PALAEONTOLOGICAL IMPACT ASSESSMENT (PIA)

Power Line Corridor, Lejweleputswa District Municipality, Free State Province

(Virginia 1, Virginia 2, Virginia 3 Solar Parks, and Power Line Corridor)

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Specialist report by:

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EXECUTIVE SUMMARY

Outline of the development project:

Bruce Rubidge and Marc Van den Brandt were appointed by Johan Botha on behalf of AGES Limpopo (Pty) Ltd to undertake the palaeontological impact assessment process for the farm Blomskraal 216 and a Power Line Corridor adjacent to the farm, near of the town of Virginia, in the Free State Province. The planned development includes the three solar parks (termed Virginia 1, Virginia 2, and Virginia 3 Solar Parks), each of approximately 300 MW capacity. This palaeontological impact assessment (PIA) is one of the specialist studies, used to determine the best areas for the development footprints. We have produced two PIA's for this project: 1) this Power Line Corridor PIA , and separately, 2) a PIA report for the farm Blomskraal, 216.

Outline of the geology and palaeontology of the study area:

The study area is situated in the Main Karoo Basin of the Free State province and is underlain by Late Permian rocky deposits of the Adelaide Subgroup of the Lower Beaufort Group of the Karoo Supergroup. These Karoo rocks are overlain by Quaternary alluvial deposits (soil) which are mostly covered by irrigated cropland, and in three smaller sections by natural vegetation, grasses and bushes. The Balfour Formation is the stratigraphic unit. Biostratigraphically, the study area lies within the upper *Daptocephalus* Assemblage Zone (*Lystrosaurus maccaigi-Moschorhinus* subzone) (Viglietti et al, 2016, Viglietti 2020). Good outcrops of fossil bearing rocks in this part of the basin, near Virginia, are sparse, and fossils are rare.

Summary of finding:

A Phase 1 Palaeontological Impact Assessment was conducted, including a Desktop Study and an onsite inspection for fossils by Marc Van den Brandt on 9 April 2021. The on-site study found that the study area is almost entirely covered in thick Quaternary alluvial deposits which in turn are covered mostly by irrigated cropland, and three small sections by natural vegetation, grass and bushes, around the Merriespruit River, the Steenbokspruit River and around a small patch immediately west of the R73 with dolerite. Only a few Isolated scattered sandstone boulders are exposed in the natural vegetation, but no fossils were found. The edges of the Merriespruit River expose Quaternary alluvium deposits (sandy to more consolidated gravel) which has potential for fossils, but none were found.

Recommendations:

We recommend that the proposed development be constrained to the irrigated cropland that covers most of the study area, currently carrying maize/corn, overlying the mapped Quaternary alluvial deposits; and the non-irrigated naturally vegetated grassland, surrounding the Merriespruit River centrally, the Steenbokspruit River in the east, and the grassland immediately West of the R73.Due to palaeontological sensitivity, we do not recommend development on the Merriespruit River, the river edges of exposed alluvium and isolated scattered sandstone boulders nearby; or the Steenbokspruit River and its three erosional gullies or tributary streams.

Stakeholders responsible for decisions or next actions:

In the event that fossils are discovered in the course of the proposed development, the Environmental Control Officer must follow the steps outlined in the Chance Find Protocol (Appendix A) whereby a qualified palaeontologist must be contacted to assess the exposure for fossils so that the necessary rescue operations are implemented. The Chance Find Protocol must be incorporated into the Environmental Management Programme (EMP) for the proposed development.

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1. INTRODUCTION AND PROJECT BACKGROUND

Bruce Rubidge and Marc Van den Brandt were appointed by Johan Botha on behalf of AGES Limpopo (Pty) Ltd on 24 March 2021, to produce two Phase 1 Palaeontological Impact Assessment reports (PIA's) to assess the potential palaeontological impact of parts of the proposed Virginia 1, Virginia 2, Virginia 3 Solar Parks and Power Line Corridor project.

Virginia 1 Solar Park by Ursa Energy (Pty) Ltd , Virginia 2 Solar Park by Fornax Energy (Pty) Ltd , and Virginia 3 Solar Park by Volans Energy (Pty) Ltd propose the establishment of new renewable energy generation facilities, in the form of Photovoltaic (PV) Power Plants), with a maximum generation capacity of up to 300 MW each, and associated connection infrastructure and structures on the farm Blomskraal, 216; Ventersburg road (4246 ha), Remainder of Palmiet Fontein, 229, Winburg road (1761 ha), Delaporte, 887, Winburg road (598 ha), and Portion 3 of Quaggafontein, 3, Winburg road (467 ha), totalling 7064.6714 ha in extent, located within the Matjhabeng and Masilonyana Municipalities, Lejweleputswa District Municipality, Free State Province (Figure 1). In addition, a 16.2 km long Power Line Corridor is proposed to connect the on-site substation to the Eskom Theseus Main Transmission Substation (MTS). The final size and location of the development area (footprint) required for the proposed project will be determined following the outcomes of the Public Participation Process and the recommendations and conclusions of the Specialist Studies conducted during the Environmental Impact Assessment (EIA) process. The Environmental Impact Assessment process permits the identification and assessment of potential environmental impacts resulting from the proposed project.

This PIA relates to the proposed development of the Power Line Corridor only.

From East to West, the Power Line Corridor begins at the Northwest border of the farm Blomskraal, 216 and then extends through De Rust, Le Roux 717, Florida 633, Te Vrede 361, Welgelegen 382, Bloemhoek 509, to reach the existing Eskom Theseus Main Transmission Substation (MTS) on Doorn Rivier 330.

Ursa Energy (Pty) Ltd , Fornax Energy (Pty) Ltd , and Volans Energy (Pty) Ltd will undertake the required Environmental Impact Assessment process and appointed AGES Limpopo (Pty) Ltd as Environmental Assessment Practitioner (EAP) in order to identify and assess potential environmental impacts, and propose appropriate mitigation and management measures as part of an Environmental Management Programme (EMP).

Specialist Studies, including this Palaeontological Impact Assessment, are required to identify all potential significant environmental impacts and issues, including impacts on heritage resources. This Palaeontological Impact Assessment forms one of the Specialist Studies required for this proposed development as part of the:

- Heritage Impact Assessment (HIAs) called for in terms of Section 38 of the National Heritage Resources Act (Act No. 25 of 1999); and the
- Environmental Impact Assessment (EIA) or Environmental Management Programme (EMP) process required.

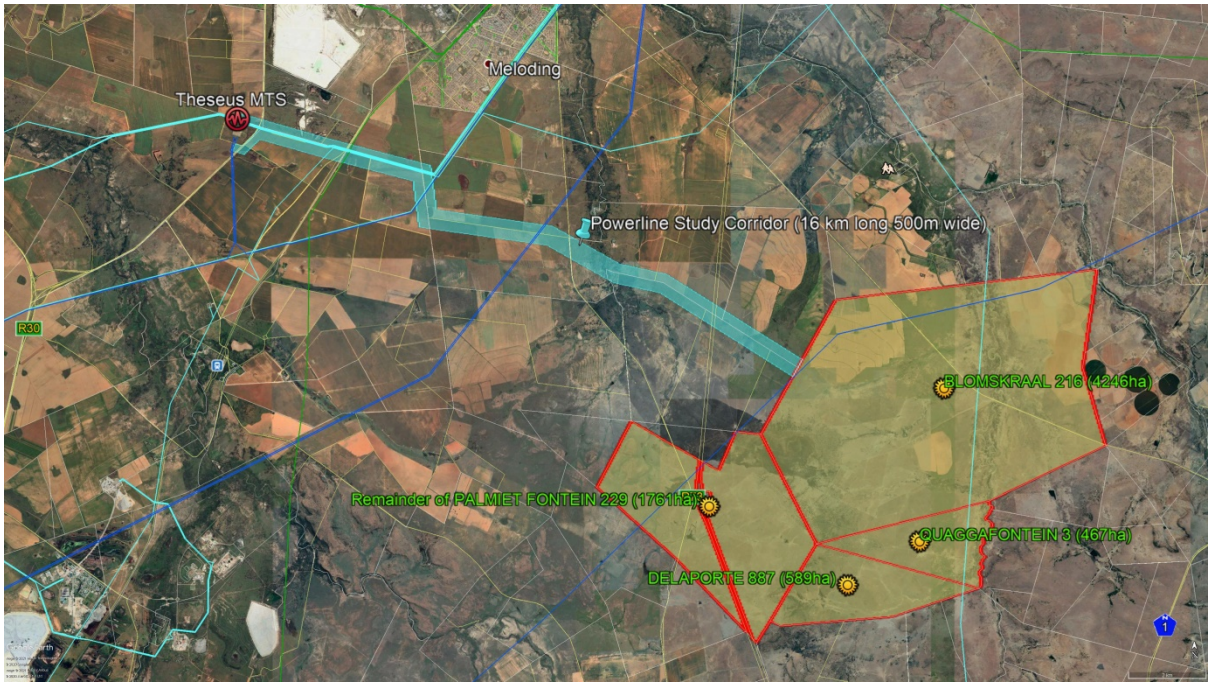

Figure 1: Google Earth projection of the proposed study area of the blue shaded Power Line Corridor, comprising a track of land 16.2 km long, 500m wide, extending North-West, from the North-Western boundary of the farm Blomskraal, 216, to the Eskom Theseus Main Transmission Substation (MTS). The farms shown (red outline, yellow shading) are part of the larger project, and are not included in this Palaeontological Impact Assessment Report.

South Africa's unique and non-renewable palaeontological heritage is protected in terms of the National Heritage Resources Act (Act No. 25 of 1999), according to which, palaeontological resources may not excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

The purpose of this Palaeontological Impact Assessment is to 1) identify potential palaeontological resources on the site of the proposed development, 2) assess the potential impact the development may have to palaeontological heritage resources, and to 3) make recommendations for protection or mitigation of impact. This PIA will therefore inform the Environmental Management Programme (EMP) for this project.

Terms of Reference:

- This PIA relates to the proposed development along the Power Line Corridor only;
- Determine and assess the potential impacts of the proposed development on palaeontological heritage resources in the proposed areas of impact;
- Determine any "no-go" areas for the proposed development in terms of potential or real damage or impacts to the palaeontological heritage resources;
- Recommend mitigation measures to minimize impacts associated with the proposed development.

2. LEGISLATIVE REQUIREMENTS

This Palaeontological Impact Assessment (PIA) for the proposed development on the farm Blomskraal, 216, is part of the Heritage Impact Assessments (HIAs) required for the proposed development, and is guided by the South African National Heritage Resources Act (Act No. 25 of 1999).

National Heritage is protected by the South African National Heritage Resources Act (Act No. 25 of 1999). Developers are required to submit development plans to SAHRA for approval. These plans must include documentation detailing the expected impact that the development will have on national heritage, including palaeontological heritage.

Categories of heritage resources recognised as part of the National Estate (Chapter 1, Section 3.2 & 3.3, National Estate) of the National Heritage Resources Act include, among others:

(3.2) Without limiting the generality of subsection (1), the national estate may include:

- *(e)* geological sites of scientific or cultural importance;
- *(f)* archaeological and palaeontological sites;
- *(i)* movable objects, including
    - *(i)* objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;

(3.3) Without limiting the generality of subsections (1) and (2), a place or object is to be considered part of the national estate if it has cultural significance or other special value because of:

- *(c)* its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;

According to Section 35 of the National Heritage Resources Act, dealing with Archaeology, palaeontology and meteorites:

35. (1) Subject to the provisions of section 8, the protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority: Provided that the protection of any wreck in the territorial waters and the maritime cultural zone shall be the responsibility of SAHRA.

(2) Subject to the provisions of subsection (8)(a), all archaeological objects, palaeontological material and meteorites are the property of the State. The responsible heritage authority must, on behalf of the State, at its discretion ensure that such objects are lodged with a museum or other public institution that has a collection policy acceptable to the heritage resources authority and may in so doing establish such terms and conditions as it sees fit for the conservation of such objects.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the

find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority:

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may:

(a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;

(b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;

(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and

(d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

3. DESCRIPTION OF THE PROPERTY OR AFFECTED ENVIRONMENT

The study area of this Palaeontological Impact Assessment relates to the Power Line Corridor that comprises a track of land (16.2 km long, 500m wide), extending from the North-Western boundary of the farm Blomskraal, 216, to the Eskom Theseus Main Transmission Substation (MTS) located on Portion 21 (a Portion of the remaining extent) of the farm Doorn Rivier, 330, Theunissen road, Free State Province (Fig. 2).

The Power Line Corridor passes along the boundaries of several farms. From East to West, the Power Line Corridor begins at the Northwest border of the farm Blomskraal, 216 and then extends through De Rust, Le Roux 717, Florida 633, Te Vrede 361, Welgelegen 382, Bloemhoek 509, to reach the existing Eskom Theseus Main Transmission Substation (MTS) on Doorn Rivier 330.

Maps used in this report include:

- 1: 50 000 Topographic map (2826 BB), showing the study area in red outline (Fig. 3);
- 1:250 000 Geological map (2826 Winburg – D.J.L Visser and C.C Nolte 1987) showing the study area in red outline (Fig. 4).

The Topographic map (2826 BB, Fig.3) shows that most of the study area is relatively flat and comprises low rolling hills and there are few major topographical features. Most of the study area comprises irrigated crop land (maize/corn), besides for three small sections of natural vegetation: In the extreme East, on the farms Le Roux 717 and Te Vrede 361, around three minor tributary streams of the Steenbokspruit River; centrally on the farm Le Roux 717, where the study area passes over the north-south running Merriespruit River; and immediately West of the R73 road is small patch of natural vegetation.

Figure 2: Google Earth projection of the location and outline boundary (in blue shading) of the Power Line Corridor, South of Virginia and Meloding.

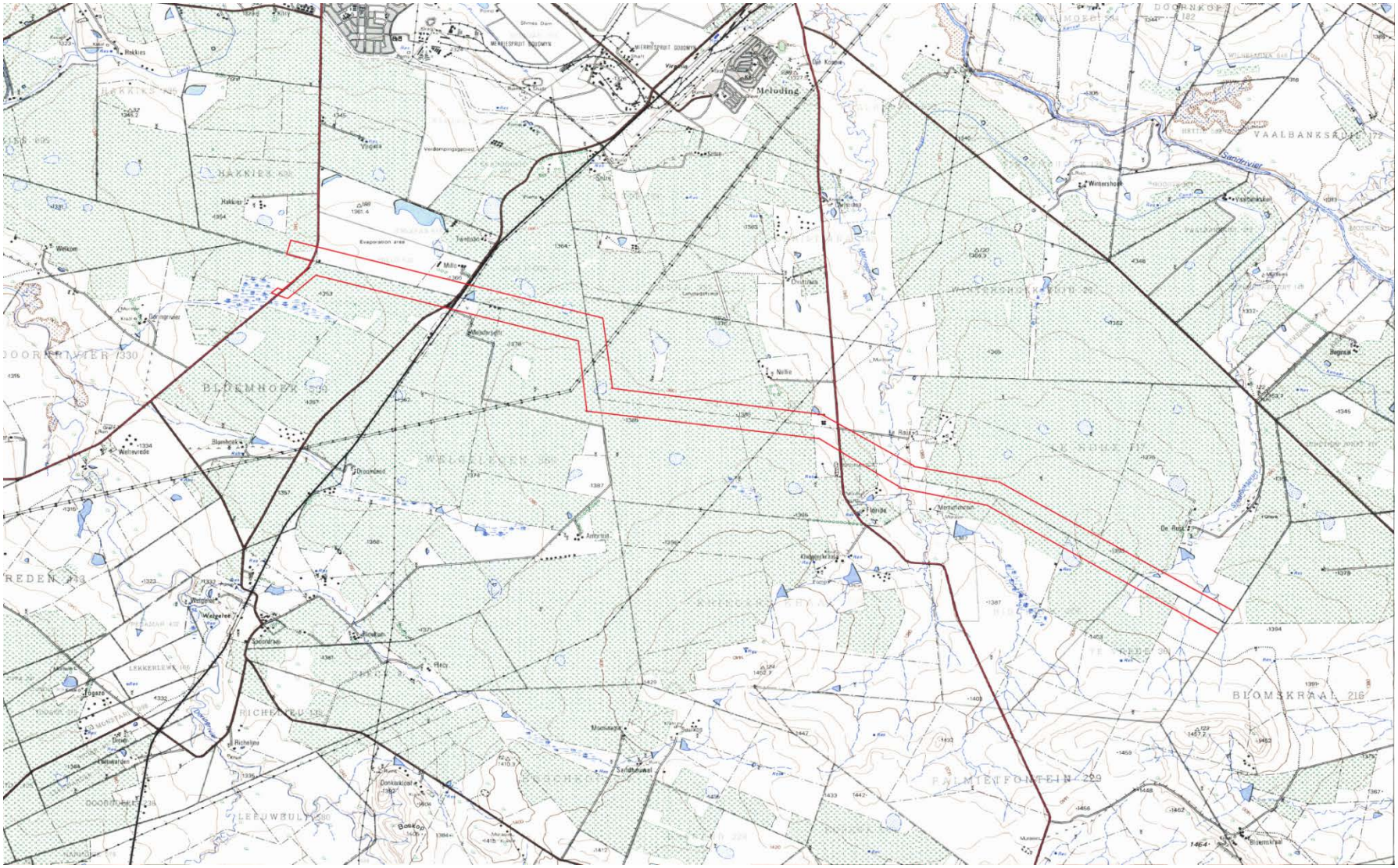

Figure 3: 1: 50 000 Topographic map (2826 BB) showing the study area in red outline, from Blomskraal, 216, passing through De Rust, Le Roux 717, Florida 633, Te Vrede 361, Welgelegen 382, Bloemhoek 509, to reach the existing Eskom Theseus Main Transmission Substation (MTS) on Doorn Rivier 330.

4. GEOLOGICAL SETTING

4a. Description of the rock units

The study area for the proposed project is situated in the Main Karoo Basin of the Free State province (Fig. 4) and the geology around Virginia comprises Late Permian deposits of the Adelaide Subgroup of the Lower Beaufort Group, Quaternary alluvial deposits and Jurassic aged dolerite (Groenewald, 2021; Mavuso, 2014).

The terrain of the study area itself comprises thick alluvial (soil) over the majority of the area. In the east, three shallow tributaries of the Steenbokspruit River cross the study area and more centrally, the Merriespruit River crosses the study area. Rocky outcrop is very rare and only isolated sandstone boulders are present near the Merriespruit River. Small patches of dolerite outcrop are seen immediately west of the Merriespruit River and the R73, on the farm Florida 633.

Quaternary alluvial deposits (Fig. 4: Qs-Yellow):

Based on the 1:250 000 Geological map, 2826 Winburg, almost the entire study area is covered with thick Quaternary alluvial deposits (soils) (Fig. 4: Qs-Yellow). This thick alluvium is underlain by Late Permian sedimentary rocks, which are not exposed, apart from a few isolated and scattered sandstone boulders. Satellite images (Google Earth) and our on-site inspection confirmed that the thick Quaternary alluvial deposits primarily support irrigated cropland, as well as three small areas of natural vegetation, around the Steenbokspruit River, the Merriespruit River, and immediately West of the R73.

Permian deposits (Fig. 4: Pa-Green):

The rocks of the Late Permian sedimentary rocks of the Adelaide Subgroup of the Lower Beaufort Group of the Karoo Supergroup (Fig. 4: Pa - Green) were deposited by meandering river systems across the floodplains of the ancient Karoo Basin (Rubidge, 1995).
Based on the 1:250 000 Geological map, 2826 Winburg, only two small regions of the study area cut into and expose these Late Permian sedimentary rocks: around the Steenbokspruit River in the east and around the Merriespruit River centrally. Our on-site inspection concentrated on these areas, which are covered with natural vegetation, grass and bushes, but found very little exposed Permian outcrop, consisting of only isolated scattered sandstone boulders.

Dolerite (Fig. 4: Jd-Pink):

According to the Geological map, 2826 Winburg, (Fig. 4: Jd-Pink) one region of intrusive Jurassic Dolerite is present in the study area, amongst the natural vegetation immediately West of the R73, and our on-site inspection confirmed isolated dolerite.

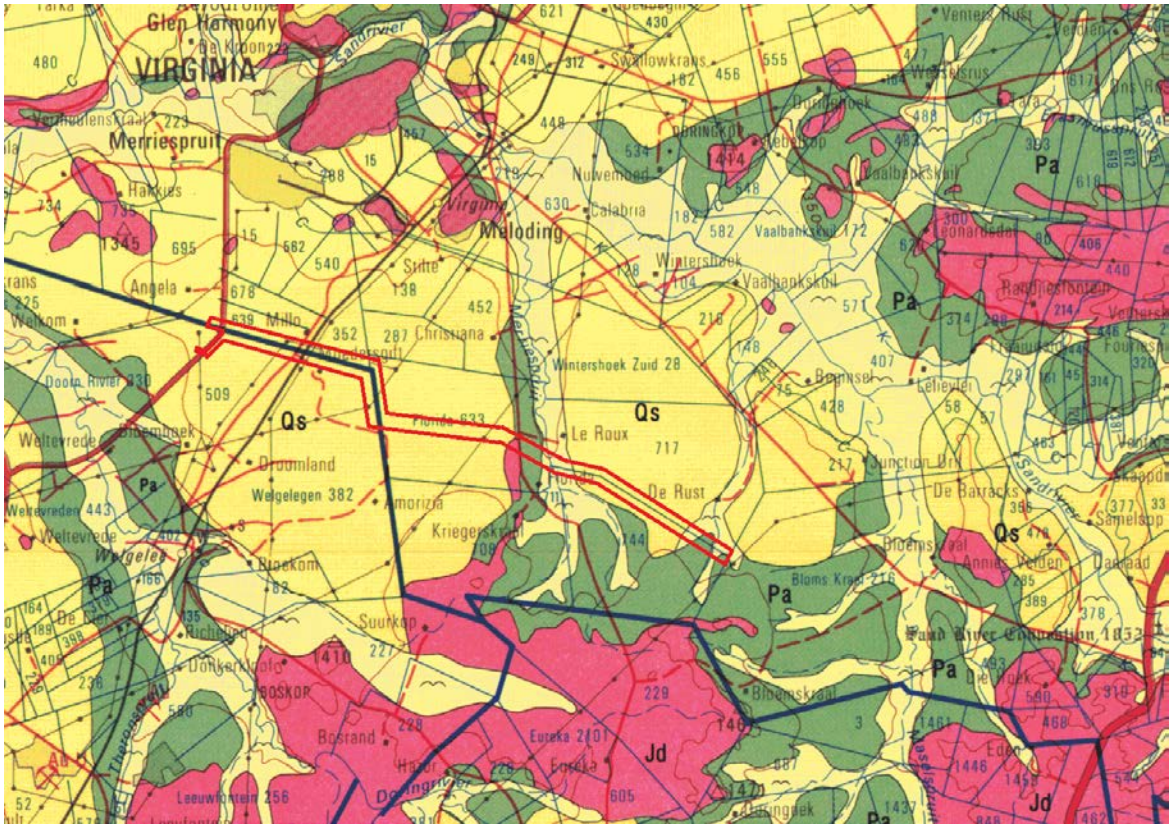

Figure 4: 1:250 000Geological map (2826 Winburg– D.J.L Visser and C.C Nolte 1987) showing the position of the study a (red outline). Pa, Permian (Adelaide Subgroup); Qs, Quaternary; Jd, Jurassic dolerite.

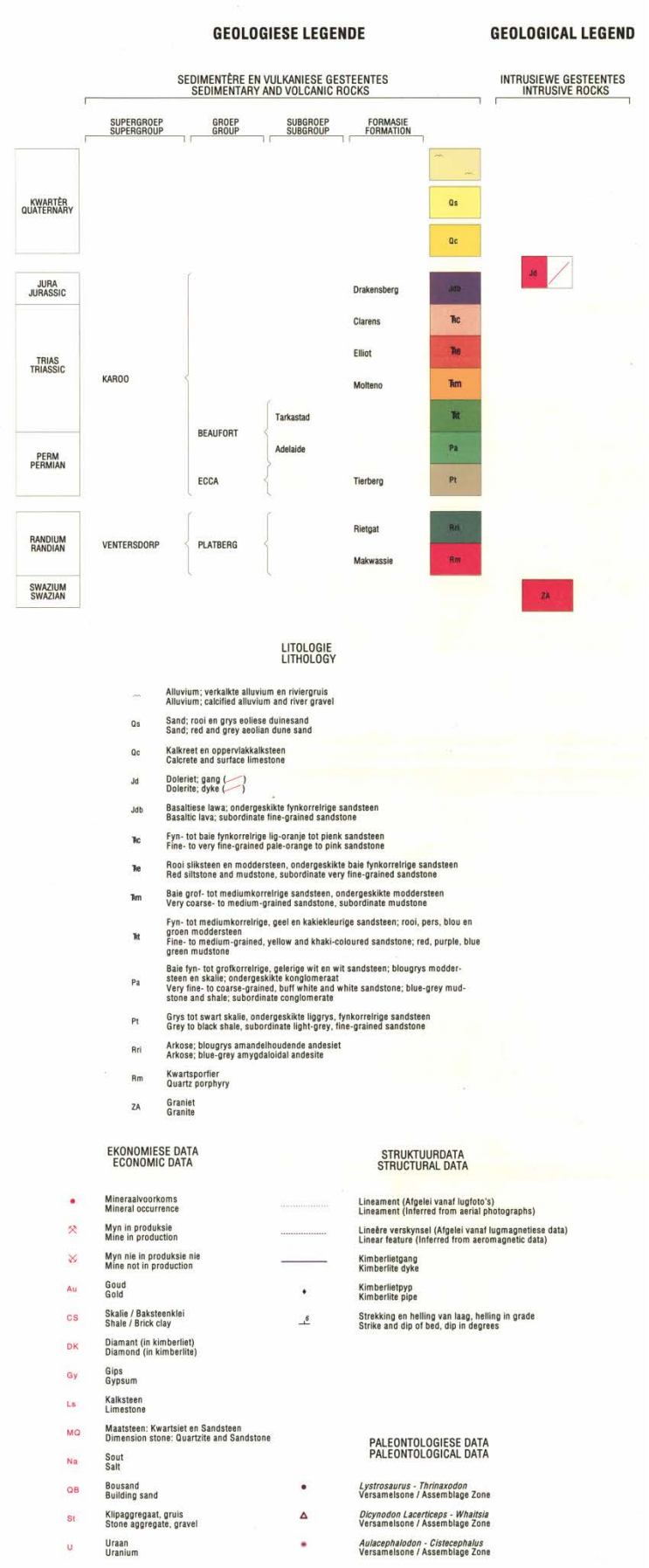

Figure 5: Key to the 1:250 000 Geological map (2826 Winburg– D.J.L Visser and C.C Nolte 1987).

5. PALAEONTOLOGICAL HERITAGE OF THE AREA

5a. Literature review

Because of its wealth of fossils the rocks of the Karoo Supergroup have been subdivided into biozones (eg. Kitching, 1977; Rubidge, 1995; Smith et al., 2020). The *Daptocephalus* Assemblage Zone (the biozone covering the study area) is Changhsingian (Late Tatarian - 253 to 251 Ma) in age (Rubidge, 2005). Recently, Viglietti (2020) proposed a two-fold subdivision of the *Daptocephalus* Assemblage Zone into lower (*Dicynodon-Theriognathus*) and upper (*Lystrosaurus maccaigi-Moschorhinus*) subzones. Good outcrops of Karoo rocks in the part of the basin, near Virginia, are sparse and are covered by thick Quaternary alluvium. Recent research by Groenewald (2021) in the Beaufort Group did not reveal any vertebrate fossils near Virginia, but did find some plant impressions of *Glossopteris* on sandstone on the farm Weltevreden (Groenewald, 2021: 118) and fossil wood (*Agathoxylon africanum,* and/or *Agathoxylon karooensis*) and an unidentified Gymnosperm.

De Ruiter et al., (2010) published a study based on three years of excavations at an early Pliocene locality referred to as Matjhabeng (formerly named the Virginia Railway Cut Site). With an estimated age of 4.0–3.5 Ma, the site is located on farm Virginia 448 (Geological map 2826BB; 28°06’39’S, 26°54’56’E), not far from the study area of this Palaeontological Impact Assessment Report, and contains an early Pliocene faunal assemblage recovered from a horizontally stratified, Riverine deposit. The site represents a temporal and geographic intermediate between the better known sites of Makapansgat to the north and Langebaanweg to the south. It also represents one of only a few river-deposited Pliocene localities in the central interior of southern Africa. These researchers recovered a diverse fossil fauna that included fish, amphibians, reptiles, birds and mammals. Mammals range in size from rodents to mammoths, including an array of proboscideans, perissodactyls and artiodactyls, alongside rare carnivores. In total, they recognized 29 taxa. Some of the taxa from Matjhabeng are shared with Langebaanweg, and others with Makapansgat, confirming the intermediate status of this locality. These researchers distinguish between gravel components that represent a high-energy river discharge while silty-sandy units represent abandoned-channel equivalents formed when the paleo-river periodically changed its course.

5b. Karoo Vertebrate Fossil Database

The Karoo Vertebrate Fossil Database documents nearly 30 000 fossil specimens collected in the Karoo over the past 150 years, curated in major South African museums and universities. A search of the database (hosted by the Evolutionary Studies Institute at the University of the Witwatersrand, Johannesburg) reveals that the area around Virginia is depauperate as far is Karoo fossils are concerned (Table 1, Fig. 6). There are no recorded Karoo fossils from the farms that comprise the study area. Two *Lystrosaurus* specimens were collected from the farm Wessels Punt (GHG111, GHG112), east of Winburg, two more from the farm Halfweg (GHG94, GHG97), between Winburg and Senekal, and a *Lystrosaurus* and a *Dicynodon* from Kruisvlei (GHG72, GHG74).

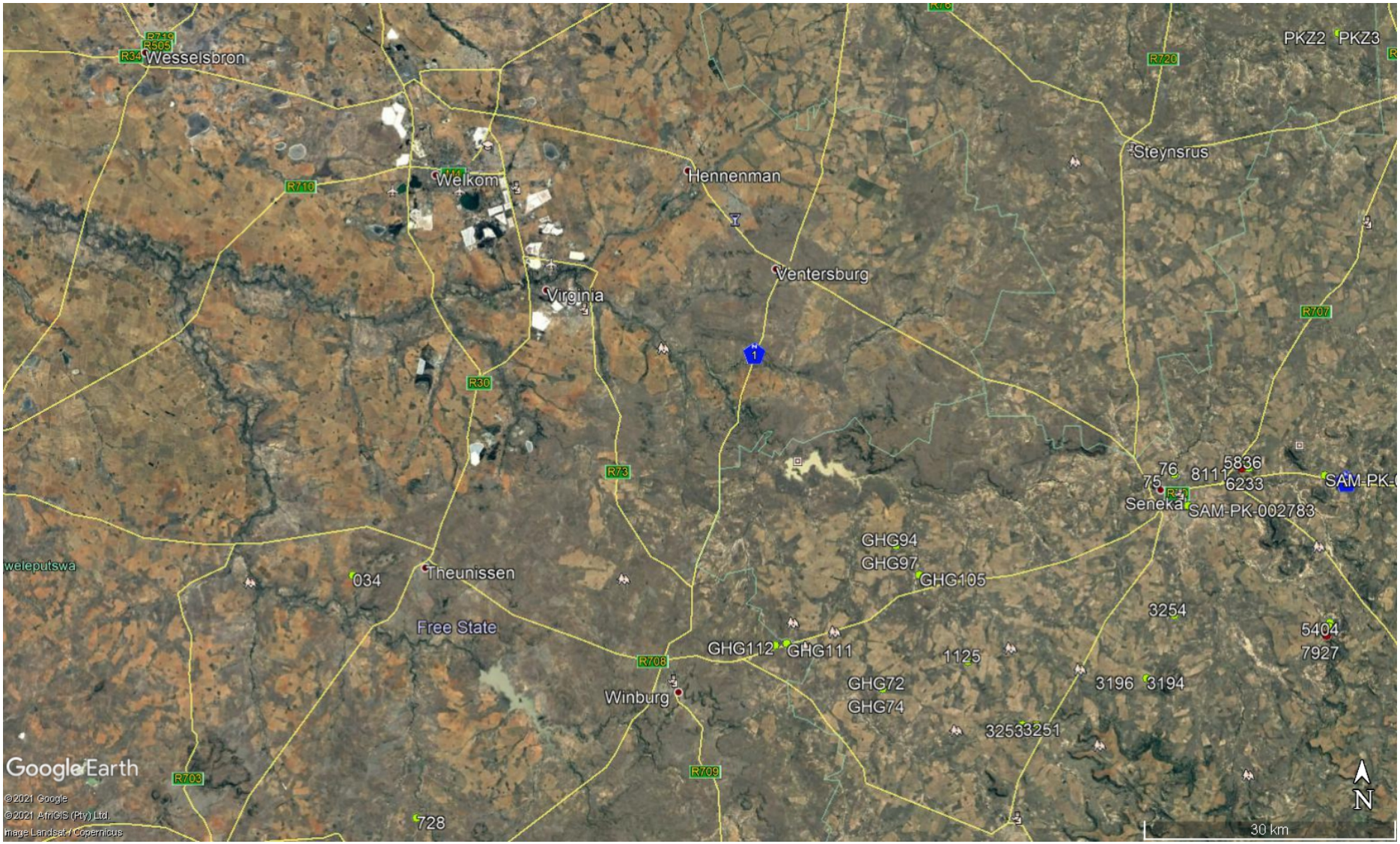

Figure 6: Fossil occurrences in the area around Virginia, Free State Province (courtesy Dr Michael Day, Karoo Vertebrate Fossil Database).

Table 1. Vertebrate Fossil records extracted from the Karoo Fossil Database for the districts of Virginia, Ventersburg, Winburg and Theunissen (courtesy Dr Michael Day).

COLL PREFIX	COLL NUM	COLLECTION	TAXON 1	TAXON 2	ORIGINAL GENUS	CURRENT GENUS	PROVINCE	DISTRICT
GHG	111	Council_for_Geoscience	Synapsida	Dicynodontia	*Lystrosaurus*	*Lystrosaurus*	FState	Winburg
GHG	112	Council_for_Geoscience	Synapsida	Dicynodontia	*Lystrosaurus*	*Lystrosaurus*	FState	Winburg
GHG	105	Council_for_Geoscience	Synapsida	Dicynodontia	*Dicynodon_lacerticeps*		FState	Senekal
GHG	72	Council_for_Geoscience		Archosauromorpha	*Proterosuchus*		FState	Marquard
GHG	74	Council_for_Geoscience	Synapsida	Dicynodontia	*Dicynodon*	*Unidentified*	FState	Marquard
GHG	94	Council_for_Geoscience	Synapsida	Dicynodontia	*Lystrosaurus*	*Lystrosaurus*	FState	Senekal
GHG	97	Council_for_Geoscience	Synapsida	Dicynodontia	*Lystrosaurus*	*Lystrosaurus*	FState	Senekal
NMQR	1125	National_Museum	Synapsida	Dicynodontia	*Lystrosaurus*	*Lystrosaurus*	FState	Marquard
COLL PREFIX	**COLL NUM**	**CADASTRAL FARM NAME**	**FARM NO.**	**MAP SHEET**	**LATITUDE**	**LONGITUDE**	**GROUP**	**ASSEMBLAGE ZONE**
GHG	111	Wessels_Punt	2315	2827AC	-28,4814	27,1475	Beaufort	*Lystrosaurus*
GHG	112	Wessels_Punt	2315	2827AC	-28,4814	27,1475	Beaufort	*Lystrosaurus*
GHG	105	?	971	2827AD	-28,4083	27,3078	Beaufort	*not_yet_verified*
GHG	72	Kruisvlei	279	2827CB	-28,5292	27,2636	Beaufort	*Lystrosaurus*
GHG	74	Kruisvlei	279	2827CB	-28,5292	27,2636	Beaufort	*Lystrosaurus*
GHG	94	Halfweg	356	2827AD	-28,3772	27,2794	Beaufort	*Lystrosaurus*
GHG	97	Halfweg	356	2827AD	-28,3772	27,2794	Beaufort	*Lystrosaurus*
NMQR	1125	Wildebeestlaagte	228	2827CB	-28,5000	27,3667	Beaufort	*Lystrosaurus*

6. APPROACH TO THIS PALAEONTOLOGICAL HERITAGE STUDY

As the Beaufort Group of the Karoo Supergroup is palaeontologically sensitive following the sensitivity map of SAHRA, a site visit and a Phase 1 Palaeontological Impact Assessment was necessitated.

6a. Phase 1 Palaeontological Impact Assessment methodology:

This Phase 1 Palaeontological Impact Assessment includes a Palaeontological Desktop Study (a background study that uses geological maps, scientific literature, institutional fossil collections, satellite images, etc.) and a field survey of the proposed development, and includes:

a) details of the property to be developed (Section 3);
b) location of the rock units that are found (Section 4);
c) descriptions of the characteristics of each rock unit (Section 4) and known palaeontological resources (Section 5);
d) assessment of the sensitivity and importance of geological units in terms of their palaeontological significance (Section 8);
e) assessment of the potential impact of the proposed development on the palaeontological resources (Section 8);
f) recommendations for conservation, if any (Section 9).

If from the Phase 1 Assessment it is evident that fossil heritage of scientific or cultural significance is threatened by the proposed development, palaeontologists may recommend a Phase 2. A Phase 2 Palaeontological Mitigation/Rescue involves planning the protection of significant sites, and may include excavations or collection (with a permit) of fossil material at sites that may be lost to development.

A Phase 3 Palaeontological Site Conservation and Management Plan may be required in rare cases where the site is so important that development will not be allowed.

Field Survey methodology:

An initial assessment of the geology of the farm using satellite images (Google Earth) showed potential Permian bedrock exposures centrally in the study area, around the Merriespruit River, and in the east, around the Steenbokspruit River. These two regions of potentially exposed rocks with potential fossil occurrences were inspected on-site by Marc Van den Brandt, an experienced karoo palaeontologist, on 9 April 2021. The on-site inspection findings are shown in Table 2 and Figure 7.

A Garmin eTrex 10 GPS was used to record GPS coordinates of sites in the Degrees, Decimal Minutes format. A 13 Megapixel (4160x3120) camera was used for photography, with a 15 cm/6 inch scale bar. Basic palaeontological field equipment, such as field notebook, brush, hammers and chisels were used.

6b. Information sources

The information presented in this Palaeontological Heritage Study (format and content) is based on the following sources:

1. SG 2.2 SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports (16 May 2007);
2. SG 2.2 SAHRA APMHOB Guidelines: Minimum Standards for Palaeontological Components of Heritage Impact Assessment Reports (October 2012);
3. South African National Heritage Resources Act (Act No. 25 of 1999);
4. Virginia 1,Virginia 2 and Virginia 3 Solar Park: Background Information Document - February 2021 supplied by Johan Botha;
5. Satellite Image (Google Earth) Virginina1,2 and3 Solar Park and Power Line Corridor Project Locality Map supplied by Johan Botha (Fig. 1);
6. Satellite Image (Google Earth) Position of the Power Line Corridor (Fig. 2);
7. Topographic map 2826 BB supplied by Johan Botha (Figs. 3);
8. Geological map (1:250 000: 2826 Winburg) (Fig. 4);
9. Relevant published Scientific literature (See Reference List);
10. A one day on-site palaeontological field inspection conducted by Dr Marc Van den Brandt on 9 April 2021;
11. Consultation with Dr David Groenewald, a Palaeontological and Geological expert of the field study area of the Free State Province;
12. Consultation with Dr Michael Day, to extract fossil occurrences in the Virginia area from the Karoo Vertebrate Fossils Database;
13. Appendix A: Chance Find Protocol.

7. DESCRIPTION OF SITES VISITED AND FOSSIL OCCURANCES

Although the entire study area was searched for fossils sites, the greatest potential for fossil discoveries along the Power Line Corridor are shown in Figure 7 and Table2.

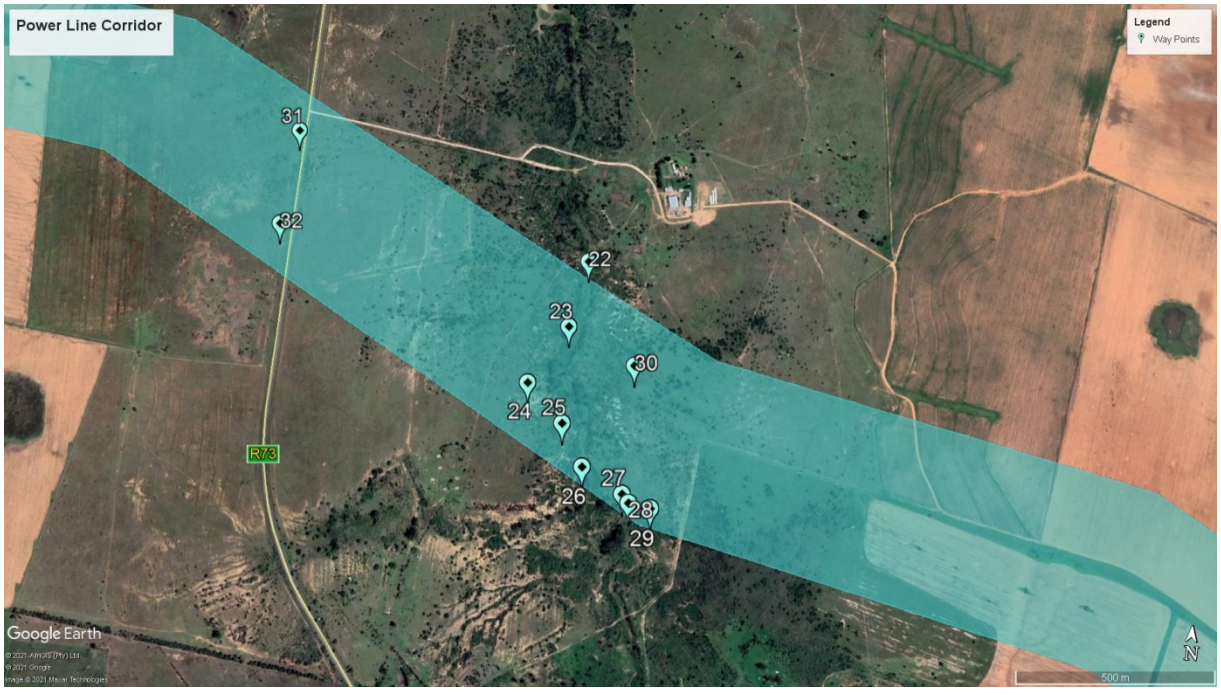

Figure 7: Sites with the most potential for fossil discoveries along the Power Line Corridor.

Table 2. Sites visited (Way Points 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32) along the Power Line Corridor. Scale bar equals 15 cm/6 inches.

Way Point	GPS Coordinates	Description	Geology & Palaeontological Significance	Photograph
22	S 28 11.288 E 26 55.450	Merriespruit River bed covered in grass, river edge with brushes and trees	No outcrop, no fossils.	
23	S 28 11.398 E 26 55.429	Merriespruit River bed, water and soil, grass, bushes and trees	No outcrop, no fossils.	

24	S 28 11.493 E 26 55.371	Near Merriespruit River, natural soil dumps and erosion.	Alluvium, 2m high, potentially fossiliferous, no fossils found.	
24	S 28 11.493 E 26 55.371	Near Merriespruit River, natural erosion.	Consolidated gravel alluvium (Quaternary), potentially fossiliferous, no fossils found.	
25	S 28 11.550 E 26 55.437	Near Merriespruit River, natural erosion	Alluvium, 1m high, potentially fossiliferous, no fossils found.	

26	S 28 11.612 E 26 55.478	Merriespruit River bed covered in grass, river edge with alluvium and brushes and trees	Alluvium, 1m high, potentially fossiliferous, no fossils found.	
27	S 28 11.646 E 26 55.548	Merriespruit River bed, water and soil, grass, bushes and trees	No outcrop, no fossils.	
27	S 28 11.646 E 26 55.548	Merriespruit River edge	Sandstone boulder and consolidated gravel alluvium (Quaternary), 2m high, potentially fossiliferous, no fossils found (wide view).	

27	S 28 11.646 E 26 55.548	Merriespruit River edge	Consolidated gravel alluvium (Quaternary), 2m high, potentially fossiliferous, no fossils found (close up).	
28	S 28 11.658 E 26 55.560	Near Merriespruit River	Sandstone boulders, potentially fossiliferous, no fossils found.	
29	S 28 11.663 E 26 55.596	Near Merriespruit River	Weathered and layered sandstone boulders, potentially fossiliferous, no fossils found.	

30	S 28 11.451 E 26 55.548	Natural vegetation, non-irrigated land, covered in grass and bushes, for cattle farming.	No outcrop, no fossils.	
31	S 28 11.110 E 26 54.896	R73 road, view West, Natural vegetation, non-irrigated land, covered in grass and bushes,	Scattered dolerite boulders, no fossil potential.	
32	S 28 11.277 E 26 54.899	R73 road, view West, Natural vegetation, non-irrigated land, covered in grass and bushes,	Scattered dolerite boulders, no fossil potential.	

8. PALAEONTOLOGICAL SENSITIVITY (HERITAGE VALUE)

The potential palaeontological resources in the study area, are grouped into LOW, MEDIUM or HIGH sensitivity (significance/impact), are shown in Table 3, according to their potential scientific value.

Table 3. P**alaeontological sensitivity (significance/impact) of geological units in the study area.**

Geological Unit	Rock Type & Age	Fossil Heritage (Virginia area)	Vertebrate Biozone	Palaeontological Sensitivity
Balfour Formation	Sandstone/ Mudstone - Late Permian	*Glossopteris* plant impressions, fragmentary fossil wood (*Agathoxylon africanum*,, *Agathoxylon karooensis*), unidentified Gymnosperm (Groenewald 2021)	*Daptocephalus* Assemblage Zone	HIGH
Quaternary alluvial deposits	Soil - early Pliocene	Bovid bones and teeth, bivalve (*Unio)* shells.	N/A	LOW
Dolerite	Dolerite - Jurassic	None	N/A	N/A

Although the Palaeontological sensitivity of the Late Permian mudstone/sandstone deposits is HIGH, Quaternary alluvial deposits (soil), with LOW sensitivity, covers almost the entire study area and almost all of the Permian bedrock. Sensitive Permian Karoo bedrock is only exposed as isolated scattered sandstone boulders near the Merriespruit River. If development is avoided in these Palaeontologically sensitive areas of Permian outcrop, the Palaeontological impact of the proposed development is LOW.

9. RECOMMENDATIONS FOR MONITORING AND MITIGATION

This Phase 1 Palaeontological Impact Assessment confirms that the study area is underlain by sedimentary rocks of Late Permian age and overlain by Quaternary alluvial deposits. Isolated scattered sandstone boulders of the palaeontological sensitive rocks of the Beaufort Group did not reveal any fossils, and the Quaternary alluvial deposits did not reveal any fossils either. As no fossils were found during our investigation in this area we recommend that from a palaeontological perspective the proposed development should proceed.

As the proposed development has the potential to expose fossils we recommend the following mitigation clauses, that the proposed development be constrained to:

- the irrigated cropland that covers most of the study area, currently carrying maize/corn, overlying the mapped Quaternary alluvial deposits (Figs. 2, 3, 4);

- the non-irrigated naturally vegetated grassland, surrounding the Merriespruit River centrally, the Steenbokspruit River in the east, and the grassland immediately West of the R73 (Figs. 2, 3, 4);

Due to palaeontological sensitivity, we do not recommend development on:

- the Merriespruit River (Figs. 2, 3, 4, Table 2), the river edges of exposed alluvium and isolated scattered sandstone boulders nearby;
- the Steenbokspruit River and its three erosional gullies or tributary streams (Figs. 2, 3, 4, Table 2);

During construction, the proposed development infrastructure will result in extensive excavations on site, possibly through the Quaternary sediment cover into the underlying bedrock, which may expose potential fossil heritage on site. The farms surrounding the study area have yielded few Permian fossils, so any fossil finds may be significant and have the potential to add to our scientific knowledge. If fossils are exposed in the process of development a qualified palaeontologist must be contacted.

The recommended mitigation procedures are detailed in Appendix A: Chance Find Protocol, which details the procedures required if fossils are exposed by excavations, and must be incorporated into the Environmental Management Programme (EMP) for the proposed development.

10. CONCLUSION

The proposed development along the Power Line Corridor is underlain by Late Permian sedimentary and potentially fossil bearing rocks, but is overlain by deep Quaternary alluvial deposits (soil). Irrigated cropland covers almost the entire study area. There are three regions of natural vegetation: around the Merriespruit and Steenbokspruit Rivers, and immediately West of the R73. The Merriespruit River exposes some alluvium and isolated scattered sandstone boulders. The natural vegetation immediately West of the R73, exposes a small region of dolerite. We found no Permian or Quaternary fossils during our onsite inspection.

It is thus recommended that, from a palaeontological perspective, the proposed Power Line Corridor development may proceed in the study area, primarily irrigated cropland, and that caution be used when constructing in the three regions of natural vegetation. Development should not take place in the Merriespruit and Steenbokspruit Rivers, since alluvium is exposed, and near the Merriespruit River where isolated sandstone boulders are exposed.

It is unlikely that fossils will be exposed as a result of the proposed development. If rocks are exposed by development this will create an opportunity to find fossils in an area which has delivered very few Karoo fossils.

Should fossils be uncovered in superficial Quaternary deposits or in the underlying Karoo sedimentary rocks during the course of development activities, the developer must immediately contact a qualified palaeontologist to assess the exposure for fossils so that the necessary rescue operations are implemented (Appendix A: Chance Find Protocol).

11. ACKNOWLEDGEMENTS

We thank Johan Botha of AGES Limpopo (Pty) for providing the relevant background information and Ted van Wyk for farm access to the study area during our on-site inspection. Dr Mike Day, Natural History Museum, London, provided information of fossils recorded near Virginia, from the Karoo Vertebrae Fossil Database and Dr David Groenewald for information relating to fossils from the Virginia area.

12. QUALIFICATIONS AND EXPERIENCE OF THE AUTHORS

Professor Bruce Rubidge is Director of the DST/NRF Centre of Excellence for Palaeosciences until the end of 2021 and is currently a Distinguished Professor at the Evolutionary Studies Institute at the University of the Witwatersrand. Following completion of his B.Sc., B.Sc. (Hons) cum laude at Stellenbosch University he was appointed to a curatorial position in the Karoo Palaeontology Department at the National Museum in Bloemfontein in 1980, becoming Head of the Department in 1982. He was appointed Director of the Bernard Price Institute (BPI) and Head of the Palaeontology Department at the University of the Witwatersrand in 1990. In 2013 he was appointed Director of the newly established DST/NRF Centre of Excellence for Palaeosciences at Wits. Rubidge has broad research interests but most of his work focusses on the remarkable fossil record of the Karoo and their significance in understanding the origin of mammals. He has published more than 180 research publications in internationally accredited journals and 36 MSc and PhD students achieved their degrees under his supervision. He has extensive experience in Palaeontological Impact Assessments.

Doctor Marc Van den Brandt is an Honorary Research Fellow in the Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg. Marc has a BCom and BCom (Hons) with distinction in Information Systems from Rhodes University (1998-2002). Following a successful career as a Business Analyst, Marc obtained his B.Sc (Hons) with distinction, MSc with distinction and PhD in Vertebrate Palaeontology from the University of the Witwatersrand (2013 – 2020) and has participated in 20 palaeontological and archeologically field trips in South Africa, mostly to Permian localities in the Beaufort Group of the Karoo Supergroup. As an early career scientist, Marc has a published five papers on Karoo Palaeontology in internationally accredited journals, focusing on the anatomy and biostratigraphy of parareptiles. Three more papers have been accepted for publication as of early 2021.

13. DECLARATION OF INDEPENDANCE

I, Bruce S. Rubidge declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

Prof Bruce S. Rubidge
PhD, FGSSA, FRSSA, Pr Sci Nat

I, Marc J. Van den Brandt, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

Dr Marc J. Van den Brandt
PhD, Palaeontologist

14. REFERENCE LIST

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APPENDIX A: CHANCE FIND PROTOCOL

<table>
<tr><td colspan="3">Chance Fossil Finds Procedure: Virginia 1, Virginia 2, and Virginia 3 Solar Parks, and Power Line Corridor, near Virginia, Free State Province.</td></tr>
<tr><td>Province & Region:</td><td colspan="2">Free State Province, Lejweleputswa District Municipality</td></tr>
<tr><td>Responsible Heritage Authority</td><td colspan="2">South African Heritage Resources Agency (SAHRA)
111 Harrington Street PO Box 4637 Cape Town 8001
Contact: Dr Ragna Redelstorff. Tel: 021 202 8651/076 2523 627. Email: rredelstorff@sahra.org.za</td></tr>
<tr><td>Rock Unit(S)</td><td colspan="2">Adelaide Subgroup (Lower Beaufort Group), and Quaternary alluvium</td></tr>
<tr><td>Potential Fossils</td><td colspan="2">Vertebrate bones & teeth, vertebrate and other burrows, plant compressions, petrified wood</td></tr>
<tr><td rowspan="5">Environmental Control Officer (ECO) Protocol or the foreman or site agent in the absence of the ECO</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo;
Context – describe position of fossils within stratigraphy (rock layering) and depth below surface;
Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering).</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation;
Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Authority for work to resume.</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock);
Photograph fossils against a plain, level background, with scale;
Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags;
Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Authority, ensure that a suitably qualified palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Authority.</td></tr>
<tr><td>Specialist Palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to the Heritage Resources Authority. Adhere to best international practice for palaeontological fieldwork and the Heritage Resources Authority minimum standards.</td></tr>
</table>