Appendix G.10

PALAEONTOLOGICAL IMPACT ASSESSMENT

Palaeontological Impact Assessment for the proposed Verkykerskop Wind Energy Facility (WEF) Cluster located in the Free State Province

Site Visit (Phase 2)

Subcontracted by

Beyond Heritage (Pty) Ltd

06 April 2025

Prof Marion Bamford
Palaeobotanist
P Bag 652, WITS 2050
Johannesburg, South Africa
Marion.bamford@wits.ac.za

1. Executive Summary

A Palaeontological Impact Assessment was requested for the proposed Verkykerskop WEF Cluster that is divided into 3 projects. The Cluster will be located in the Thabo Mofutsanyane District Municipality and Phumelela Local Municipality, near the town of Harrismith, in the Free State Province of South Africa. The three projects are:

- Groothoek WEF (up to 300MW)
- Kromhof WEF (up to 300MW)
- Normandien WEF (up to 300MW)

The connection of the powerlines (132kV) will be a separate process and therefore does not form part of the current project scope.

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 site visit and walkdown Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed sites lie on the potentially very highly sensitive rocks of the Beaufort Group that might preserve late Permian and early Triassic fossil vertebrates and plants. The site visit conducted in late August 2024 (winter) by palaeontologists confirmed that there were NO FOSSILS visible on the land surface in the project footprint. The land is mountainous with flat-topped hills (mesas), thick grasslands used for grazing or ploughed fields. Since it is not known what lies below the surface 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 excavations or drilling activities have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

The impact without mitigation is LOW and with mitigation is VERY LOW.
There are no no-go areas, no buffers required and there is no cumulative impact.

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

2. **Declaration of independence and summary of expertise**.

a. Declaration

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Beyond Heritage (Pty) Ltd, Modimolle, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision-making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

b. Expertise

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf, PSSA
Experience: 36 years research and lecturing in Palaeontology; over 28 years PIA studies and over 450 projects completed.

c. Specialist declaration of independence and statement of objectivity for the assessment.

Declaration of Independence
I, Marion Bamford, declare that –
General declaration:

- I act as the independent palaeontology practitioner in this application,
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant,
- I declare that there are no circumstances that may compromise my objectivity in performing such work,
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation,
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application,
- I have no, and will not engage in, conflicting interests in the undertaking of the activity,
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority,
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties

and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application,
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- All the particulars furnished by me in this form are true and correct,
- I will perform all other obligations as expected from a heritage practitioner in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations.

d. **Summary of the specialist's expertise**

I, Marion Bamford, am a professional Palaeontologist with a PhD in Palaeontology (Wits University, 1990). I have more than 35 years of experience in palaeontological research and have published over 190 papers in peer-reviewed journals and published more than 14 scholarly book chapters. I review manuscripts for international and local journals and also review funding proposals for international funding bodies. Currently I am the Director of the Evolutionary Studies Institute, the only palaeontological institute in Southern Africa.

I have completed more than 450 palaeontological impact assessments (desktop and site visit studies) in the last 28 years for a variety of projects (solar energy projects, wind energy projects, powerlines, roads, infrastructure, housing and retail projects and from all over South Africa. I have been subcontracted by over 30 different companies. From my own projects and training provided by me and other staff in the ESI for Palaeontological Impact Assessments, I am familiar with the legislation.

Table of Contents

3. Project Background

WSP Group Africa (Pty) Ltd (WSP) has been appointed to undertake an Environmental Impact Assessment (EIA) to meet the requirements under the National Environmental Management Act (Act 107 of 1998) (NEMA), for the various applications associated with the proposed Verkykerskop Wind Energy Facility (WEF) Cluster located in the Free State Province.

The Verkykerskop WEF Cluster is divided into 3 projects. The following facilities will require a Scoping and EIA (S&EIA) process:

- Groothoek WEF (up to 300MW)
- Kromhof WEF (up to 300MW)
- Normandien WEF (up to 300MW)

The connection of the powerlines (132kV) will be a separate process and therefore does not form part of the current project scope.

Project Location

The proposed Verkykerskop WEF Cluster is located in the Thabo Mofutsanyane District Municipality and Phumelela Local Municipality, near the town of Harrismith, in the Free State Province of South Africa (Figure 1).

The details of the property associated with the proposed Verkykerskop WEF Cluster, including the 21-digit Surveyor General (SG) codes for the cadastral land parcels are outlined in **Error! Reference source not found.**.

Table 1: Verkykerskop WEF Cluster Affected Farm Portions

PROJECT	FARM NAME	SG 21 CODE
Groothoek WEF	Portion 0 of Farm Schoonzicht No.80	F01500000000008000000
	Portion 0 of Farm Groothoek No. 89	F01500000000008900000
	Portion 0 of Farm Kromdraai No. 273	F01500000000027300000
	Portion 0 of Farm Kransbank No.288	F01500000000028800000
	Portion 0 of Farm Kranspunt No.459	F01500000000045900000
	Portion 0 of Farm Van Kope No.1319	F01500000000131900000
Kromhof WEF	Remaining Extent of Farm Leiden No. 2	F01500000000000200000
	Remaining Extent of Farm Myn-Burg No. 3	F01500000000000300000
	Remaining Extent of Farm Naauw Kloof No. 4	F01500000000000400000

PROJECT	FARM NAME	SG 21 CODE
	Remaining Extent of Farm Krom Hof No. 530	F01500000000053000000
	Remaining Extent of Farm Puntje No. 1240	F01500000000124000000
	Remaining Extent of Farm Aanfield No. 253	F01500000000025300000
	Portion 1 of Farm Aanfield No. 253	F01500000000025300001
	Remaining Extent of Farm Ox Hoek No. 98	F01500000000009800000
	Portion 1 of Farm Ox Hoek No. 98	F01500000000009800001
	Portion 2 of Farm Ox Hoek No. 98	F01500000000009800002
	Portion 3 of Farm Ox Hoek No. 98	F01500000000009800003
	Remaining Extent of Farm Markgraaff's Rest No. 478	F01500000000047800000
Normandien WEG	Portion 0 of Farm Christina No. 90	F01500000000009000000
	Portion 0 of Farm Mooiplaats No. 391	F01500000000039100000
	Portion 0 of Farm Brak Krans No. 554	F01500000000055400000
	Portion 0 of Farm Rooi Koppen No. 600	F01500000000060000000
	Portion 0 of Farm Goedgedacht No. 724	F01500000000072400000
	Portion 0 of Farm Kruger Wens No.1062	F01500000000106200000
	Portion 0 of Farm Scotland No. 1238	F01500000000123800000
	Portion 0 of Farm Lusthof No.1321	F01500000000132100000
	Remaining Extent of the Farm Welgelukt No. 1416	F01500000000141600000
	Portion 0 of Farm Inzicht No. 1428	F01500000000142800000
	Portion 1 of Farm Johanna No. 1395	F01500000000139500001
	Portion 1 of Farm Bull Hoek No. 329	F01500000000032900001

PROJECT	FARM NAME	SG 21 CODE
	Portion 1 of Farm Goede Hoop No. 982	F01500000000098200001
	Portion 2 of the Farm Driekoppen No. 485	F01500000000048500002
	Remaining Extent of portion 3 of the Farm Driekoppen No. 485	F01500000000048500003
	Portion 4 of Farm Driekoppen No. 485	F01500000000048500004
	Portion 5 of Farm Driekoppen No. 485	F01500000000048500005
	Remaining extent of Farm Johanna No. 1395	F01500000000139500000
	Remainder Farm Bull Hoek No. 329	F01500000000032900000
	Remaining Extent of the Farm Driekoppen No. 485	F01500000000048500000

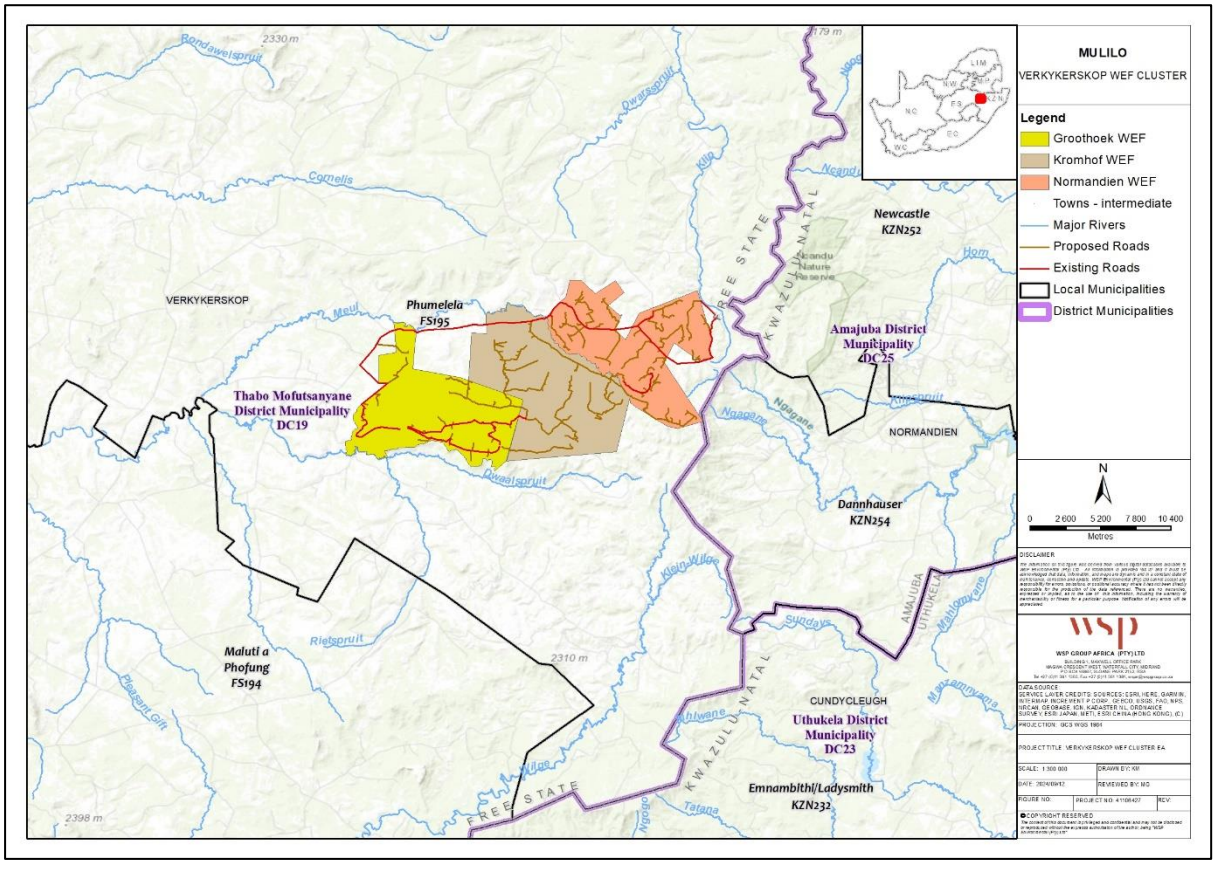

Figure 1: Locality map for the Verkykerskop WEF Cluster.

Table 2: WEF Technical details

DETAIL	GROOTHOEK	KROMHOF	NORMANDIEN
Applicant Name	Groothoek Wind Power (Pty) Ltd	Kromhof Wind Power (Pty) Ltd	Normandien Wind Power (Pty) Ltd
Municipalities	Thabo Mofutsanyana District Municipality Phumelela Local Municipality		
Extent	6 170 ha	7269 ha	6 067 ha
Buildable area	150 ha	150 ha	150 ha
Export Capacity	Up to 300MW	Up to 300MW	Up to 300MW
Power system technology	Wind		
Number of Turbines	Up to 55	Up to 55	Up to 60
Rotor Diameter	up to 200m		
Hub Height	up to 140m		
Hard Standing Dimensions	up to 0,8 ha per turbine		
Turbine Foundations	Area of 0,07ha per turbine and crane platform/pad – 0,5ha. Excavation up to 4.5 m deep, constructed of reinforced concrete to support the mounting ring. Once tower established, footprint of foundation is covered with soil.		
Substation	4 x 33kV/132kV onsite collector substation (IPP Portion) being up to 2ha.		
Powerlines	33kV cabling to connect the wind turbines to the onsite collector substations, to be laid underground where practical.		
Construction camp and laydown area	Construction compounds including site office inclusive of Concrete Batching plant of up to 1ha Site office of 4 ha laydown area of 8ha		
Internal Roads	Up to 8m in width (operational road surface width excluding V drains and cabling). During construction the disturbed road footprint will be up to 14m wide including v-drains and trenching for cabling)		
O&M Building	O&M office of up to 1ha.		
BESS	Battery Energy Storage System (BESS) (100MW/800MWh). Li-ion solid state batteries Export Capacity of up to 800MWh Total storage capacity 100MW Storage capacity of up to 6-8 hours The BESS will be housed in containers covering a total approximate footprint of up to 7ha		

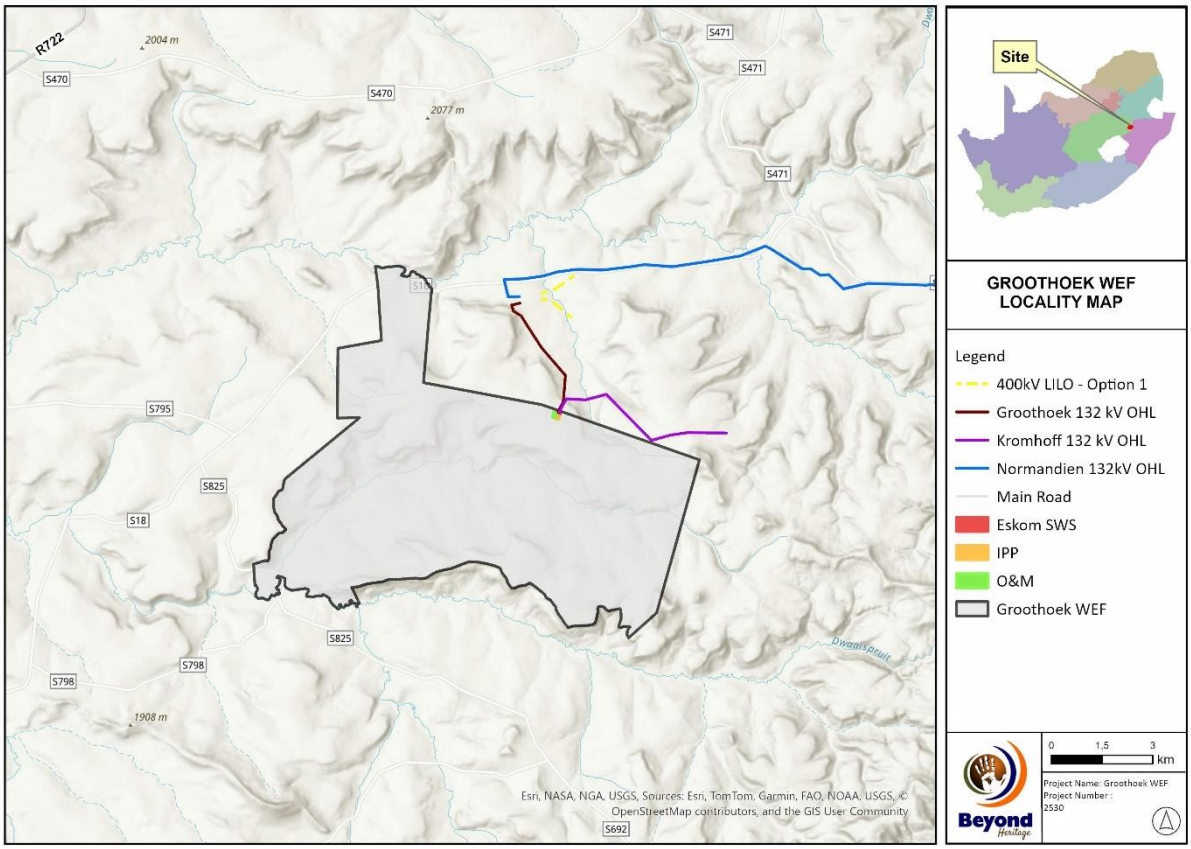

Figure 1: Locality map for the Groothoek WEF.

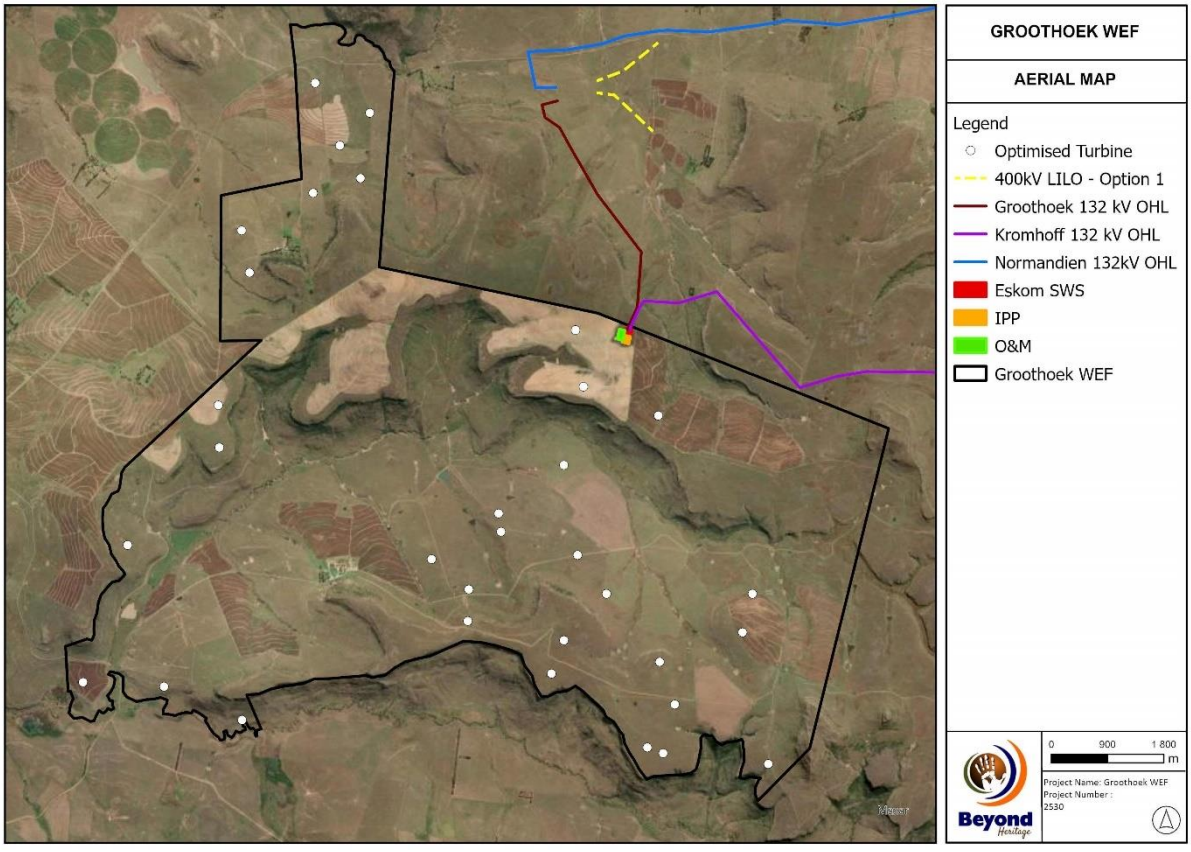

Figure 3: Aerial map for the Groothoek WEF with turbine locations

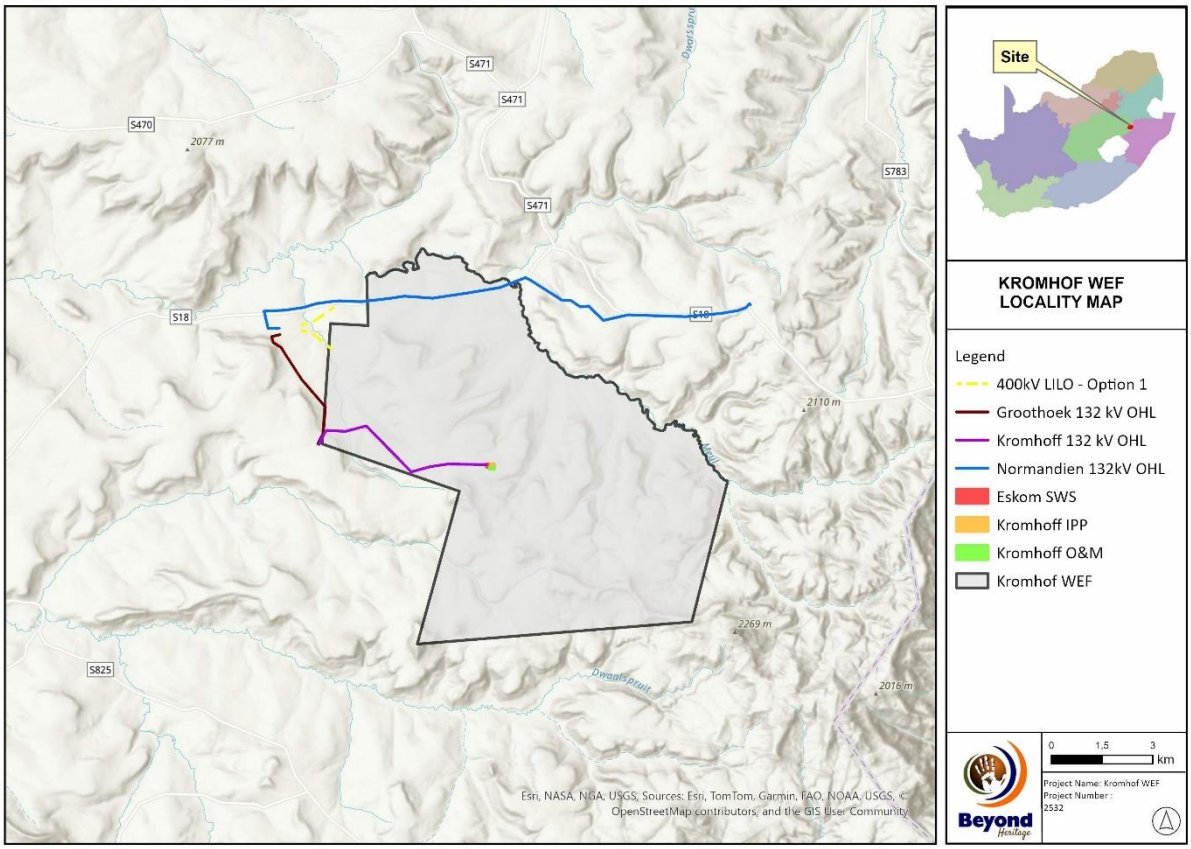

Figure 4: Locality map for the Kromhof WEF.

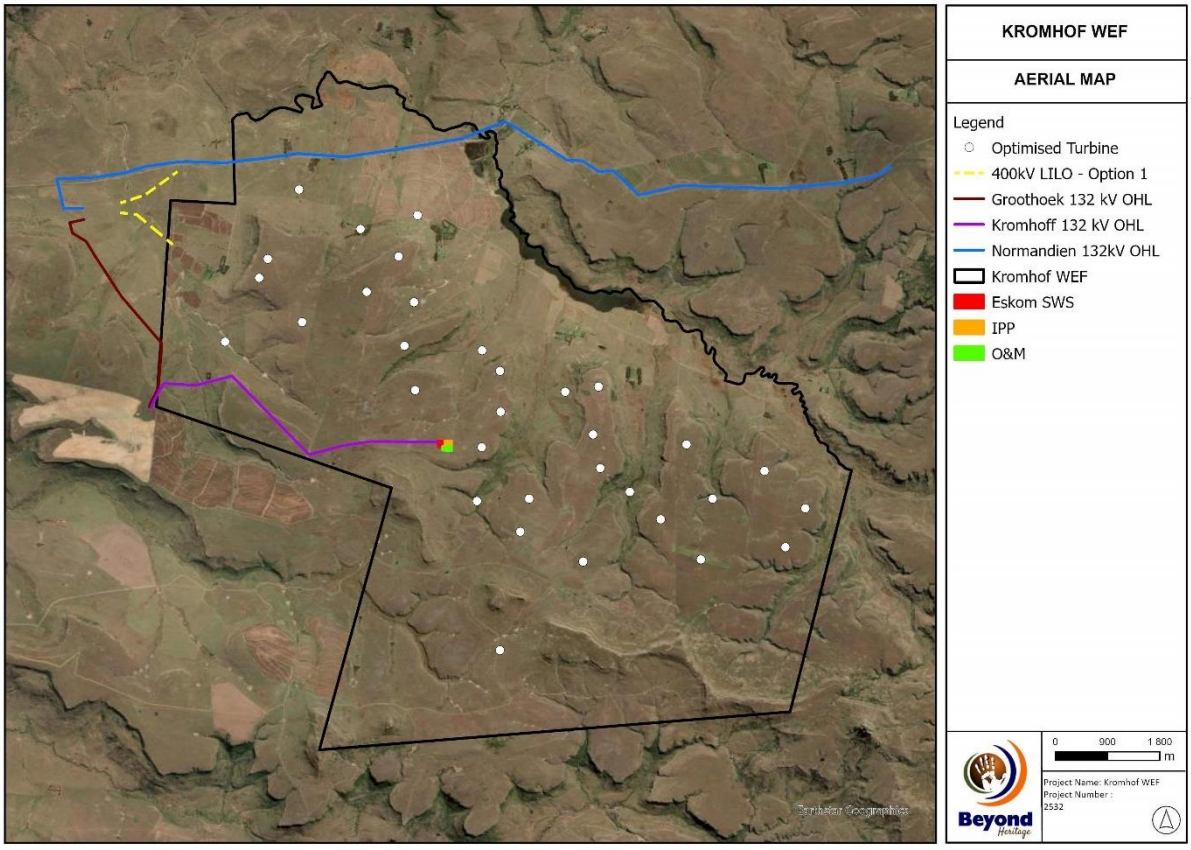

Figure 5: Aerial map for the Kromhof WEF with turbine locations

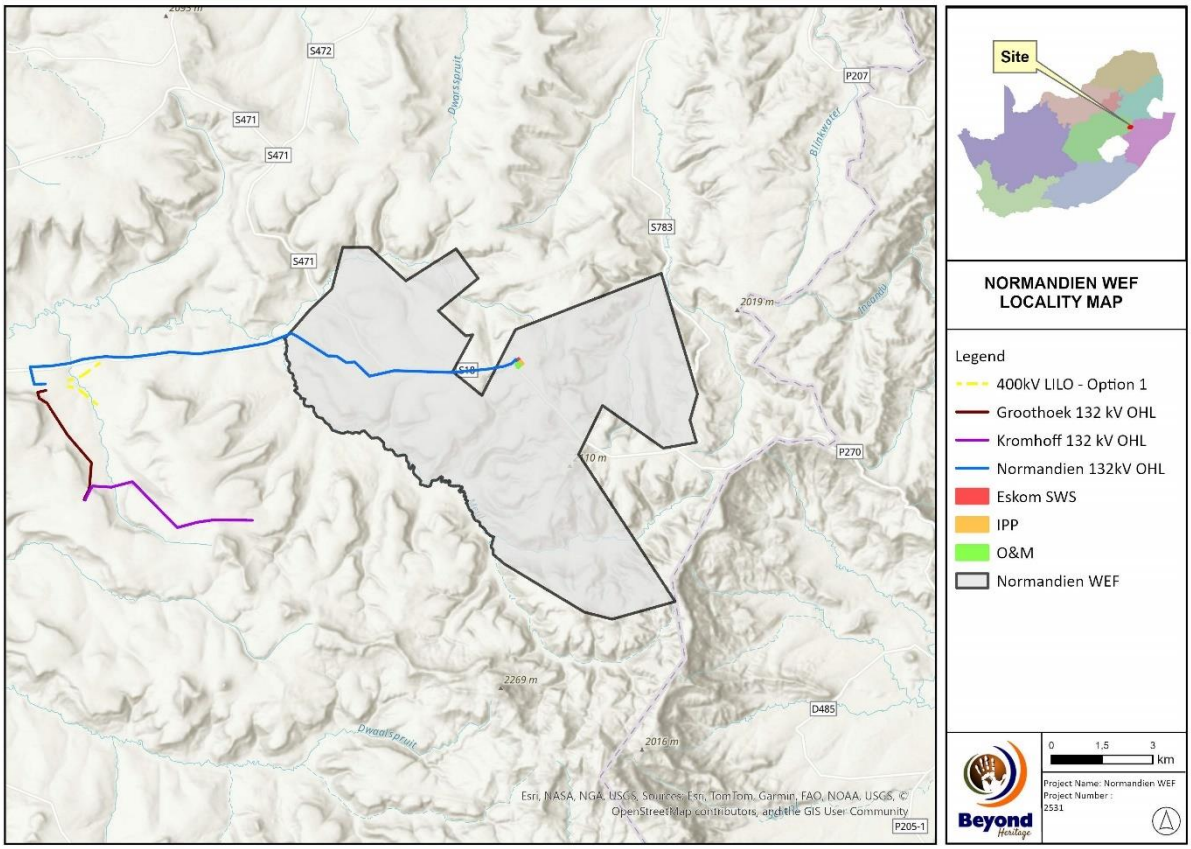

Figure 6: Locality map for the Normandien WEF.

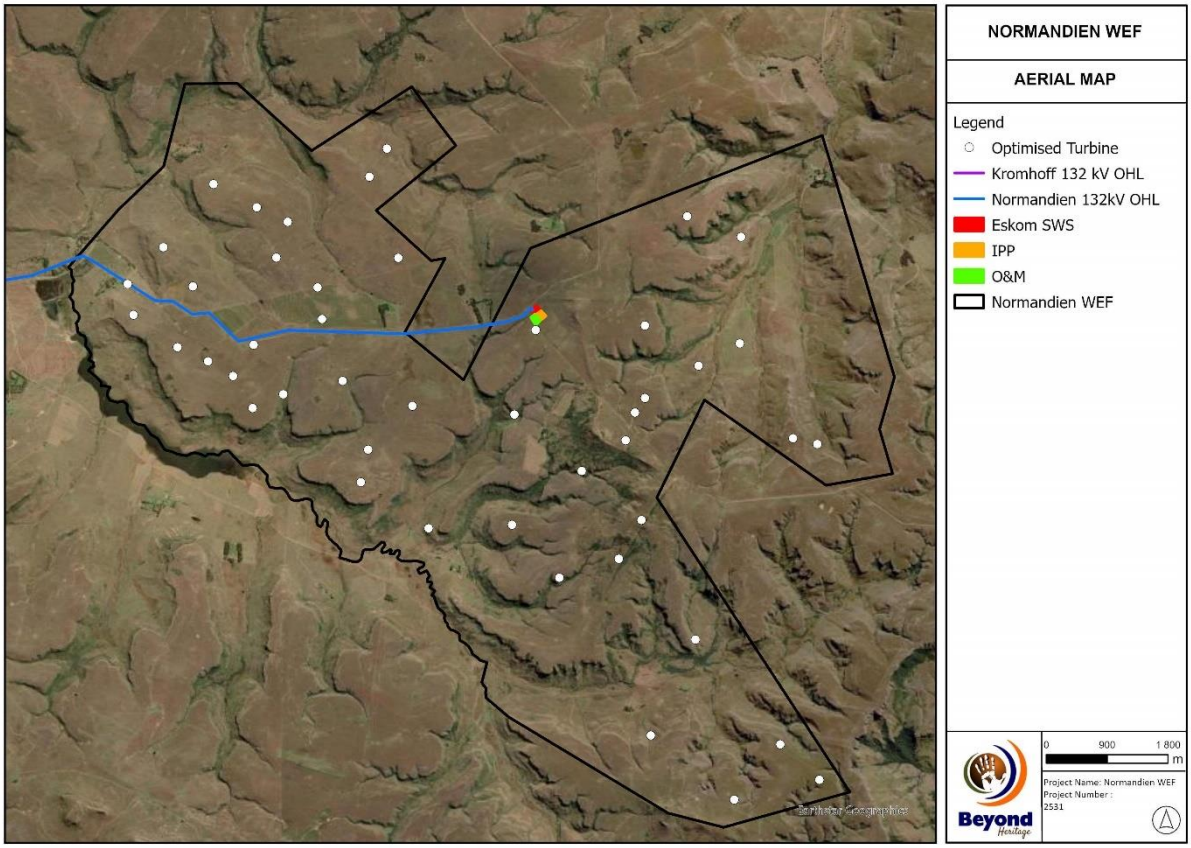

Figure 7: Aerial map for the Normandien WEF with turbine locations.

A site visit and walkdown Palaeontological Impact Assessment was requested for the Verkykerskop WEF Cluster 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), the site visit observations for the Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 3: 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,	Section 2
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Section 2
b	A declaration that the person is independent in a form as may be specified by the competent authority	Section 2
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 3
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 6
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 4
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 6
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 7
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 8
k	Any mitigation measures for inclusion in the EMPr	Section 10, Appendix A

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 10, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 8
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 8, 10
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

4. 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; eg https://sahris.sahra.org.za/map/palaeo ; DFFE palaeosensitivity screener.
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*applicable to this assessment*);
3. Walkdown to look for fossils on the land surface (no excavations permitted) and any fossils seen must be photographed and GPS coordinates noted.
4. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility, and
5. Determination of fossils' representativity or scientific importance to decide if the fossils can be destroyed or a representative sample collected.
6. If important fossils or fossil sites are encountered recommendation can be made to avoid the site (no-no area), establish a buffer area around the site, or remove the fossils.

5. Geology and Palaeontology

i. Project location and geological context

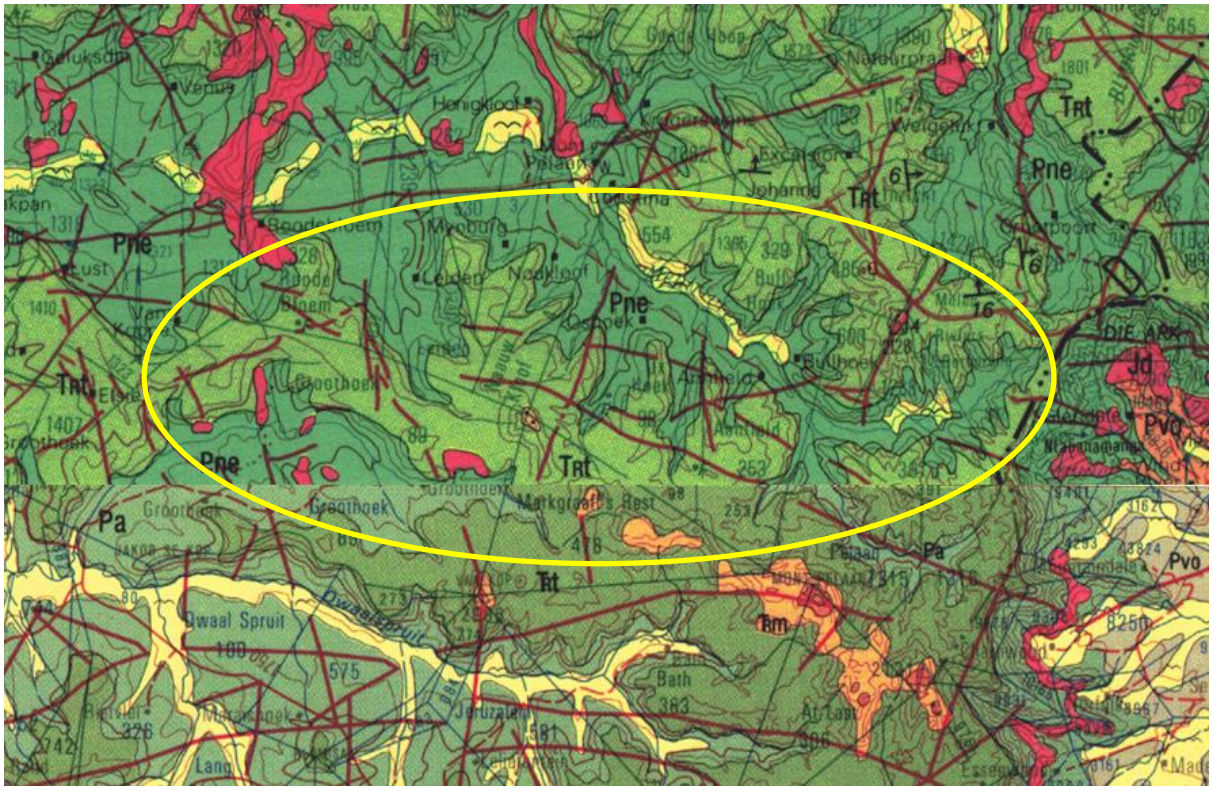

Figure 8: Geological map of the area around the Verkykerskop WEF Cluster. The location of the proposed project is indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 4. Map enlarged from the Geological Survey 1: 250 000 map 2728 Frankfort (north) and 2828 Harrismith (south).

Table 4: 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
Q	Quaternary	Alluvium, sand, calcrete	Quaternary ca 1.0 Ma to Present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, Ca 183 Ma
Trm	Molteno Fm, Stormberg Group, Karoo SG	Light red to buff aeolian sands, siltstones	Middle Triassic
Trt	Tarkastad Subgroup, Beaufort Group, Karoo SG	Mudstone, siltstone, sandstone	Early Triassic
Pa/Pne	Normandien Fm, Adelaide Subgroup, Beaufort Group, Karoo SG	Mudstone, siltstone, sandstone	Late Permian
Pvo	Volksrust Fm, Ecca Group, Karoo SG	Dark-grey shales, siltstones	Middle Permian

The project lies in the east central part of the Main Karoo Basin where the middle to upper strata of the Karoo Supergroup are exposed (Figure 8). Much younger fluvial sands and alluvium have been deposited in the valleys and depressions during the Quaternary period.

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 glacigene 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.

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.

In this part of the basin, in the Free State and KwaZulu Natal, only one formation is recognised in the Adelaide Subgroup, the thick Normandien Formation. The latter has been divided into four but they are not mapped at this scale (Rubidge, 2005; Smith et al., 2020).

In the central and eastern part of the Karoo Basin the Tarkastad Subgroup of the Beaufort Group is composed of two formations, the lower Verkykerskop and upper Driekoppen Formations.

Overlying the Beaufort Group are the three formations of the Stormberg Group. They are absent from the western part of the basin but are more uniform across the eastern part of the basin. Capping the Stormberg Group are the Drakensberg Group basalts and dykes that signalled the end of deposition in the Karoo basin. The Stormberg Group formations are the lower Molteno Formation shales, the Elliot Formation that has recently been divided into the lower and upper Elliot Formation, and the upper Clarens Formation.

Large exposures of Jurassic dolerite dykes occur throughout the area. These intruded through the Karoo sediments around 183 million years ago at about the same time as the Drakensberg basaltic eruption.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for development is in the very highly sensitive Beaufort Group rocks (red).

Figure 9: SAHRIS palaeosensitivity map for the site for the proposed Verkykerskop WEF Cluster shown within the yellow polygon. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

The **Adelaide Subgroup** is part of the eastern foredeep basin and was deposited in the overfilled or non-marine phase (Catuneanu et al., 2005) and so comprises terrestrial deposits. There are numerous fining-upward cycles, abundant red mudrocks and sedimentary structures that indicate deposition under fluvial conditions (Johnson et al., 2006). Some of the lower strata probably represent a subaerial upper delta-plain environment and the generally finer grained materials are typical of meandering rather than braided rivers. Channel deposits are indicated by sandstones while overbank deposits are indicated by the mudstones (Johnson et al., 2006).

The **Normandien Formation** is represented by the *Daptoccephalus* Assemblage Zone
The **Daptocephalus Assemblage Zone** is recognised by the co-occurrence of the dicynodontoid *Daptocephalus leoniceps*, the therocephalian *Theriognathus microps*, and the cynodont *Procynosuchus delaharpeae* (Viglietti, 2020). This has been further divided into two subzones, the lower *Dicynodon -Theriognathus* Subzone (in co-occurrence with *Daptocephalus*), and the upper *Lystrosaurus maccaigi – Moschorhinus kitchingi* Subzone (ibid). Other taxa include fish, amphibians, parareptiles, eureptiles, biarmosuchians, anomodontians, gorgonopsians, therocephaleans, cynodonts and molluscs. The flora is more diverse than the older Assemblage Zones and comprises glossopterids, mosses, ferns, sphenophytes, lycopods, cordaitaleans and gymnosperm woods (Plumstead, 1969; Anderson and Anderson, 1985; Bamford, 2004).

The early Triassic **Verkykerskop Formation** (lower Tarkastad Subgroup) represents shallow, braided environment with pulsatory discharges. It also has abandoned channel fills and braidplain environments, and the latter just representing a braidplain environment (Catuneanu et al., 1998). The ***Lystrosaurus declivis* Assemblage Zone** occurs in this formation and it is typified by a low diversity of herbivorous vertebrates, the abundance of the dicynodont therapsid *Lystrosaurus declivis* in association with the dicynodont therapsid *Lystrosaurus murrayi* (Botha and Smith, 2020). Other fauna include the non-mammaliaform epicynodont therapsid *Thrinaxodon liorhinus*, the procolophonoid parareptile *Procolophon trigoniceps*, and the absence of the dicynodont therapsid *Daptocephalus leoniceps* (ibid). Apart from the usual range of fish, amphibians and therapsid groups, the plants (rare) include glossopterids, lycopods, sphenophytes, ferns and early gymnosperms (Plumstead, 1969; Anderson and Anderson, 1985; Bamford, 2004; Barbolini et al., 2018).

The Early to middle Triassic **Driekoppen Formation** (Tarkastad Subgroup) is home to the ***Cynognathus* Assemblage Zone**. This post Permo-Triassic extinction event and recovery phase has a lower diversity of fauna and flora. It is typified by the presence of the cynodont genus *Cynognathus* (Kitching, 1995; Hancox et al., 2020), and has been divided into three subzones, namely the lower *Langbergia-Garjainia* Subzone, the *Trirachodon-Kannemeyeria* Subzone and the upper *Cricodon-Ufudocyclops* Subzone (Hancox et al., 2020). Other fauna include, fish, amphibians, parareptiles, eureptiles, therocephalians, cynodontians and trace fossils. Plants of the Burgersdorp Formation no longer include the glossopterids; there are lycopods (*Gregicaulis*), sphenophytes (*Calamites)*, ferns (*Asterotheca, Cladophlebis*), seed ferns (*Lepidopteris, Dicroidium*), cycads (*Pseudoctenis, Nilssonia*), ginkgos (*Ginkgoites, Sphenobaiera*) and conifers (*Sewardistrobis, Agathoxylon, Podocarpoxylon*) (Plumstead, 1969; Anderson and Anderson, 1985; Bamford, 2004; Barbolini et al., 2018).

Stormberg Group

The **Molteno Formation**, of upper Triassic age, represents braided streams on a vast braid plain, rare coal deposits with a few filled in abandoned channel tracts and some ponded bodies of water (Catuneanu et al., 1998). It was a part of the ever-shrinking Karoo Basin and only occurs around the margins of the Drakensberg Mountains. There are no vertebrate fossils in this formation but footprints of three-toed vertebrates are common in some parts (Anderson et al., 1998).

In contrast, the flora is extremely rich and diverse in pockets around Little Switzerland, Molteno, Birds River and others (Anderson and Anderson, 1985). The flora includes the lower plants such as bryophytes, ferns, lycopods and sphenophytes, the now extinct seed ferns such as *Dicroidium* (dominant), *Lepidopteris, Yabiella, Taeniopteris, Dejerseya*, cycads such as *Pseudoctenis, Nilssoniopteris*, gymnosperms such as *Ginkgoites, Sphenobaiera, Rissikia, Voltziopsis, Heidiphyllum, Pagiophyllum,* and incertae sedis (Plumstead, 1969; Anderson and Anderson, 1983, 1985, 2002. 2020; Bamford 2004; Anderson et al., 2019a, b, 2020). There is no vertebrate assemblage zone for the Molteno

From the SAHRIS map above the area is indicated as very highly sensitive (red) so a site visit and walkdown was done in late August 2024. Observations and photographs are presented below in Figures 10-16.

iii. Site Visit Observations

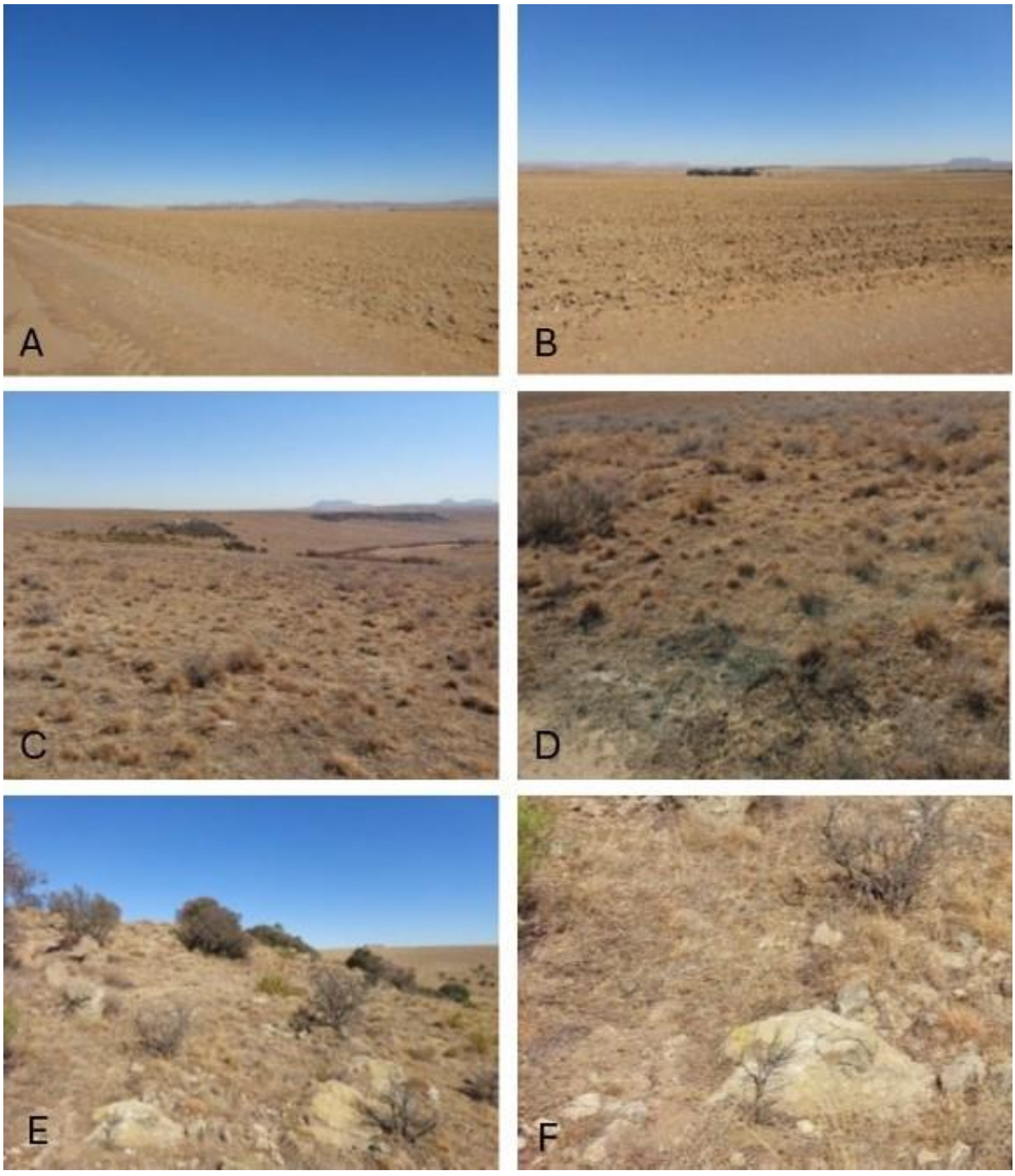

Figure 10: Verkykerskop WEF Cluster site visit photographs Groothoek section. A-B – open ploughed fields showing deep soils and rocky outcrops. C-D – grasslands with thick vegetation and no rocky outcrops. E-F – small hill with sandstones but no mudstones (where one might find fossils).

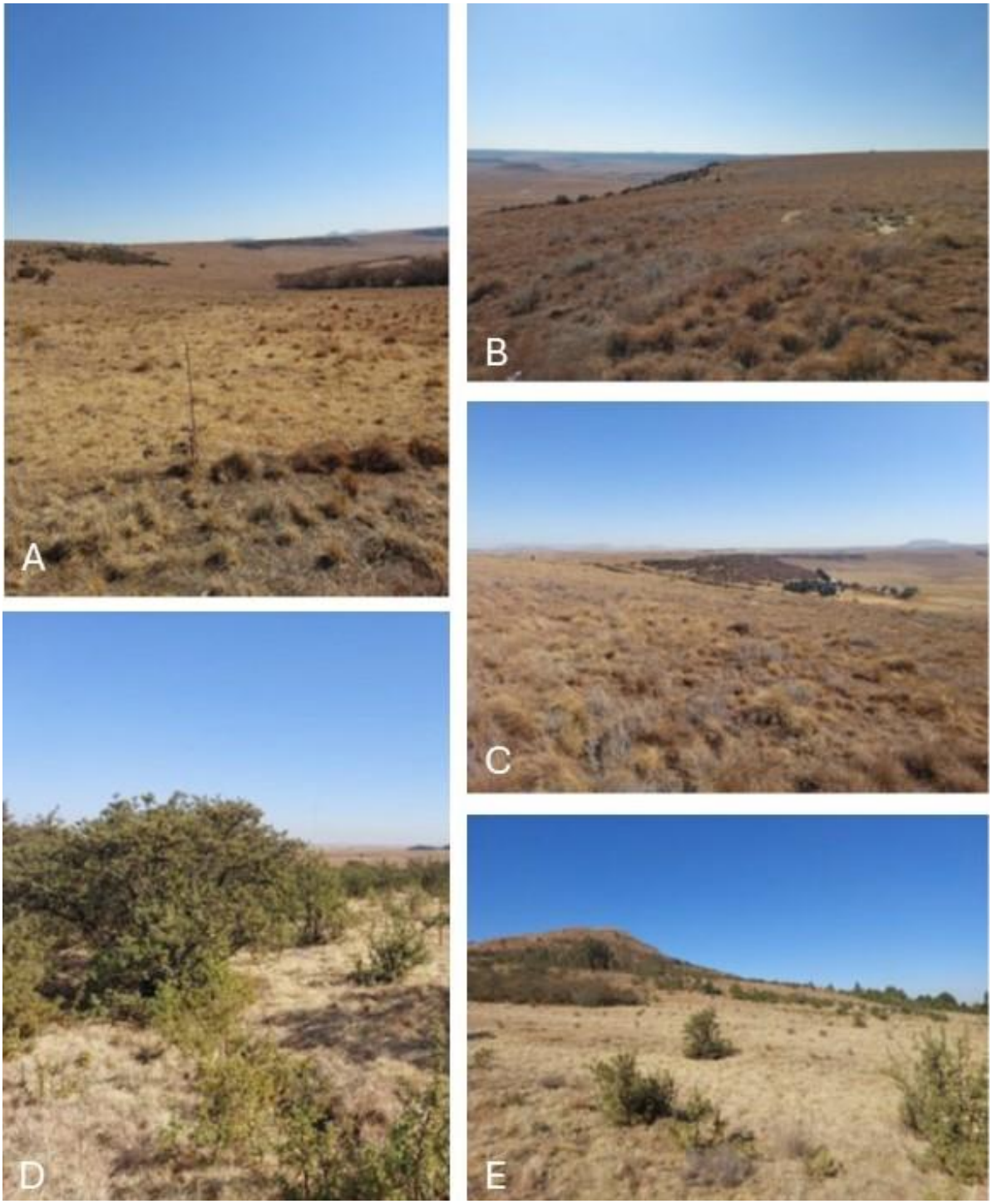

Figure 11: A-C – open, high altitude grasslands. The hard ledges are composed of sandstones. D-E sandstone ridges with some thorny vegetation. No fossils seen.

Figure 12: A-E – high ground that is covered with grasslands. C, E – view along two sandstone ridges. Coarse-grained material and no fossils present. The sides of the hill were too steep and crumbly to access.

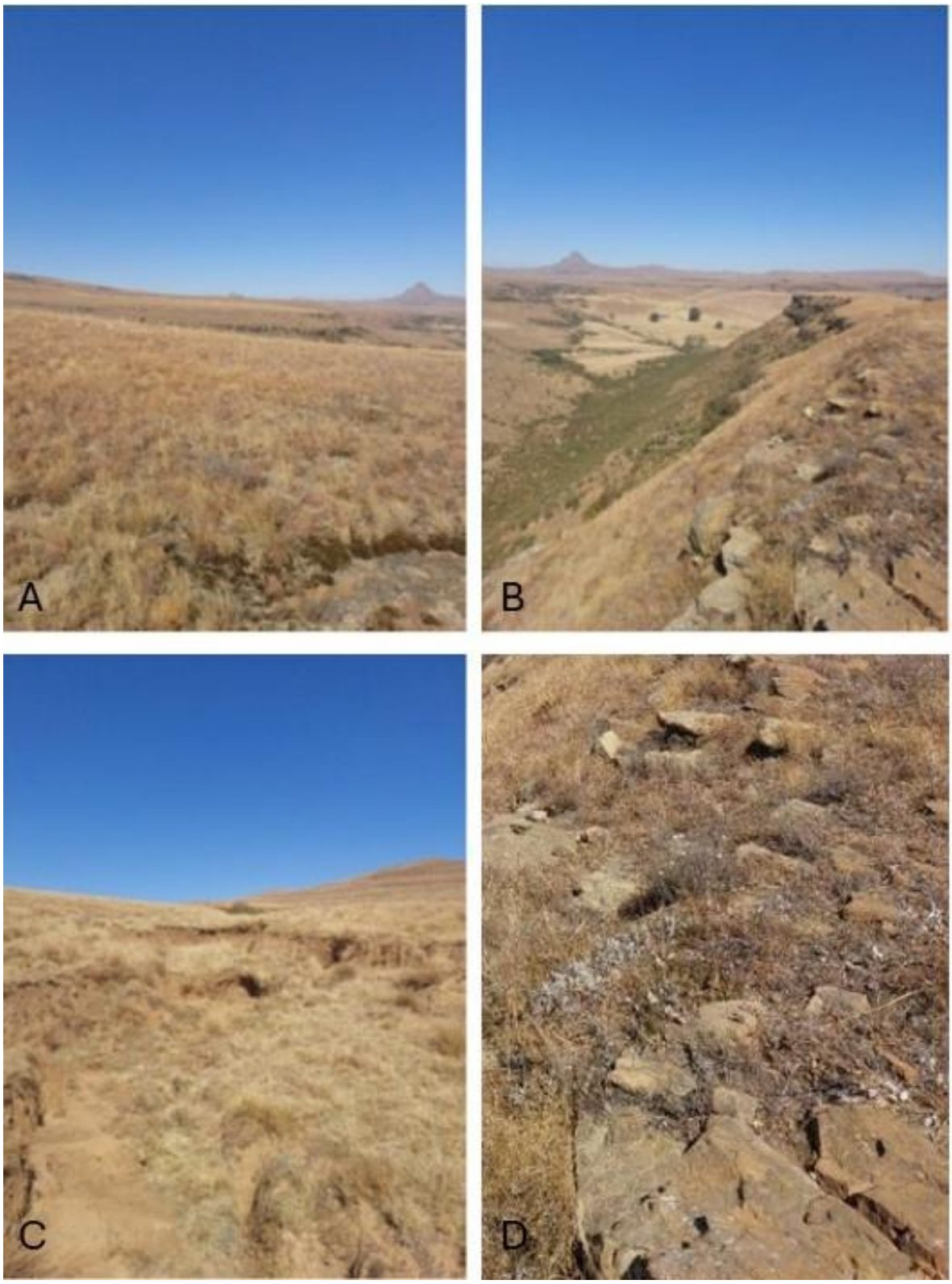

Figure 13: Kromhof section. A-B – view along the sandstone ridges. C – view along an erosion gully where one could find fossils because the soils have been eroded but no bones or plants were seen. D – sandstone outcrop with some interesting weathering patters but no fossils.

Figure 14: A-B – views along the mountain tops. C – weathered sandstone outcrop but no fossils. D – rare dolerite outcrop and no fossils as expected. Grasses are short on the thin soils but no fossils seen.

Figure 15: A-B – weathered coarse sandstone outcrop with a close up of the laminations in the sandstone indicating depositional pattern typical of shallow water. No fossils. C-D more views of the general area. E – road cutting showing the fine pebbles from much younger deposits.

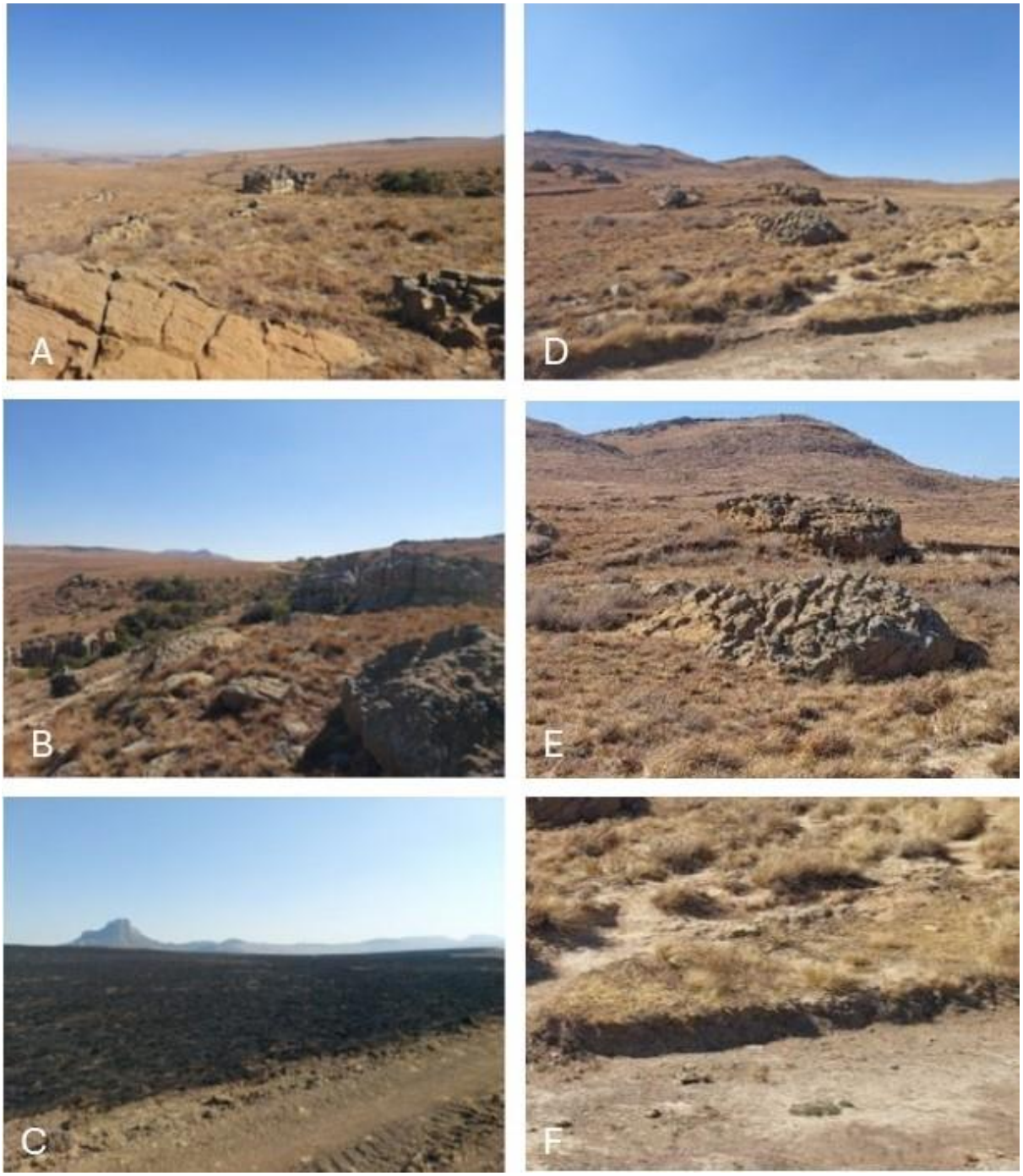

Figure 16: Normandien section. A-C – general views of the area showing mountains and grasslands. D – an outcrop of weathered sandstone making strange small columns in the distance (close-up in E), and close-up of the flat sandstone surface from the foreground of D shown in F. No fossils, no traces or footprints seen.

6. Impact assessment

Assessment of Impacts and Mitigation (WSP method).

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

Following the mitigation sequence/hierarchy of five levels:

a) Avoid/prevent significant impact
b) Minimise
c) Rehabilitate/restore
d) Off-set
e) No-go,

mitigation in the form of removing any important fossils (steps a and b) will reduce realty the impact of this project on the palaeontological heritage.

The key objectives of the risk assessment are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Ranked criteria listed in Table 5a and the scores for the palaeontological impact are given in Table 5b.

Table 5a: Impact Assessment and Scoring according to WSP protocols.

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

Mitigation

The impact on the palaeontological heritage can be reduced greatly by a palaeontologist conducting a pre-construction site visit to look for fossils and removing any scientifically important fossils with the relevant SAHRA permit.
(See Section 8 and Appendix A).

Positive/Negative Impact

The discovery and removal of fossils as a direct result of this project has a positive impact because prior to these excavations any particular fossils or fossil deposit were unknown to science.

Additional Environmental Impacts

As far as the palaeontology is concerned, there are no additional impacts because the fossils are inert and inactive.

Cumulative Impacts

As far as the palaeontology is concerned, there are no cumulative impacts because each site is unique and may or may not have fossils. Fossil bones may be scattered over the landscape but their distribution is erratic and unpredictable. If a bone-bed or plant

outcrop occurs this would be an aerially small concentration of fossils and very unlikely to extend beyond tens of metres. Therefore, projects on adjacent land parcels are unlikely to add any impact on this project.

No-Go areas
There are NO no-go areas because the fossils, if present, can be removed and curated in a recognised institution such as a museum or university that has the facilities to store and research the fossil material.

Impact Phase
It is only during the **Construction Phase** that there could be any impact on the palaeontological heritage because this is when the ground will be broken for excavations for foundations and infrastructure. Fossils occur in the ground. The operational and de-commissioning phases will not affect the palaeontology.

Table 5b: Potential impacts of this project. (C = Construction Phase, O = Operational Phase, D = Decommissioning phase, M = Magnitude, E = Extent, R = Reversibility, D = Duration, P = Probability, S = Significance, Ca = Character, Con = Confidence)

Aspect	Impact	C	O	D	M	E	R	D	P	S		Ca	Con
Palaeontology													
	Without Mitigation				2	1	5	4	2	24	Low	(-)	High
	With Mitigation				1	1	3	1	2	12	Very Low	(-)	High
		✓			**Mitigation Measures:** • Site visit by a palaeontologist to look for surface fossils. • Photograph then rescue the fossils but do not remove them from the site until a SAHRA permit ha been obtained. • Construction phase/excavations – on-site responsible person to check new excavations for fossils. • Photograph and rescue any fossils • Send photographs to a palaeontologist to confirm the importance of the fossils: not a fossil/poor fossil/very common types – no action required OR rescue and call a palaeontologist to collect OR stop all excavations until a palaeontologist can excavate very important fossils.							
	Listing Notice 1: GNR 983 - Activity 1, 12, 19, 24 (ii); Listed Notice 2 GNR 984 – Activity 1, 4, 15												
	Without Mitigation				1	2	1	2	0	0	N/A	(-)	High
	With Mitigation				1	1	1	2	0	0	N/A	(-)	High
			x	x	**Mitigation Measures:** • N/A								

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 and type to fossils so a site visit is required by SAHRA. Furthermore, the material to be excavated is soil and this does not preserve fossils. Since

there is a small chance that fossils from the Formation of the Beaufort Group 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 Low without mitigation and Very Low with Mitigation**

7. 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. The sands of the Quaternary period would not preserve fossils. From the site visit observations there were NO FOSSILS on the land surface. It is not known, however, what rocks or possible fossils lie below the surface until excavations have commenced.

8. 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. Outcrops of the Beaufort Group (Normandien, Verkykerskop and Driekoppen Formations) in other parts of the country have fossil vertebrates and plants so there is a chance that they also occur in this area. The site visit and walk through in late August 2024 (winter), however confirmed that there were NO FOSSILS in the project footprint. There is a chance that fossils may occur below the ground surface in the mudstones, siltstones or shales of the Beaufort Group rocks 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 and infrastructure have commenced then they should be rescued, SAHRA informed and a palaeontologist called to assess and collect a representative sample. The impact on the palaeontological heritage would be low, as far as the palaeontology is concerned, so the project should be authorised.

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

9. 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.

Bamford, M.K. 2004. Diversity of woody vegetation of Gondwanan southern Africa. Gondwana Research 7, 153-164.

Barbolini, N., Rubidge, B.S., Bamford, M.K. 2018. A new approach to biostratigraphy in the Karoo retroarc foreland system: utilising restricted-range palynomorphs and their first appearance datums for correlation. Journal of African Earth Sciences 140, 114-133.

Bordy, E.M., Hancox, P.J. and Rubidge, B.S., 2005. The contact of the Molteno and Elliot formations through the main Karoo Basin, South Africa: a second-order sequence boundary. South African Journal of Geology, 108, 351-364

Botha, J., Smith, R.M.H., 2020. Biostratigraphy of the Lystrosaurus declivis Assemblage Zone (Beaufort Group, Karoo Supergroup). South African Journal of Geology 123, 207-216.

Catuneanu, O., Hancox, P.J., Rubidge, B.S., 1998. Reciprocal flexural behaviour and contrasting stratigraphies: a new basin development model for the Karoo retroarc foreland system. Basin Research 10, 417-439.

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.

Smith, R.M.H., Rubidge, B.S., Day, M.O., Botha, J., 2020. Introduction to the tetrapod biozonation of the Karoo Supergroup. South African Journal of Geology 123(2), 131-140.

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.

Viglietti, P.A., 2020. Biostratigraphy of the *Daptocephalus* Assemblage Zone (Beaufort Group, Karoo Supergroup). South African Journal of Geology 123, 191-206.

10. Fossil 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 (trace fossils such as stromatolites or microbialites, 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 17-18). 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.

11. **Appendix A** – Examples of fossils from the Beaufort Group

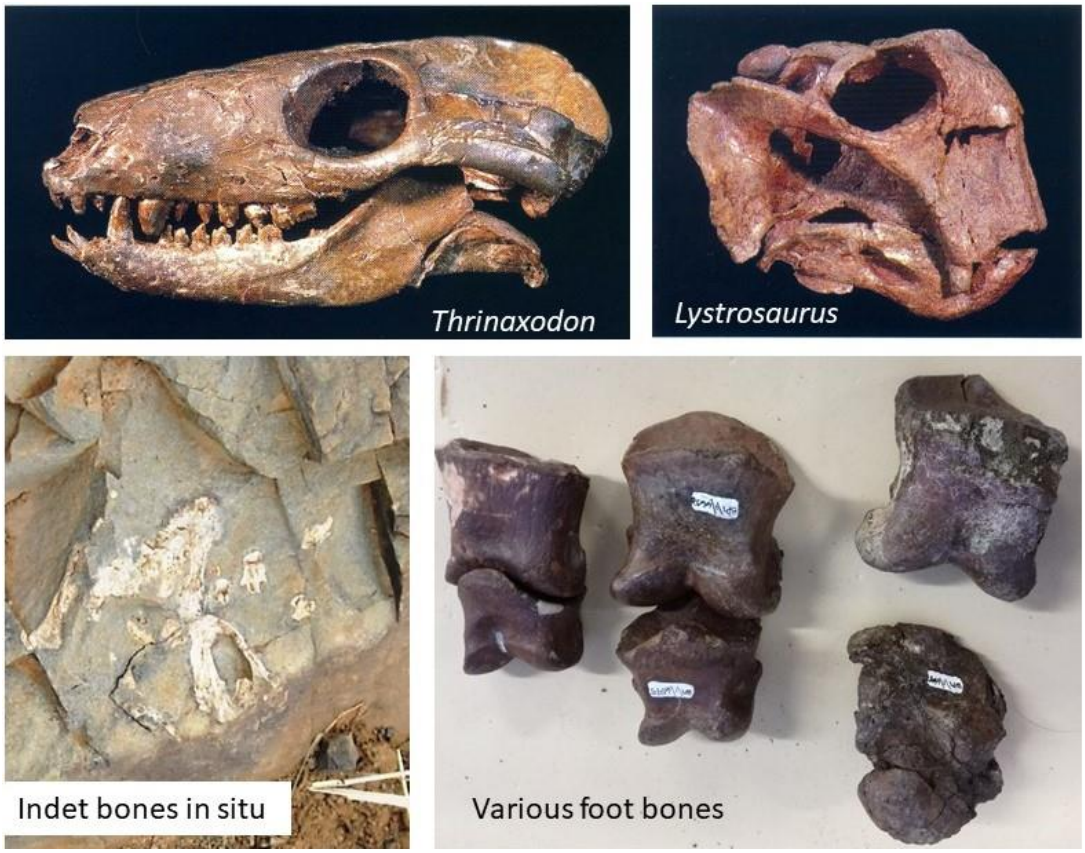

Figure 18: Photographs of fossil vertebrate bones that could be found in the Beaufort Group rocks, to assist the on-site responsible person.

Figure 19: Photographs of fossil plants that could be found in the Beaufort Group rocks, to assist the on-site responsible person.