

**PALAEONTOLOGICAL IMPACT ASSESSMENT FOR THE
PROPOSED HDF RENEWSTABLE® SIVUTSE ON THE FARM
BERGVLIET 65HS AND REMAINING EXTENT OF THE FARM
RIETFONTEIN 66HS, WITHIN THE DR PIXLEY KA ISAKA SEME LOCAL
MUNICIPALITY IN THE MPUMALANGA PROVINCE**

Desktop Study (Phase 1)

For

Nsovo Environmental Consulting

02 September 2023; 24 June 2024

Prof Marion Bamford

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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf, PSSA
Experience: 34 years research and lecturing in Palaeontology
26 years PIA studies and over 350 projects completed

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Nsovo Environmental Consulting, Midrand, 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: *MKBamford*

Executive Summary

A Palaeontological Impact Assessment was requested for the HDF Renewstable® Sivutse Energy Project for the proposed hydrogen power plant near Majuba Power Station on parcel located on Portions 1, 6, 34 and the Remaining Extent of the Farm Bergvliet 65HS as well as the Remaining Extent of the Farm Rietfontein 66HS, approximately 3 km northeast of Majuba Power Station and approximately 7 km southwest of Amersfoort.

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 site lies on the non-fossiliferous Jurassic dolerite and close to the highly sensitive Volksrust Formation (Ecca Group, Karoo Supergroup). No fossils have been recorded from this site, nonetheless, a Fossil Chance Find Protocol should be added to the EMP. 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 or drilling for foundations, infrastructure and amenities have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Low	Low	Paleontological Impact Assessment	Section 7.2. SAHRA Requirements

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1. Background

As part of the Eskom lander tender MWP1247GX, Hydrogene de France (HDF) has been awarded 1782 ha of Eskom’s land to develop 8 Renewstable® power plants in the province of Mpumalanga, South Africa. Distributed over Five (5) plots within Tutuka and Majuba Coal Power Stations, HDF-Energy is part of a cluster of different project developers, also awarded land in the area to develop infrastructure related to renewable energy production. HDF-Energy, under its Special Purpose Company (SPC) “Renewstable Mpumalanga (Pty) Ltd”, is undertaking the development and implementation of 4 projects referred to as Majuba Cluster that consists of the following:

- Renewstable® Qhakaza
- Renewstable® Bokamoso
- **Renewstable® Sivuste**
- Renewstable® Ntokozo

The project involves developing the 74MW Renewstable Sivutse Power Plant, a high-capacity renewable power plant based on hydrogen BESS storage technology that harnesses renewable energy from a Photovoltaic (PV) Park and converts it into hydrogen using an electrolyser system. This hydrogen is stored in a compressed gas form; subsequently, when the photovoltaic park generates insufficient energy, the stored hydrogen is utilised to produce electricity for the grid through a fuel cell system. This innovative approach ensures a continuous and reliable power supply even when the PV park's energy production is inadequate. The system will only emit oxygen and water vapour as by-products.

The electricity produced by the plants will be purchased by a private(s) off-taker (s) at an agreed rate under the Power Purchase Agreement (PPA) for at least 25 years from the commissioning. The power plant is scheduled to be commissioned in 2027 and will contribute to the greening of the local power grid and enhance the territory's energy independence. The proposed development entails the following primary infrastructure:

Table 1: Primary infrastructures

Primary Infrastructure	Power produced
Baseload electricity	55MW day, and evening 12 MW night
Solar plant	210MWp

Electrolyser	60MW
Green H2 storage	250MWh
High-capacity fuel cells	12MW
Battery power	220MW
Battery storage	55MWh
Capacity production	87%
Land required	315 hectares
Electricity production	841.09 MWh daily 307 000 MWh yearly

Associated infrastructure includes the following:

- Hydrogen Power Centre
- Control Room
- Access/Service roads
- Buildings
- Fencing and Security
- Communications DC and AC cables installed underground and overhead
- High Voltage Collector station that will be shared with other IPPS

This report is for the proposed Renewstable® Sivutse on Portions 1, 6, 34 and the Remaining Extent of the Farm Bergvliet 65HS as well as the Remaining Extent of the Farm Rietfontein 66HS, approximately 3 km northeast of Majuba Power Station

The Farm Bergvliet is adjacent to Majuba Power Station and the project area is under cultivation so has been cleared of indigenous vegetation and rocks decades previously.

A Palaeontological Impact Assessment was requested for the Sivutse site (Farm Rietfontein 66) for a hydrogen power plant. 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 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). Includes the requirements from GNR Appendix 6 of GN 326 EIA Regulation 2017.

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
ai	Details of the specialist who prepared the report,	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
k	Any mitigation measures for inclusion in the EMPr	Section 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

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

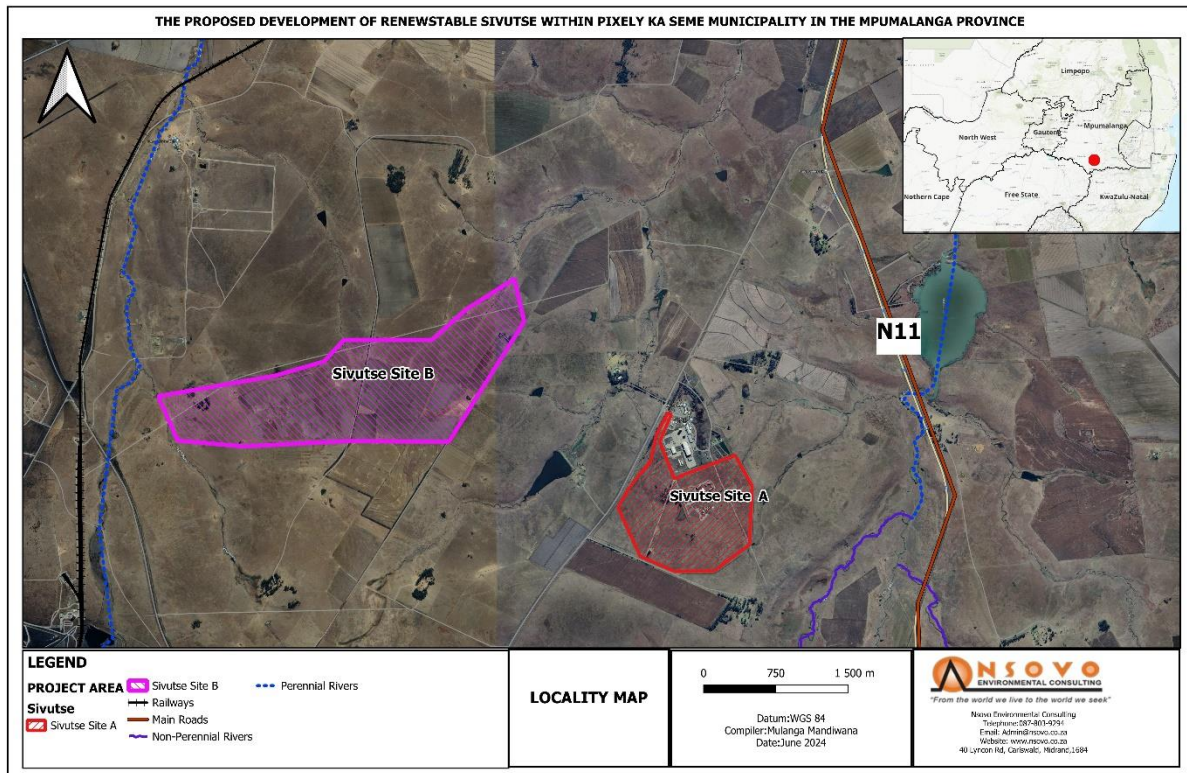


Figure 1: Google Earth map of the general area to show the relative landmarks.



Figure 2: Google Earth Map of the proposed development of the RS Sivutse hydrogen plant and solar collectors (blue) on Farm Rietfontein 66.

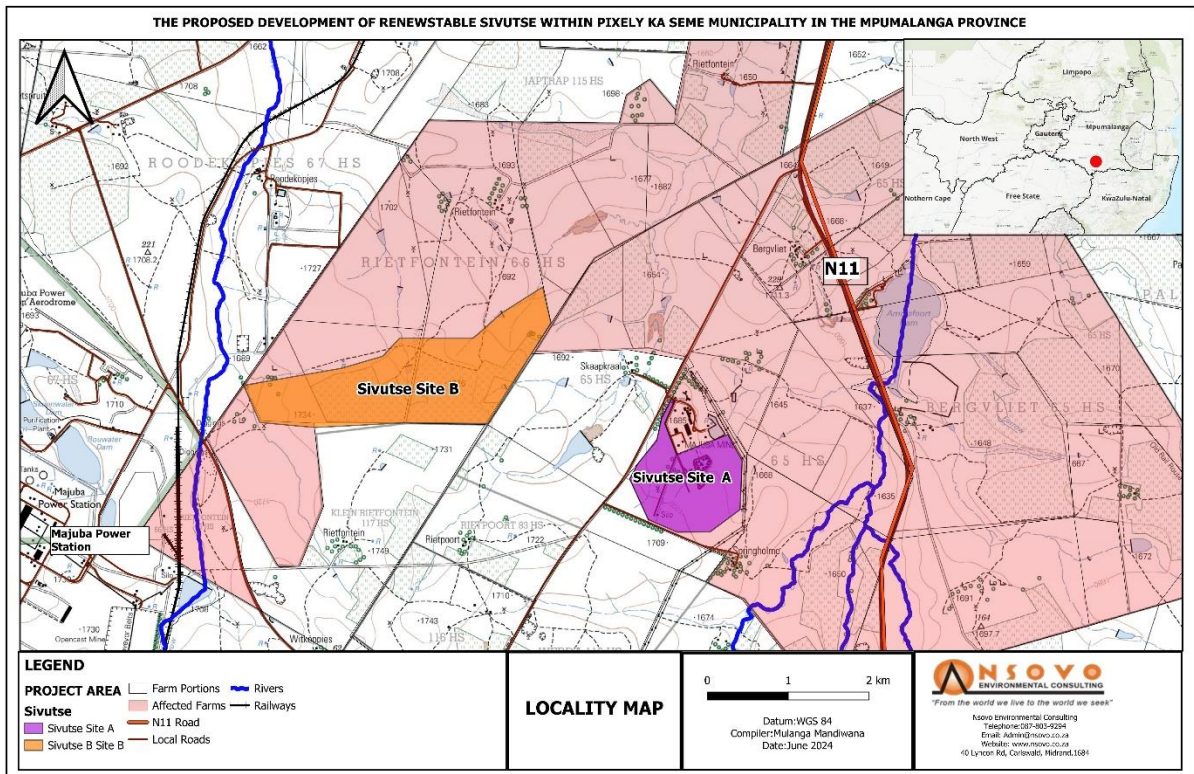


Figure 3: Topographic map for the RS Sivutse site (A and B) and surrounding properties.

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; eg <https://sahris.sahra.org.za/map/palaeo>
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' representativity 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

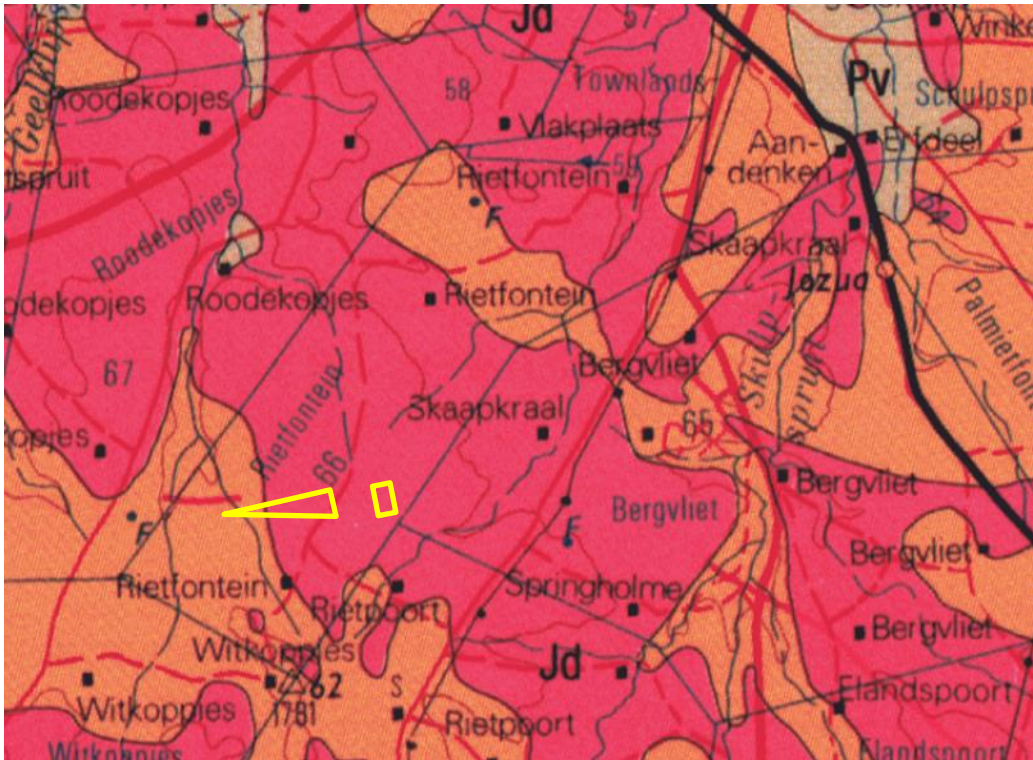


Figure 4: Geological map of the area around the Sivutse hydrogen plant on Farm Bergvliet indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2726 Frankfort.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006. 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	Alluvium, sand, calcrete	Quaternary Ca 1.0 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 183 Ma
Pvo	Volksrust Fm, Ecca Group, Karoo SG	Grey-black fine-grained mudstone, sandstone	Late Permian, ca 260 - 257 Ma
Pv	Vryheid Fm, Ecca Group, Karoo SG	Shale, mudstone, coal, sandstone	Middle Permian ca 266 - 260 Ma

The project lies in the central part of the main Karoo Basin where the basal Karoo Supergroup rocks are exposed. Large expanses of Jurassic dolerite have intruded through the Karoo sediments. Unconformably overlying the Karoo rocks are much younger, Quaternary sands and alluvium (Figure 4).

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.

Overlying the basal Dwyka Group glaciogene 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 central and eastern part are the following formations, from base upwards: Pietermaritzburg, Vryheid and Volksrust Formations. 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 (Cadle et al., 1993; Johnson et al., 2006).

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.

During the Cenozoic there were several phases of uplift of the African continent and subsequent, weathering, erosion and downcutting of the rocks. Much of the sedimentary material was deposited offshore but some river valleys and depressions have retained sands and alluvium. They are difficult to date because they have been reworked and re-deposited (Botha, 2020) but most of them are Late Quaternary in age.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 5. The site for development is on non-fossiliferous Jurassic dolerite (volcanic intrusive rock)

that is indicated as grey and close to the potentially fossiliferous Volksrust Formation (orange) on the SAHRIS map.

The **Vryheid Formation** lies on the uneven topography of pre-Karoo or Dwyka Group rocks in the northern and northwestern margins but lies directly on the Pietermaritzburg Formation in the central and eastern part. The lithofacies show a number of upward-coarsening cycles, some very thick, and they are essentially deltaic in origin. Coal seams originated where peat swamps developed on broad abandoned alluvial plains, and less commonly in the backswamps or interfluves. Most of the economically important coal seams occur in the fluvial successions (ibid). In the east (Mpumalanga and northern KwaZulu Natal), the Vryheid formation can be subdivided into a lower fluvial-dominated deltaic interval, a middle fluvial interval, and an upper fluvial-dominated deltaic interval again (Taverner-Smith et al., 1988).

Fossil plants of the *Glossopteris* flora occur in the Vryheid Formation. This flora includes *Glossopteris* leaves, seeds, fructifications, roots and wood, as well other groups such as the lycopods, sphenophytes, ferns, cordaitaleans and early gymnosperms (Plumstead, 1969; Anderson and Anderson, 1985; Bamford, 2004).

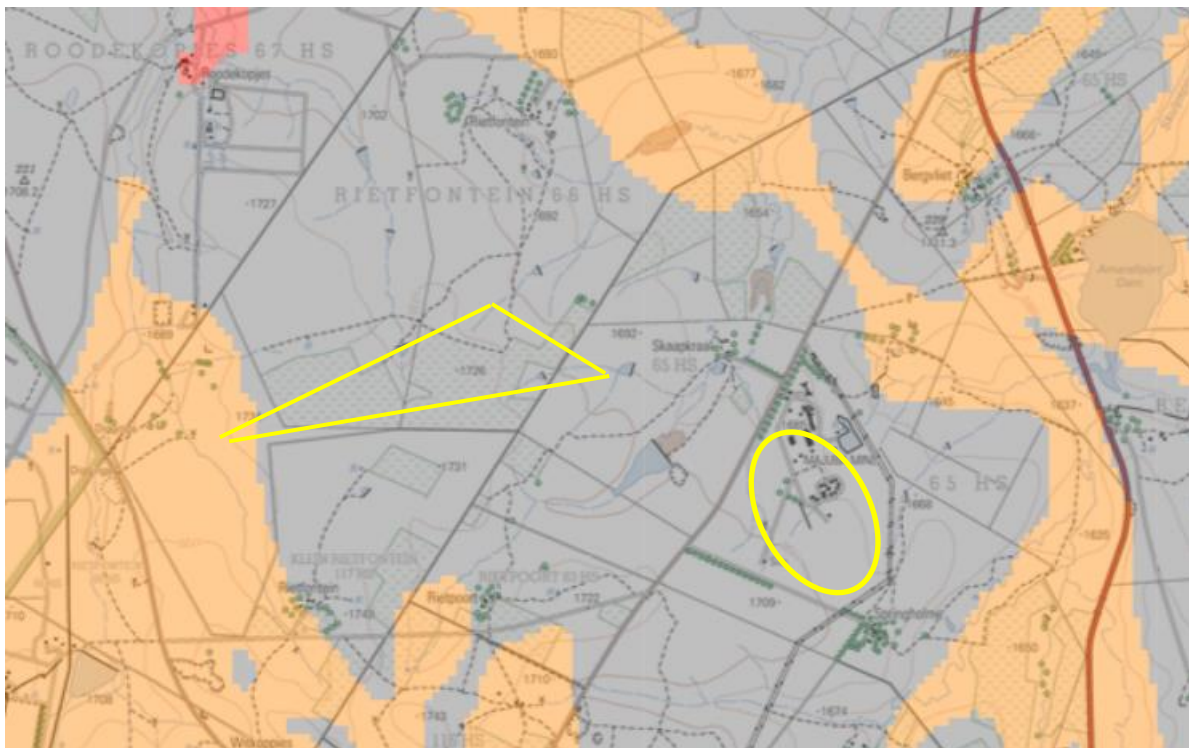


Figure 5: SAHRIS palaeosensitivity map for the site for the proposed Sivutse hydrogen power plant and PS sites (two parts) shown within the yellow polygons. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

The **Volksrust Formation** is the upper part of the Ecca Group (and lower Beaufort according to Smith et al., 2020) and is predominantly argillaceous and the grey to black silty shale with thin, usually bioturbated siltstone or sandstone lenses and beds that occur

mostly in the upper and lower boundaries. The very thick and fine-grained sediments represent an open shelf environment where muds were deposited from suspension with (Johnson et al., 2006) in a deepwater environment. It is not known if this was an inland sea or open marine setting but the discovery of the marine bivalve, *Megadesmus*, (albeit one instance) about 25km west southwest of Newcastle in Volksrust Formation shales, points to a marine influence for at least part of the sequence (Cairncross et al., 2005).

Jurassic dolerite is an intrusive volcanic rock and does not preserve any fossils.

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	Soils and dolerite do not preserve fossils; so far there are no records from the Jurassic dolerite of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be negligible
	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 fragments from nearby shales, 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 loose soils and sands that cover the area or in the Jurassic dolerite that will be excavated. 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 wrong type (volcanic) to preserve fossils. Furthermore, the material to be excavated is soil and this does not preserve fossils. Since there is a small chance that fossils from the nearby Volksrust Formation may have been transported and 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 might contain fossil plant, insect, invertebrate and vertebrate material. The sands and soils of the Quaternary period would not preserve fossils. Jurassic dolerite does 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. There is an extremely small chance that fossils may occur in the underlying shales or mudstones of the Volksrust Formation so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations for foundations, infrastructure and amenities 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.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Low	Low	Paleontological Impact Assessment	Section 7.2. SAHRA Requirements

7. References

- Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodrumus of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.
- Bamford, M.K. 2004. Diversity of woody vegetation of Gondwanan southern Africa. *Gondwana Research* 7, 153-164.
- Cadle, A.B., Cairncross, B., Christie, A.D.M., Roberts, D.L., 1993. The Karoo basin of South Africa: the type basin for the coal bearing deposits of southern Africa. *International Journal of Coal Geology* 23, 117-157.
- Cairncross, B. 1990. Tectono-sedimentary settings and controls of the Karoo Basin Permian coals, South Africa. *International Journal of Coal Geology* 16: 175-178.
- Cairncross, B. 2001. An overview of the Permian (Karoo) coal deposits of southern Africa. *African Earth Sciences* 33: 529-562.
- Cairncross, B., Beukes, N.J., Coetzee, L.L., Rehfeld, U., 2005. The Bivalve *Megadesmus* from the Permian Volksrust Shale Formation (Karoo Supergroup), northeastern Karoo Basin, South Africa: implications for late Permian Basin development. *South African Journal of Geology* 108, 547-556.

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.

Taverner-Smith, R., Mason, T.R., Christie, A.D.M., Smith, A.M., van der Spuy, M., 1988. Sedimentary models for coal formation in the Vryheid Formation, northern Natal. Bulletin of the Geological Survey of South Africa, 94. 46pp.

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 discard 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 Figures 6-7). 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 Eccca Group



Figure 6: Photographs of fossils plants that can be found in Eccca Group rocks, but more likely in the Vryheid Formation.

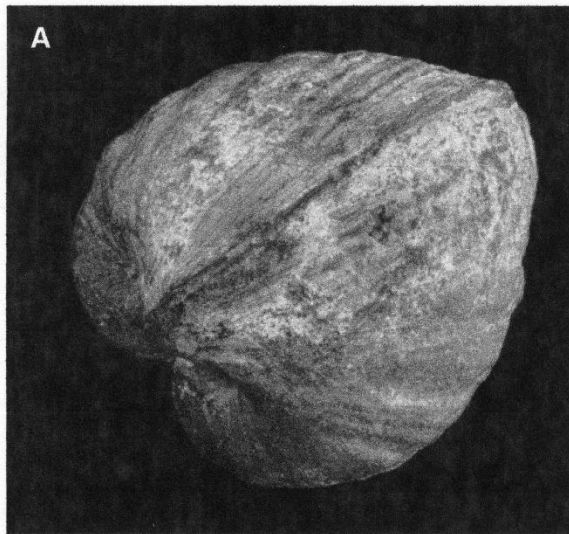


Figure 11. (A). Dorsal view of the *Megadesmus* bivalve. The fossil is 9 cm dorsal to ventral, and 8.4 cm lateral. See text for taxonomic details.

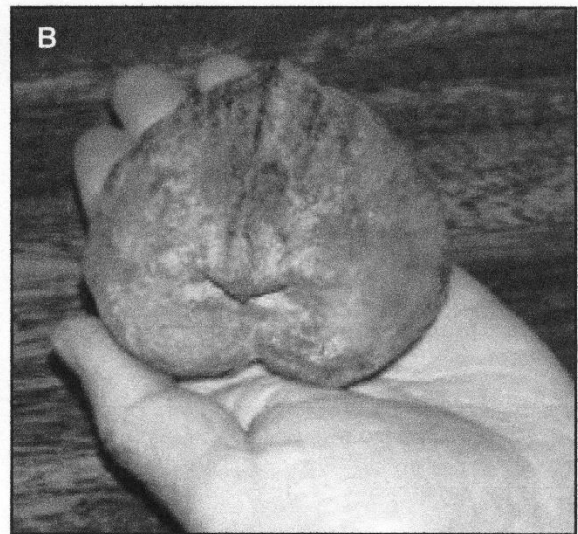


Figure 11. (B). Close-up of the anterior, dorsal section of the bivalve.

Figure 7: Photograph of the bivalve *Megadesmus* from the Volksrust Formation.

10. Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD July 2023

Present employment: Professor; Director of the Evolutionary Studies Institute.
Member Management Committee of the NRF/DSI Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa

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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

v) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	13	0
Masters	13	3
PhD	14	6
Postdoctoral fellows	14	4

vi) 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 12 - 20 students per year.

vii) 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: *Cretaceous Research*: 2018-2020

Associate Editor: *Royal Society Open*: 2021 -

Review of manuscripts for ISI-listed journals: 30 local and international journals

viii) Palaeontological Impact Assessments

25 years' experience in PIA site and desktop projects

- Selected from recent projects only – list not complete:

- 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
- Glosam Mine 2022 for AHSA
- Wolf-Skilpad-Grassridge OHPL 2022 for Zutari
- Iziduli and Msenge WEFs 2022 for CTS Heritage
- Hendrina North and South WEFs & SEFs 2022 for Cabanga
- Dealesville-Springhaas SEFs 2022 for GIBB Environmental
- Vhuvhili and Mukondelei SEFs 2022 for CSIR
- Chemwes & Stilfontein SEFs 2022 for CTS Heritage
- Equestria Exts housing 2022 for Beyond Heritage
- Zeerust Salene boreholes 2022 for Prescali
- Tsakane Sewer upgrade 2022 for Tsimba
- Transnet MPP inland and coastal 2022 for ENVASS
- Ruighoek PRA 2022 for SLR Consulting (Africa)
- Namli MRA Steinkopf 2022 for Beyond Heritage

ix) **Research Output**

Publications by M K Bamford up to July 2023 peer-reviewed journals or scholarly books: over 170 articles published; 5 submitted/in press; 14 book chapters. Scopus h-index = 31; Google Scholar h-index = 39; -i10-index = 120 based on 7032 citations.

Conferences: numerous presentations at local and international conferences.