Palaeontological Impact Assessment for the proposed construction of a private and public Hospital in Estcourt, KwaZulu Natal Province

Site Visit / Phase 2 Study

For

EnviroPro

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Prof Marion Bamford
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Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 30 years research; 22 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by EnviroPro, 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 prosed construction of a private hospital southwest of Esctourt on the Ntabamhlope Road for Ndlomzintu Trading CC. 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 area.

The proposed site lies on the dark grey shales of the Estcourt Formation (now called the Normandien Formation, late Permian, Beaufort Group). Since the latter could potentially contain fossil plant impressions of the *Glossopteris* flora, a site visit and survey were undertaken on 07 September by Dr and Mr House. The proposed site for the hospital is on deep soils with no rocky outcrops or exposed shales. There were no fossil plants or vertebrates on the property. It is the opinion of the professional palaeontologists that this project can proceed as it will not impact upon the palaeontological record of South Africa.

Table of Contents

1. Background

Ndlomzintu Trading (Pty) Ltd proposes to construct a private hospital to the southwest of the town of Estcourt, along Ntabamhlope Road on Erf 3229, Estcourt, KwaZulu Natal. The project involves the construction of a number of buildings as well as water and sewer reticulation and electricity supply (Figures 1-3).

A site visit was carried out on 07 September because the site is indicated as very highly palaeontologically sensitive (Figure 4) in order 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). The results (observations and photographs) of the Phase 2 (site visit) Palaeontological Impact Assessment (PIA) was completed for the proposed development and is presented here.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (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 A
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A
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	N/A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	N/A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	N/A
nii	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	N/A
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies if any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A

Figure 1: Google Earth map of the proposed site for the Private Hospital, to the southwest of the town of Estcourt.

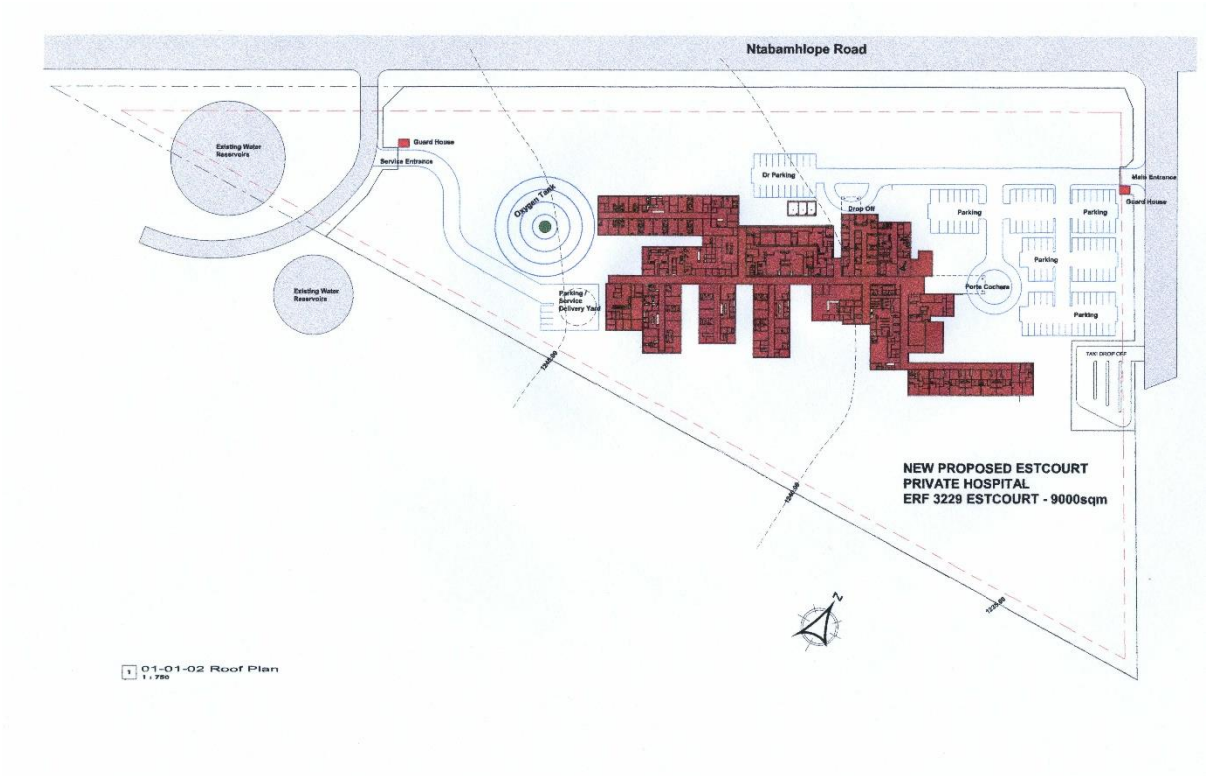

Figure 2: Site plan for the proposed Private Hospital on Erf 3229, Estcourt, KwaZulu Natal.

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. (as reported herein);
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 site lies in the central-eastern part of the Main Karoo Basin and comprises rocks of the lower Karoo Supergroup, in particular the Estcourt Formation (Beaufort Group, Karoo Supergroup). This formation is now called the Normandien Formation (Johnson et al., 2006). There are large intrusions of dolerite dykes that were emplaced during the Jurassic and are associated with the massive basalt outpouring of the Drakensberg Mountains. The dykes do not preserve fossils because they are igneous in origin and, furthermore, tend to destroy fossils in their immediate vicinity. They will not be considered further.

The early Permian Pietermaritzburg Formation dark grey shales were deposited in deep water environments as the Karoo inland sea filled with meltwater from the receding glaciers from the mountainous region to the south. Shales, mudstones and sandstones make up the Vryheid Formation, together with coal seams, formed when the climate warmed and the vegetation flourished. These are overlain by the dark grey shales with some clay inclusions of the Normandien (Estcourt) Formation (Beaufort Group).

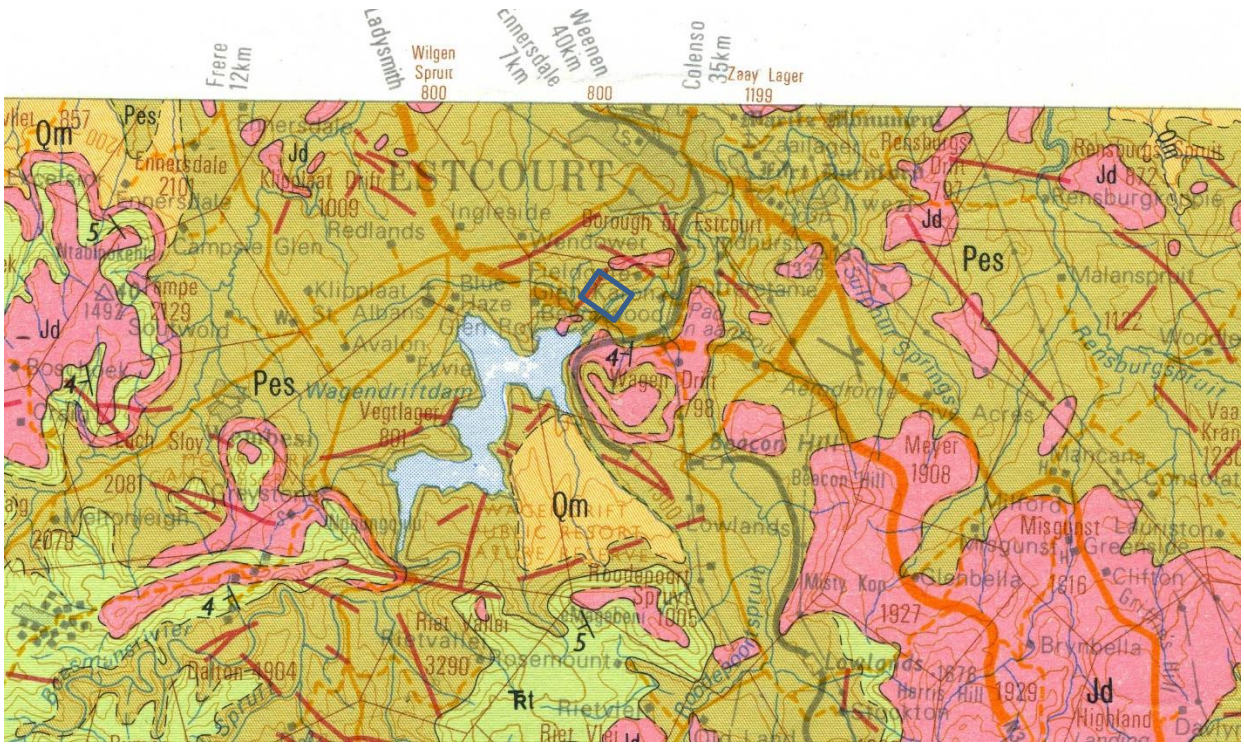

Figure 3: Geological map of the area around Estcourt with the proposed project indicated within the blue rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2928 Drakensberg.

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

Symbol	Group/Formation	Lithology	Approximate Age
Qm	Masotcheni Fm, Kalahari Group; Quaternary	Partly consolidated sediments, laterite and clay	Last 2.5 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Trt	Tarkastad subgroup, Beaufort Group, Karoo SG.	Fine to medium-grained sandstone, maroon, green and blue mudstones,	Early Triassic, ca 250-240 Ma
Pes	Estcourt Fm, (now Normandien Fm), Beaufort Group, Karoo SG.	Dark grey shales, often with clay inclusions	Late Permian, Beaufort;

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for development is entirely in the dark grey shales of the Normandien Formation (Beaufort Group, Karoo Supergroup) that are late Permian in age. The Normandien Formation potentially can preserve fossils of the *Glossopteris* flora, such as leaves, reproductive structures, root impressions, and other plant groups such as lycopods, sphenophytes and ferns (Plumstead, 1969; Claassen, 2008; Prevec et al., 2009). A variety of fish, reptiles and therapsids (mammal-like reptiles) had evolved by this time but bones are hardly ever preserved together with plant fossils because they require different depositional conditions.

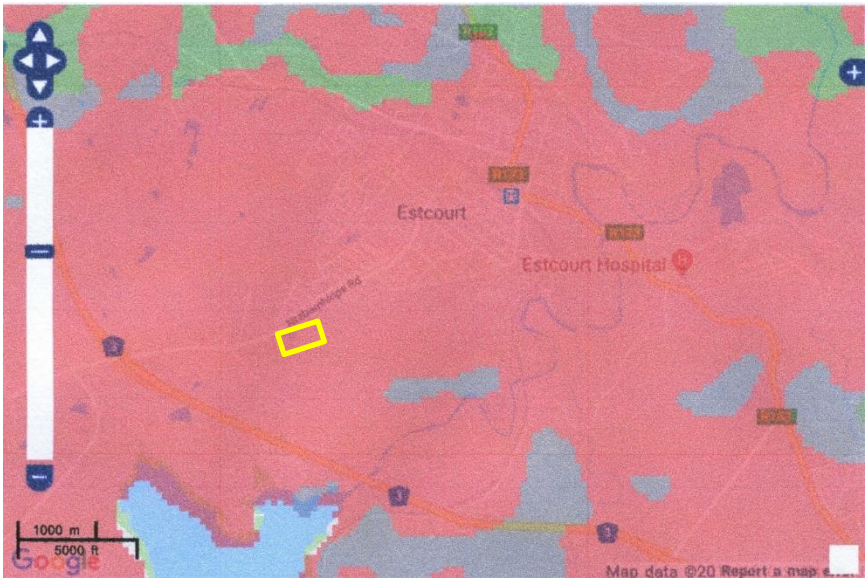

Figure 3: SAHRIS palaeosensitivity map for the proposed Estcourt Private Hospital to the southwest of the town centre, shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as very highly sensitive (red). The site was visited and surveyed on 7 September and the results are given below.

Iii. Observations from site visit

GPS coordinates	Observations	Figure
Stop 1 29° 01’ 21” S 29° 51’ 01” E	The notification of the project was attached to a wattle tree (Acacia mearnsii). Two old reservoirs were visible on the edge of the property; in the foreground the grassland on deep soils is visible	5a, b
Stop 2 29° 01’ 43” S 29° 51’ 14” E	Some of the area had been burned so it was easy to see the underlying strata that comprised deep alluvial soils and no shales or mudstones that might have preserved fossils. Termitaria show what soils lie below the surface and do not form on rock.	5c, d
Stop 3 29° 01’ 17” S 29° 51’ 01” E	Isolated rocks and cobbles are present in the grassland but it is not known if they are in situ or brought in by previous agricultural activities on the land. The rocks are sandstones and dolerite fragments. No fossils were seen	6a-d

Only the soils and natural vegetation (grassland) with invader species such as Acacia mearnsii were found on the site. Patches of the grassland had been burned recently which made is easier to see the soils. The area is flat and there are no rocky or shaley outcrops that could potentially preserve fossil plant impressions. No fossils of any kind were found.

From previous research in the Normandien Formation (Plumstead, 1989; Anderson and Anderson, 1985; Claassen, 2008; Prevec et al., 2009) it is well established that plant fossil sites are rich, but they are sporadic and do not occur throughout the Normandien Formation.

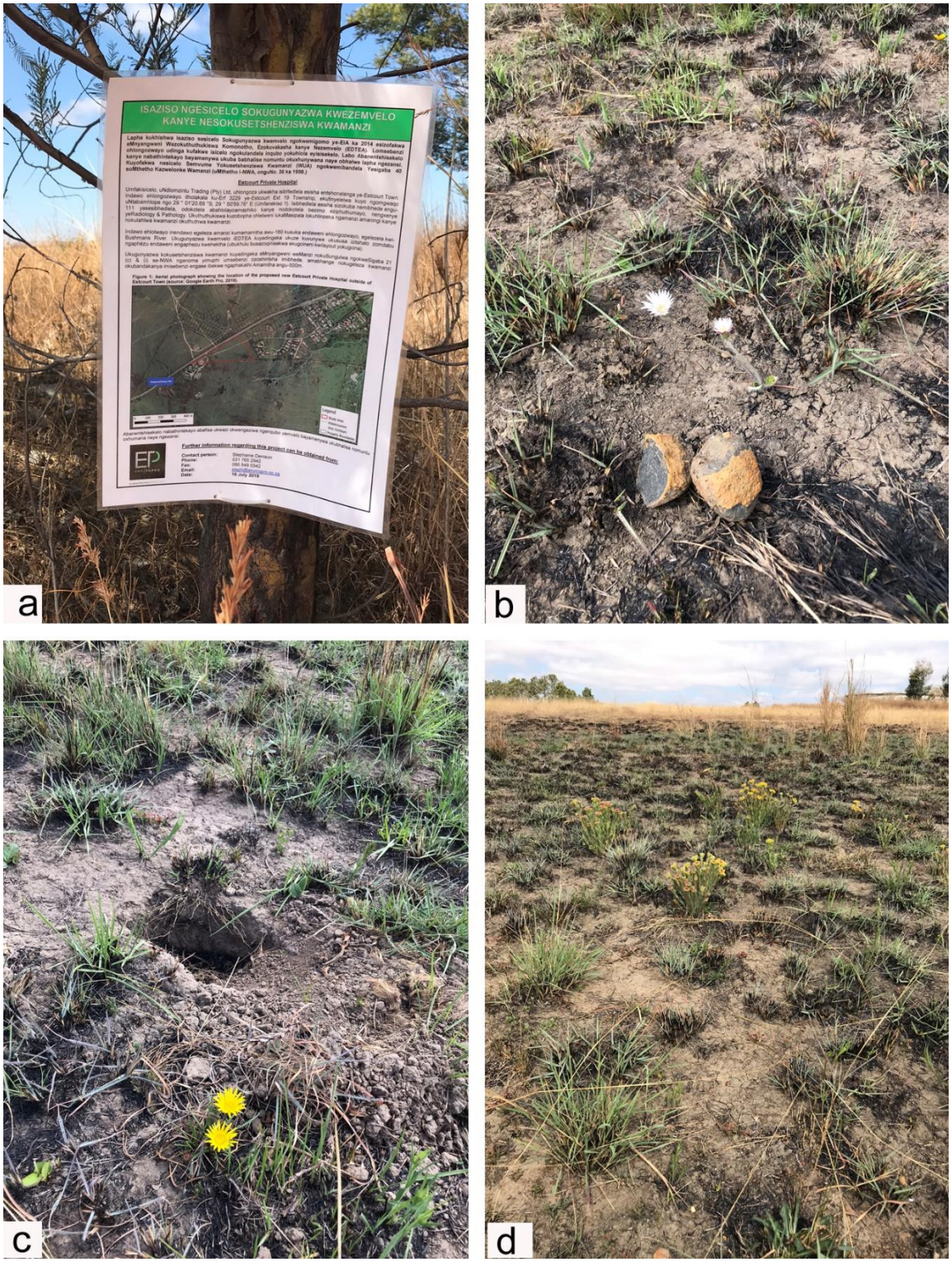

Figure 5: Photographs from site visit on 07 September 2019. A – project notification attached to a wattle tree. B – burned grass revealing isolated rocks (possibly dolerite). C – hole dug to establish soil depth. D – burned grass in the foreground and grassland with the old reservoirs in the background.

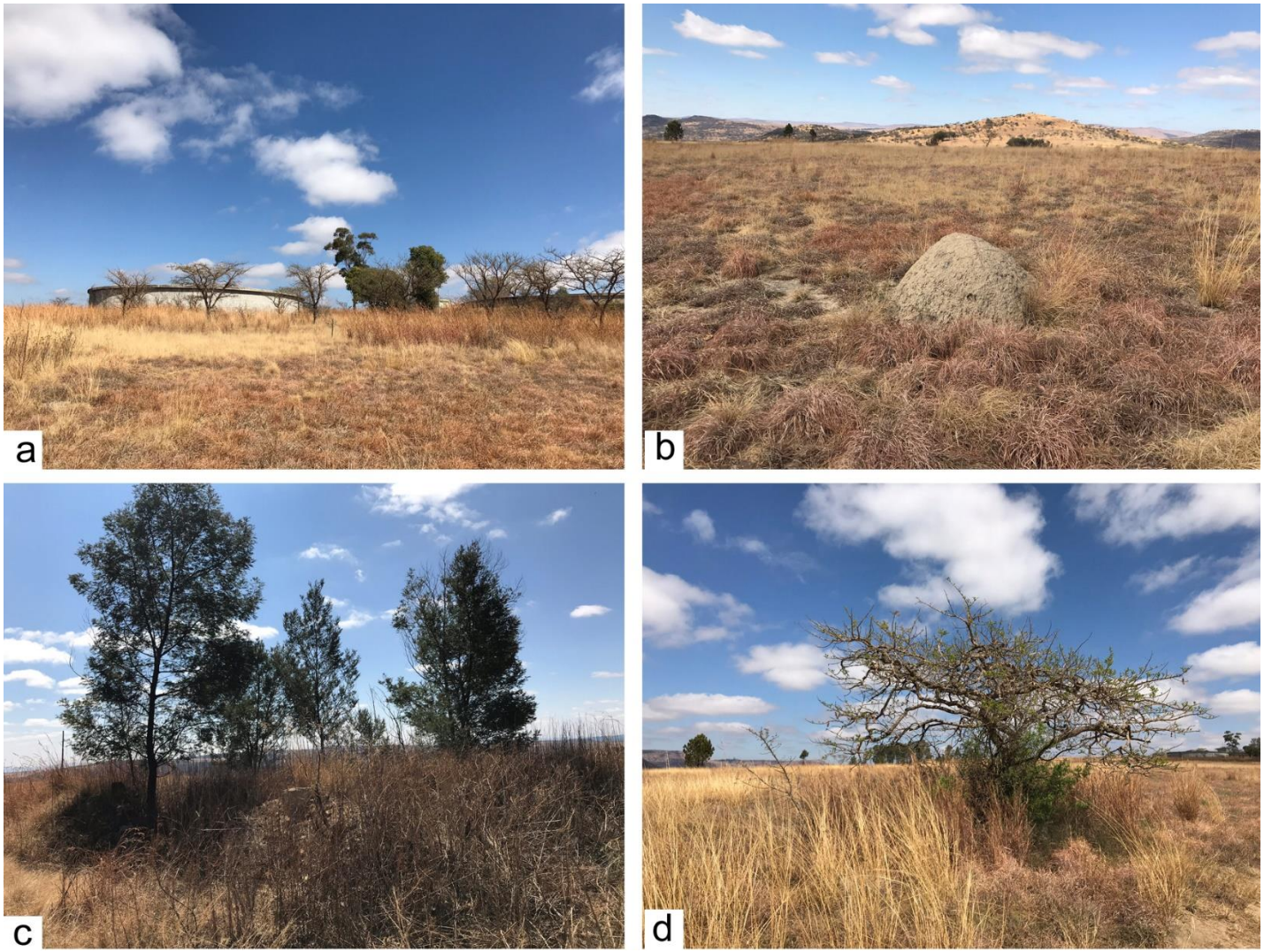

Figure 6: Photographs of site visit. A – view of both old reservoirs. B – termite mound showing the light coloured soils beneath the upper dark soils. D – minor ridge with invasive wattle trees (*Acacia mearnsii*). D – view to the south with an indigenous *Acacia* tree,

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	Normandien Fm plant fossils might occur in this region but the surface is highly disturbed. 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 *Glossopteris* flora in the shales, the spatial scale will be localised within the site boundary.
	M	-
	H	-

PART B: ASSESSMENT		
PROBABILITY	H	-
	M	-
	L	It is extremely unlikely that any fossils would be found in the soils in the ploughed field. They might occur in outcrops of shale or mudstone. The site visit confirmed that there were not shale or mudstone outcrops on the site and that there were NO fossils.

The total ABSENCE of fossils of any kind was confirmed by the site visit and survey, even though the Normandien Formation could potentially preserve fossils of the *Glossopteris* flora. Furthermore, it was evident that the area had been cleared previously for agricultural purposes and that the soils were relatively deep.

Foundations for the proposed hospital buildings, water, sewer and electrical amenities would be in the region of 2m deep or less. Based on the nature of the project, these activities are unlikely to impact upon the fossil heritage, even if preserved well below the land surface in the development footprint. Taking account of the defined criteria, the potential impact to fossil heritage resources is very low to zero.

5. Assumptions and uncertainties

Based on the site visit and observations, 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 do contain fossil plant, insect, invertebrate and vertebrate material in this particular locality. The dolerite does not preserve fossils. The sediments in the site are already very disturbed, and the site visit showed that there were no fossils.

6. Recommendation

Based on the site visit and experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the dolerite, soils of the previously cleared and ploughed field. It is the opinion of the palaeontologists that, as far as the palaeontology is concerned, the project may proceed.

7. References

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodromus of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Claassen, M., 2008. A note on the biostratigraphic application of Permian plant fossils of the Normandien Formation (Beaufort Group, northeastern Main Karoo Basin), South Africa. South African Journal of Geology 111, 263-280.

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.

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.

Prevec, R, Labandeira, C.C., Neveling, J., Gastaldo, R.A., Looy, C., Bamford, M., 2009. Portrait of a Gondwanan ecosystem: A new Late Permian locality from KwaZulu-Natal, South Africa. Review of Palaeobotany and Palynology 156, 454-493.

Appendix A – Details of specialists

Curriculum vitae (short) - Marion Bamford PhD
June 2019

I) Personal details

Surname	:	**Bamford**
First names	:	**Marion Kathleen**
Present employment	:	Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa-
Telephone	:	+27 11 717 6690
Fax	:	+27 11 717 6694
Cell	:	082 555 6937

E-mail : marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) Professional qualifications

Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+
Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

vii) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	6	1
Masters	8	1
PhD	10	3
Postdoctoral fellows	9	3

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 –
Cretaceous Research: 2014 -

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

xi) Research Output

Publications by M K Bamford up to June 2019 peer-reviewed journals or scholarly books: over 130 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 26; Google scholar h index = 30;
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)

Short CV for Dr Alisoun House PhD

Current position – Postdoctoral Fellow, Evolutionary Studies Institute, University of the Witwatersrand
Email: Alisoun.house@wits.ac.za

Education
BSc – 1984 – Botany major; University of the Witwatersrand
BSc Honours – 1985 – Botany; University of the Witwatersrand
MSc – 1989 – Botany and Palynology
PhD – 2012- 2015 – Palynology; University of the Witwatersrand

Publications
House, A., Balkwill, K., 2013. FIB-SEM: An Additional Technique for Investigating Internal Structure of Pollen Walls. Microscopy and Microanalysis 19, 1535–1541. doi:10.1017/S1431927613013263

House, A., Balkwill, K., 2016. Labyrinths, columns and cavities: new internal features of pollen grain walls in the Acanthaceae detected by FIB–SEM. Journal of Plant Research 129, 225–240. DOI 10.1007/s10265-015-0777-9

House, A.V., Bamford, M.K. (accepted 5 Sept2019). Investigating the utilisation of woody plant species at an Early Iron Age site in KwaZulu-Natal, South Africa by means of identifying archaeological charcoal. Archaeological and Anthropological Sciences AASC-D-19-00055R1

Palaeontological Impact Assessment Experience:
May 2018 – SARAO Williston and Carnoarvon for Digby Wells
August 2019 – Idlanga Coal MR, Rietvlei, Vryheid area – Digby Wells
September 2019 – Schmidtsdrift PR for Thaya Environmental Specialist