

**Palaeontological Impact Assessment for the  
proposed prospecting activities on various farms  
in the district of Mankwe, Groot Marico and  
Zeerust, North West Province**

**Desktop Study (Phase 1)**

**For**

**Prescali Environmental Consultants (Pty) Ltd**

**16 June 2022**

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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 Prescali Environmental Consultants (Pty) Ltd, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

A handwritten signature in blue ink, appearing to read 'M Bamford', with a horizontal line underneath.

Signature:

## **Executive Summary**

A Palaeontological Impact Assessment was requested for the proposed prospecting right application by Salene Manganese (Pty) Ltd on various farms in the Mankwe, Zeerust and Groot Marico Districts, Northwest Province.

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 proposed borehole sites lie on the Quaternary Kalahari sand but are targeting the non-fossiliferous Bushveld Igneous Complex below the sands. Although sands do not preserve fossils, these overlying sands might have trapped fossils in features such as palaeo-pans or palaeo-springs. No such feature is visible in the satellite imagery. 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 drilling activities have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

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# 1. Background

Salene Manganese (Pty) Ltd is applying for a prospecting right for the following Minerals: Nickel ore, Silver ore, Copper ore, Gold, Cobalt, Platinum Group Metals (PGM), Chrome, Titanium, Barium, Magnesite and Rare Earth Elements (REE) and a BAR has been done by Prescali Environmental Consultants (Pty) Ltd - Salene/NWNickel.PR/BAR 2022, entitled "Basic Assessment Report for the proposed prospecting activities on various farms in the district of Mankwe, Groot Marico and Zeerust, North West Province.

Prospecting will take place on the following farms: Roodekopjesfontein 15-JP, Zelikatskop 16-JP, Knapdaar 26-JP, Farm 10 902-JP, Schoonlaagte 935-KP, Nooitgedacht 938-KP, Farm 6 939-KP, Leeuwkopje 952-KP, Driekop 14-JP, Magdalenas Kuil 37-JP, Kuilenburg 39-JP, Giglio 42-JP, Doornlaagte 51-JP, Medfordt Park 52-JP, Vriendschap 53-JP, Koedoespoort 64-JP and Koedoespoort 68-JP within the administrative district of Mankwe, Groot Marico and Zeerust, North West Province.

DMRE Reference Number: NW30/5/1/1/2/13162 PR

According to the BAR Non-Invasive Activities have already taken place. These involved desktop studies, assessing historical data, geological mapping and compilation of data. From the interpretation of the data and resource estimation, the position of boreholes has been planned. The second phase is the prospecting right application for the drilling, an Invasive Activity, and so the reason for this palaeontological impact assessment (PIA)..

## Drilling:

An estimated 10 holes will be drilled in this phase and most require as short access road from the nearest farm road. After assessing results of these holes, more drilling will be planned if required. Co-ordinates of holes will be finalized at that stage. Rehabilitation of the drill sites will be monitored to ensure compliance with the environmental management programme. Normal industry practice in terms of assaying, mineralogical testing and metallurgical testing will be followed (details in the BAR).

Table 1: The proposed ten drill holes (see Figures 1-3) and geology (see Figure 4).

No	Latitude	Longitude	Farm	Geology
4	S25° 07' 54.47"	E26° 20' 12.84"	41- Rooderand	Quaternary
5	S25° 06' 45.21"	E26° 20' 38.09"	41- Rooderand	Quaternary
6	S25° 06' 13.54"	E26° 20' 39.63"	15 - Roodekopjesfontein	Quaternary
7	S25° 05' 19.00"	E26° 21' 14.00"	15 - Roodekopjesfontein	Quaternary
8	S25° 04' 24.00"	E26° 21' 07.00"	15- Roodekopjesfontein	Quaternary
9	S25° 03' 45.16"	E26° 20' 40.64"	15- Roodekopjesfontein	Quaternary
10	S25° 02' 57.67"	E26° 20' 21.37"	15- Roodekopjesfontein	Quaternary
11	S25° 12' 20.68"	E26° 10' 44.43"	42 - Giglio	Quaternary
12	S25° 09' 59.00"	E26° 16' 39.00"	41- Rooderand	Quaternary
13	S25° 01' 04.00"	E26° 19' 50.00"	15- Roodekopjesfontein	Quaternary

A Palaeontological Impact Assessment was requested for the prospecting right application for the Zeerust Salene 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 2: 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).

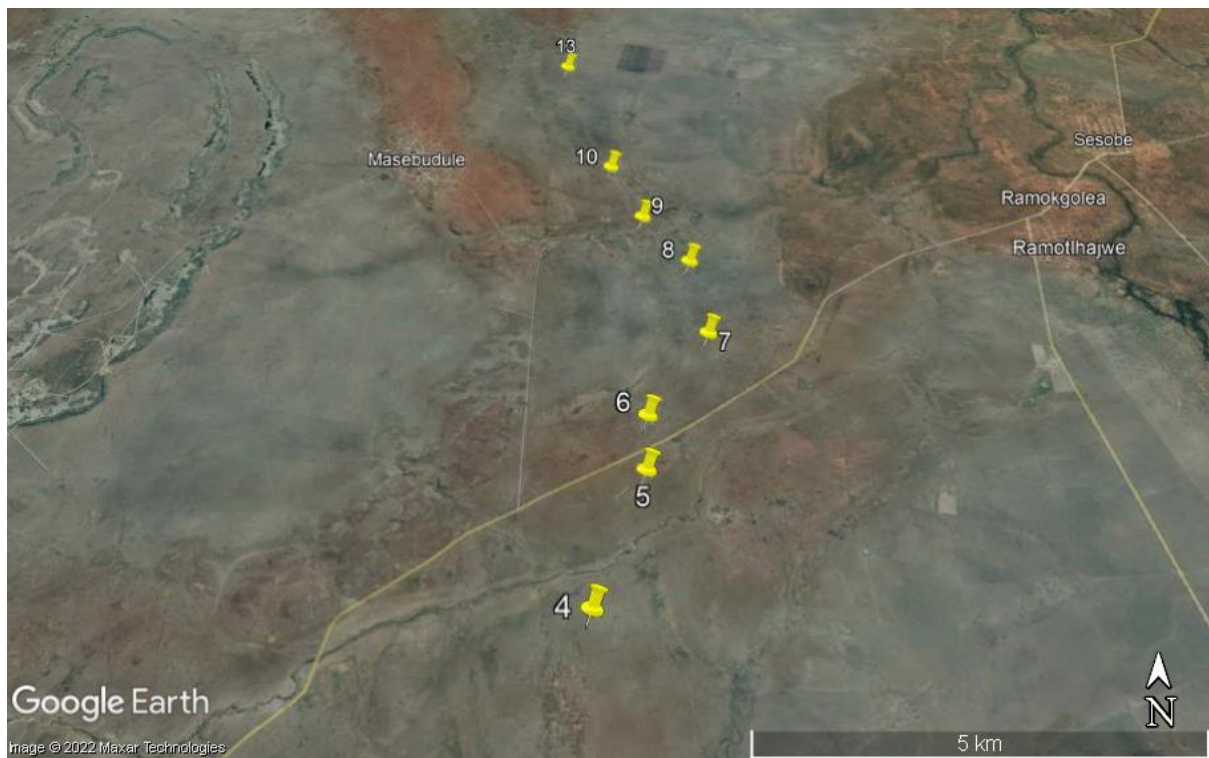
	<b>A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:</b>	<b>Relevant section in report</b>
ai	Details of the specialist who prepared the report,	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix 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 EMP	Section 8, Appendix A

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

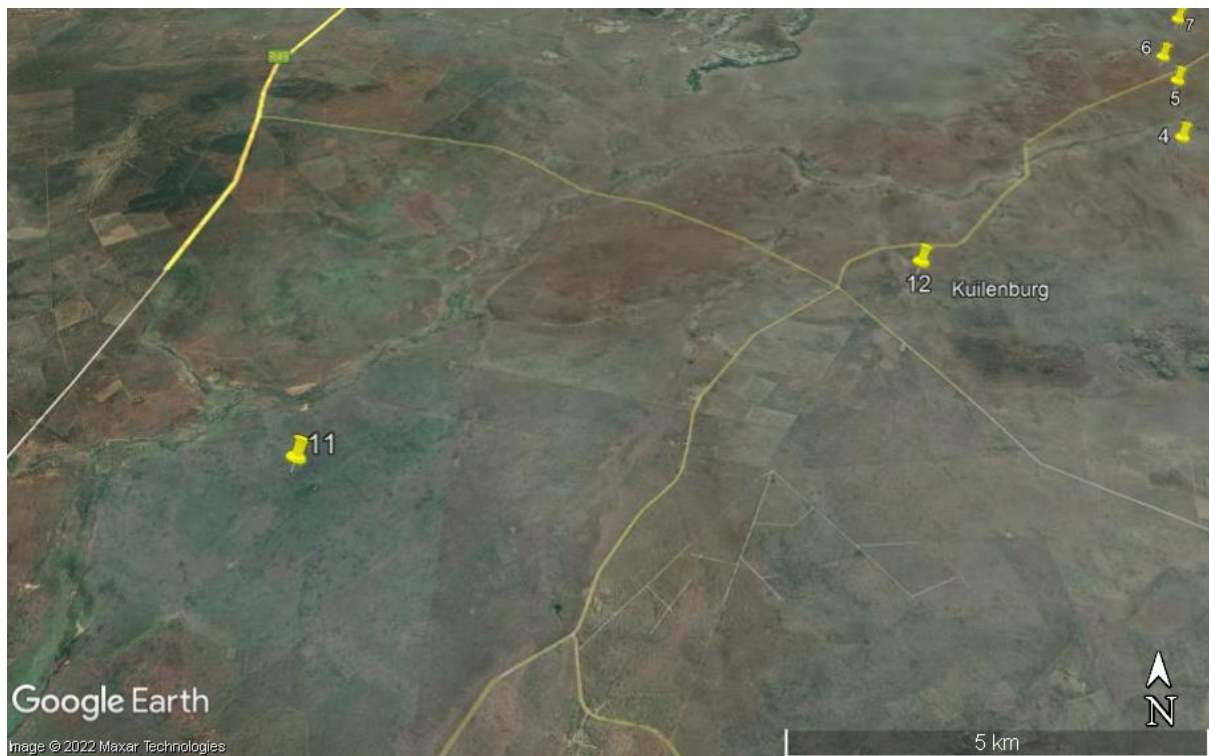


**Figure 1: Google Earth map of the general area to show the relative landmarks. The drill hole sites for the project are shown by the pins.**





**Figure 2: Google Earth Map of the proposed northern 8 drill hole sites (4-10, 13) shown by the pins.**



**Figure 3: Google Earth map with the two southern drill hole sites (11, 12) shown by the pins.**



## 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

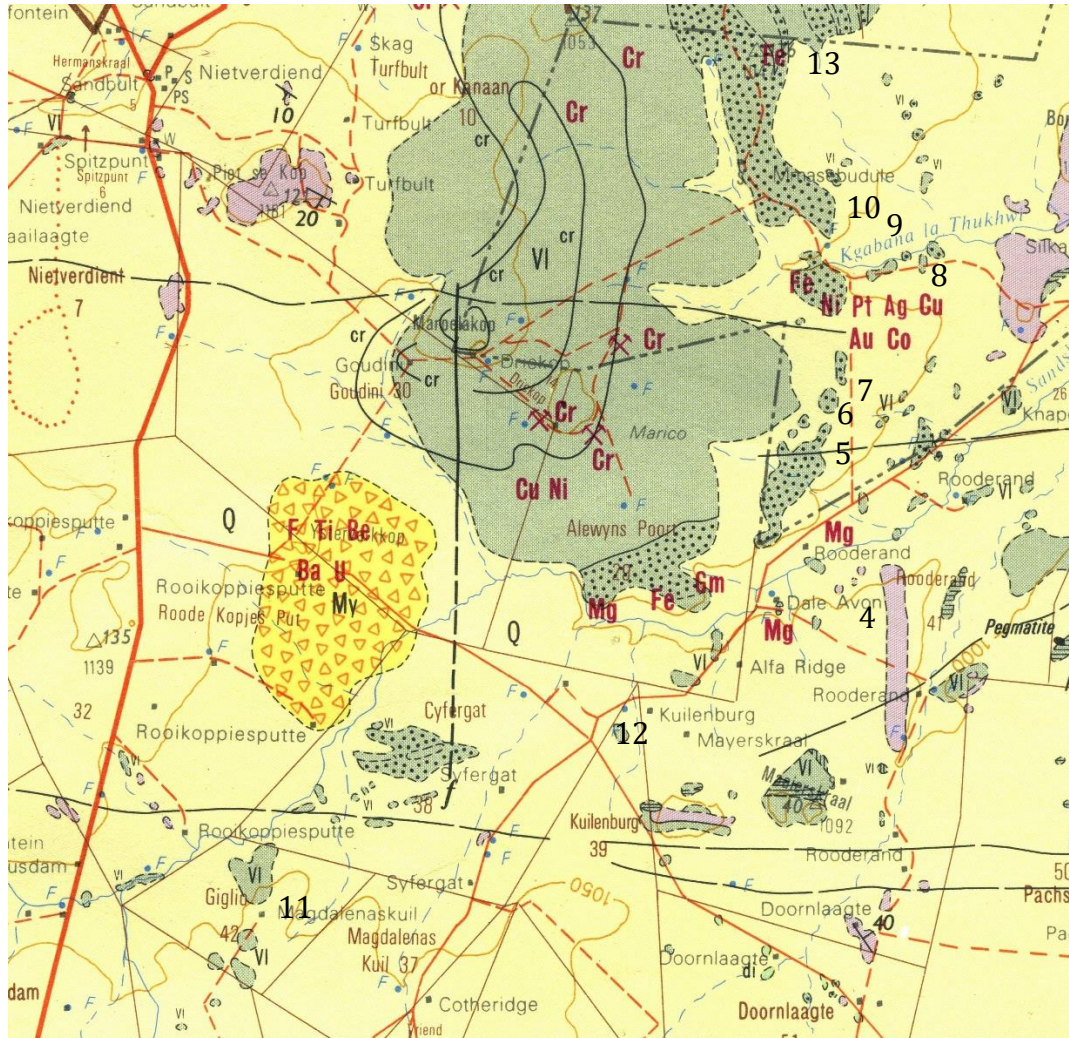
The project lies in the northwestern part of the Transvaal Basin where the marginal outcrops of the Rustenburg Layered Suite are exposed. Most of the area is covered by Quaternary Kalahari Sands.

The Transvaal Sequence comprises at least three cycles of basin filling and tectonic activity. The uppermost part of the sequence was intruded by the Rustenburg Layered Suite of the Bushveld Igneous Complex after the deposition of the Magaliesburg Formation at around 2060 million year ago (Eriksson et al. 2006; 2055 Ma in Zeh et al., 2020), with the Magaliesberg Formation of the Pretoria Group forming the floor rocks in most areas (Eriksson et al., 2006). In other areas of the basin the lavas and other subordinate sedimentary rocks of the Rooiberg Group form the floor instead (ibid).

The Bushveld Igneous Complex is a complex series of volcanic and metamorphosed rocks and contains economically important reserves of the Platinum Group Elements (Cawthorn et al., 2006). These rocks are volcanic in origin so not preserve any fossils.

The Quaternary Kalahari sands form an extensive cover of much younger deposits over much of the Northern Cape Province and Botswana. Haddon and McCarthy (2005) proposed that the Kalahari basin formed as a response to down-warp of the interior of the southern Africa, probably in the Late Cretaceous. This, along with possible uplift along epeirogenic axes, back-tilted rivers into the newly formed Kalahari basin and deposition of the Kalahari Group sediments began. Sediments included basal gravels in river channels, sand and finer sediments. A period of relative tectonic stability during the mid-Miocene saw the silcretisation and calcretisation of older Kalahari Group lithologies, and this was followed in the Late Miocene by relatively minor uplift of the eastern side of

southern Africa and along certain epeirogenic axes in the interior. More uplift during the Pliocene caused erosion of the sand that was then reworked and redeposited by aeolian processes during drier periods, resulting in the extensive dune fields that are preserved today.



**Figure 4: Geological map of the area around the proposed Salene drill holes indicated by their numbers. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2526 Rustenburg.**

Table 3: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006; Partridge et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
My	Ystervarkkop Complex	Pyroclastic breccia, metacarbonatite, volcanic rocks	Palaeoproterozoic

Symbol	Group/Formation	Lithology	Approximate Age
Vr	Rayton Fm, Pretoria Group, Transvaal SG	quartzite	Palaeoproterozoic Ca 2650 Ma
VI	Tweelaagte Bronzitite, Rustenburg Layered Suite, Bushveld Igneous complex	Pyroxenite; dunite, harzburgite	Palaeoproterozoic Ca 2650 Ma

There are numerous pans in the Kalahari, generally 3–4 km in diameter (Haddon and McCarthy, 2005). According to Goudie and Wells (1995) there are two conditions required for the formation of pans. Firstly, the fluvial processes must not be integrated, and second, there must be no accumulation of aeolian material that would fill the irregularities or depressions in the land surface. Favoured materials or substrates for the formation of pans in South Africa are Dwyka and Eccra shales and sandstones (ibid).

Most pans in the Kalahari Basin are filled by a layer of clayey sand or calcareous clays and are flanked by lunette dunes formed as a result of deflation of the pan floor during arid periods (Lancaster, 1978a, b; Haddon and McCarthy, 2005). At some localities in the south western Kalahari spring-fed tufas have formed at the margins of pans during periods where groundwater discharge was high (Lancaster, 1986). These tufas may contain evidence of algal mats and stromatolites and may also be associated with calcified reed and root tubes (Lancaster, 1986). Many of the pans are characterised by diatomaceous earth, diatomite or kieselguhr, a white or grey, porous, light-weight, fine-grained sediment composed mainly of the fossilised skeletons of diatoms. Associated with some palaeo-pans and palaeo-springs are fossil bones, root casts, pollen and archaeological artefacts. Well-known sites are Florisbad and Deelpans in the Free State, Wonderkrater in Limpopo and Bosluispan in the Northern Cape.

Overlying many of these areas are loose sands and sand dunes of the Gordonia Formation, Kalahari Group of Quaternary Age. The Gordonia Formation is the youngest of six formations and is the most extensive, stretching from the northern Karoo, Botswana, Namibia to the Congo River (Partridge et al., 2006). It is considered to be the biggest palaeo-erg in the world (ibid). The sands have been derived from local sources with some additional material transported into the basin (Partridge et al., 2006). Much of the Gordonia Formation comprises linear dunes that were reworked a number of times before being stabilised by vegetation (ibid).

## ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 5, 6. Although the target for the drill cores is the underlying rocks that are non-fossiliferous because they are volcanic in origin, the access roads and tops of the drill sites are in the Kalahari sands, probably the Gordonia Formation. These sands are transported and do not preserve fossils but they might cover fossil traps such as palaeo-pans and palaeo-springs. These features are usually visible in the satellite imagery but no such features are evident in the area. These traps might have fragmented and transported but robust bones or silicified wood or roots of Quaternary age.



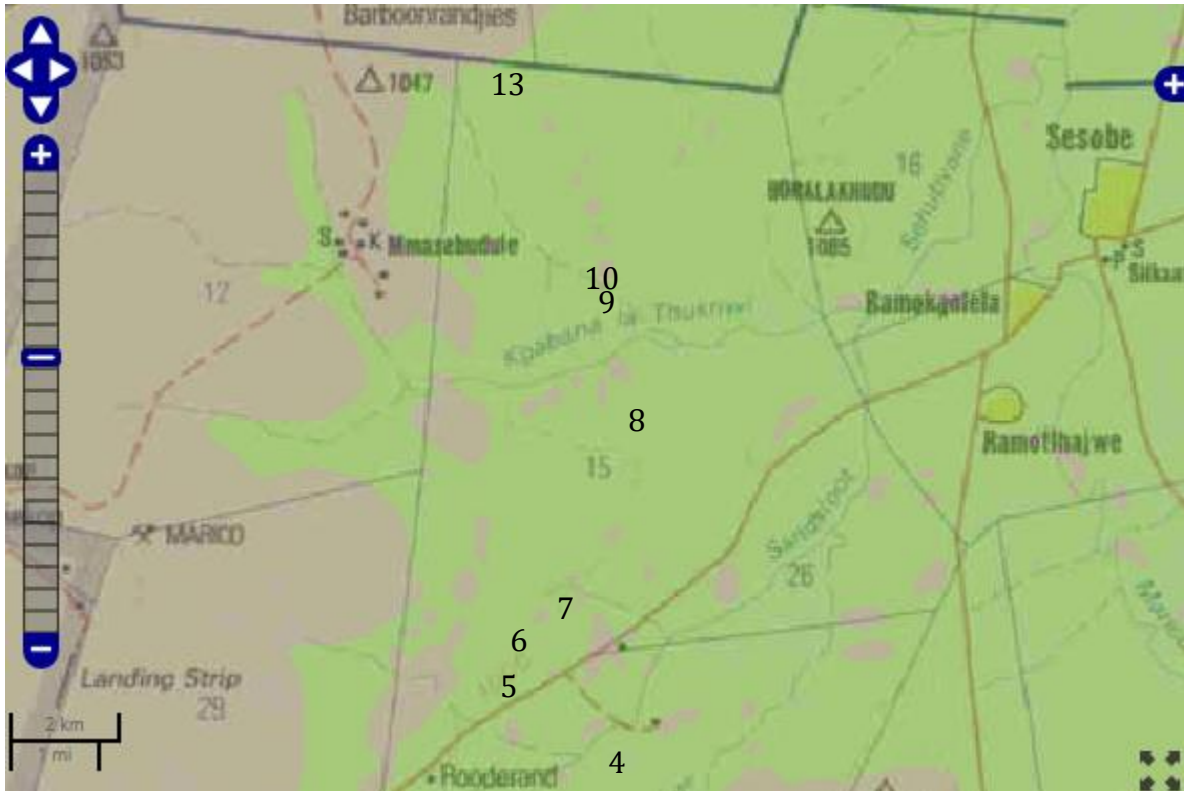


Figure 5: SAHRIS palaeosensitivity map for the site for the proposed northern cluster of boreholes (4-10, 13) shown by the numbered dots. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

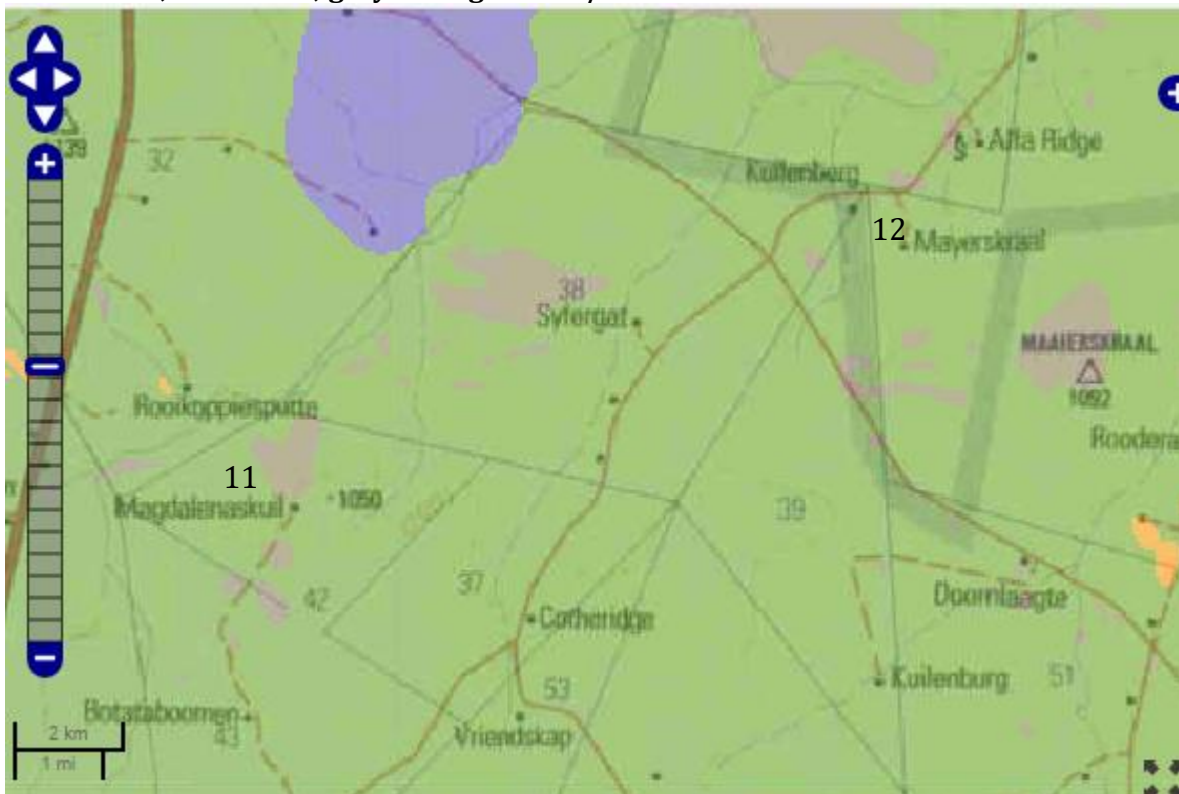


Figure 6: SAHRIS palaeosensitivity map for the site for the proposed southern boreholes (11-12) shown by the numbered dots. Background colours as above.

From the SAHRIS map above the area is indicated as moderately sensitive (green) for all the drill hole sites and their short access roads as they all fall on the Quaternary Kalahari sands.

## 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**

<b>PART A: DEFINITION AND CRITERIA</b>		
<b>Criteria for ranking of the SEVERITY/NATURE of environmental impacts</b>	<b>H</b>	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	<b>M</b>	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	<b>L</b>	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	<b>L+</b>	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	<b>M+</b>	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	<b>H+</b>	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
<b>Criteria for ranking the DURATION of impacts</b>	<b>L</b>	Quickly reversible. Less than the project life. Short term
	<b>M</b>	Reversible over time. Life of the project. Medium term
	<b>H</b>	Permanent. Beyond closure. Long term.
<b>Criteria for ranking the SPATIAL SCALE of impacts</b>	<b>L</b>	Localised - Within the site boundary.
	<b>M</b>	Fairly widespread – Beyond the site boundary. Local
	<b>H</b>	Widespread – Far beyond site boundary. Regional/ national
<b>PROBABILITY (of exposure to impacts)</b>	<b>H</b>	Definite/ Continuous
	<b>M</b>	Possible/ frequent
	<b>L</b>	Unlikely/ seldom

**Table 3b: Impact Assessment**

<b>PART B: Assessment</b>		
<b>SEVERITY/NATURE</b>	<b>H</b>	-
	<b>M</b>	-

<b>PART B: Assessment</b>		
	<b>L</b>	Sands do not preserve fossils; so far there are no records from the Kalahari Group of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be negligible
	<b>L+</b>	-
	<b>M+</b>	-
	<b>H+</b>	-
<b>DURATION</b>	<b>L</b>	-
	<b>M</b>	-
	<b>H</b>	Where manifest, the impact will be permanent.
<b>SPATIAL SCALE</b>	<b>L</b>	Since the only possible fossils within the area would be fossils trapped in palaeo-pans or palaeo-dunes beneath the sands, the spatial scale will be localised within the site boundary.
	<b>M</b>	-
	<b>H</b>	-
<b>PROBABILITY</b>	<b>H</b>	-
	<b>M</b>	-
	<b>L</b>	It is extremely unlikely that any fossils would be found in the loose soils and sands that cover the area because no traps are evident. 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 either volcanic in origin or transported sands and these do not preserve fossils. Since there is an extremely small chance that fossils may be trapped in pans below the sands and 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 dolerites, sandstones, shales and sands are typical for the country and do not contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period would not preserve fossils but they might cover traps such as palaeo-pans and palaeo-springs.

## 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 sands and soils of

the Quaternary. There is a very small chance that fossils may be trapped in underlying palaeo-pans or palaeo-springs but no such feature is visible in the satellite imagery. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once road construction and drilling 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 as far as the palaeontology is concerned, the project should be authorised.

## 7. References

- Cawthorn, R.G., Eales, H.V., Walraven, F., Uken, R., Watkeys, M.K., 2006. The Bushveld Complex. 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 261-281.
- 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.
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- 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.
- 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 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 7). 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. 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 Quaternary sands



**Figure 7: Photographs of fossils recovered from Quaternary Kalahari Group sands and alluvium. Note their fragmentary nature.**

## 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  
 Telephone : +27 11 717 6690  
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 E-mail : [marion.bamford@wits.ac.za](mailto:marion.bamford@wits.ac.za) ;  
[marionbamford12@gmail.com](mailto: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
- Klipportjie and Finaalspan 2017 for Delta BEC
- Ledjaja 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.