

**Palaeontological Impact Assessment for the proposed
Prospecting Rights application on Farms Driebooms
Leegte 245, Groot Zwart Bast 189 and Jagt Kolk 244,
Kenhardt, Northern Cape Province**

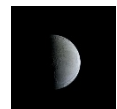
Desktop Study (Phase 1)

For

Basia Environmental Consultants and

28August 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 Archaeological and Heritage Services Africa (Pty) Ltd, Centurion, 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 Mining Rights Application by Newnite (Pty) Ltd for three farm in the Kenhardt district, Northern Cape Province. The properties are Portions 1, 2, RE of Farm Driebooms Leegte 245, Portions 1, 2, 3 and RE of Farm Groot Zwart Bast 189 and all of Farm Jagt Kolk 244.

SAHRA has recommended a desktop (Phase 1) palaeontological impact assessment (CaseID: 16378) 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.

The proposed site predominantly lies on the moderately sensitive diamictites and tillites of the Dwyka Group (Karoo Supergroup) and on the aeolian sands of the Gordonia Formation (Quaternary Kalahari Group). Only the mudstone facies of the Dwyka Group are likely to preserve invertebrates or fossil plants of the early Glossopteris flora. In the Gordonia Formation, only palaeo-pans or palaeo-springs are likely to entrap any fossils, but 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 palaeontological site visit is required unless fossils are found by the environmental officer, or other responsible person, once drilling and prospecting have commenced. As far the palaeontology is concerned, the project may be authorised

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1. Background

Basia Environmental Consultants has been appointed by Newnite (Pty) Ltd to conduct an Environmental Authorisation (EA) Application for proposed prospecting activities on three farms: Portion 1, 2 & the Remaining extent of farm Driebooms Leegte 245; Portion 1, 2, 3 and the Remaining extent of farm Groot Zwart Bast 189 and Portions 3, 5 & 8 of Jagt Kolk 244. They are located near Kenhardt Town, within the Kai !Garib Municipality, Northern Cape Province (DMR Ref: NC 30/5/1/1/2/ 12737 PR).

A draft Basic Assessment Report (DBAR) has been submitted in terms of the National Environmental Management Act, 1998 (NEMA) and the 2017 EIA Regulations for activities that trigger the Mineral and Petroleum Resources Development Act, 2002 (MPRDA)(As amended). The proposed prospecting right application area will cover 7 094.4861 ha and will include 15 boreholes to an approximate depth of 200 m, with equipment storage, security offices, ablution facilities and sample storage. The location of the boreholes is known and presented in Figure 10 of the BAR.

The preliminary comment from SAHRA noted that a palaeontological impact assessment is required (SAHRA CaseID: 16378).

A desktop (Phase 1) Palaeontological Impact Assessment was completed for the project 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), and is reported herein.

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 2
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 if any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A

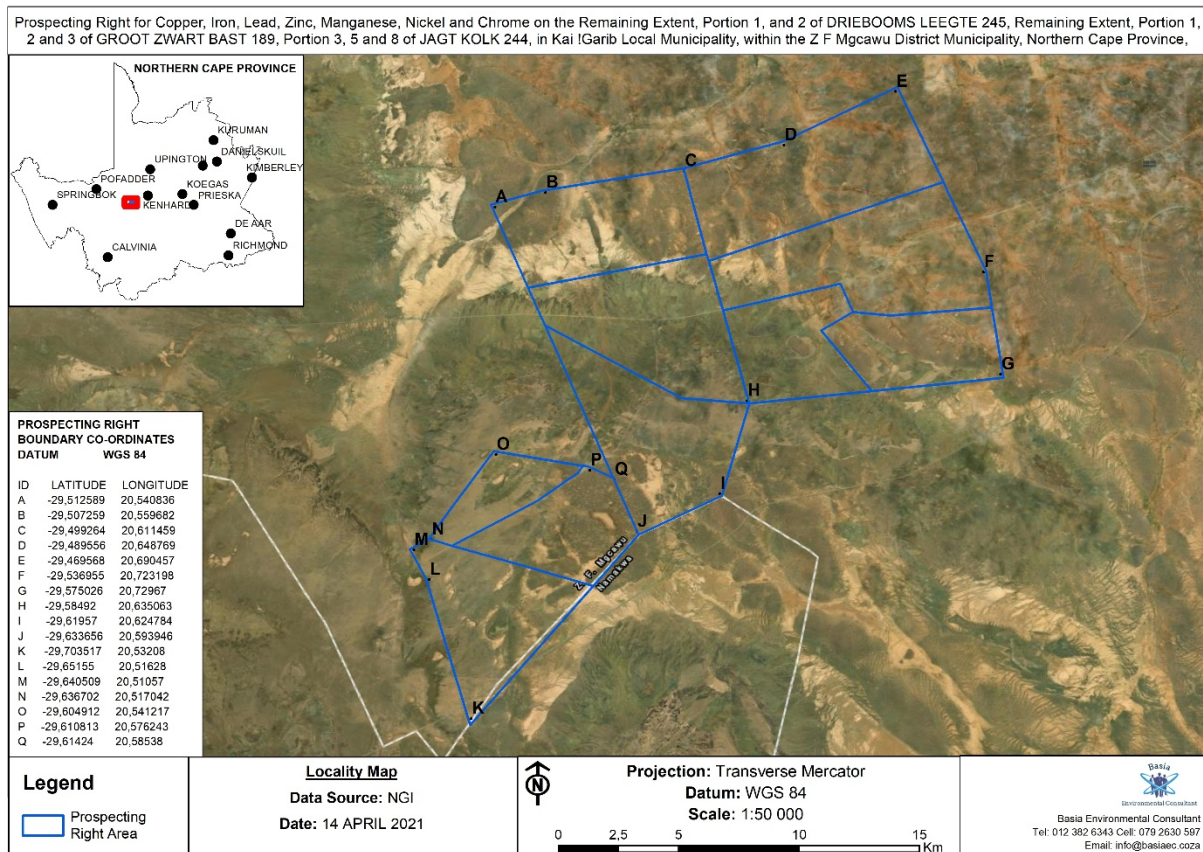


Figure 1: Google Earth map of the proposed prospecting rights area to the west of Kenhardt, Northern Cape Province, with the sections shown by the blue outline. Map supplied by Basia Environmental Consultant.

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

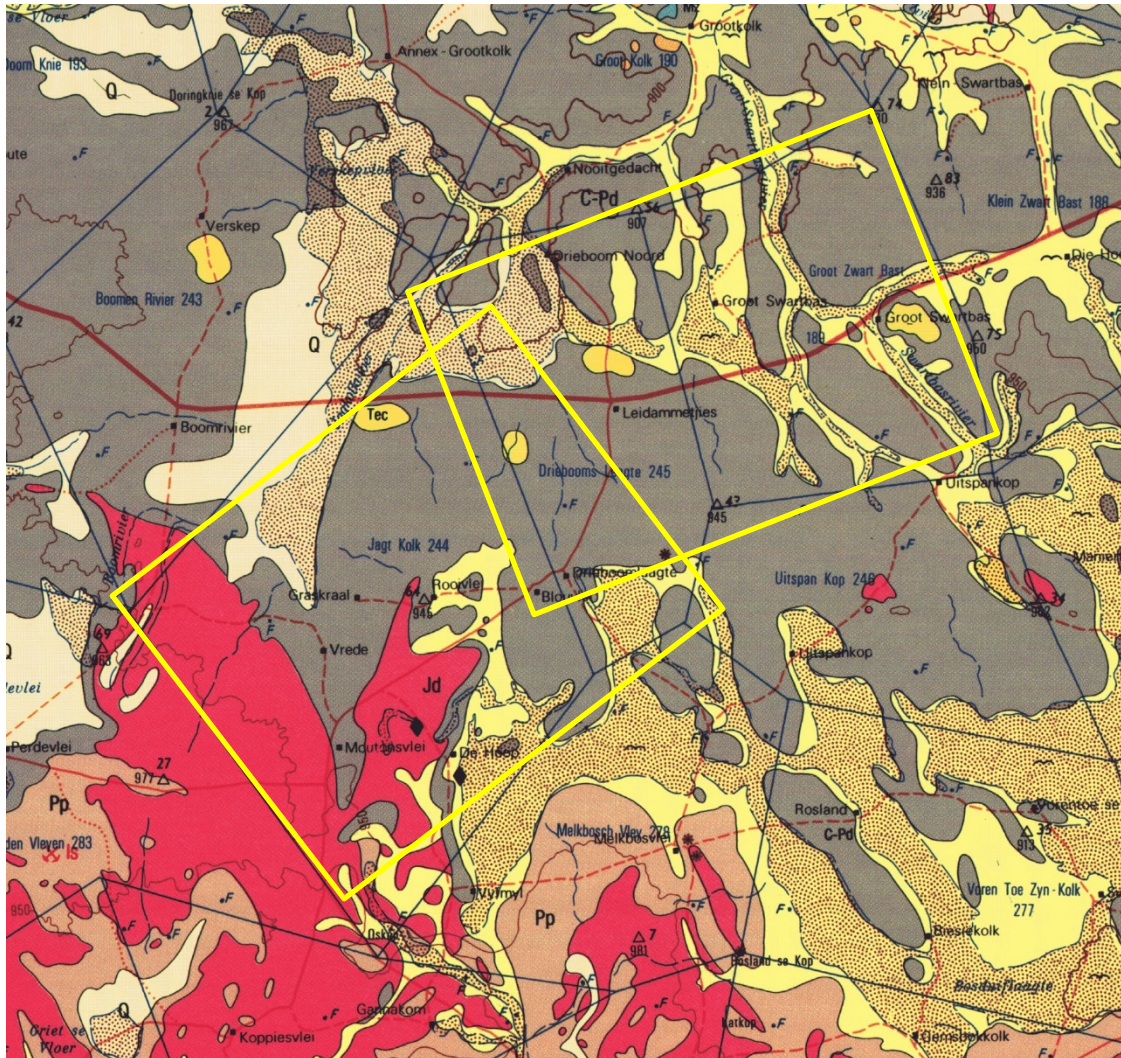


Figure 2: Geological map of the area around the three farms for the PR application, Driebooms Leegte 245, Groot Zwart Bast 189 and Jagt Kolk 244. The location of the proposed project is indicated within the yellow rectangles. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2920 Kenhardt.

Table 2: Explanation of symbols for the geological map and approximate ages (Johnson 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	Soil, alluvium, sand	Neogene, ca 2.5 Ma to present
Qg	Gordonia Fm, Kalahari Group	Aeolian sand	Late Quarternary

Symbol	Group/Formation	Lithology	Approximate Age
Tec	Tertiary calcrete	calcrete	Late Tertiary – early Quaternary
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pp	Prince Albert Fm, Ecca Group, Karoo SG	Green-brown massive mudstone, shale, sandstone, dolomitic limestone	Early Permian, ca 295 – 290 Ma
C-Pd	Dwyka Group, Karoo SG	Diamictites, tillites, sandstone, mudstone, dolomitic limestone	Late Carboniferous – Early Permian, ca 310 – 295 Ma

The site lies in the northwestern margin of the Main Karoo Basin with the basal Karoo Supergroup rocks exposed, and overlain by much younger sands and alluvium of the Kalahari Group.

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 the west and central part are the following formations, from base upwards: **Prince Albert Formation**, Whitehill Formation, Collingham Formation, Laingsburg / Ripon Formations, Tierberg / Fort Brown Formations, and Waterford Formation. In the Free State 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. Neither these rocks nor the overlying Stormberg Group rocks are present in this area. Jurassic aged dolerite has intruded through the Karoo Supergroup strata in a wide area around the Drakensberg Mountains, and signalled the end of the Karoo sedimentation.

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.

The oldest dated sands are from the northwest of Kuruman at Mamatwan, ca 60 – 58 ka (Thomas and Shaw, 2003; Haddon and McCarthy, 2005). Dates from sands farther to the west and northwest, showed that in much of the southern dune field two significant phases of linear dune development occurred, between about 30 and 23 ka and 17 and 8 ka ago (ibid). OSL dates on minor dune forms within the linear dune field reveal that Holocene dune building activity possibly occurred at 6 and 2–1 ka. Some of these old surfaces have been stabilised by the formation of calcretes, silcretes and duricrusts that formed by chemical action in wet to dry to wet cycles. The “Tertiary limestones” are a catchall phrase for these deposits

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 Ecca 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 Deelpan in the Free State, Wonderkrater in Limpopo and Bosluispan in the Northern Cape. In this region under study is the Kathu Complex.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The site for prospecting is mostly in the Dwyka Group diamictites and tillites and partly on the Quaternary Gordonia Formation.

The **Dwyka Group** is made up of seven facies that were deposited in a marine basin under differing environmental settings of glacial formation and retreat (Visser, 1986, 1989; Johnson et al., 2006). In the north and east these are called the Mbizane Formation, and the Elandsvlei Formation in the south and west. Described below are the seven facies (Johnson et al., 2006 p. 463-465):

The massive diamictite facies comprises highly compacted diamictite that is clast-poor in the north. It was deposited in subaqueous or subglacial positions.

The stratified diamictite comprises alternating diamictite, mudrock, sandstone and conglomerate beds. They are interpreted as being rapidly deposited, sediment gravity flows but with some possible reworking of the subglacial diamictites.

The massive carbonate-rich diamictite facies is clast-poor and was formed by the rainout of debris, with the carbonate probably originating by crystallisation from interstitial waters.

The conglomerate facies ranges from single layer boulder beds to poorly sorted pebble and granule conglomerates. The boulder beds are interpreted as lodgement deposits whereas the poorly sorted conglomerates are a product of water-reworking of diamicton by high-density sediment gravity flows.

The sandstone facies were formed as turbidite deposits.

The mudrock with stones facies represents rainout deposits in the distal iceberg zone.

The **mudrock facies** consists of dark-coloured, commonly carbonaceous mudstone, shale or silty rhythmite that was formed when the mud or silt in suspension settled. This is the only fossiliferous facies of the Dwyka Group.

The Dwyka *Glossopteris* flora outcrops are very sporadic and rare. Of the seven facies that have been recognised in the Dwyka Group fossil plant fragments have only been recognised from the mudrock facies. They have been recorded from around Douglas only (Plumstead, 1969; Anderson and Anderson, 1985; Johnson et al., 2006) although the Dwyka Group exposures are very extensive. Jurassic Dolerites do not contain fossils as they are igneous intrusives.

There are some good examples of fossils and artefacts in the **Quaternary** palaeopans and palaeosprings of the Kalahari. The Kathu Complex includes the excavated sites of Kathu Pan1 (KP1), Kathu Townlands and Bestwood 1 (BW 1). At Kathu Pan, evidence of early hominin occupation has been observed at multiple locations within the pan, but ESA deposits have only been excavated at KP 1. Stratum 4a at KP1 was dated by a combination of OSL and ESR/U-series to ca. 500 k BP (Beaumont, 2004; Walker et al., 2014; Lukich et al., 2020).

Palaeo-pans and palaeo-springs are visible in satellite imagery because of their topography and often are associated with lunette dunes. Vegetation changes are also common. No such

features are seen in the Google Earth images. Aeolian sediments that cover most of the region, do not preserve fossils because they have been reworked and windblown.

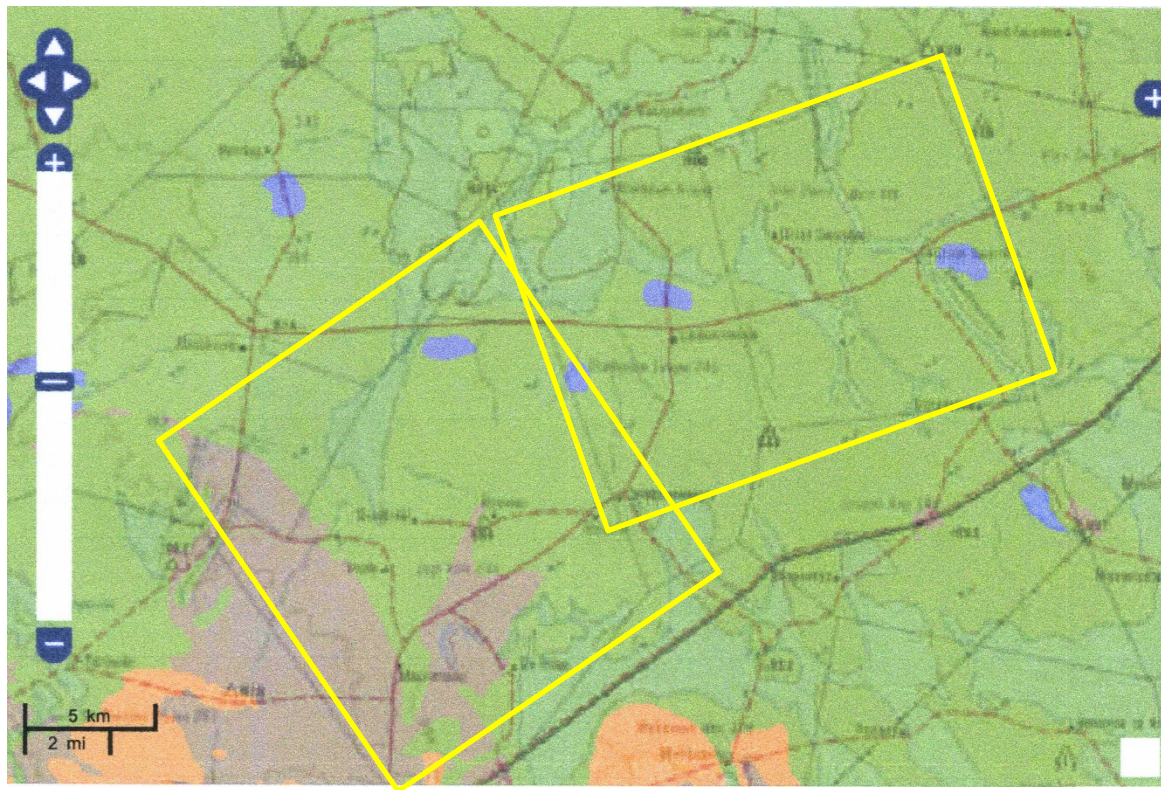


Figure 3: SAHRIS palaeosensitivity map for the site for the proposed PR application west of Kenhardt shown within the yellow rectangles. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

TABLE 3A: CRITERIA FOR ASSESSING IMPACTS

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	H	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.

	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	L	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	L	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	H	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

TABLE 3B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	H	-
	M	-
	L	Aeolian sands and alluvium do not preserve fossils; so far there are no records from the Dwyka Group of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be very unlikely.
	L+	-
	M+	-
	H+	-
DURATION	L	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	L	Since the only possible fossils within the area would be fossil plants from the <i>Glossopteris</i> flora in the mudstones of the Dwyka Group, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	It is extremely unlikely that any fossils would be found in the Dwyka Group diamictites and tillites, only the mudstones but have not yet been recorded in this area. 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 the correct age to preserve fossils, but the wrong facies (Dwyka Group tillites and diamictites). Aeolian sands do not preserve fossils. Furthermore, the material to be targeted is far below ground and metamorphosed so do not preserve fossils. Since there is an extremely small chance that fossils from the Dwyka Group rocks 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 some might contain fossil plant, insect, invertebrate and vertebrate material. No Dwyka Group fossils have been recorded from this area and besides would only be present in the mudstone facies that are uncommon. The aeolian sands of the Quaternary period would not preserve fossils and there do not appear to be any features such as palaeo-pans or palaeo-springs that could entrap 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 aeolian sands of the Quaternary, and no features such as palaeo-pans or palaeo-springs are evident. There is a very small chance that fossils may occur in the mudstones of the Dwyka Group although none has been recorded from this area. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found once drilling and prospecting has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample (See Section 8 and Appendix A).

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8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations / drilling / mining activities begin.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations/mining 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, 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 4, 5). 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 Dwyka Group and from Quaternary deposits



Figure 4: Examples of Dwyka Group plants: *Vertebraria*, *Glossopteris* leaves x 2; fragments of silicified wood.



Figure 5: Examples of fragments of bones from a Quaternary palaeo-pan with shoes for scale.

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD July 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
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 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
- 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 July 2021 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)