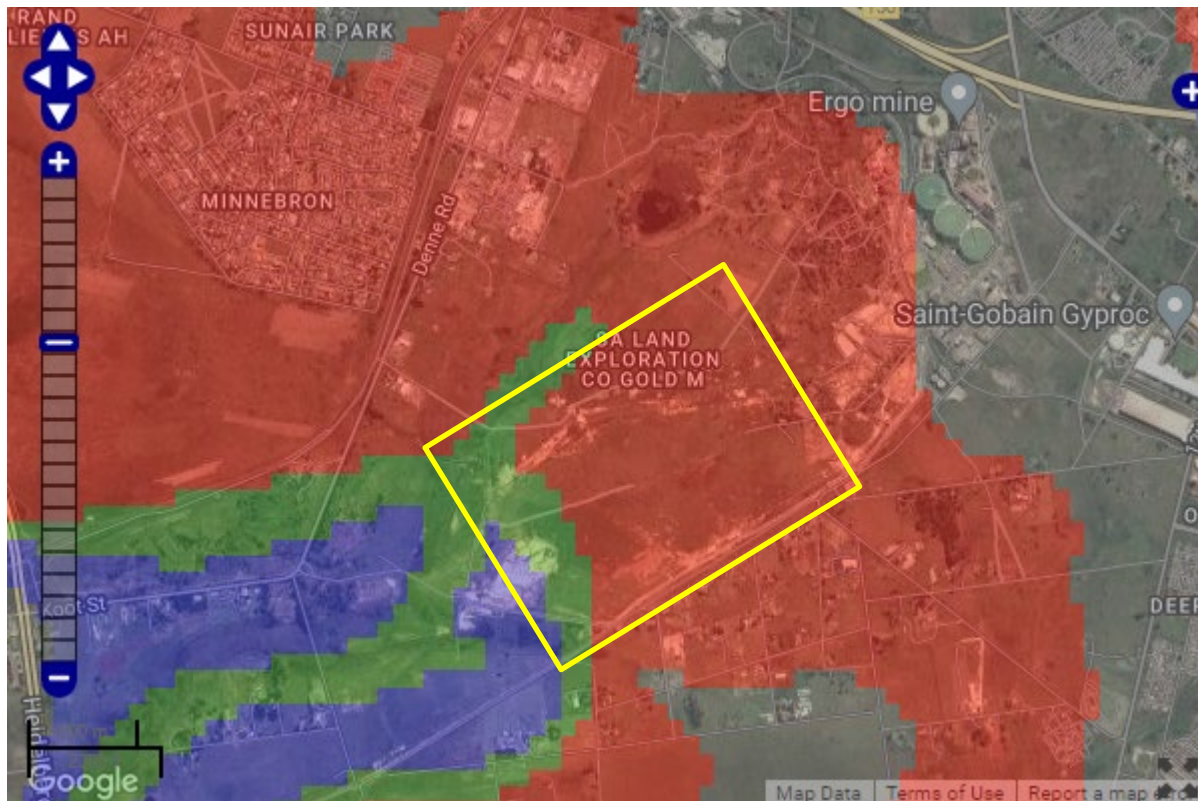


Figure 4: SAHRIS palaeosensitivity map for the site for the proposed northeast sites (preferred layout) for the Ergo Mining Solar Phase 2 project shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

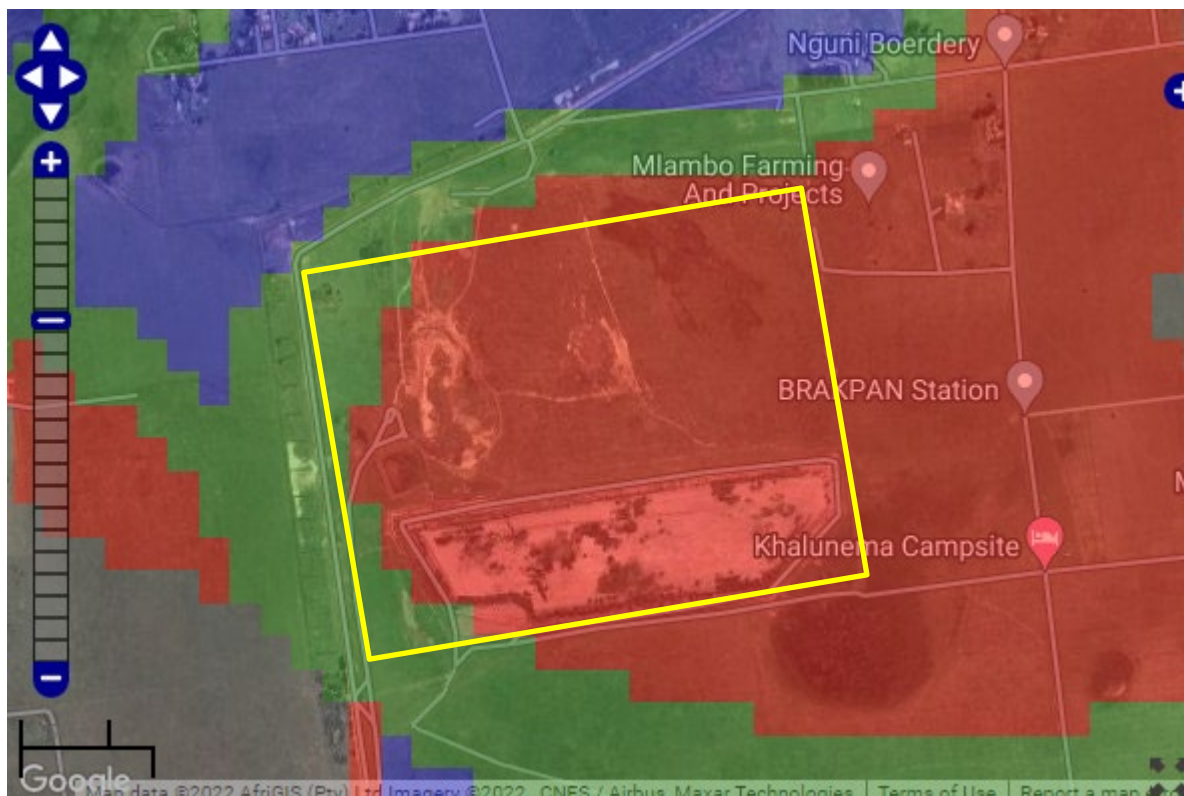


Figure 5: SAHRIS palaeosensitivity map for the Ergo Mining Solar Phase 2 southwest location (alternate layout) within the yellow outline. Background colours as for Figure 4.

Most of both the northeast and the southwest sites are on very highly sensitive rocks of the Vryheid Formation and a site visit would normally be required BUT, as can be seen in Figure 2, the area is covered in vegetation that has been established on the rehabilitated mine dumps, or on the dumps (southern part of the southwest site). Thus the project footprints are on highly disturbed land. A site visit before new ground is broken would be a waste of time as there would be no fossils on the land surface.

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

Table 3a: Criteria for assessing impacts

Activity:	Construction of the Photovoltaic Plant (all three sites)				
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?	<ul style="list-style-type: none"> • 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:	<ul style="list-style-type: none"> • N/A 				
Cumulative impacts:	<ul style="list-style-type: none"> • N/A 				
Residual impacts:	<ul style="list-style-type: none"> • N/A 				

Climate Change:	<ul style="list-style-type: none"> N/A.
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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:

$$S=(E+D+M) P$$

$$S \text{ for each site} = (1+0+0)0 = 0 = \text{LOW}$$

$$S \text{ for grid connection} = (5+1+0)2 = 12 = \text{LOW}$$

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).

Mitigation would be the removal of fossils if they found once excavations commence (See Section 8 for Fossil Chance Find Protocol).

Impact Assessment

The impact on the palaeontological heritage would be LOW for all three sites.

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 kind and ages to contain fossils, however the site is highly disturbed from previous mining activities and subsequent rehabilitation activities. Since there is an extremely small chance that fossils from below the land surface of the Vryheid Formation 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 dolomites, sandstones, shales and sands are typical for the country and only some contain 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. In addition, the area is already disturbed by mining activities and infrastructure. There is a very small chance that fossils may occur in the below ground shales of the early Permian Vryheid Formation so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the contractor, environmental officer, or other responsible person once excavations for foundations, poles 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 low so the project should be authorised. As far as the palaeontology is concerned, there is no preference for the site of the photovoltaic collectors, or for the grid connection.

7. References

- Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodrum 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.
- Eriksson, P.G., Altermann, W., Hartzler, F.J., 2006. The Transvaal Supergroup and its precursors. 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.
- Isbell, J.L., Henry, L.C., Gulbranson, E.L., Limarino, C.O., Fraiser, F.L., Koch, Z.J., Ciccioli, P.I., Dineen, A.A., 2012. Glacial paradoxes during the late Paleozoic ice age: Evaluating the equilibrium line altitude as a control on glaciation. *Gondwana Research* 22, 1-19.
- 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.
- McCarthy, T.S., 2006. The Witwatersrand 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 155-186.
- 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.
- Visser, J.N.J., 1986. Lateral lithofacies relationships in the glaciogene Dwyka Formation in the western and central parts of the Karoo Basin. *Transactions of the Geological Society of South Africa* 89, 373-383.
- Visser, J.N.J., 1989. The Permo-Carboniferous Dwyka Formation of southern Africa: deposition by a predominantly subpolar marine icesheet. *Palaeogeography, Palaeoclimatology, Palaeoecology* 70, 377-391.
- Zeh, A., Wilson, A.H., Gerdes, A., 2020. Zircon U-Pb-Hf isotope systematics of Transvaal Supergroup – Constraints for the geodynamic evolution of the Kaapvaal Craton and its hinterland between 2.65 and 2.06 Ga. *Precambrian Research* 345, 105760.
<https://doi.org/10.1016/j.precamres.2020.105760>

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 or trace fossils) 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 discard 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.

9. Appendix A – Examples of fossils from the Vryheid Formation

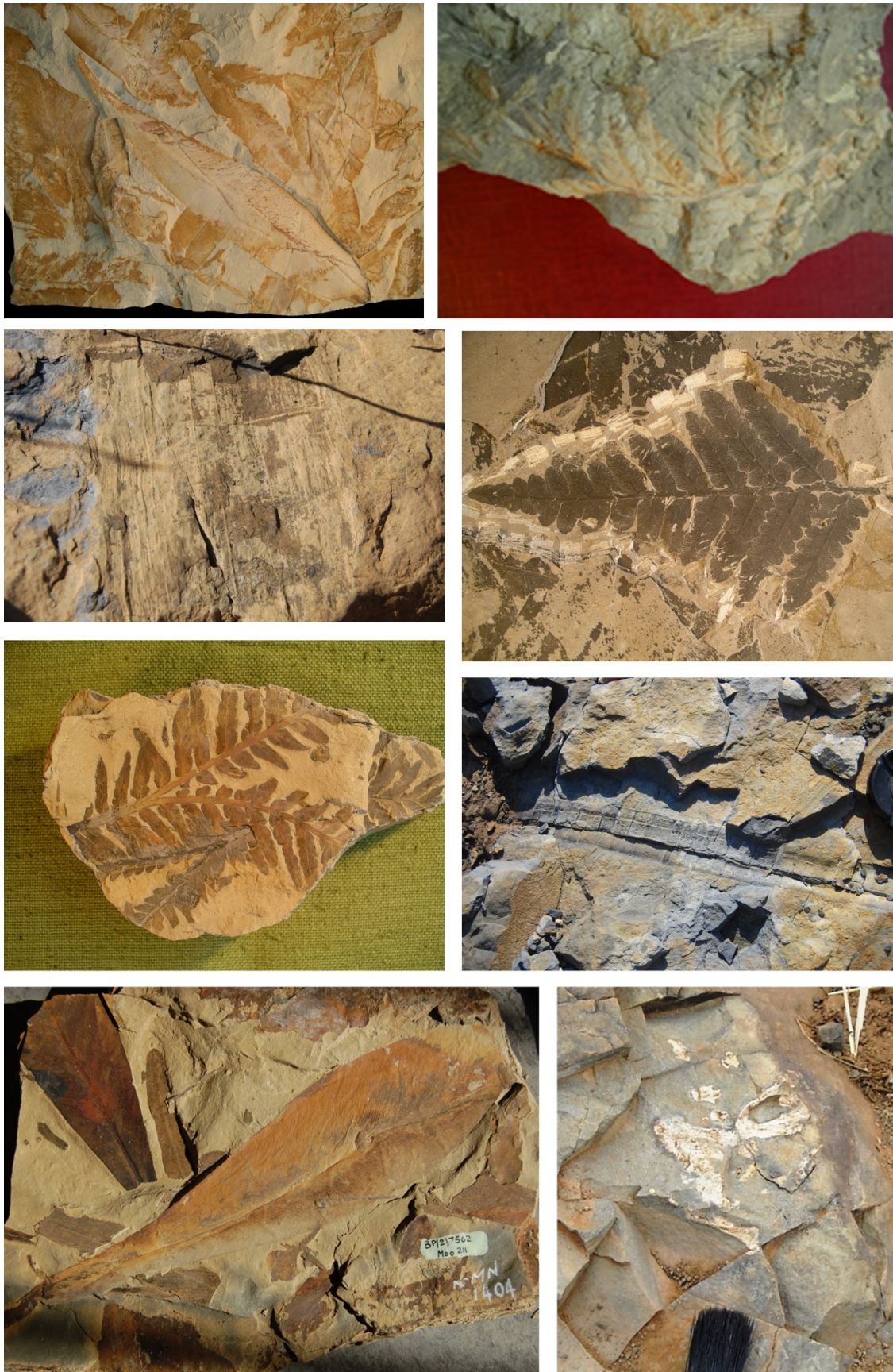


Figure 6: Photographs of fossil plants of the *Glossopteris* flora from the Vryheid Formation. Note bottom left pictures shown fossil bones in situ.

10. Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD **January 2022**

i) Personal details

Surname : **Bamford**
First names : **Marion Kathleen**
Present employment: Professor; Director of the Evolutionary Studies Institute.
Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa
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Cell : 082 555 6937
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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.
NRF Rating: C-2 (1999-2004); B-3 (2005-2015); B-2 (2016-2020); B-1 (2021-2026)

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	13	0
Masters	11	3
PhD	11	6
Postdoctoral fellows	15	1

viii) Undergraduate teaching

Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 45 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology;
Micropalaeontology – average 12-20 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 –
Associate Editor Open Science UK: 2021 -
Review of manuscripts for ISI-listed journals: 30 local and international journals
Reviewing of funding applications for NRF, PAST, NWO, SIDA, National Geographic,
Leakey Foundation

x) Palaeontological Impact Assessments

Selected from the past five years only – list not complete:

- 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
- Frankfort-Windfield Eskom Powerline 2020 for 1World
- 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

xi) Research Output

Publications by M K Bamford up to January 2022 peer-reviewed journals or scholarly books: over 160 articles published; 5 submitted/in press; 10 book chapters.

Scopus h-index = 30; Google scholar h-index = 35; i10-index = 92

Conferences: numerous presentations at local and international conferences.