BANZAI ENVIRONMENTAL

PGS HERITAGE

PALAEONTOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED POWERLINE AND GRID CONNECTION ASSOCIATED WITH THE AUTHORISED UMSINDE EMOYENI AND KHANGELA EMOYENI WIND ENERGY FACILITIES IN THE NORTHERN AND WESTERN CAPE PROVINCES.

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Client:	Nala Environmental
PGS Project No:	602HIA

PGS HERITAGE

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Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist 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 consider, 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 a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realize that a false declaration is an offense 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.

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

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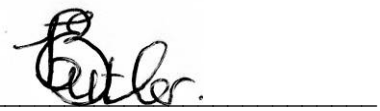
SIGNATURE: 

ACKNOWLEDGEMENT OF RECEIPT

Report Title	**Palaeontological Impact Assessment for the proposed powerline and grid connection associated with the authorised Umsinde Emoyeni and Khangela Emoyeni Wind Energy Facilities in the Northern Cape.**		
Control	**Name**	**Signature**	**Designation**
Author	**Elize Butler**		**Palaeontologist**
Reviewed			
Client			

CLIENT: Nala Environmental

CONTACT PERSON: ARLENE SINGH

SIGNATURE:  _____

The heritage impact assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1: NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 2 – refer to **Appendix A**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 10	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1 and 11	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1 and 11	
(g) An identification of any areas to be avoided, including buffers	None Section 1 and 11	
(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;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(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 1 and 11	
(k) Any mitigation measures for inclusion in the EMPr	Section 12	
(l) Any conditions for inclusion in the environmental authorisation	Section 12	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 12	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 11	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities 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	Section 1 and 11	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process will be conducted as part of the EIA and EMPr process.
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(2) Where a government notice 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.	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the Palaeontological Impact Assessment (PIA) to assess the proposed development of a 132kV powerline, 132kV on-site switching stations, new access/service tracks and watercourse crossing points associated with the authorised Umsinde Emoyeni and Khangela Emoyeni Wind Energy Facilities. In accordance with the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PIA is necessary to confirm if fossil material could potentially be present in the planned development area, to evaluate the potential impact of the proposed development on the Palaeontological Heritage and to mitigate possible damage to fossil resources.

The proposed development is underlain by Quaternary superficial deposits, Balfour-, and Teekloof Formations of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) while large areas of the development footprint are underlain by Jurassic dolerite. The PalaeoMap of the South African Heritage Resources Information System indicates that the Palaeontological Sensitivity of the Jurassic Dolerite is Zero as it is igneous in origin and thus unfossiliferous, Ouaternary deposits has a Moderate Palaeontological Sensitivity while that of the Adelaide Subgroup is Very High (Almond and Pether, 2009; Almond et al., 2013). Due to the Very High Sensitivity of the Adelaide Subgroup a field assessment was triggered.

Extensive fieldwork by South African researchers have been conducted in the Murraysburg area and over time almost 2000 fossils have been collected. These fossils are now housed in Museums in South Africa. This information has been included in this report.

An overall 6-day site-specific field survey of the development footprint was conducted on foot and by motor vehicle during April, May, and July 2022. (The field was extremely wet in April and the site visit was postponed to May 2022, although circumstances had not much improved).

During the site visit the following was found:
A few weathered, fossiliferous outcrops were identified in the development footprint. In addition, three small areas have been identified on the National Palaeontology Databases.

Thus, an **overall medium** palaeontological significance is allocated to the development footprint. Three powerline alternatives (i.e. Preferred Alternative, Alternative 1 and Alternative 2) as well as an extended development corridor enabling the 132kV powerline to connect either to the south face of the Gamma substation yard or approach from the east) is considered for the development. From a Palaeontological view there is no preference between these alternatives. The development will thus not lead to detrimental impacts on the palaeontological reserves of the area (if mitigations measures are followed) and construction of the development may be authorised to its whole extent.

Recommendations:

- The ECO for this project must be informed that sediments of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) have a **Very High Palaeontological Sensitivity**.
- **Training of accountable supervisory personnel** by a qualified palaeontologist in the recognition of fossil heritage is is very important and necessary.
- If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources Agency (SAHRA) (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation (recording and collection) can be carried out.
- Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).
- These recommendations should be incorporated into the Environmental Management Plan for the proposed development.

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TERMINOLOGY AND ABBREVIATIONS

Archaeological resources

This includes:

- material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artifacts, human and hominid remains, and artificial features and structures.
- rock art is any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation.
- features, structures, and artifacts associated with a military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influences its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place.
- carrying out any works on or over or under a place.
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place.
- constructing or putting up for display signs or boards.
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Fossil

Mineralized bones of animals, shellfish, plants, and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures, and equipment of cultural significance.
- places to which oral traditions are attached or which are associated with living heritage.
- historical settlements and townscapes.
- landscapes and natural features of cultural significance.
- geological sites of scientific or cultural importance.
- archaeological and palaeontological sites.
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa.

Holocene

The most recent geological time period which commenced 10 000 years ago.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Table 2: Abbreviations

Abbreviations	Description
APM	Archaeology, Palaeontology and Meteorites
ASAPA	Association of South African Professional Archaeologists
BAR	Basic Assessment Report
CRM	Cultural Resource Management
DFFE	Department of Forestry, Fisheries and the Environment
ECO	Environmental Control Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NECSA	Nuclear Energy Corporation of South Africa
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PDA	Palaeontological Desktop Assessment
PIA	Palaeontological Impact Assessment
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
REDZs	Renewable Energy Development Zones
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
WEF	Wind Energy Farm

1 INTRODUCTION

Eskom Holding SOC Ltd proposes the development of a 132kV powerline, three 132kV on-site substations/switching stations, new access/service tracks and watercourse crossing points associated with the authorised Umsinde Emoyeni and Khangela Emoyeni Wind Energy Facilities. PGS Heritage was commissioned to conduct the Heritage Impact Assessment for this project while Banzai Environmental was in turn appointed to conduct the Palaeontological Impact Assessment (**Figure1-3**).

1.1 Project Background

The following description for the project has been supplied by Nala Environmental.

The proposed project includes the following:

- The establishment of a 132kV collector substation (switching station) within the authorised Umsinde Emoyeni WEF site (adjacent to the WEF facility substation) with a footprint of approximately 100m X 80m (~0.8ha) to be located within an assessment footprint that encompasses a 300m radius.
- The establishment of a 132kV collector substation (switching station) within the authorised Khangela Emoyeni WEF site (adjacent to the WEF facility substation) with a footprint of approximately 100m X 80m (~0.8ha) to be located within an assessment footprint that encompasses a 300m radius.
- The establishment of a 132kV collector substation (switching station) within the authorised Ishwati Emoyeni WEF site (adjacent to the WEF facility substation) with a footprint of approximately 120m X 100m (~1.2 ha) with an assessment footprint that encompasses a 300m radius.
- The establishment of a 132kV powerline within a 400m corridor (200m on either side) that will extend from the Khangela switching station to the Ishwati switching station (35,5km), and then onward for 24,9km to the Eskom Gamma Substation. In addition, a further length of 132kV powerline (within a 400m wide corridor) will extend from the Umsinde switching station to the Khangela switching station for 7,73km OR it may connect directly into the Khangela-Ishwati powerline at the Khangela switching station. An extended powerline development corridor of approximately 1,5km wide has been assessed in the vicinity of the Gamma Substation, that will enable the 132kV powerline to connect to either the south face of the Gamma Substation yard or approach from the east. The 132kV Powerline from Umsinde to Khangela, and from Khangela to Ishwati and onward to Gamma Substation will be a single- or double-circuit powerline, with a single set of pylons structures with a maximum height of 35m Access/service tracks (jeep track) up to 7m wide and associated watercourse crossings will be associated with the powerline, and will be located within the assessed powerline corridor.

The following alternatives are proposed for the powerline access tracks and water crossings

1.2 Layout Alternatives.

Table 3: 132kV Powerline within a 400m corridor and gravel access track approximately 7m wide

	Preferred Alternative		**Alternative 1**		**Alternative 2**	
	Latitude	**Longitude**	**Latitude**		**Longitude**	
Start (on-site substation at Umsinde Emoyeni WEF site)	31°51'13.38"S	24° '25.58"E	31°51'13.38"S	24°1'25.58"E	31°51'13.38"S	24° 1'25.58"E
Point 2	31°50'14.37"S	24° 0'50.32"E	31°50'14.37"S	24° 0'50.32"E	31°50'14.37"S	24° 0'50.32"E
Point 3	31°48'43.59"S	3°57'55.92"E	31°48'43.59"S	3°57'55.92"E	1°48'43.59"S	3°57'55.92"E
Start (on-site substation at Khangela Emoyeni WEF site)	31°48'43.05"S	23°57'42.71"E	31°48'43.05"S	23°57'42.71"E	31°48'43.05"S	23°57'42.71"E
Point 4	31°50'14.63"S	23°55'28.86"E	31°50'14.63"S	23°55'28.86"E	31°50'14.63"S	23°55'28.86"E
Point 5	31°49'13.74"S	23°53'33.39"E	31°49'13.74"S	23°53'33.39"E	31°49'13.74"S	23°53'33.39"E
Point 6	31°49'7.26"S	23°52'39.52"E	31°49'7.26"S	23°52'39.52"E	31°49'7.26"S	23°52'39.52"E
Point 7	31°47'31.74"S	23°49'11.72"E	31°47'31.74"S	23°49'11.72"E	31°47'31.74"S	23°49'11.72"E
Point 8	31°45'32.28"S	23°45'29.58"E	31°45'32.28"S	23°45'29.58"E	31°45'32.28"S	23°45'29.58"E
Point 9	31°43'29.18"S	23°45'1.23"E	31°44'1.56"S	23°42'34.93"E	31°44'1.56"S	23°42'34.93"E
Point 10	31°42'48.88"S	23°40'11.59"E	31°43'6.86"S	23°42'18.16"E	31°42'48.88"S	23°40'11.59"E
			31°42'48.88"S	23°40'11.59"E		
Point 11 (Ishwati Collector Sub)	31°42'24.42"S	23°39'30.33"E	31°42'24.42"S	23°39'30.33"E	31°42'24.42"S	23°39'30.33"E
Point 12	31°42'34.31"S	23°38'58.91"E	31°42'34.31"S	23°38'58.91"E	31°42'34.31"S	23°38'58.91"E
Point 13	31°43'9.01"S	23°38'11.49"E	31°43'9.01"S	23°38'11.49"E	31°43'9.01"S	23°38'11.49"E
Point 14	31°43'54.78"S	23°35'20.23"E	31°43'54.78"S	23°35'20.23"E	31°43'54.78"S	23°35'20.23"E
Point 15	31°40'58.19"S	23°25'27.11"E	31°40'58.19"S	23°25'27.11"E	31°40'58.19"S	23°25'27.11"E
End (Extended 1,5km development corridor to (Gamma Substation) Preferred Alternative from the east	31°40'46.22"S	23°24'46.55"E	31°40'46.22"S	23°24'46.55"E	31°40'46.22"S	23°24'46.55"E

End (Extended 1,5km development corridor to Gamma Substation) Preferred Alternative from the south	31°40'56.04"S	23°24'40.11"E	31°40'56.04"S	23°24'40.11"E	31°40'56.04"S	23°24'40.11"E

Table 4:Water Crossing Points along the 132kV Powerline within a 400m corridor and gravel access track approximately 7m wide from the Umsinde Emoyeni switching station and extended 1,5km corridor to the Gamma Substation (Preferred Alternative):

	Latitude	Longitude
1	31°50'19.03"S	24° 0'53.39"E
2	31°50'3.75"S	24° 0'29.57"E
3	31°49'45.02"S	23°59'54.60"E
4	31°49'29.32"S	23°59'21.69"E
5	31°49'26.30"S	23°59'15.08"E
6	31°48'45.54"S	23°57'49.85"E
7	31°48'49.81"S	23°57'25.48"E
10	31°49'7.43"S	23°56'58.50"E
11	31°49'31.94"S	23°56'27.65"E
12	31°49'40.61"S	23°56'18.15"E
13	31°49'44.88"S	23°56'13.20"E
14	31°49'51.22"S	23°56'3.28"E
15	31°50'9.12"S	23°55'13.03"E
16	31°50'5.26"S	23°55'4.77"E
17	31°50'1.27"S	23°54'53.34"E
18	31°49'54.93"S	23°54'34.34"E
19	31°49'48.88"S	23°54'19.74"E
20	31°49'11.42"S	23°52'52.04"E
21	31°49'2.48"S	23°52'29.87"E
22	31°49'2.48"S	23°52'29.87"E
23	31°48'54.21"S	23°52'11.01"E
24	31°48'37.28"S	23°51'29.15"E
25	31°48'15.52"S	23°50'42.47"E
26	31°48'3.96"S	23°50'21.82"E
27	31°48'0.38"S	23°50'11.91"E
28	31°47'54.04"S	23°49'57.04"E
29	31°47'49.36"S	23°49'48.22"E
30	31°47'42.48"S	23°49'32.80"E
31	31°47'29.54"S	23°49'3.06"E
32	31°47'24.85"S	23°48'57.55"E
33	31°47'17.42"S	23°48'41.86"E
34	31°47'5.30"S	23°48'28.92"E
35	31°46'47.13"S	23°47'53.94"E
36	31°46'43.00"S	23°47'46.51"E
37	31°46'32.81"S	23°47'26.41"E
38	31°46'14.08"S	23°46'51.16"E
39	31°45'50.68"S	23°46'6.55"E
40	31°45'44.34"S	23°45'57.46"E
41	31°45'37.73"S	23°45'41.49"E
42	31°45'32.23"S	23°45'29.65"E
43	31°44'16.22"S	23°45'14.23"E
44	31°43'17.57"S	23°44'19.70"E
45	31°43'10.68"S	23°43'22.42"E
46	31°43'1.60"S	23°42'21.84"E

47	31°42'53.89"S	23°41'36.96"E
48	31°42'51.96"S	23°40'17.37"E
49 (Ishwati-Gamma)	31°42'55.81"S	23°38'31.08"E
50	31°43'4.90"S	23°38'18.00"E
51	31°43'10.68"S	23°38'3.68"E
52	31°43'13.71"S	23°37'54.31"E
53	31°43'14.26"S	23°37'48.81"E
54	31°43'15.64"S	23°37'41.92"E
55	31°43'23.35"S	23°37'12.46"E
56	31°43'27.21"S	23°36'59.24"E
57	31°43'27.48"S	23°36'54.28"E
58	31°43'31.06"S	23°36'38.04"E
59	31°43'39.60"S	23°36'8.43"E
60	31°43'44.28"S	23°35'49.57"E
61	31°43'51.16"S	23°35'29.19"E
62	31°43'53.37"S	23°35'18.18"E
63	31°43'50.34"S	23°35'7.71"E
64	31°43'32.16"S	23°34'4.79"E
65	31°43'21.70"S	23°33'34.22"E
66	31°43'13.99"S	23°33'6.69"E
67	31°42'46.31"S	23°31'39.25"E
68	31°42'32.27"S	23°30'55.47"E
69	31°42'24.28"S	23°30'28.76"E
70	31°42'21.25"S	23°30'18.98"E
71	31°42'4.04"S	23°29'20.74"E
72	31°41'48.90"S	23°28'28.42"E
73	31°41'46.56"S	23°28'19.61"E
74	31°41'33.06"S	23°27'34.72"E
75	31°41'18.19"S	23°26'41.30"E
76	31°41'2.15"S	23°25'44.57"E
77	31°40'53.69"S	23°25'14.01"E

The basic assessment report will include the 132kV powerline alternatives within the 400m corridor from the new switching station at the authorised Umsinde Emoyeni Wind Energy Facility to Khangela Emoyeni switching station to the Ishwati switching station and then a 1,5km extended development corridor that will enable the 132kV powerline to connect either to the south face of the Gamma substation yard or approach from the east. This will also include the access tracks and water crossings along the powerline routes.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-five years. She has experience in locating, collecting, and curating fossils. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

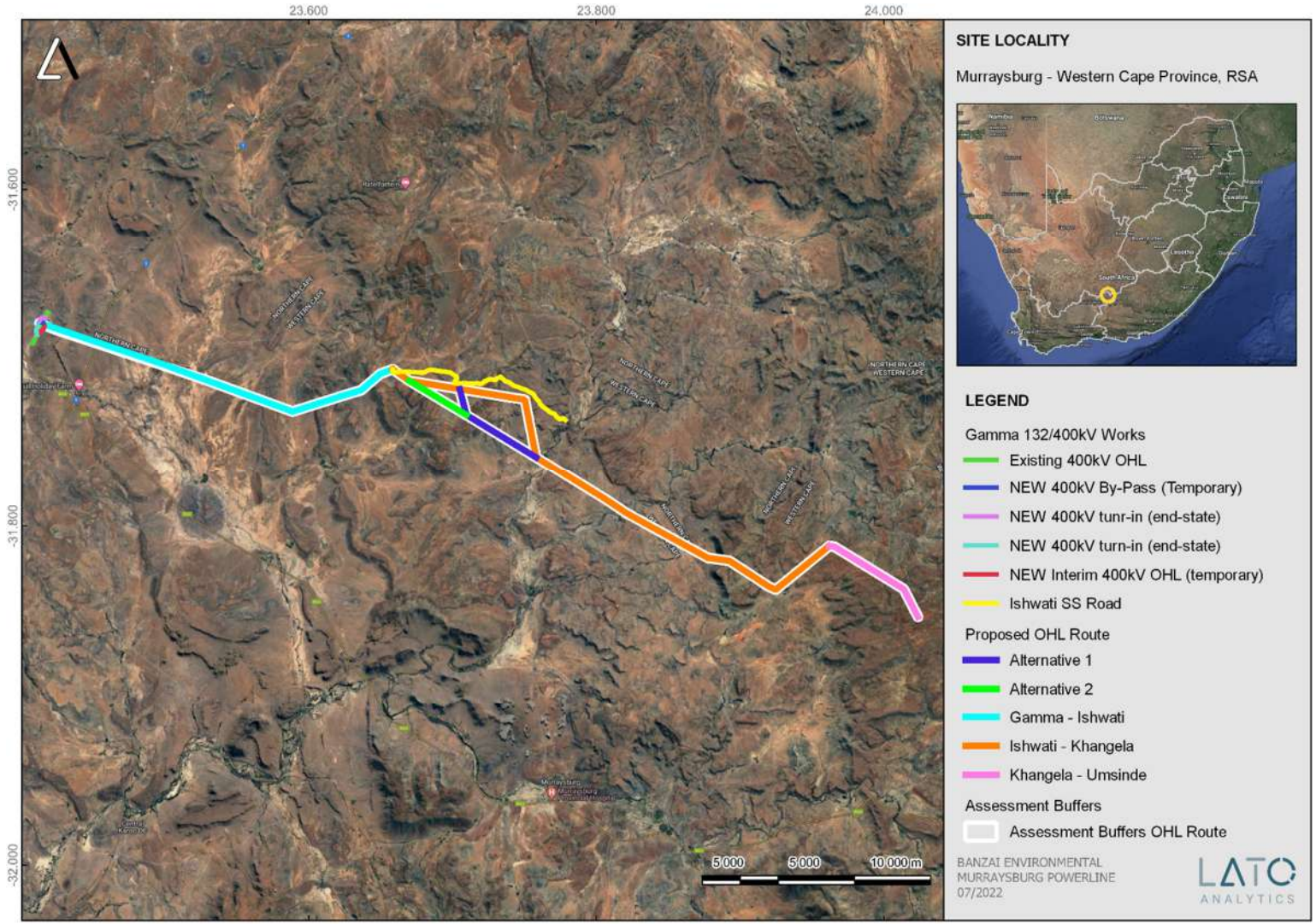


***Figure 1**: Google Earth (2021) Image of the proposed development of a 132kV powerline, 132kV on-site substations, new access/service tracks and watercourse crossing points associated with the authorised Umsinde Emoyeni and Khangela Emoyeni Wind Energy Facilities..*

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**".

The identification, evaluation and assessment of any cultural heritage site, artefact or finds in the South African context is required and governed by the following legislation:

- National Environmental Management Act (NEMA) Act 107 of 1998
- National Heritage Resources Act (NHRA) Act 25 of 1999
- Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified.

The following section in each Act are directly applicable to the identification, assessment, and evaluation of cultural heritage resources.

GNR 982 (Government Gazette 38282, 14 December 2014) promulgated under the National Environmental Management Act (NEMA) Act 107 of 1998

- Basic Assessment Report (BAR) – Regulations 19 and 23
- Environmental Impacts Assessment (EIA) – Regulation 23
- Environmental Scoping Report (ESR) – Regulation 21
- Environmental Management Programme (EMPr) – Regulations 19 and 23

National Heritage Resources Act (NHRA) Act 25 of 1999

- Protection of Heritage Resources – Sections 34 to 36
- Heritage Resources Management – Section 38

MPRDA Regulations of 2014

Environmental reports to be compiled for application of mining right – Regulation 48

- Contents of scoping report – Regulation 49
- Contents of environmental impact assessment report – Regulation 50
- Environmental management programme – Regulation 51
- Environmental management plan – Regulation 52

The NEMA (No 107 of 1998) states that an integrated EMP should (23:2 (b)) "…*identify, predict, and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage*".

In agreement with legislative requirements, EIA rating standards as well as SAHRA policies the following comprehensive and legally compatible PIA report have been compiled.

Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length.
- the construction of a bridge or similar structure exceeding 50 m in length.
- any development or other activity which will change the character of a site—
- (Exceeding 5 000 m² in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m² in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

The aim of a Palaeontological Impact Assessment (PIA) is to minimise the effect of the development on potential fossils at the development site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the purpose of the PIA is: 1) to identify the palaeontological importance of the rock formations in the footprint; 2) to evaluate the

palaeontological magnitude of the formations; 3) to clarify the **impact** on fossil heritage; and 4) to suggest how the developer might protect and lessen possible damage to fossil heritage.

The palaeontological status of each rock section is calculated as well as the possible impact of the development on fossil heritage by a) the palaeontological importance of the rocks, b) the type of development and c) the quantity of bedrock removed.

When the development footprint has a moderate to high palaeontological sensitivity a field-based assessment is necessary. The desktop and the field survey of the exposed rock determine the impact significance of the planned development and recommendations for further studies or mitigation are made. Destructive impacts on palaeontological heritage usually only occur during the construction phase while the excavations will change the current topography and destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

Mitigation usually precede construction or may occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. Preceding excavation of any fossils a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact as possible because our knowledge of local palaeontological heritage may be increased

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation, and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kml's) in the proposed development.
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect, and cumulative:

a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
c. Cumulative impacts result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present, or reasonably foreseeable future activities.

- Fair assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed development of a 132kV powerline, 132kV on-site substations/ switching stations, extended development corridor that will enable the 132kV powerline to connect either to the south face of the Gamma substation yard or approach from the east, as well as new access/service tracks and watercourse crossing points associated with the authorised Umsinde Emoyeni and Khangela Emoyeni Wind Energy Facilities is depicted on two 1:250 000 Geological Maps (Council of Geoscience, Pretoria; **Figure 3-6**). The largest portion of the development is depicted on the 1:250 000 Victoria West 3122 (1989) Geological Map in the west while a small portion of the development is depicted on the 3124 Middelburg (1997) Geological Map in the east. These maps indicates that the proposed development is underlain by Quaternary superficial deposits (yellow, single bird figure), Balfour (Pb, green), Teekloof (Pto/Pth, dark green) Formations of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) while large areas of the development footprint are underlain by Jurassic dolerite (Jd, red). Recent Shape files compiled by the Council of Geosciences (Pretoria) is depicted in **Figure 7**.

The PalaeoMap of the South African Heritage Resources Information System indicates that the Palaeontological Sensitivity of the Jurassic Dolerite is Zero as it is igneous in origin and thus unfossiliferous, that of the Quaternary deposits is Moderate while that of the Adelaide Subgroup is Very High (Almond and Pether, 2009; Almond *et al*., 2013).

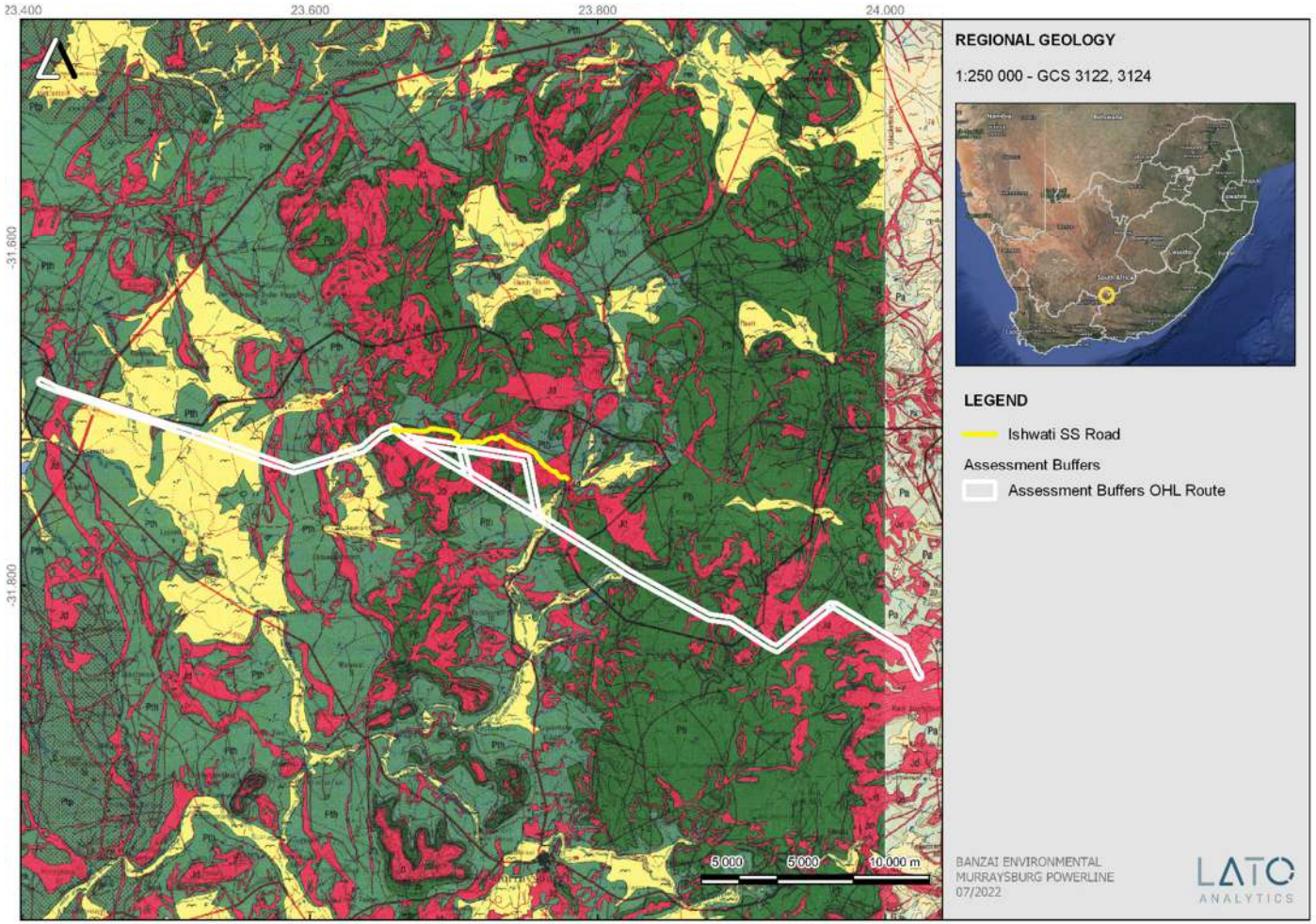


***Figure 2**: Extract of the 1:250 000 Victoria West 3122 (1989) and 3124 Middelburg (1997) Geological map (Council of Geoscience, Pretoria) indicating the surface geology of the proposed development. The development is underlain by Quaternary superficial deposits (yellow, single bird figure), Balfour (Pb, green), Teekloof Formations (Pto / Pth, dark green) of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) with large areas of the development footprint underlain by Jurassic dolerite (Jd, red).*

Table 5:Legend of the 1:250 000 3122 Victoria West Geological map (1989) (Council of Geoscience, Pretoria)

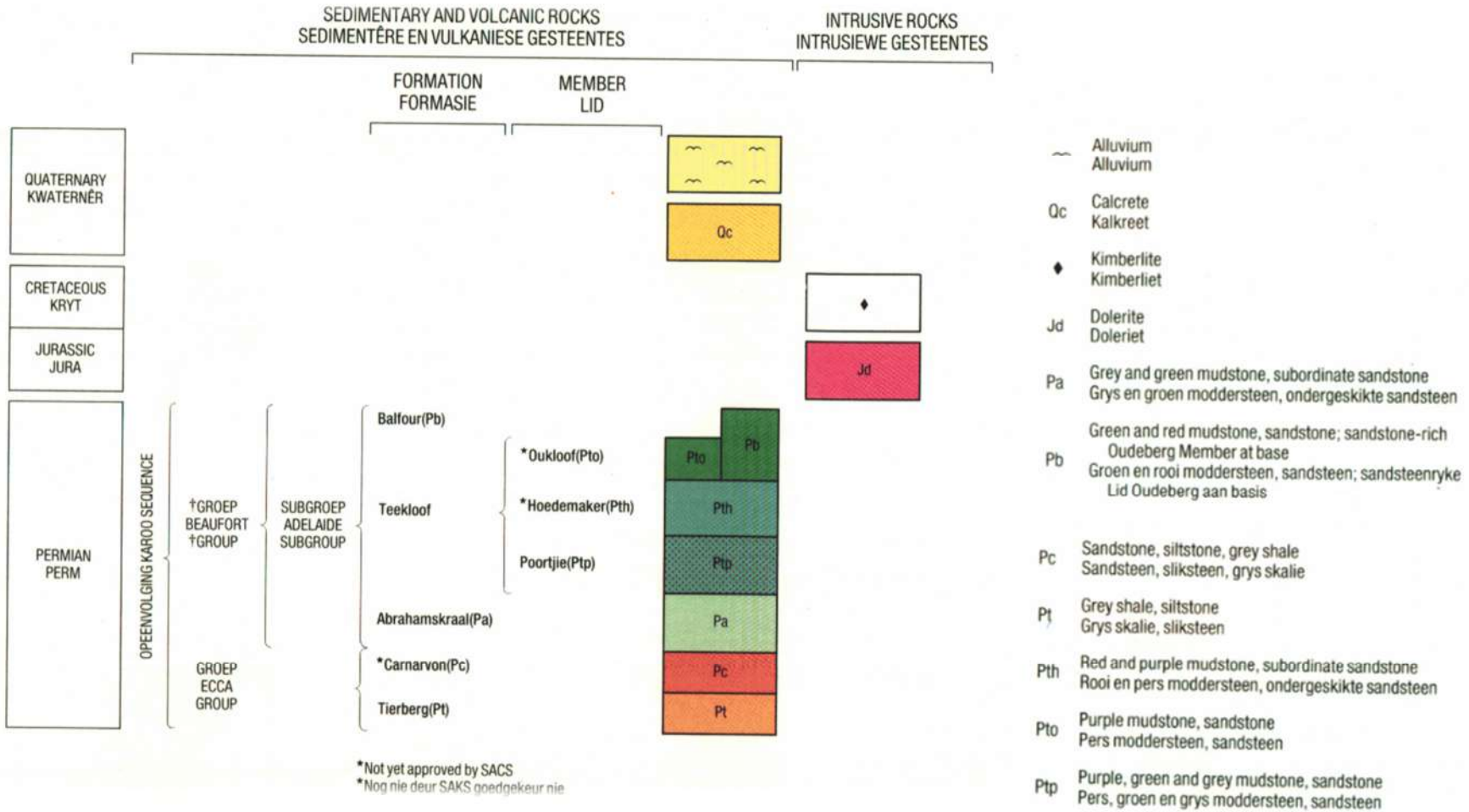
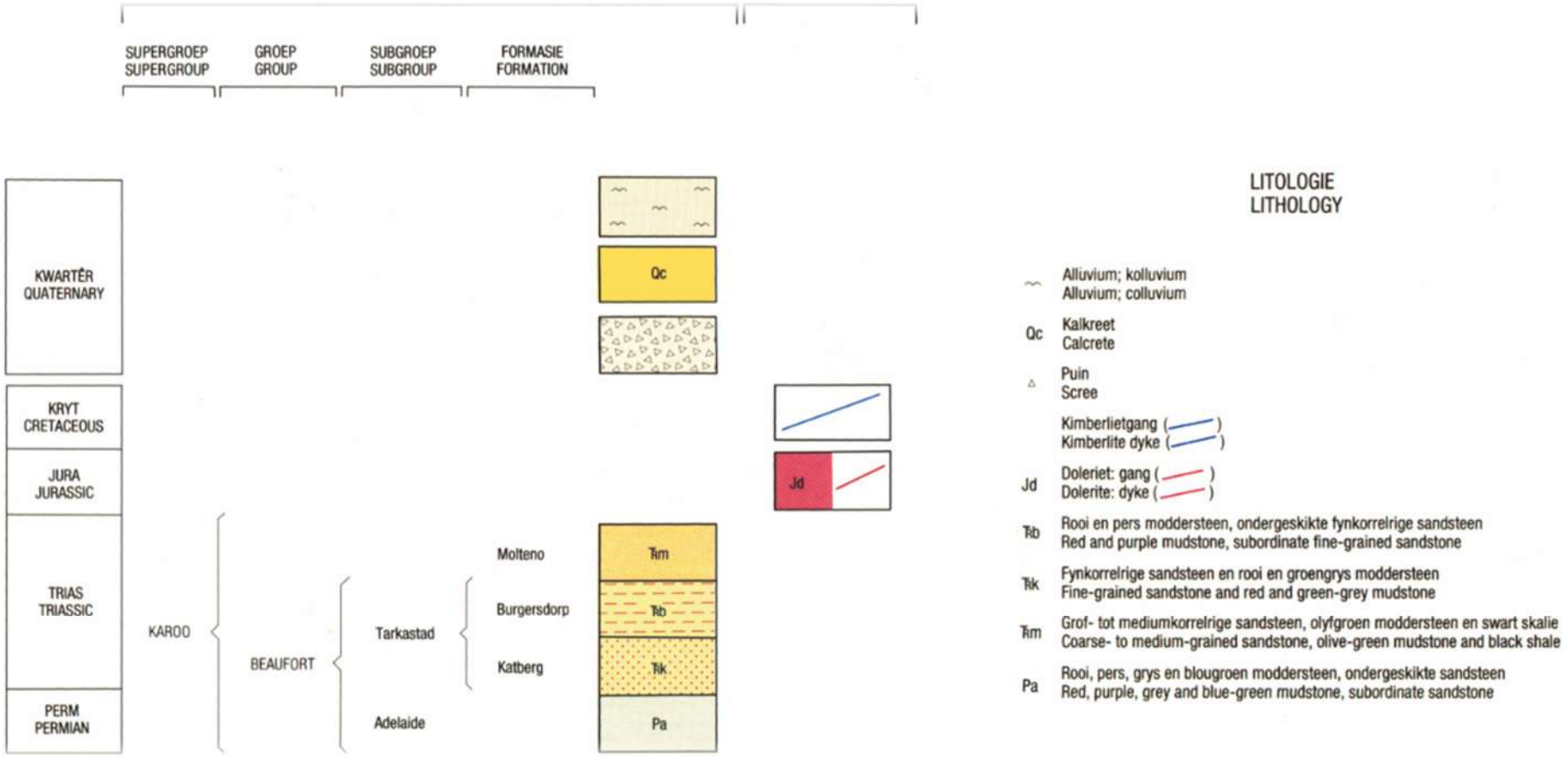


Table 6:Legend of the 1:250 000 Middelburg 3124 (1997) Geological Map (Council of Geoscience, Pretoria).



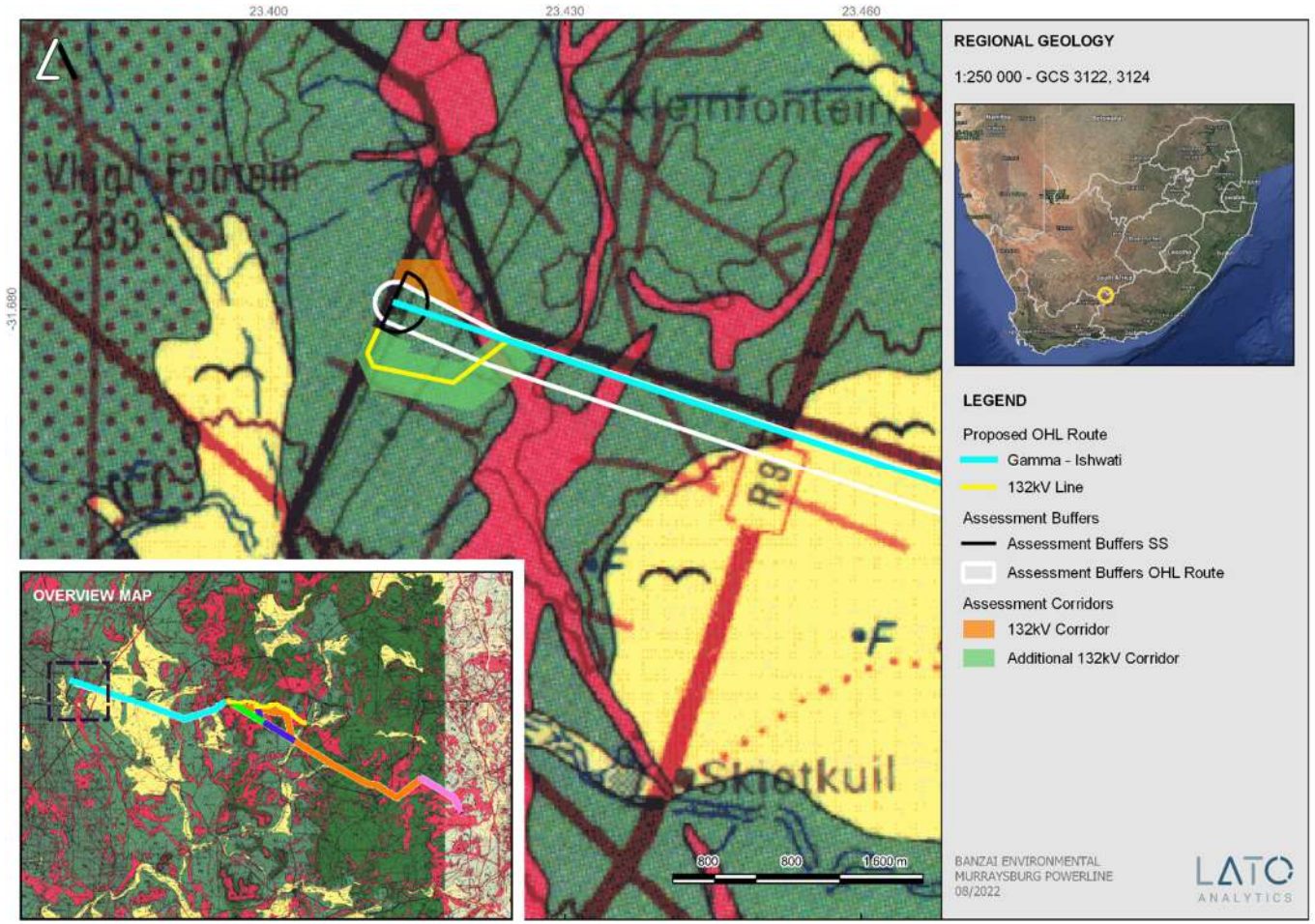


***Figure 3**: Extract of the 1:250 000 Victoria West 3122 (1989) Geological map (Council of Geoscience, Pretoria) indicating the Gamma substation and western margin of the proposed development underlain by Jurassic dolerite (red, Jd), Quaternary superficial deposits (yellow, single bird figure), and Teekloof (Pto / Pth, dark green) Formation of the Adelaide Subgroup*

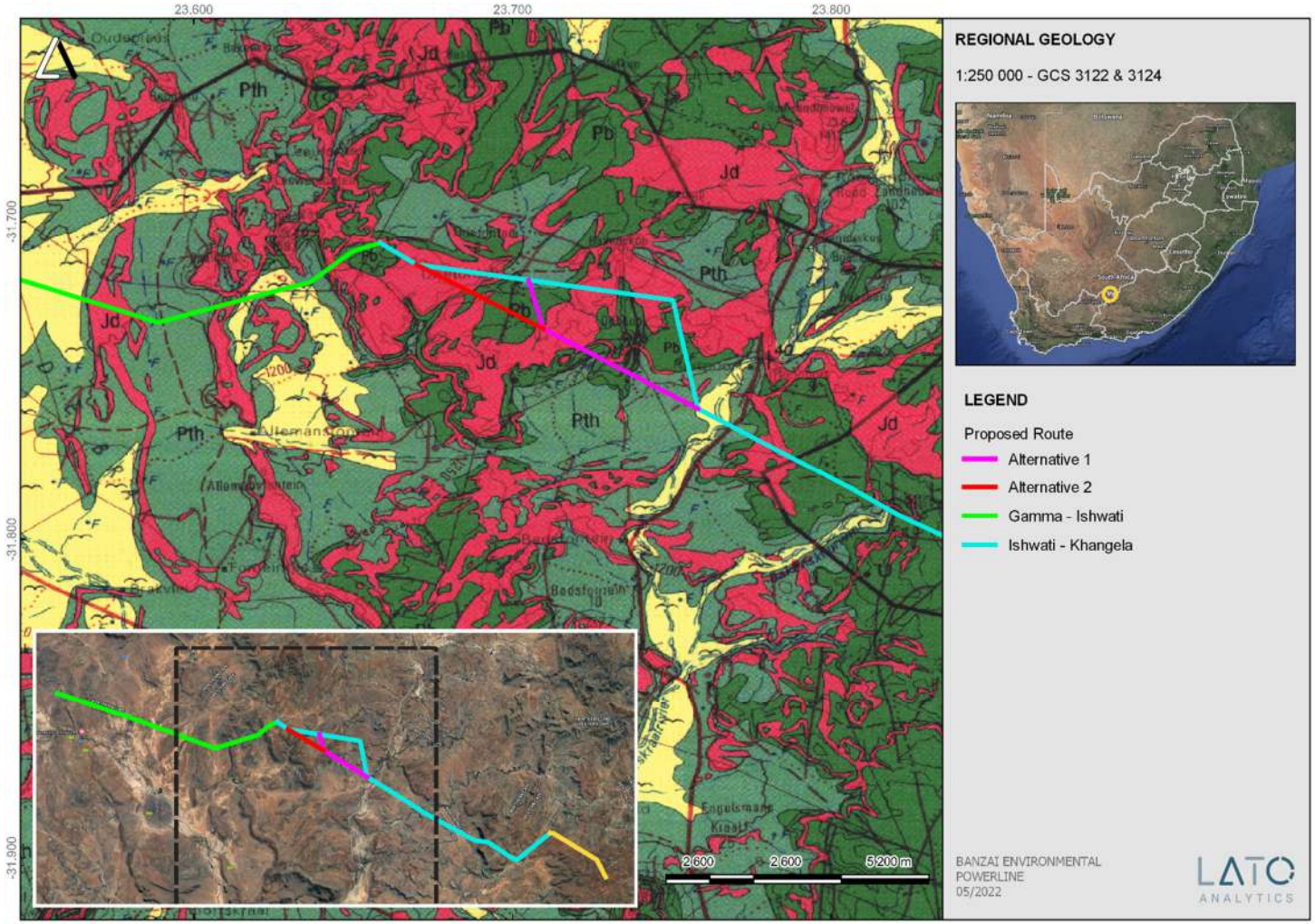


***Figure 4**: Extract of the middle section of the proposed development indicates that the development is underlain by the Balfour Formations (Pb, green), Jurassic dolerite (Jd, red), small portions of the Teekloof Formation (Pto / Pth, dark green) as well as Quaternary superficial deposits (yellow, single bird figure).*

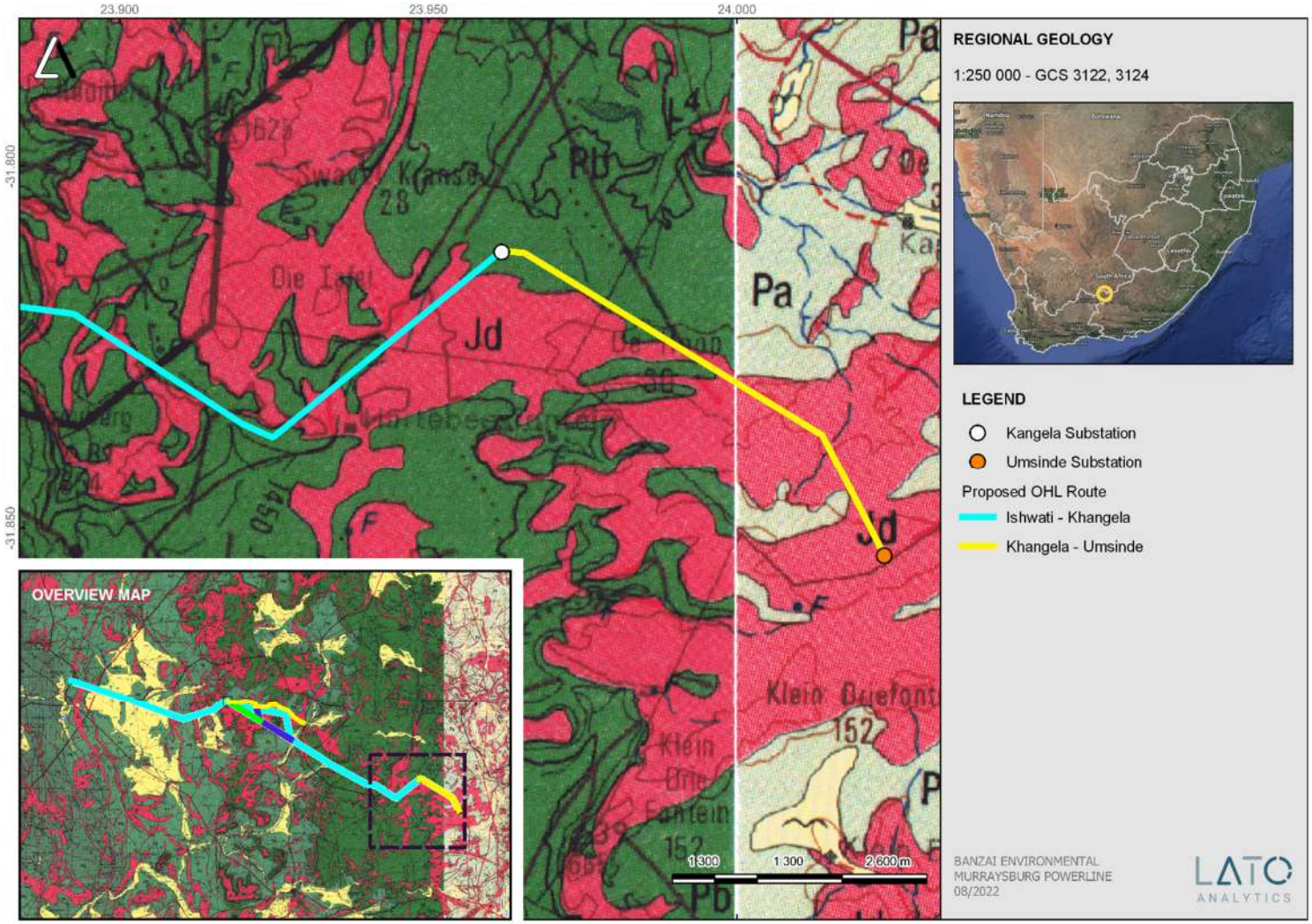


***Figure 5**: Extract of the eastern section of the proposed development indicates that the development is underlain by the Balfour Formations (Pb, green), Adelaide Subgroup (Pa; ivory); Jurassic dolerite (Jd, red) as well as a very small portion of the Quaternary superficial deposits (yellow, single bird figure).*

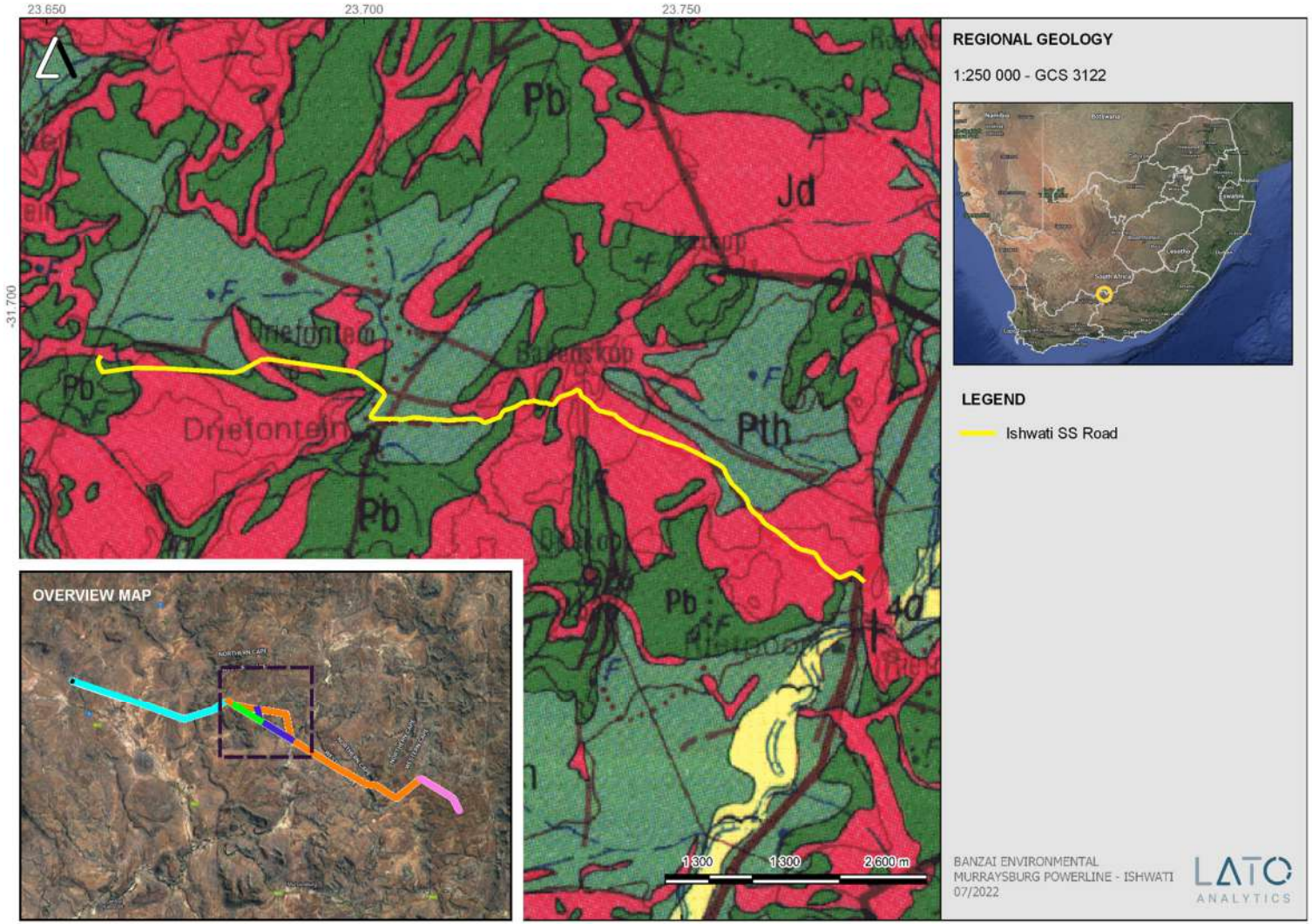


***Figure 6**: Extract of the proposed Ishwati SS Road indicates that the development is underlain by the Balfour Formations (Pb, dark green), the Teekloof Formation (Pth, green); Jurassic dolerite (Jd, red) as well as a very small portion of the Quaternary superficial deposits (yellow, single bird figure).*

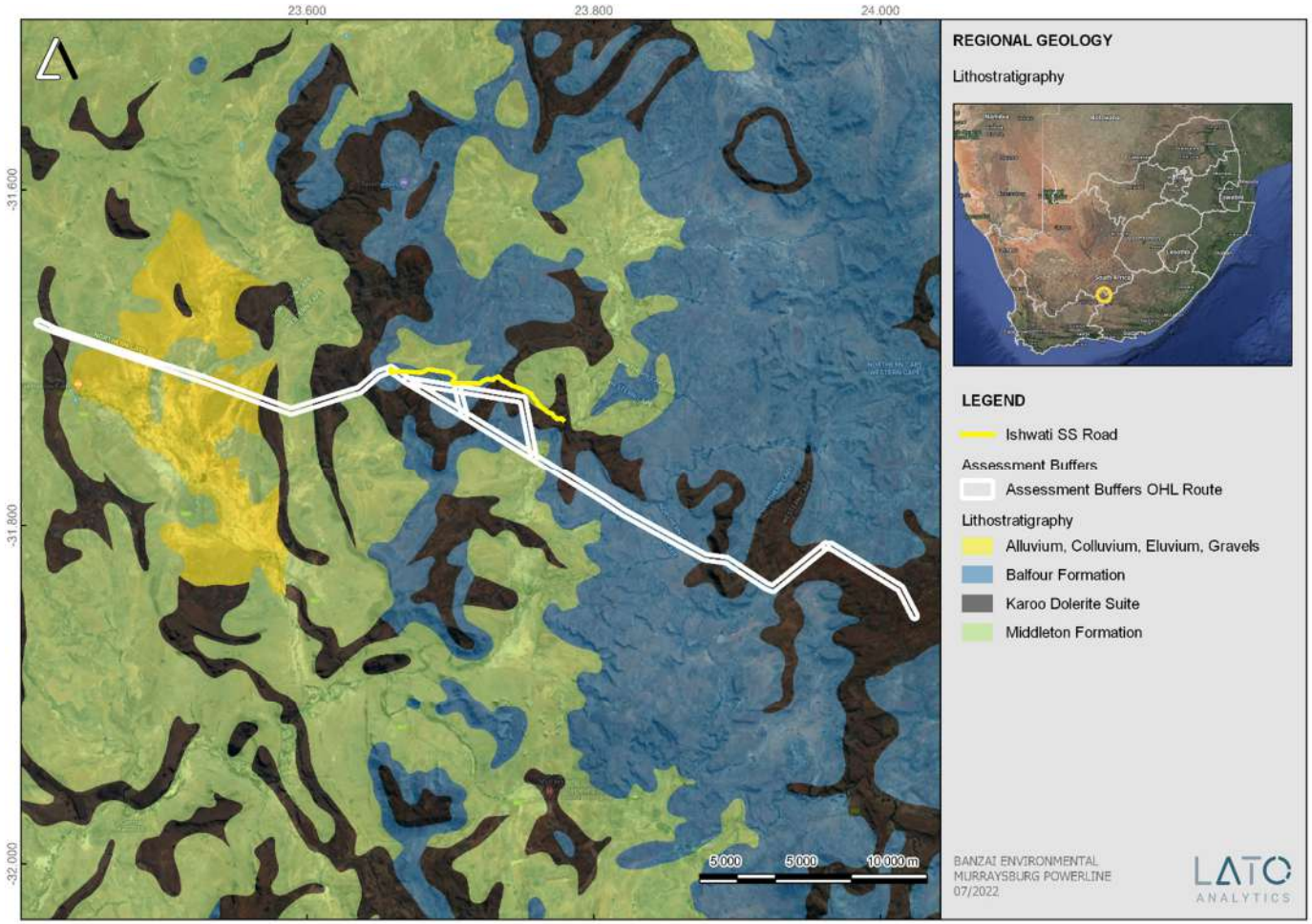


***Figure 7**: Geology indicated by Shape Files (compiled by the Council of Geosciences, Pretoria). The proposed development is underlain by Quaternary sediments (alluvium, colluvium and elluvium) the Balfour, and Middleton Formations of the Beaufort Group (Karoo Supergroup) as well as Jurassic Dolerite.*

Quaternary superficial deposits are the youngest geological deposits formed during the Quaternary (approximately 2.6 million years ago to present). In the proposed development, areas of alluvium, colluvium and eluvium is present. Research has indicated that Quaternary deposits reveal palaeoclimatic changes in the different geological formations (Hunter et al., 2006). The climatic fluctuations in the Cenozoic Era were responsible for the formation of most geomorphologic features in southern Africa (Maud, 2012). Various warming and cooling events occurred in the Cenozoic but climatic changes during the Quaternary, specifically the last 1.8 Ma, were the most drastic climate changes relative to all climate variations in the past Barnosky (2005). Climate in the Quaternary Period were both drier and wetter than the present and resulted in changes in river flow patterns, sedimentation processes and vegetation variation (Tooth et al., 2004). Fossil assemblages of this Group are generally very low in diversity and occur over a wide range. These fossils represent terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods, and trace fossils. The palaeontology of the Quaternary superficial deposits has been relatively neglected in the past. Late Cenozoic calcrete may comprise of bones, horn corns as well as mammalian teeth. Tortoise remains have also been uncovered as well as trace fossils which includes termite and insect's burrows and mammalian trackways. Amphibian and crocodile remains have been uncovered where the depositional settings in the past were wetter. According to the SAHRIS Palaeomap these sediments has a Moderate Palaeontological Sensitivity.

The development area is known for its **dolerite** "koppies". Numerous wind turbines will be located on these unfossiliferous sediments (**Figure 3-6**) and will thus not have an impact on the Palaeontological Heritage of the area. These outcrops form part of the Karoo Igneous Province is one of the worlds classic continental flood basalt (CFB) provinces. This Suite was formed approximately 183 million years ago and consists of intrusive and extrusive rocks that occur over a large area (Duncan et al, 2006). Generally, the flood basalts do not contribute to prominent volcanic structures but instead are formed by successive eruptions from a set of fissures that form sub-horizontal lava flows (sills and dikes) varying in thickness. This lava caps the landscape on which they erupted. As the Karoo is an old flood basalt province it is today preserved as erosional fragments of a more extensive lava cap that covered much of southern Africa in the geological past. It is estimated that the Karoo lava outcrop currently covered at least 140 000 km^2 while it was larger in the past [~2 000 000 km^2 (Cox 1970, 1972)]. The Karoo Igneous Province can be divided into the Lebombo and the Drakensberg Groups. This Igneous Province contains a large volume of flood basalts as well as silicic volcanic rocks. These units consist of hyodacite and rhyolitic magma and crops out along the Lebombo monocline. Individual units span up to 60 km and sometimes show massive pyroclastic structures and are thus classified as rheoignimbrites. Lock *et al* (1974) found evidence in the Eastern Cape that in the early stages of volcanism magma interacted with ground water to produce volcaniclastic deposits as well as phreatic and phreatomagmatic diatremes. Eales *et al* (1984) also found

evidence of aqueous environments during early volcanism by the existence of pillow lavas and associated hyaloclastite breccias and thin lenses of fluviatile sandstones interbedded with the lowermost magmas.

Large areas of the proposed development (**Figure 3-6**) are underlaid by sediments of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup). The Adelaide Subgroup is represented by the **Teekloof** (oldest) and **Balfour Formations** (youngest) of the Beaufort Group (Beaufort Group, Karoo Supergroup).

The Beaufort Group overlays the Ecca Group and consists essentially of sandstones and shales, deposited in the Karoo Basin from the Middle Permian to the early part of the Middle Triassic periods and was deposited on land through alluvial processes. The Beaufort Group covers a total land surface area of approximately 200 000 km^2 in South Africa and is the first fully continental sequence in the Karoo Supergroup. The Beaufort Group is divided into the Adelaide Subgroup and the overlying Tarkastad Subgroup. The Adelaide rocks were deposited under a humid climate that allowed for the establishment of wet floodplains with high water tables and are interpreted to be fluvio-lacustrine sediments.

The Adelaide Subgroup contains alternating greyish-red, bluish-grey, or greenish-grey mudrocks in the southern and central parts of the Karoo Basin with very fine to medium grained, grey lithofeldspathic sandstones. Thicker sandstones of the Adelaide are usually multi-storey and usually have cut-and fill features. The sandstones are characterized internally by horizontal lamination together with parting lineation and less frequent trough cross-bedding as well as current ripple lamination. The bases of the sandstone units are massive beds, while ripple lamination is usually confined to thin sandstones towards the top of the thicker units. The mudrocks of the Adelaide Subgroup usually has massive and blocky weathering. Sometimes desiccation cracks and impressions of raindrops are present. In the mudstones of the Beaufort Group calcareous nodules and concretions occur throughout (Johnson et al, 2006).

The flood plains of the Beaufort Group (Karoo Supergroup) are internationally renowned for the early diversification of land vertebrates and provide the worlds' most complete transition from early "reptiles" to mammals. The Beaufort Group is subdivided into a series of biostratigraphic units based on its faunal content (Kitching 1977; Keyser *et al*, 1977; Rubidge 1995; Smith *et al,* 2020; Viglietti 2020). The **Teekloof Formation** is biostratigraphically represented by the ***Cistecephalus* Assemblage Zone (CiAZ)** while the Balfour Formation is represented by the ***Daptocephalus* Assemblage Zone (DAZ)** which is divided in the upper (younger) ***Lystrosaurus maccaigi - Moschorhinus*** and lower (older) ***Dicynodon-Theriognathus Subzones*** (**Figure 8**) (Viglietti, 2020).

The *Cistecephalus* Assemblage Zone (CiAZ) has recently been radiometrically-dated and ages range from 256 to 255 My (million years). This diverse AZ is dominated by small herbivorous

dicynodonts like *Pristerodon* and *Diictodon* as well as the molelike *Cistecephalus*. Larger herbivores include *Aulacephalod*on, *Dinanomodon*, *Rhachiocephalus*, and Endothiodon that is very rare. Large carnivores include the gorgonopsians *Aelurognathus*, *Smilesaurus*, and *Rubidgea* while smaller carnivores include, Eutherocephalians (*Ictidosuchops* and *Itidosuchoides). Scylacocephalus, Lycaenops* and *Aloposaurus* represents the gorgonopsians. Pararepiles and Pareiasaurus are also present. The biozone defining fossils of the CiAZ is *Cistecephalus*, *Oudenodon* and *Aulacephalodon* and is depicted in **Figure 9**.

In the southern Karoo Basin, west of 24°, the CiAZ spans the upper section of the Teekloof Formation. In the basin east of 24°, the CiAZ is present in the uppermost section of the Middleton Formation and lowermost section of the Balfour Formation. Vertebrate fossils in the CiAZ are found in the olive-grey, grey, and dark reddish-brown mudrock sequences. Smith (1993) interpreted the CiAZ as floodplain deposits comprising of proximal and distal flood basin facies, levee, and crevasse splay. Catuneanu et al., (2005) found that these sediments accumulated between numerous low sinuosity rivers that flowed across broad low-angle distributary fans from the Gondwanide foothills to the eastern and western sub-basins. Tetrapod fossils are generally found in the 0,5 to 1m thick proximal floodplain facies consisting of massive olive grey siltstone beds. Fossils usually comprise of disarticulated skulls and skeletons while articulated skeletons are extremely rare. Bones are usually enveloped by pedogenically precipitated calcareous nodular material soon after burial thus protecting them from later compaction (Smith, 2020). Concentrations of pockets of *Cistecephalus* skulls occur throughout a large area in the CiAZ. It is suggested that these pockets were deposited during a generally wetter floodplain environment. Smith (2020) also describes fish scale lenses, non-marine bivalve (Palaeomutela) conglomerates as well as bone clusters and fish scale-bearing coprolites to support this interpretation.

The *Daptocephalus* Assemblage Zone (DaAZ**)** overlies the Cistecephalus Assemblage Zone**.** Viglietti et al (2017) found that this biostratigraphic subdivision west of 24°E correlates with the upper portion of the Teekloof Formation (Steenkampsvlakte and Javanerskop members). Between 24°E and 25° E the biozone is allocated to the Balfour Formation ranging from uppermost Oudeberg Member to the Elandsberg to the lower Palingkloof Member. This biozone corresponds to the Normandien Formation east of 25°E (Catuneanu et al., 1995).

This AZ consists of the uppermost Permian strata in the Main Karoo Basin and is characterized by the co-occurrence of the dicynodontoid *Daptocephalus leoniceps (**Figure 10**)*, the therocephalian *Theriognathus microps*, and the cynodont *Procynosuchus delaharpeae*. Two characteristic faunal assemblages have been recognised in this AZ dividing this assemblage zone in two subzones. The lower portion of the DaAZ contains fossils of the Dicynodon - Theriognathus Subzone (co-occurring with *Daptocephalus*, **Figure 11**) and the upper portion Lystrosaurus maccaigi – Moschorhinus kitchingi Subzone (**Figure 12**). *L.maccaigi* appears in the upper DaAZ and with *Daptocephalus* and *Moschorhinus* is the defining taxa of the upper

DaAZ. The appearance of L.maccaigi in the upper DaAZ precedes the disappearance of *Procynosuchus*, and *Theriognathus* as well as the significant drop in diversity and abundance of the DaAZ (Viglietti et al., 2016, 2018).

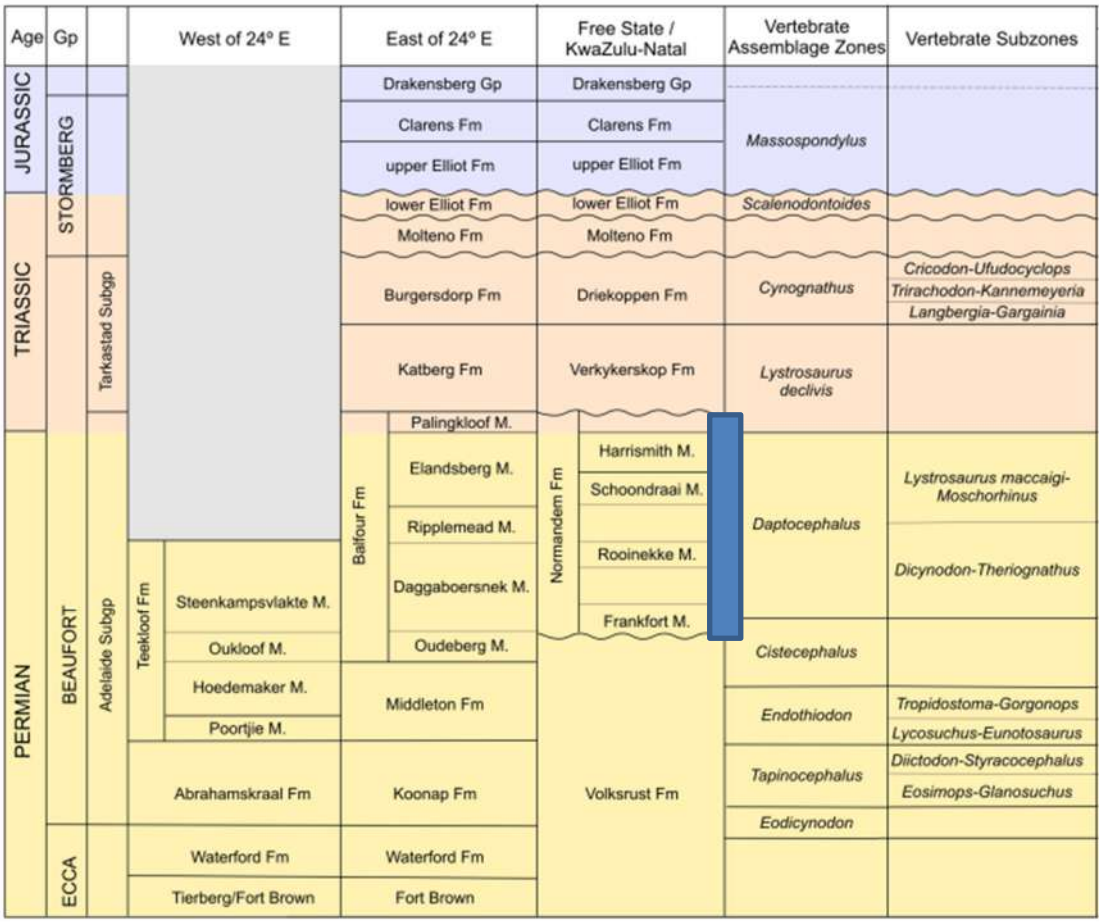


***Figure 8**: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa. Solid lines indicate known ranges, dotted lines indicate suspected but not confirmed ranges, single dot represents the stratigraphic position of the taxa that have only been recovered from a single bed.*

Wavy lines indicate unconformities. (PLYCSR=Pelycosauria and MAMMFMES+Mammaliaformes. Gp=group, Subgp-Supbroup, Fm=Formation, M=Member

The proposed cemetery development is indication in blue.

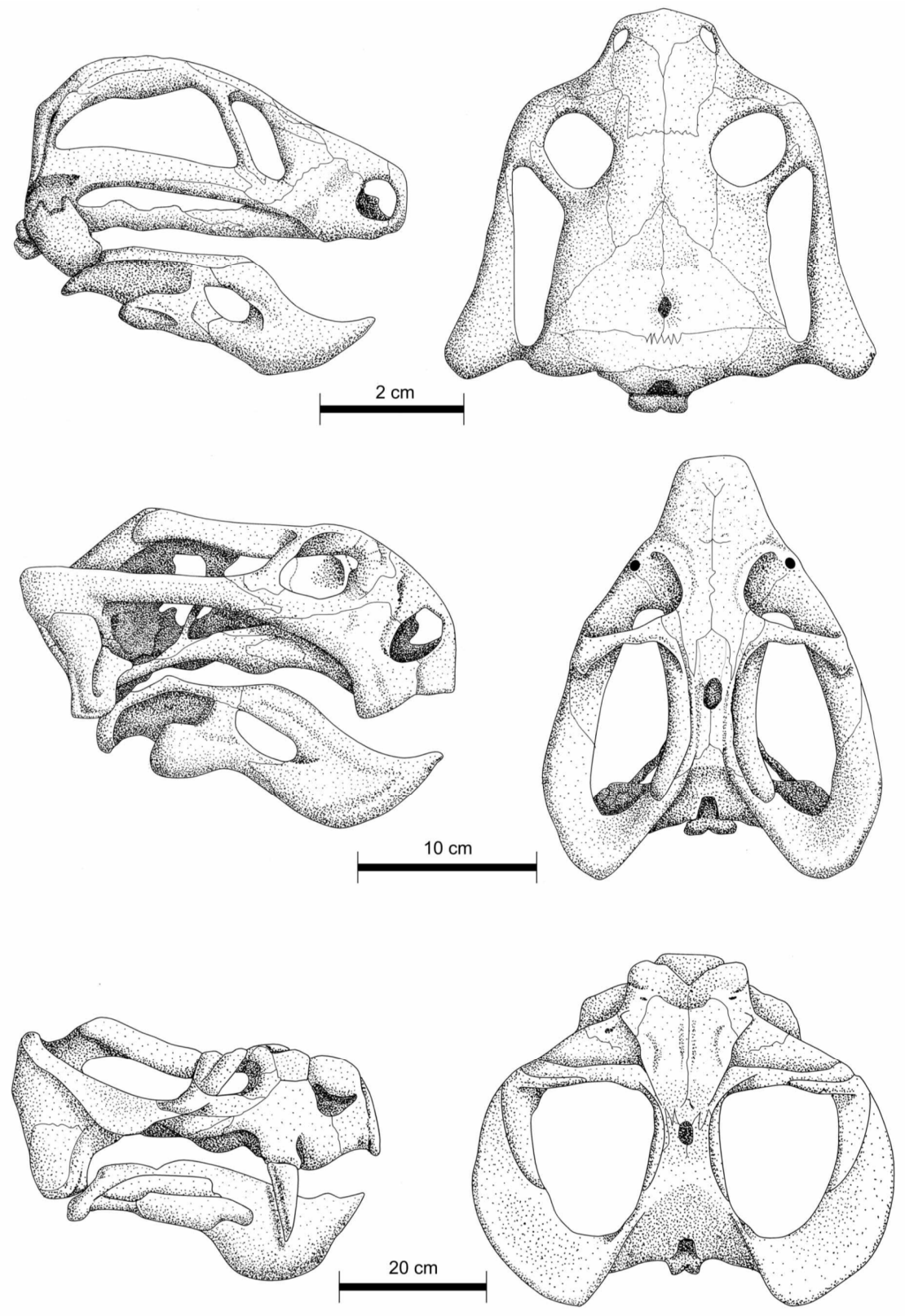


***Figure 9**:Lateral and dorsal views of the biozone-defining fossils of the Cistecephalus Assemblage Zone namely Cistecephalus microrhinus (top), Oudenodon bainii (centre) and, Aulacephalodon bainii (bottom), (Image taken from Smith 2020).*

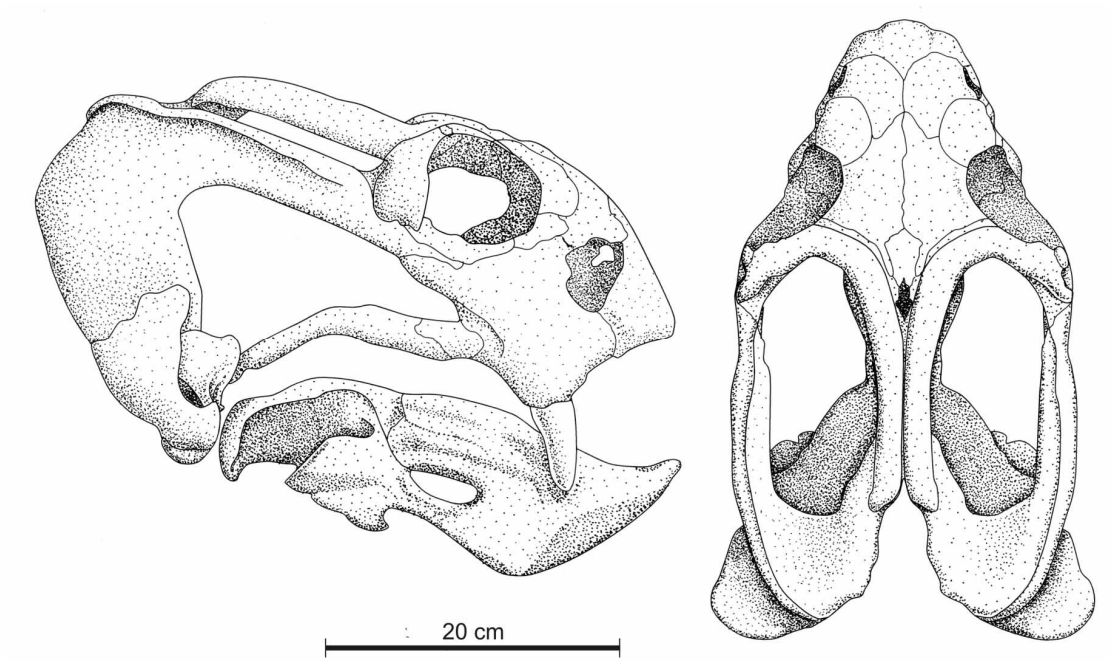


Figure 10: The skull of the dicynodont Daptocephalus leoniceps in lateral and dorsal view the main biozone defining fossil (Image taken from Viglietti, 2020).

Vertebrate fossils present in the DaAZ include isolated skulls and articulated skeletons. These fossils are recovered from fine mudrocks and siltstones. Most vertebrate fossils are enclosed in calcareous nodules. Plant fossils include Glossopteris leaf and stem impressions and sphenophytes are locally common (especially in the Daggaboersnek and lower Ripplemead Member) (Johnson 1976; Tordiffe, 1978; Johnson et al., 2006). Bender (2001, 2002) described fossils fish in the lower Ripplemead Member in the Nieu Bethesda district.

The DaAZ reaches a thickness of about 500m in the southern portion of the basin. The DaAZ becomes thinner to the north (Kitching, 1977; Viglietti et al., 2016, 2017b) where it reaches about 90 m. The upper DaAZ in the Steenkampsvlakte and Javanerskop Members (Balfour Formation in the Eastern Cape) reaches a maximum of 230 m (Viglietti et al., 2017a). Currently L.maccaigi have not been recovered west of 24°E suggesting that the DaAZ is eroded away or equivalent strata never deposited. The Dicynodon-Theriognathus Subzone is at its thickest (330 m) in the southern portion of the basin thinning to about 30 m in the southern Free State (Gariep dam) Viglietti et al., 2017a). This subzone is not present further north in the main Karoo Basin.

Sandstones comprise of 20% to 25%of the Dicynodon-Theriognathus Subzone. Fine-grained sandstones are arkosic in structure and consists of trough and planar crossbedding with some ripple laminated sections at the sandstone tops. The Dicynodon-Theriognathus Subzone is characterised by siltstone and mudstone (75% to 80%) that is generally about 20m thick. The top of the Dicynodon-Theriognathus Subzone includes most of the arenaceous Ripplemead member and comprise of thinly bedded, minor red mudstones, varve-like tabular green beds interbedded with thin wave-rippled sandstone and siltstone beds.

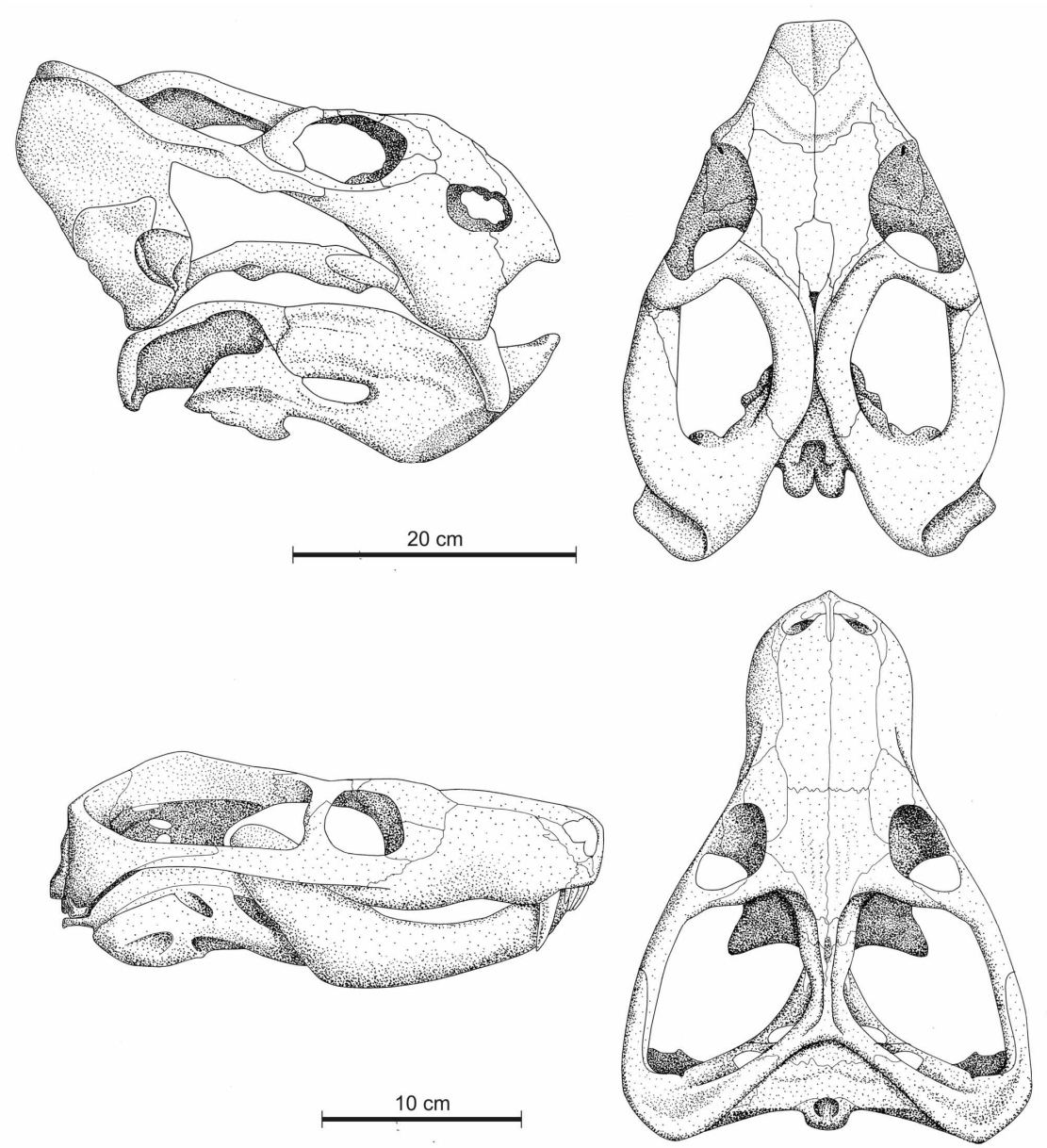


Figure 11*: Skulls of the biozone defining fossils of the Dicynodon-Theriognathus Subzone in lateral and dorsal views. Dicynodon lacerticeps (top), Theriognathus microps (bottom) (Image taken from* Viglietti*, 2020).*

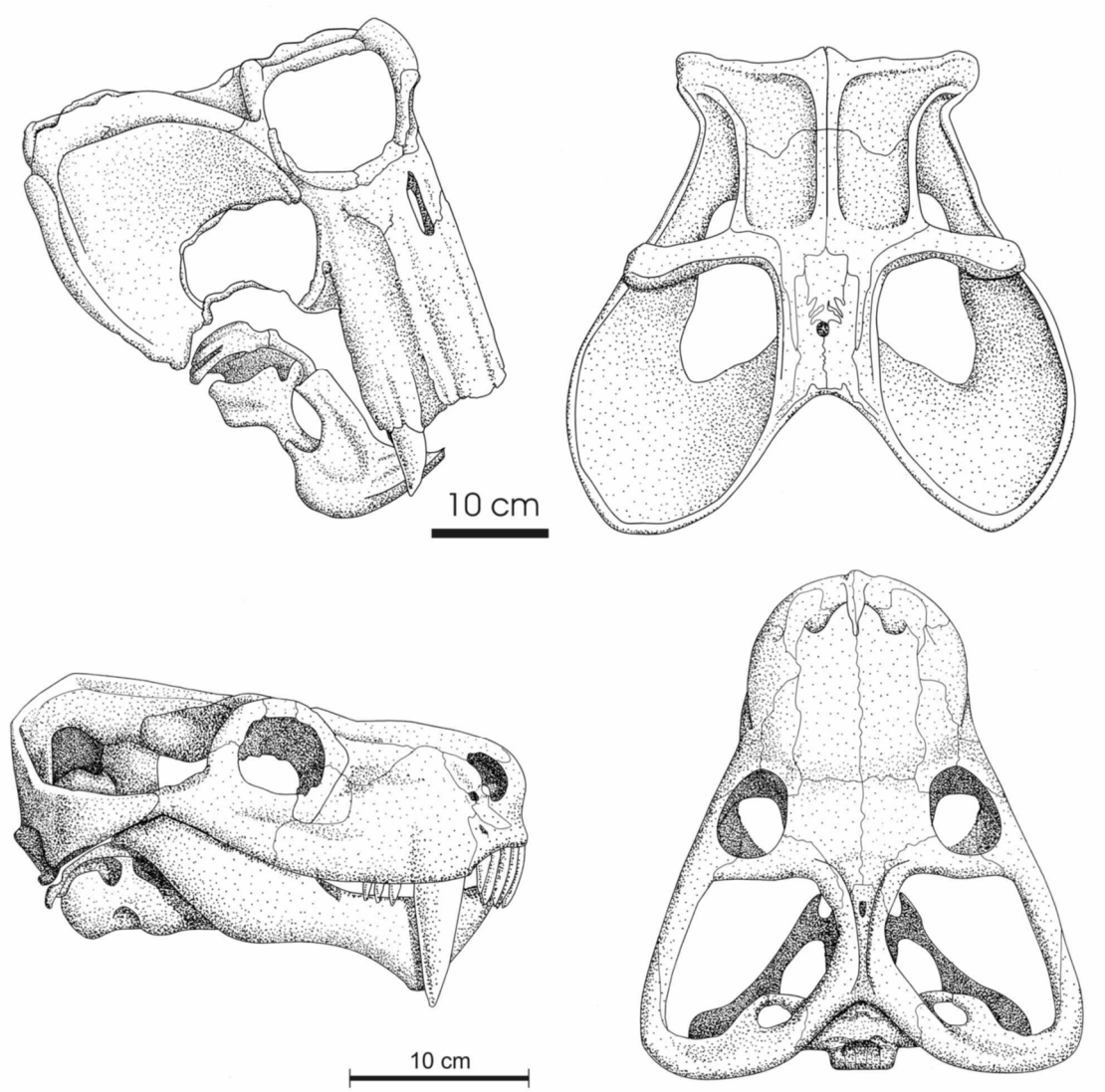


***Figure 12**:Biozone defining fossils of the Lystrosaurus maccaigi- Moschorhinus Subzone. The skulls of the Lystrosaurus maccaigi (top) and Moschorhinus kitchingi (bottom) in lateral and dorsal views (Image taken from* Viglietti*, 2020).*

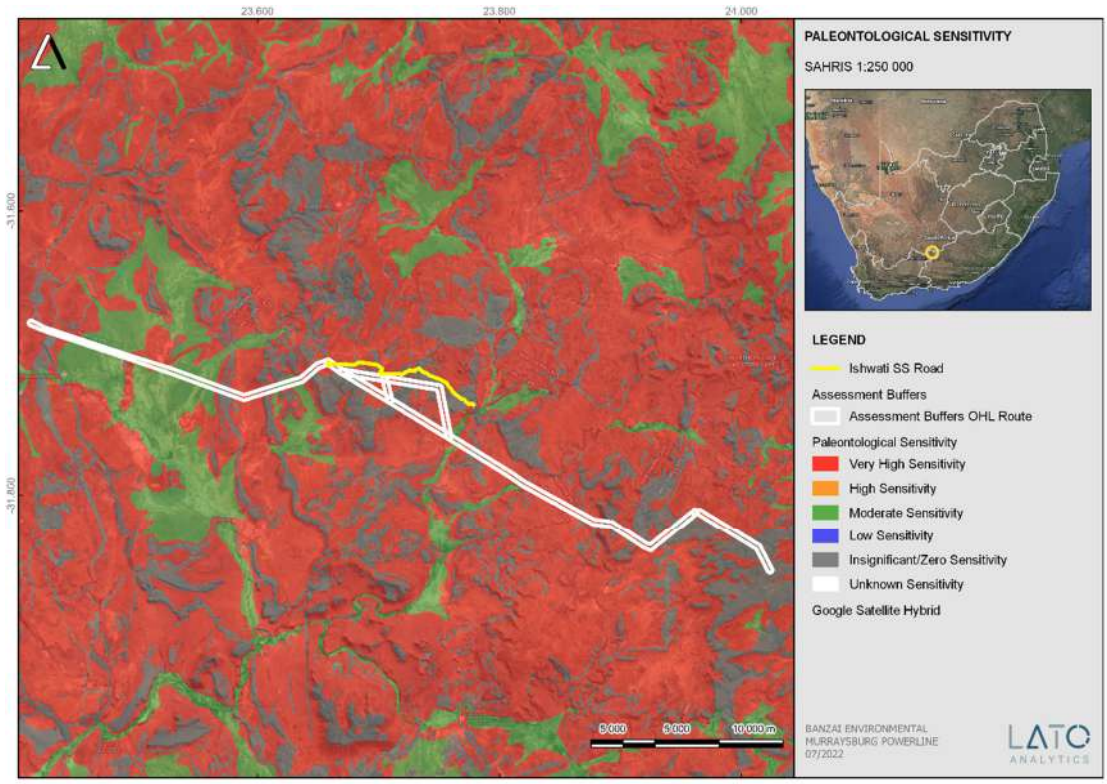


***Figure 13**: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) overlain with the proposed development corridors.*

According to the SAHRIS Palaeosensitivity map (**Figure 13)** the proposed development is underlain by sediments with a Very High (red), Moderate (green) and Zero (grey) Palaeontological Sensitivity.

Table 7:Palaeontological Sensitivity on SAHRIS

Colour	Sensitivity	Required Action
RED	**VERY HIGH**	**field assessment and protocol for finds is required**
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	**MODERATE**	**desktop study is required**
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	**INSIGNIFICANT/ZERO**	**no palaeontological studies are required**
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

The colours on the PalaeoMap indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

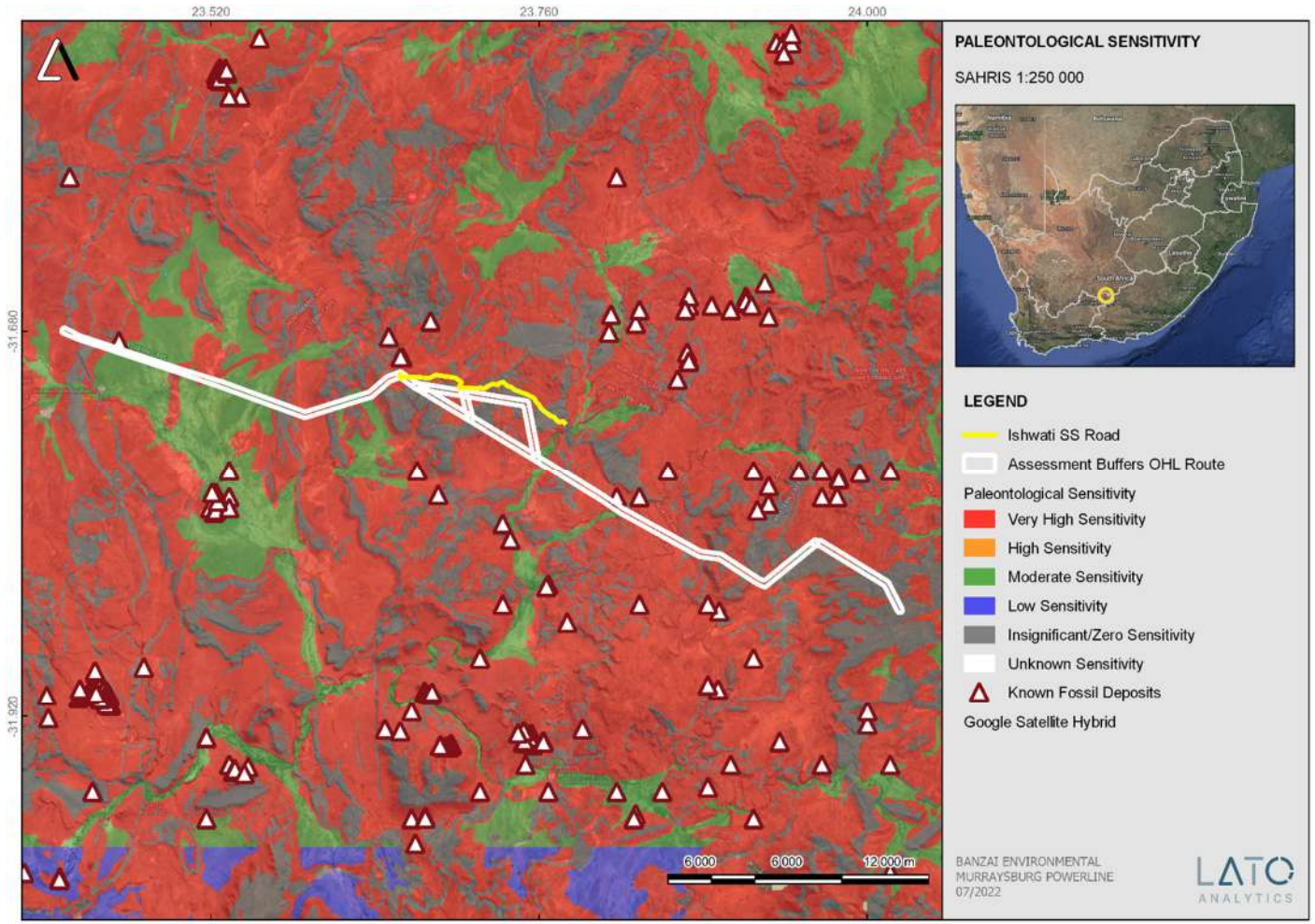


Figure 14: SAHRIS PalaeoMap indicating fossil finds of the National Palaeontological Database with white triangles. Only three fossiliferous areas are present close to the development footprint.

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development is located 25 km north of Murraysburg and approximately 63 km south west of Richmond in the Northern Cape.

Table 8: Location of the proposed development.

Study Area GPS Coordinates	Latitude	Longitude
Most western point	31°40'45.90"S	23°24'45.71"E
Crossing with N1	31°41'26.67"S	23°27'9.67"E
Most Eastern point	31°51'13.38"S	24° 1'25.58"E

7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a desktop study and includes PIA reports in the same area, aerial photos, and Google Earth images, topographical as well as geological maps.

7.1 Assumptions and Limitations

When conducting a PIA several factors can affect the accuracy of the assessment. The focal point of geological maps is the geology of the area and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is used to provide information on the existence of fossils in an area which was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **assumed** that exposed fossil heritage is present within the footprint.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- 1: 250 000 3122 Victoria West Geological map (1989) (Council of Geoscience, Pretoria)

- 1:250 000 Middelburg 3124 (1997) Geological Map (Council of Geoscience, Pretoria).
- A Google Earth map with polygons of the proposed development was obtained from PGS Consultants.
- PIAs in the same area include Almond (2015; 2018), 2020.

9 SITE VISIT

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle in April and May 2022. A few weathered fossil outcrops were identified.

***Figure 15**: View over Gamma Substation*

***Figure 16**:Western margin of the proposed development indicates low vegetation on Quaternary sediments*

***Figure 17**: View overlooking the farm Skietkuil. Lush vegetation on the mantling Quaternary deposits*

***Figure 18**: View over a portion of the middle of the proposed development shows flat planes surrounded by dolerite ridges*

Figure 19:Unfossiliferous sandstone and mudstone outcrops

***Figure 20**: Dolerite outcrop just outside the assessment corridor.*

***Figure 21**:Fragmented fossil in the power line corridor (Balfour Formation, mudstone)*
(GPS coordinates -31.780789; 23.816100)

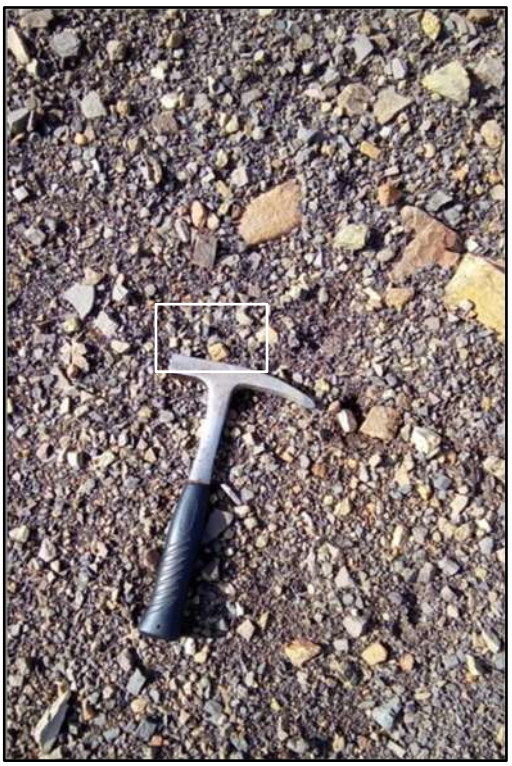


***Figure 22**:Loose, isolated vertebrate bone fragment*
(GPS coordinates -31.688115; 23.418207)

Figure 23:Loose, isolated vertebrate bone fragment imbedded in mudstone
(GPS coordinates -31.690436; 23.418833)

Figure 24:Loose plant impression
(GPS coordinates -31.708164; 23.662842)

Figure 25:Loose vertebrate bone fragment
(GPS coordinates -31.707714; 23.673675)

Figure 26: *In situ* bone impressions (possible ribs) (Balfour Formation)
(GPS coordinates -31.707469; 23.676322)

Figure 27: Vertebrate rib fragments (*in situ*) (Balfour Formation)
(GPS coordinates -31.711244; 23.698753)

Figure 28: Tetrapod burrow (*in situ)* (Balfour Formation)
(GPS coordinates -31.714789; 23.709142)

Figure 29: Tetrapod *in situ* long bone fragment (Balfour Formation, mudstone).
(GPS coordinates -31.780789; 23.816100)

Figure 30: Weathered *in situ* bone fragment (Balfour Formation)
(GPS coordinates -31.801339; 23.960836)

Figure 31: Weathered *in situ* bone fragment (Balfour Formation) (GPS coordinates -31.801212; 23.961043)

Figure 32: In situ tetrapod bone fragment (Middleton Formation)
(GPS coordinates -31.800234; 23.961648)

***Figure 33**: Weathered ripple marks in siltstone.*

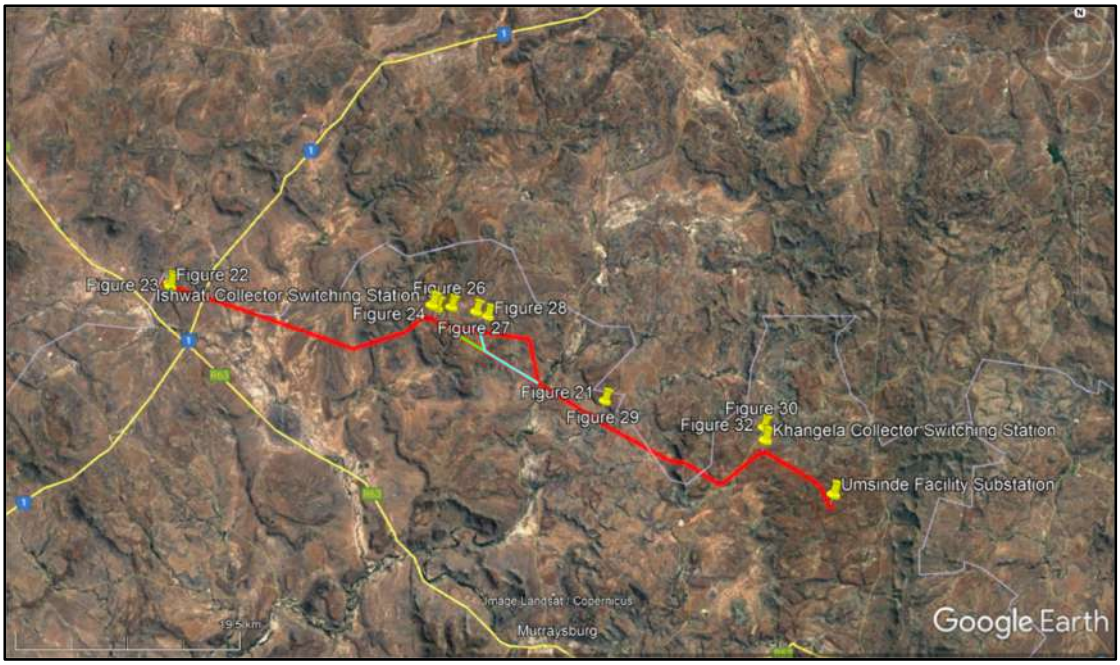


Figure 34: Fossils found in the grid connection footprint

10 IMPACT ASSESSMENT METHODOLOGY

10.1 Impact Assessment Methodology

The impact significance rating methodology, as provided by Nala, is guided by the requirements of the NEMA EIA Regulations 2014 (as amended).

Direct, indirect, and cumulative impacts associated with the projects must be assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;
- The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium, or high; and
- the **status**, which will be described as either positive, negative, or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.

» the *degree* to which the impact can be *mitigated.*

The **significance** is calculated by combining the criteria in the following formula:

S = (E+D+M)P

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

» < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
» 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
» > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Example of Impact table summarising the significance of impacts (with and without mitigation)

Nature: **[Outline and describe fully the impact anticipated as per the assessment undertaken]**		
	Without mitigation	**With mitigation**
Extent	High (3)	Low (1)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: "Mitigation", means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible. Provide a description of how these mitigation measures will be undertaken keeping the above definition in mind		
Residual Impacts: "Residual Risk", means the risk that will remain after all the recommended measures have been undertaken to mitigate the impact associated with the activity (Green Leaves III, 2014).		

10.2 Impact Assessment Table

Table 9: Impact ratings for the proposed development (powerline alternatives i.e (Preferred Alternative, Alternative 1 and Alternative 2, x3 switching stations (i.e., Umsinde, Khangela and Ishwati), as well as an extended development corridor enabling the 132kV powerline to connect either to the south face of the Gamma substation yard or approach from the east, and access tracks and watercourse crossings)

Nature: The general palaeontological sensitivity of the geological formations is rated as very high. Thus, the chance of discovering fossils during construction activities is rated as very probable.		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (3)
Magnitude	Very high (10)	Very high (10)
Probability	Probable (3)	Probable (3)
Significance	**Medium (51)**	**Medium(45)**
Status (positive or negative)	Negative	Positive
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: ▪ The ECO for this project must be informed that sediments of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) have a **Very High Palaeontological Sensitivity**. ▪ **Training of accountable supervisory personnel** by a qualified palaeontologist in the recognition of fossil heritage is very important and necessary. ▪ If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to ▪ South African Heritage Resources Agency (SAHRA) (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation (recording and collection) can be carried out. ▪ Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012). ▪ These recommendations should be incorporated into the Environmental Management Plan for the proposed development.		
Residual Impacts: Thus, an overall medium palaeontological sensitivity is allocated to the development footprint. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological reserves of the area and construction of the development may be authorised to its whole extent.		

10.3 SUMMARY OF IMPACT TABLES

Only the site will be affected by the proposed development. The proposed development will have a negative impact on Fossil Heritage. The expected duration of the impact is assessed as

potentially permanent to long term. The impact is very likely to occur pre mitigation and could happen after mitigation post mitigation. The impact occurring will be Moderate pre-mitigation a Moderate post-mitigation. If mitigation is correctly implemented the impact will be positive as fossils will be available for scientific study.

11 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by Quaternary superficial deposits, Balfour-, and Teekloof Formations of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) while large areas of the development footprint are underlain by Jurassic dolerite. The PalaeoMap of the South African Heritage Resources Information System indicates that the Palaeontological Sensitivity of the Jurassic Dolerite is Zero as it is igneous in origin and thus unfossiliferous, Ouaternary deposits has a Moderate Palaeontological Sensitivity while that of the Adelaide Subgroup is Very High (Almond and Pether, 2009; Almond et al., 2013). Due to the Very High Sensitivity of the Adelaide Subgroup a field assessment was triggered.

Extensive fieldwork by South African researchers have been conducted in the Murraysburg area and over time almost 2000 fossils have been collected. These fossils are now housed in Museums in South Africa. This information has been included in this report.

An overall 6-day site-specific field survey of the development footprint was conducted on foot and by motor vehicle during April, May, and July 2022. (The field was extremely wet in April and the site visit was postponed to May 2022, although circumstances had not much improved).

During the site visit the following was found:
A few weathered, fossiliferous outcrops were identified in the development footprint. In addition, three small areas have been identified on the National Palaeontology Databases.

Thus, an **overall medium** palaeontological significance is allocated to the development footprint. Three powerline alternatives (i.e Preferred Alternative, Alternative 1 and Alternative 2) as well as an extended development corridor enabling the 132kV powerline to connect either to the south face of the Gamma substation yard or approach from the east) is considered for the development. From a Palaeontological view there is no preference between these alternatives. The development will thus not lead to detrimental impacts on the palaeontological reserves of the area (if mitigations measures are followed) and construction of the development may be authorised to its whole extent.

Recommendations:

- The ECO for this project must be informed that sediments of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) have a **Very High Palaeontological Sensitivity**.

- **Training of accountable supervisory personnel** by a qualified palaeontologist in the recognition of fossil heritage is is very important and necessary.
- If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources Agency (SAHRA) (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation (recording and collection) can be carried out.
- Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).
- These recommendations should be incorporated into the Environmental Management Plan for the proposed development.

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- These recommendations should be incorporated into the Environmental Management Plan for the proposed development.

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12 CHANCE FINDS PROTOCOL

A following procedure will only be followed if fossils are uncovered during excavation.

12.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 25 of 1999) (NHRA).** According to Section 3 of the Act, all Heritage resources include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**".

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

12.2 Background

A fossil is the naturally preserved remains (or traces) of plants or animals embedded in rock. These plants and animals lived in the geologic past millions of years ago. Fossils are extremely rare and irreplaceable. By studying fossils, it is possible to determine the environmental conditions that existed in a specific geographical area millions of years ago.

12.3 Introduction

This informational document is intended for workmen and foremen on construction sites. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

It is the responsibility of the Environmental Site Officer (ESO) or site manager of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the absence of the ESO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

12.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS coordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO (site manager). Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once the Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

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APPENDIX A – ELIZE BUTLER CV

ELIZE BUTLER

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	26 years in Palaeontology

EDUCATION:	B.Sc Botany and Zoology, 1988 University of the Orange Free State
	B.Sc (Hons) Zoology, 1991 University of the Orange Free State
	Management Course, 1991 University of the Orange Free State
	M. Sc. *Cum laude* (Zoology), 2009 University of the Free State

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

MEMBERSHIP

Palaeontological Society of South Africa (PSSA)	2006-currently

EMPLOYMENT HISTORY

Part time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part time laboratory assistant	Department of Virology University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

TECHNICAL REPORTS

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Butler, E. 2015. Palaeontological Impact Assessment of the proposed township establishment on the remainder of portion 6 and 7 of the farm Sunnyside 2620, Bloemfontein, Mangaung metropolitan municipality, Free State, Bloemfontein.

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Butler, E. 2015. Palaeontological Impact Assessment of the proposed Woodhouse 2 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.

Butler, E. 2015. Palaeontological Impact Assessment of the proposed Orkney solar energy farm and associated infrastructure on the remaining extent of Portions 7 and 21 of the farm Wolvehuis 114, near Orkney, North West Province. Bloemfontein.

Butler, E. 2015. Palaeontological Impact Assessment of the proposed Spectra foods broiler houses and abattoir on the farm Maiden Manor 170 and Ashby Manor 171, Lukhanji Municipality, Queenstown, Eastern Cape Province. Bloemfontein.

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Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Modikwa Filling Station on a Portion of Portion 2 of Mooihoek 255 Kt, Greater Tubatse Local Municipality, Limpopo Province. Bloemfontein.

Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Heidedal filling station on Erf 16603, Heidedal Extension 24, Mangaung Local Municipality, Bloemfontein, Free State Province. Bloemfontein.

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Butler, E. 2016. Palaeontological Impact Assessment of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.

Butler, E. 2016. Chris Hani District Municipality Cluster 9 water backlog project phases 3a and 3b: Palaeontology inspection at Tsomo WTW. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoort concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoort, Northern Cape. Savannah South Africa. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment of the proposed upgrading of the main road MR450 (R335) from Motherwell to Addo within the Nelson Mandela Bay Municipality and Sunday's River valley Local Municipality, Eastern Cape Province. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment construction of the proposed Metals Industrial Cluster and associated infrastructure near Kuruman, Northern Cape Province. Savannah South Africa. Bloemfontein.

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Butler, E. 2016: Palaeontological desktop assessment of the establishment of the proposed residential and mixed-use development on the remainder of portion 7 and portion 898 of the farm Knopjeslaagte 385 Ir, located near Centurion within the Tshwane Metropolitan Municipality of Gauteng Province. Bloemfontein.

Butler, E. 2017. Palaeontological impact assessment for the proposed development of a new cemetery, near Kathu, Gamagara local municipality and John Taolo Gaetsewe district municipality, Northern Cape. Bloemfontein.

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Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Establishment of a Diesel Farm and a Haul Road for the Tshipi Borwa mine Near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.

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Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of a 132KV powerline from the Tweespruit distribution substation (in the Mantsopa local municipality) to the Driedorp rural substation (within the Naledi local municipality), Free State province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the new coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of a Photovoltaic Solar Power station near Collett substation, Middelburg, Eastern Cape. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment for the proposed township establishment of 2000 residential sites with supporting amenities on a portion of farm 826 in Botshabelo West, Mangaung Metro, Free State Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed prospecting right project without bulk sampling, in the Koa Valley, Northern Cape Province. Bloemfontein.

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Butler, E. 2017. Palaeontological Impact Assessment of the proposed Belvior aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.

Butler, E. 2017. PIA site visit and report of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of Tina Falls Hydropower and associated power lines near Cumbu, Mthlontlo Local Municipality, Eastern Cape. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of the Mangaung Gariep Water Augmentation Project. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed Belvoir aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.

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Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of a railway siding on a Portion of portion 41 of the farm Rustfontein 109 is, Govan Mbeki local municipality, Gert Sibande district municipality, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed consolidation of the proposed Ilima Colliery in the Albert Luthuli local municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed extension of the Kareerand Tailings Storage Facility, associated borrow pits as well as a storm water drainage channel in the Vaal River near Stilfontein, North West Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of a filling station and associated facilities on the Erf 6279, district municipality of John Taolo Gaetsewe District, Ga-Segonyana Local Municipality Northern Cape. Bloemfontein.

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Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Overvaal Trust PV Facility, Buffelspoort, North West Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed development of the H_2 Energy Power Station and associated infrastructure on Portions 21; 22 And 23 of the farm Hartebeestspruit in the Thembisile Hani Local Municipality, Nkangala District near Kwamhlanga, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the Sandriver Canal and Klippan Pump station in Welkom, Free State Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the 132kv and 11kv power line into a dual circuit above ground power line feeding into the Urania substation in Welkom, Free State Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed diamonds alluvial & diamonds general prospecting right application near Christiana on the remaining extent of portion 1 of the farm Kaffraria 314, registration division HO, North West Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Hartebeesfontein, near Panbult, Mpumalanga. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Rustplaas near Piet Retief, Mpumalanga. Bloemfontein.

Butler, E. 2018. Palaeontological Impact Assessment for the Proposed Landfill Site in Luckhoff, Letsemeng Local Municipality, Xhariep District, Free State. Bloemfontein.

Butler, E. 2018. Palaeontological Impact Assessment of the proposed development of the new Mutsho coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.

Butler, E. 2018. Palaeontological Impact Assessment of the authorisation and amendment processes for Manangu mine near Delmas, Victor Khanye local municipality, Mpumalanga. Bloemfontein.

Butler, E. 2018. Palaeontological Desktop Assessment for the proposed Mashishing township establishment in Mashishing (Lydenburg), Mpumalanga Province. Bloemfontein.

Butler, E. 2018. Palaeontological Desktop Assessment for the Proposed Mlonzi Estate Development near Lusikisiki, Ngquza Hill Local Municipality, Eastern Cape. Bloemfontein.

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PGS HERITAGE

PALAEONTOLOGICAL: SITE SENSITIVITY VERIFICATION

CONTENTS

1. INTRODUCTION

The applicant, Eskom Holdings SOC Limited is proposing the establishment of the 132kV grid connection infrastructure (overhead powerline and x3 on-site switching stations), associated access tracks & watercourse crossings associated with the authorised Emoyeni Wind Energy Facilities located in the Beaufort West & Ubuntu Local Municipalities, Northern and Western Cape Provinces.

The following Environmental Authorisations for various grid connection infrastructure and wind energy facilities related to the Emoyeni Wind Energy Facilities and their authorised grid connection infrastructure were previously obtained:

Umsinde Emoyeni Wind Energy Facility	DFFE Ref: 14/12/16/3/3/2/686 on 06 September 2018
132kV Grid connection Infrastructure associated with the Umsinde Emoyeni WEF	DFFE Ref: 14/12/16/3/3/2/684 on 06 September 2018
Khangela Emoyeni Wind Energy Facility	DFFE REF:. 14/12/16/3/3/2/687 on the 06 September 2018
132kV Grid connection Infrastructure associated with the Khangela Emoyeni WEF	DFFE REF:. 14/12/16/3/3/2/685 on 06 September 2018
Ishwati Emoyeni Wind Energy Facility	DFFE Ref: 12/12/20/2351 on 2 July 2015
Transmission grid connection infrastructure (Eskom Gamma Main Transmission Substation)	DFFE Ref: 14/12/16/3/3/2/410 on 02 July 2015
Distribution grid connection infrastructure (Eskom distribution grid connection infrastructure consisting of 132kV power lines and on-site switching station located within the authorised Ishwati Emoyeni Wind Energy Facility)	DFFE Ref: 14/12/16/3/3/2/411 on 02 July 2015

Following receipt of the relevant Environmental Authorisations for the grid connection infrastructure for the Umsinde and Khangela Emoyeni Wind Energy Facilities (DFFE Ref:14/12/16/3/3/2/684 and DFFE Ref:.14/12/16/3/3/2/685) , it was noted that several listed activities that were relevant to the grid infrastructure had not been considered , therefore new a Basic Assessment process will be undertaken that will now consider all the applicable listed activities as per the EIA Regulations. In addition, due to alterations in the wind farm layouts, and based on further technical analysis and liaison with Eskom's technical and grid access units it was determined that the previously authorised powerline routings intended to evacuate electricity generated from these authorised wind energy facilities to the National Grid via the Gamma Substation are no longer suitable/ optimal and will need to be revised to cater for final wind farm layouts, and Eskom's connection requirements. A new Basic Assessment will therefore be undertaken to assess the revised (re-optimised) grid connection layout as well all applicable listed activities, including the listed activities omitted from the original BA process. The proposed 400m wide development corridor that has been identified for the development of the

grid connection infrastructure required to evacuate power generated from the authorised Emoyeni WEFs, is informed by the most feasible grid connection point into the national grid from a technical, economic and environmental perspective.

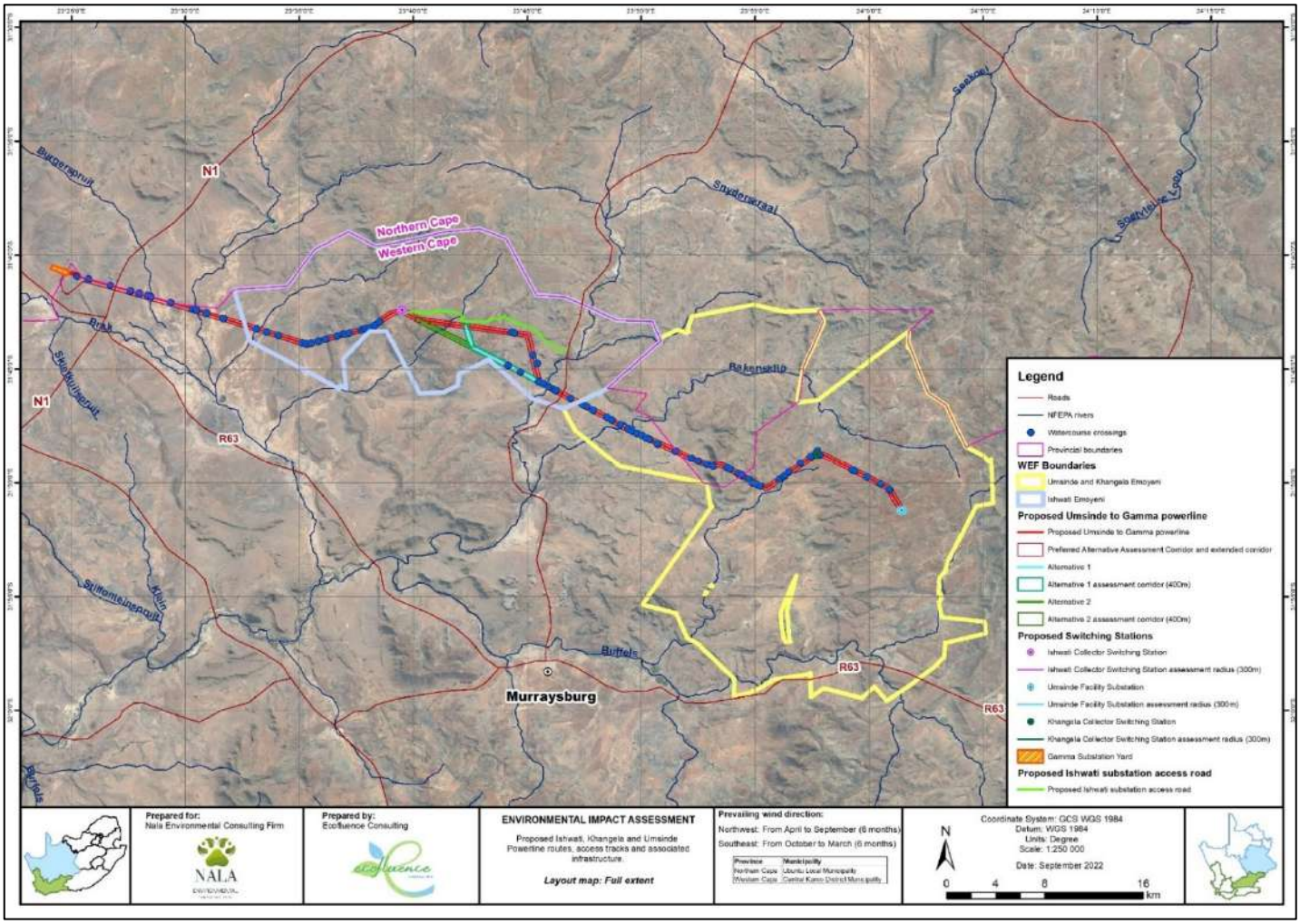


Figure 1. Proposed Layout map for the proposed development corridor and associated infrastructure related to the Emoyeni Wind Energy Facilities

Since the Umsinde Emoyeni and Khangela Emoyeni Wind Energy Facilities have been selected as preferred bidder projects by private offtakers and based on further technical analysis and liaison with Eskom's technical and grid access units it was determined that the previously authorised powerline routings intended to evacuate electricity generated from these authorised wind energy facilities to the National Grid via the Gamma Substation are no longer suitable/ optimal and will need to be revised to cater for final wind farm layouts, and Eskom's connection requirements. Therefore, new grid connection infrastructure is proposed that is in line with Eskom's technical and feasibility requirements. The following Infrastructure has been assessed:

- The establishment of a 132kV collector substation (switching station) within the authorised Umsinde Emoyeni WEF site (adjacent to the WEF facility substation) with a footprint of approximately 100m X 80m (~0.8ha) to be located within an assessment footprint that encompasses a 300m radius.
- The establishment of a 132kV collector substation (switching station) within the authorised Khangela Emoyeni WEF site (adjacent to the WEF facility substation) with a footprint of approximately 100m X 80m (~0.8ha) to be located within an assessment footprint that encompasses a 300m radius.

- The establishment of a 132kV collector substation (switching station) within the authorised Ishwati Emoyeni WEF site (adjacent to the WEF facility substation) with a footprint of approximately 120m X 100m (~1.2 ha) with an assessment footprint that encompasses a 300m radius.

- The establishment of a 132kV powerline within a 400m wide corridor that will extend from the Khangela switching station to the Ishwati switching station (~36km), and then onward for ~25km to the Eskom Gamma Substation. In addition, a further length of 132kV powerline (within a 400m wide corridor) will extend from the Umsinde switching station to the Khangela switching station for ~8km OR it may connect directly into the Khangela-Ishwati powerline at the Khangela switching station. An extended powerline development corridor of approximately 1.91 km^2 has been assessed in the vicinity of the Gamma Substation, that will enable the 132kV powerline to connect to either the south face of the Gamma Substation yard or approach from the east, depending on the available connection point at the time of connection. The 132kV Powerline from Umsinde to Khangela, and from Khangela to Ishwati and onward to Gamma Substation will be a single- or double-circuit overhead powerline, with a single set of pylons structures with a maximum height of 35m Access/service tracks (jeep track) up to 7m wide and associated watercourse crossings will be associated with the powerline, and will be located within the assessed powerline corridor.

- The establishment of a new access road approximately 14km long from the existing public road from Richmond to the Ishwati switching station site. The proposed new access road will be unsealed and up to 12m wide during construction , but will be reduced to a maximum of 6 m width during operation. The access road will largely follow an existing farm road (to be upgraded), but will also entail development of a new length of road.

The proposed grid infrastructure along with the access roads and water crossings are located within the authorised Umsinde, Khangela and Ishwati Wind Energy Facilities northeast of the town of Murraysburg. The authorised Umsinde Emoyeni WEF (DFFE REF: 14/12/16/3/3/2/686), Khangela Emoyeni Wind Energy Facility (DEA REF:. 14/12/16/3/3/2/687) and the Ishwati Emoyeni Wind Energy Facility (DFFE REF: DFFE Ref: 12/12/20/2351) sites are located within the Beaufort West Renewable Energy Development Zone (REDZ) and the majority of the new proposed grid connection infrastructure falls within the REDZ and the Central Corridor of the Strategic Transmission Corridors.

Table 1.1: Location of proposed new development corridor housing the 132kV grid connection infrastructure, access tracks and watercourse crossings:

Province	Northern and Western Cape Province
Local Municipality	Beaufort West and Ubuntu Local Municipality
District Municipality	Central Karoo and Pixley ka Seme District Municipality
Nearest Town	Murraysburg
Ward No.	Ward 1 (BWLM), Ward 3 (ULM)
Details of properties affected	• Portion 1 of farm Klein Driefontein No. 152 • Remainder of Farm De Hoop No. 30; • Portion 2 of Farm De Hoop No. 30 • Remainder of Farm Swavel Kranse No. 28 • Portion 2 of Farm Swavel Kranse No. 28 • Portion 4 (portion of portion 1) of Farm Driefontein 26 • Portion 6 of Farm Klipplaat No. 109 Portion 4 (portion of portion 2) of Farm Klipplaat No. 109 • Portion 1 of the Farm Klipplaat No. 109

	• Remainder Klipplaat No. 109 • Portion 1 of the Farm Uitvlugtfontein No. 265 • The Farm Riet Poort No. 9 • Remainder of Farm Driefontein No. 8 • Portion 3 of Farm Badfontein No. 10 (powerline alternative 1 route) • Remainder of Farm Leeuwenfontein No. 6 • Portion 2 of Farm Leeuwenfontein No. 6 • Portion 4 (a portion of portion 1) of Farm Allemansfontein No.7 • Portion 2 (a portion of portion 1) of Farm Allemansfontein No.7 • The Farm Klein Los Kop No.5 • Remainder of the Farm Schietkuil No.3

Table 1.2. The centre line co-ordinates of the 400m wide development corridor* are presented below for the proposed corridor alternatives:

	Preferred Alternative		**Alternative 1**		**Alternative 2**	
	Latitude	**Longitude**	**Latitude**		**Longitude**	
Start (on-site substation at Umsinde Emoyeni WEF site)	31°51'13.38"S	24° 1'25.58"E	31°51'13.38"S	24° 1'25.58"E	31°51'13.38"S	24° 1'25.58"E
Point 2	31°50'14.37"S	24° 0'50.32"E	31°50'14.37"S	24° 0'50.32"E	31°50'14.37"S	24° 0'50.32"E
Point 3	31°48'43.59"S	23°57'55.92"E	31°48'43.59"S	23°57'55.92"E	31°48'43.59"S	23°57'55.92"E
Start (on-site substation at Khangela Emoyeni WEF site)	31°48'43.05"S	23°57'42.71"E	31°48'43.05"S	23°57'42.71"E	31°48'43.05"S	23°57'42.71"E
Point 4	31°50'14.63"S	23°55'28.86"E	31°50'14.63"S	23°55'28.86"E	31°50'14.63"S	23°55'28.86"E
Point 5	31°49'13.74"S	23°53'33.39"E	31°49'13.74"S	23°53'33.39"E	31°49'13.74"S	23°53'33.39"E
Point 6	31°49'7.26"S	23°52'39.52"E	31°49'7.26"S	23°52'39.52"E	31°49'7.26"S	23°52'39.52"E
Point 7	31°47'31.74"S	23°49'11.72"E	31°47'31.74"S	23°49'11.72"E	31°47'31.74"S	23°49'11.72"E
Point 8	31°45'32.28"S	23°45'29.58"E	31°45'32.28"S	23°45'29.58"E	31°45'32.28"S	23°45'29.58"E
Point 9	31°43'29.18"S	23°45'1.23"E	31°44'1.56"S	23°42'34.93"E	31°44'1.56"S	23°42'34.93"E
Point 10	31°42'48.88"S	23°40'11.59"E	31°43'6.86"S	23°42'18.16"E	31°42'48.88"S	23°40'11.59"E
			31°42'48.88"S	23°40'11.59"E		

Point 11 (Ishwati Collector Sub)	31°42'24.42"S	23°39'30.33"E	31°42'24.42"S	23°39'30.33"E	31°42'24.42"S	23°39'30.33"E
Point 12	31°42'34.31"S	23°38'58.91"E	31°42'34.31"S	23°38'58.91"E	31°42'34.31"S	23°38'58.91"E
Point 13	31°43'9.01"S	23°38'11.49"E	31°43'9.01"S	23°38'11.49"E	31°43'9.01"S	23°38'11.49"E
Point 14	31°43'54.78"S	23°35'20.23"E	31°43'54.78"S	23°35'20.23"E	31°43'54.78"S	23°35'20.23"E
Point 15	31°40'58.19"S	23°25'27.11"E	31°40'58.19"S	23°25'27.11"E	31°40'58.19"S	23°25'27.11"E
End (Extended 1.91 km^2 development corridor to (Gamma Substation) Preferred Alternative from the east	31°40'46.22"S	23°24'46.55"E	31°40'46.22"S	23°24'46.55"E	31°40'46.22"S	23°24'46.55"E
End (Extended 1.91 km^2 development corridor to Gamma Substation) Preferred Alternative from the south	31°40'56.04"S	23°24'40.11"E	31°40'56.04"S	23°24'40.11"E	31°40'56.04"S	23°24'40.11"E

Table 1.3. Water Crossing Points along the 132kV Powerline within a 400m-wide corridor and gravel access track approximately 7m wide from the Umsinde Emoyeni switching station and extended 1.91 km^2 corridor to the Gamma Substation (Preferred Alternative):

Gamma Substation to Ishwati Switching Station					
Watercourse Crossing	GPS Coordinates		Watercourse Crossing	GPS Coordinates	
	Latitude	Longitude		Latitude	Longitude
1	31° 40.895'S	23° 25.233'E	16	31° 43.839'S	23° 35.129'E
2	31° 41.036'S	23° 25.743'E	17	31° 43.889'S	23° 35.303'E
3	31° 41.303'S	23° 26.688'E	18	31° 43.853'S	23° 35.487'E
4	31° 41.551'S	23° 27.579'E	19	31° 43.738'S	23° 35.826'E
5	31° 41.647'S	23° 27.969'E	20	31° 43.660'S	23° 36.141'E
6	31° 41.776'S	23° 28.327'E	21	31° 43.518'S	23° 36.634'E
7	31° 41.815'S	23° 28.474'E	22	31° 43.458'S	23° 36.905'E
8	31° 42.067'S	23° 29.346'E	23	31° 43.453'S	23° 36.987'E

9	31º 42.354'S	23º 30.316'E	**24**	31º 43.389'S	23º 37.208'E
10	31º 42.405'S	23º 30.479'E	**25**	31º 43.261'S	23º 37.699'E
11	31º 42.538'S	23º 30.925'E	**26**	31º 43.238'S	23º 37.813'E
12	31º 42.772'S	23º 31.654'E	**27**	31º 43.229'S	23º 37.905'E
13	31º 43.233'S	23º 33.111'E	**28**	31º 43.178'S	23º 38.061'E
14	31º 43.362'S	23º 33.570'E	**29**	31º 43.082'S	23º 38.300'E
15	31º 43.536'S	23º 34.080'E	**30**	31º 42.930'S	23º 38.518'E

Ishwati Switching Station to Khangela Switching Station					
Watercourse Crossing	**GPS Coordinates**		**Watercourse Crossing**	**GPS Coordinates**	
	Latitude	**Longitude**		**Latitude**	**Longitude**
31	31º 42.866'S	23º 40.290'E	**58**	31º 47.823'S	23º 49.804'E
32	31º 43.284'S	23º 41.134'E	**59**	31º 47.901'S	23º 49.951'E
33	31º 43.688'S	23º 41.937'E	**60**	31º 48.006'S	23º 50.198'E
34	31º 42.898'S	23º 41.616'E	**61**	31º 48.066'S	23º 50.364'E
35	31º 43.027'S	23º 42.364'E	**62**	31º 48.259'S	23º 50.708'E
36	31º 44.009'S	23º 42.534'E	**63**	31º 48.621'S	23º 51.486'E
37	31º 43.178'S	23º 43.374'E	**64**	31º 48.904'S	23º 52.183'E
38	31º 43.261'S	23º 44.255'E	**65**	31º 49.041'S	23º 52.498'E
39	31º 43.293'S	23º 44.328'E	**66**	31º 49.190'S	23º 52.867'E
40	31º 44.504'S	23º 43.539'E	**67**	31º 49.215'S	23º 53.392'E
41	31º 44.270'S	23º 45.237'E	**68**	31º 49.404'S	23º 53.891'E
42	31º 44.826'S	23º 44.149'E	**69**	31º 49.442'S	23º 53.813'E
43	31º 45.124'S	23º 44.700'E	**70**	31º 49.598'S	23º 54.228'E
44	31º 44.812'S	23º 45.526'E	**71**	31º 49.640'S	23º 54.290'E
45	31º 45.537'S	23º 45.494'E	**72**	31º 49.691'S	23º 54.376'E
46	31º 45.845'S	23º 46.109'E	**73**	31º 49.860'S	23º 54.672'E
47	31º 45.739'S	23º 45.958'E	**74**	31º 50.021'S	23º 54.889'E
48	31º 45.629'S	23º 45.691'E	**75**	31º 50.088'S	23º 55.079'E
49	31º 46.235'S	23º 46.853'E	**76**	31º 50.152'S	23º 55.217'E
50	31º 46.547'S	23º 47.440'E	**77**	31º 49.854'S	23º 56.055'E
51	31º 46.717'S	23º 47.775'E	**78**	31º 49.748'S	23º 56.220'E
52	31º 46.785'S	23º 47.899'E	**79**	31º 49.677'S	23º 56.303'E
53	31º 47.088'S	23º 48.482'E	**80**	31º 49.532'S	23º 56.461'E
54	31º 47.290'S	23º 48.698'E	**81**	31º 49.124'S	23º 56.975'E
55	31º 47.414'S	23º 48.959'E	**82**	31º 48.830'S	23º 57.425'E
56	31º 47.492'S	23º 49.051'E	**83**	31º 48.558'S	23º 57.715'E
57	31º 47.708'S	23º 49.547'E	**84**	31º 48.759'S	23º 57.831'E

Khangela Switching Station to Umsinde Switching Station		
Watercourse Crossing	**GPS Coordinates**	
	Latitude	**Longitude**

83	31º 48.558'S	23º 57.715'E
84	31º 48.759'S	23º 57.831'E
85	31º 48.886'S	23º 58.233'E
86	31º 49.101'S	23º 58.643'E
87	31º 49.438'S	23º 59.251'E
88	31º 49.489'S	23º 59.362'E
89	31º 49.750'S	23º 59.910'E
90	31º 50.062'S	24º 00.493'E
91	31º 50.317'S	24º 00.890'E

Table 1.4. Proposed New Access Road Co-ordinates to the authorised Ishwati Substation site:

	Latitude	**Longitude**
Start (off the existing unnamed gravel road)	31º 44.203'S	23º 46.714'E
Middle	31º 42.906'S	23º 42.942'E
End (Authorised Ishwati Substation site)	31º 42.407'S	23º 39.506'E

In terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations [4 December 2014, Government Notice (GN) R982, R983, R984 and R985, as amended], various aspects of the proposed developments may have an impact on the environment and are considered to be listed activities. These activities require authorisation from the National Competent Authority (CA), namely the Department of Forestry, Fisheries and the Environment (DFFE), prior to the commencement thereof. Further to this as per GN R. 2313 : ***Adoptions of the standard for the development and expansion of powerlines and substation with identified geographical areas and the exclusion of this infrastructure from the requirements to obtain Environmental Authorisation***, the Standard was adopted in terms of section 24(10)(a) of the Act for the purpose of excluding the activities contemplated in paragraph 5.1 and 5.2 of the Schedule from the requirement to obtain environmental authorisation prior to commencement. In terms of the procedural requirement set out in the standard, screening tool reports have been undertaken for the grid corridor and associated infrastructure and site sensitivity verifications have been undertaken by the relevant specialists in accordance with the sensitivity themes. As per 6.1. of the GNR .2313, "Where any part of the infrastructure occurs on an area for which the environmental sensitivity for any environmental theme is identified as being very high or high by the national web based environmental screening tool and confirmed to be such through the application of the procedures set out in the Standard", the site sensitivity verifications have been performed as per the procedural requirements set out.

In accordance with GN 320 and GN 1150 (20 March 2020)[1] of the NEMA EIA Regulations of 2014 (as amended), prior to commencing with a specialist assessment, a site sensitivity verification must be undertaken to confirm the current land use and environmental sensitivity of the proposed project areas as identified by the National Web-Based Environmental Screening Tool (i.e., Screening Tool). Elize Butler, as palaeontology specialist, have been commissioned to verify the sensitivity of the project sites under these specialist protocols.

The scope of this report is for one (1) application, namely the 132KV grid connection infrastructure, associated access tracks & water course crossings associated with the authorised Emoyeni wind energy facilities, near Murraysburg, Beaufort West and Ubuntu Local Municipalities and Central Karoo and Pixely ka Seme District Municipalities, Western Cape, and Northern Cape Provinces.

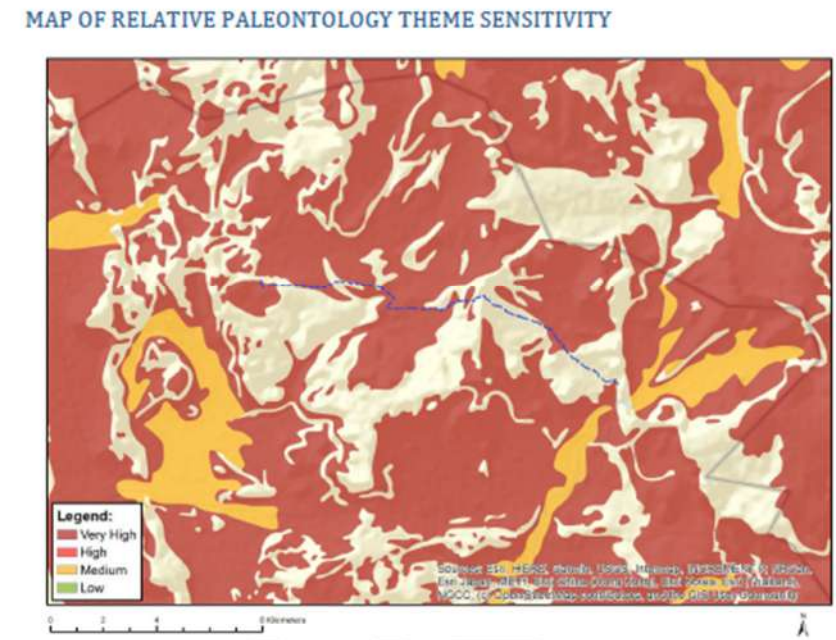
[1] GN 320 (20 March 2020): Procedures for The Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation

2. SITE SENSITIVITY VERIFICATION METHODOLOGY

The following information sources were consulted to compile this report:
The Palaeontology Sensitivity Verification was undertaken by the following methodology:

- The site sensitivity is established through the National Environmental Web-Based Screening Tool
- The Site is mapped on the relevant Geological Map to determine the underlying geology of the development
- Then the site is mapped on the South African Heritage Resources Information System (SAHRIS) PalaeoMap, and the Sensitivity of the proposed development established.
- Other information is obtained by using satellite imagery and
- Palaeontological Impact Assessments and Desktop Assessments of projects in the same area are studied.
- A site investigation was conducted for this project

3. OUTCOME OF SITE SENSITIVITY VERIFICATION



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

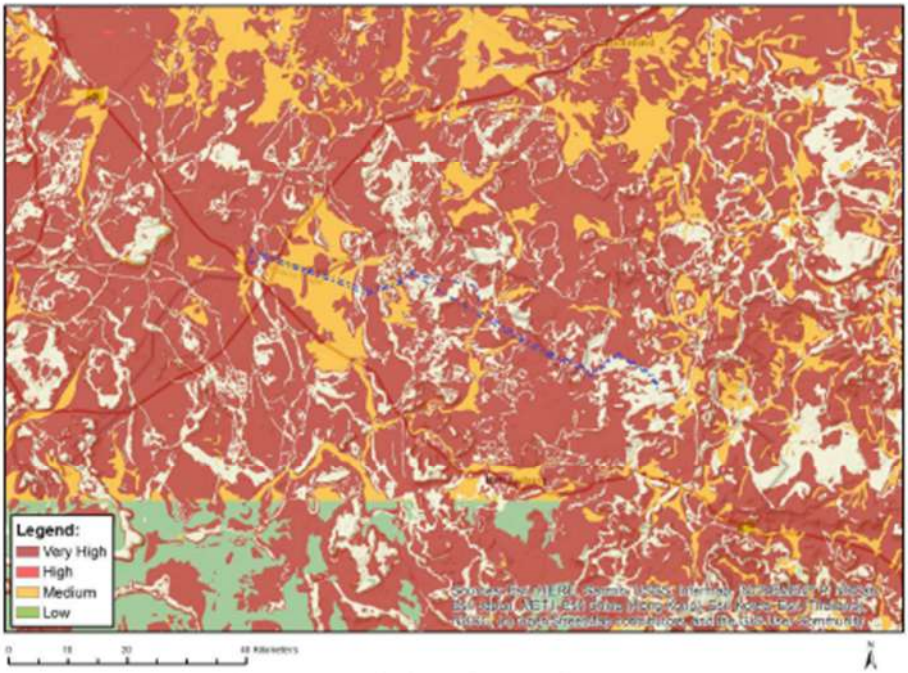
Sensitivity Features:

Sensitivity	Feature(s)
Very High	Features with a Very High paleontological sensitivity

Figure 2: Palaeontological Sensitivity of the access roads generated by the National Environmental Web-bases Screening Tool.

According to the screening tool the proposed access roads has a Very High (dark red) and Unknown (white) Palaeontological Sensitivity.

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Features with a Medium paleontological sensitivity
Very High	Features with a Very High paleontological sensitivity

Figure 3: Palaeontological Sensitivity of the proposed 400m Grid Corridor generated by the National Environmental Web-bases Screening Tool.

According to the screening tool the proposed 400m Grid Corridor is underlain by sediment with a Very High (dark red), Medium (orange), and Unknown (white) Palaeontological Sensitivity.

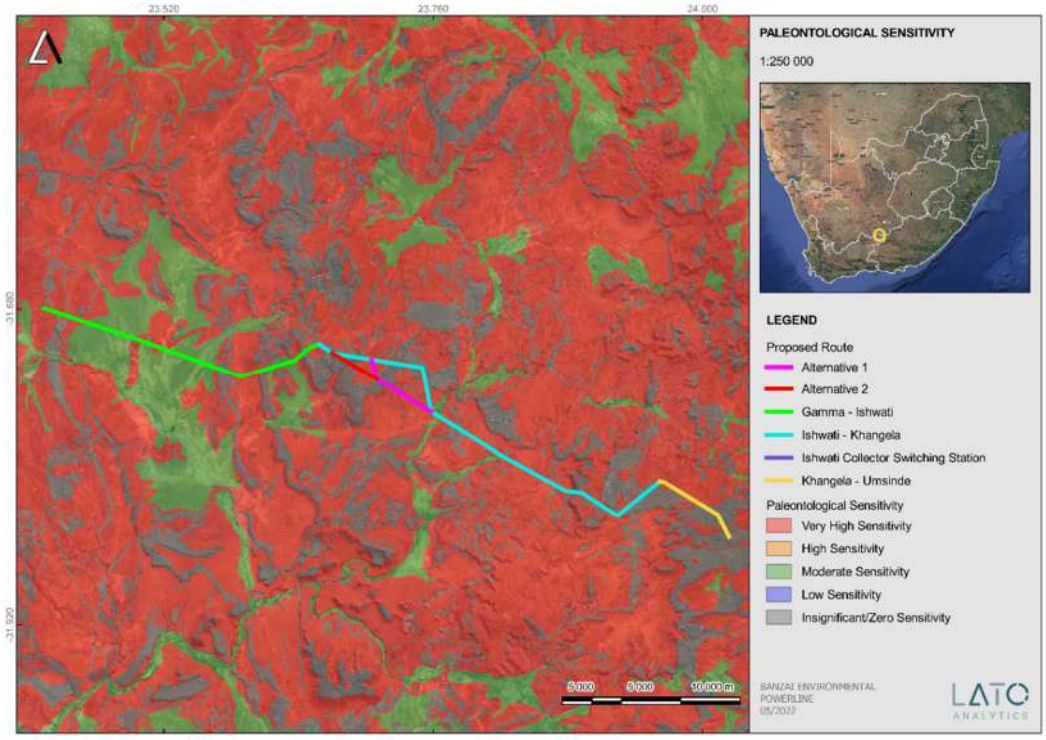


Figure 3: Extract of the SAHRIS Palaeomap (Council of Geosciences, Pretoria) indicating the Palaeontological study area.

According to the SAHRIS Palaeomap the proposed development is underlain by sediments with a Very High (red), Moderate (green) and Zero (grey) Palaeontological Sensitivity.

4. CONCLUSION

Most of the powerline, access roads and associated infrastructure is concentrated on the higher-lying areas in the development. These areas are mostly underlain by Karoo dolerite that are unfossiliferous. Only a relatively small area of the developments is underlain by potentially fossiliferous Lower Beaufort sedimentary rocks and older consolidated alluvium. Several weathered *in situ* and loose vertebrate fossils were uncovered during the 2022 winter walkdown of the development footprints. These fossil finds were expected as the surrounding area of the developments are known to be highly fossiliferous as almost 2000 fossils have been collected by research teams in the past. This classification is thus confirmed to be accurate (National Environmental Web-bases Screening Tool and SAHRIS) as far as the impact of the proposed powerline, substation and associated infrastructure is concerned, based on actual conditions recorded on the ground during the site visit in the winter months of 2022.