PALAEONTOLOGICAL FIELD INVESTIGATION
PHASE 1 REPORT

PROPOSED MELKSPRUIT-RIEBEEK 132kV POWERLINE

Located in the northern part of the Maletswai Local Municipality within the Joe Gqabi District Municipality in the Eastern Cape Province of South Africa

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EXECUTIVE SUMMARY

Metsi-Metseng Geological and Environmental Services CC was appointed by Eskom's Eastern Cape Operating Unit (East London) to undertake a Phase 1 Palaeontological Field Investigation, assessing the potential palaeontology impact of the proposed Melkspruit-Riebeek 132kV powerline and associated infrastructure project located in the northern part of the Maletswai Local Municipality within the Joe Gqabi District Municipality in the Eastern Cape Province of South Africa.

This report forms part of the requirements of the Department of Environmental Affairs and Tourism as per the conditions on the Environmental Authorization (DEA Ref 12/12/20/2318) whereby Eskom must appoint a Palaeontologist prior to the construction phase of the development that will have the responsibility to ensure that the recommendations referred to in the SAHRA Review are implemented and to ensure compliance with the provisions of the study that was done in the BAR phase.

Eskom proposes to construct approximately 48km of 132kV Chicadee overhead powerline and associated monopole infrastructure. The proposed powerline is located in the northern part of the Maletswai Local Municipality of the Eastern Cape. The 132kV powerline will take off from the Melkspruit substation, approximately 1km west of Aliwal North, and travel approximately 48 km in an easterly direction to the Riebeek substation.

Prior to the field investigation a preliminary assessment (desktop study) of the topography and geology of the study areas was made using appropriate 1:250 000 geological maps in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc) were identified within the study area and the known fossil heritage within each rock unit was inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

Priority palaeontological areas were identified within the development footprint to focus the field investigation's time and resources. The aim of the fieldwork was to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

The study area is mainly underlain by Triassic sedimentary rocks of the Karoo Supergroup. The western part is underlain by the sediments of the Burgersdorp Formation, of the Tarkastad Subgroup, Upper Beaufort Group, of the Karoo Supergroup. This formation is intruded by Karoo Dolerite and overlain by more recent Quaternary alluvial deposits of the Orange and Kraai River drainage systems. The eastern part is underlain by the Molteno and Elliot Formations of the Stormberg Group, which are lightly intruded by Karoo Dolerite Suite.

The shallow sandstone hilltops, scree covered slopes and the deep bedrock in the intermediate valleys limit the potential for finding fossils on the powerline route. The small construction footprint of the pylons together with the existing maintenance road already developed (as part of the current powerline) further lower the potential for finding fossils. Therefore, the palaeontological sensitivity will be low with no significant heritage impact.

It is however recommended: That the resident ECO be informed and made aware of the small potential of finding fossils especially where fresh bedrock will be exposed by the excavations. If fossil material is later discovered it must be appropriately protected and the discovery reported to a palaeontologist for the removal thereof.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1. Background

Metsi-Metseng Geological and Environmental Services CC was appointed by Eskom's Eastern Cape Operating Unit (East London) to undertake a Phase 1 Palaeontological Field Investigation, assessing the potential palaeontology impact of the proposed Melkspruit-Riebeek 132kV powerline and associated infrastructure project located in the northern part of the Maletswai Local Municipality within the Joe Gqabi District Municipality in the Eastern Cape Province of South Africa.

This report forms part of the requirements of the Department of Environmental Affairs and Tourism as per the conditions on the Environmental Authorization (DEA Ref 12/12/20/2318) whereby Eskom must appoint a Palaeontologist prior to the construction phase of the development that will have the responsibility to ensure that the recommendations referred to in the SAHRA Review are implemented and to ensure compliance with the provisions of the study that was done in the BAR phase.

1.2. Aims and Methodology

A Phase 1 investigation is often the last opportunity to record the fossil heritage within the development footprint. These records are very important to understand the past and form an important part of South Africa's National Estate.

Following the *"SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports"* the aims of the palaeontological impact assessment were:

- to identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

Prior to the field investigation a preliminary assessment (desktop study) of the topography and geology of the study areas was made using appropriate 1:250 000 geological maps in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc) were identified within the study area and the known fossil heritage within each rock unit was inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

Priority palaeontological areas were identified within the development footprint to focus the field investigation's time and resources. The aim of the fieldwork was to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

The likely impact of the proposed development on local fossil heritage was determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1.1 below.

Table 1.1 Palaeontological Sensitivity Analysis Outcome Classification

Sensitivity	Description
Low Sensitivity	Areas where there is likely to be a negligible impact on the fossil heritage. This category is reserved largely for areas underlain by igneous rocks. However, development in fossil bearing strata with shallow excavations or with deep soils or weathered bedrock can also form part of this category.
Moderate Sensitivity	Areas where fossil bearing rock units are present but fossil finds are localised or within thin or scattered sub-units. Pending the nature and scale of the proposed development the chances of finding fossils are moderate. The developer should be made aware of the potential for finding fossils. If fossil material is later discovered it must be appropriately protected and the discovery reported to the appropriate Heritage Authority so that any appropriate mitigation by a palaeontological specialist can be considered and implemented, at the developer's expense.
High Sensitivity	Areas where fossil bearing rock units are present with a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in outcrops and exposed bedrock. The chances of finding fossils during excavations by a professional palaeontologist are high. Palaeontological mitigation measures need to be incorporated into the Environmental Management Plan. The mitigation should involve the comprehensive recording and collection of surface and embedded fossils along and close to the development footprint by a professional palaeontologist.

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, palaeontological mitigation measures should be incorporated into the Environmental Management Plan.

2. PROJECT DESCRIPTION

Eskom proposes to construct approximately 48km of 132kV Chicadee overhead powerline and associated monopole infrastructure. The proposed powerline is located in the northern part of the Maletswai Local Municipality of the Eastern Cape. The Maletswai Local Municipality is situated in the Joe Gqabi District Municipality, south of the Orange River which separates the municipality from the Free State Province.

The 132kV powerline will take off from the Melkspruit substation, approximately 1km west of Aliwal North, and travel approximately 48 km in an easterly direction to the Riebeek substation (Figure 2.1). Associated infrastructure include the installation of OPGW on the Melkspruit-Riebeek 132kV line, installation of 132/66kv 2 x 40MVA transformers at the Riebeek substation and installation of a second 66/22kV 2 x 20MVA transformer at the Sterkspruit substation.

Figure 2.1 Locality of the proposed Melkspruit-Riebeek powerline

3. GEOLOGY OF THE AREA

The study area is mainly underlain by Triassic sedimentary rocks of the Karoo Supergroup (Figure 4.1). The western part is underlain by the sediments of the Burgersdorp Formation, of the Tarkastad Subgroup, Upper Beaufort Group, of the Karoo Supergroup. This formation is intruded by Karoo Dolerite and overlain by more recent Quaternary alluvial deposits of the Orange and Kraai River drainage systems. The eastern part is underlain by the Molteno and Elliot Formations of the Stormberg Group, which are lightly intruded by Karoo Dolerite Suite.

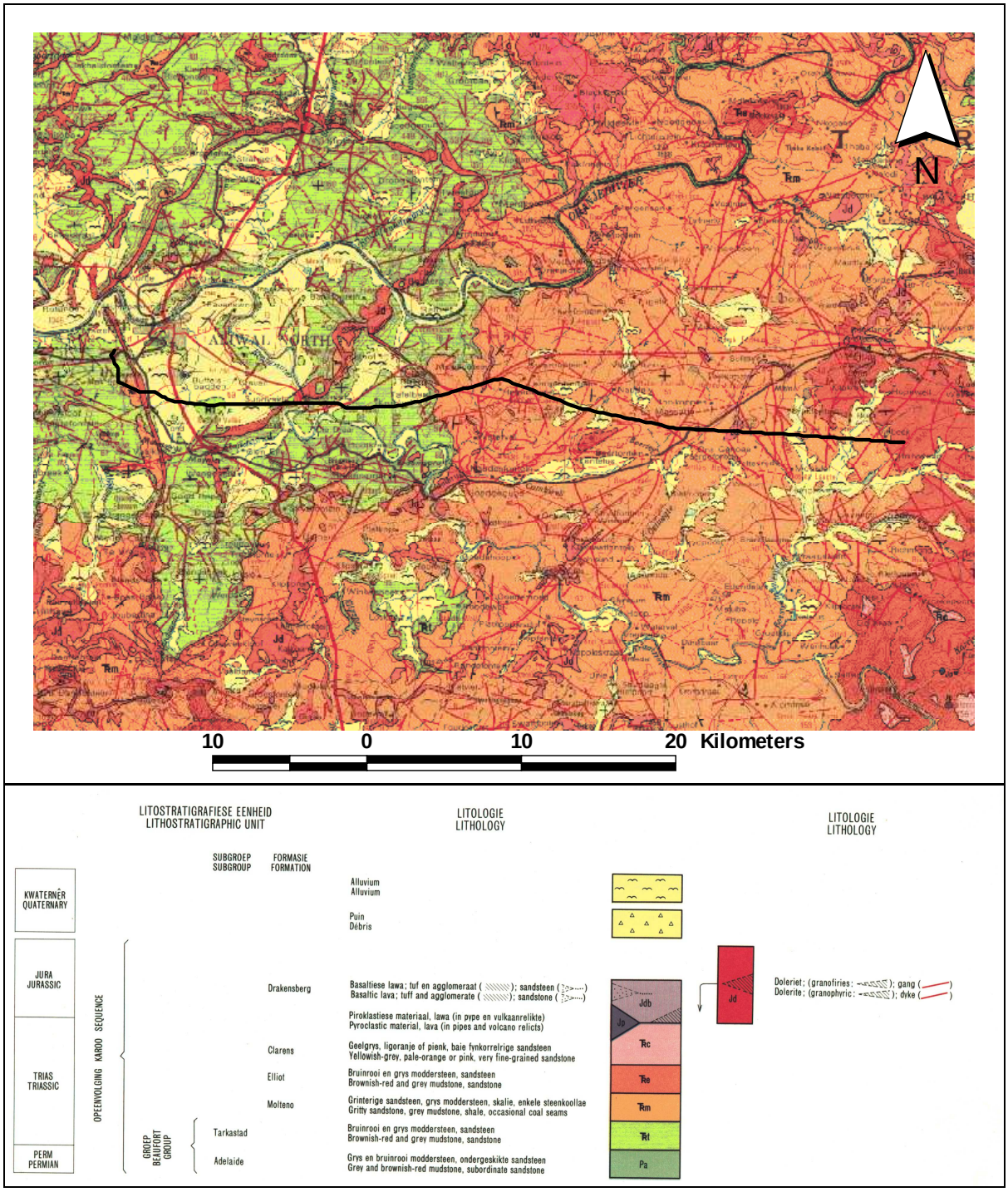

Figure 3.1 **Geology of the study area at Aliwal North (Geo Map 3026 Aliwal North)**

4. PRELIMINARY PALAEONTOLOGICAL ASSESSMENT RESULTS

A desktop study was done by Dr J Almond during October 2011. The results as summarised by SAHRA in their Review Comment on Palaeontological Impact Assessments, Ref. 9/2/006/0001 and 9/2/057/001 dated 18 May 2012 are as follow:

"The Burgersdorp Formation has previously yielded important Triassic continental fossil biota, amongst which those belong to the *Cynognathus* Assemblage Zone, one of the richest Early-Mid Triassic biotas worldwide. Also the Molteno Formation has a very rich palaeontological assemblage composed by megaflora fossil, silicified wood, palynomorph assemblages, fossil fish, insects and trace fossils. These assemblages are evidence of the interaction between early plants and insects in the Later Triassic Period.

The rich fossil material of the Elliot Formation is assigned to the *Euskelesaurus* Assemblage Zone and amongst its biota are rare amphibians, sauropodomorph, theropod and ornithishicna dinosaurs, rauisuchians, cynodont and dicynodont therapsids, conchostracans and sparse invertebrate trace fossils and plants, which have high palaeontological significance."

5. FIELD INVESTIGATION

A field investigation of the site was conducted on 26 and 27 February 2013 by Dr Johan Loock and Mr Tom Hugo, experienced fieldworkers. The aim of the fieldwork was to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area. The results are discussed according to the proposed pylon placements as illustrated in figure 5.1.

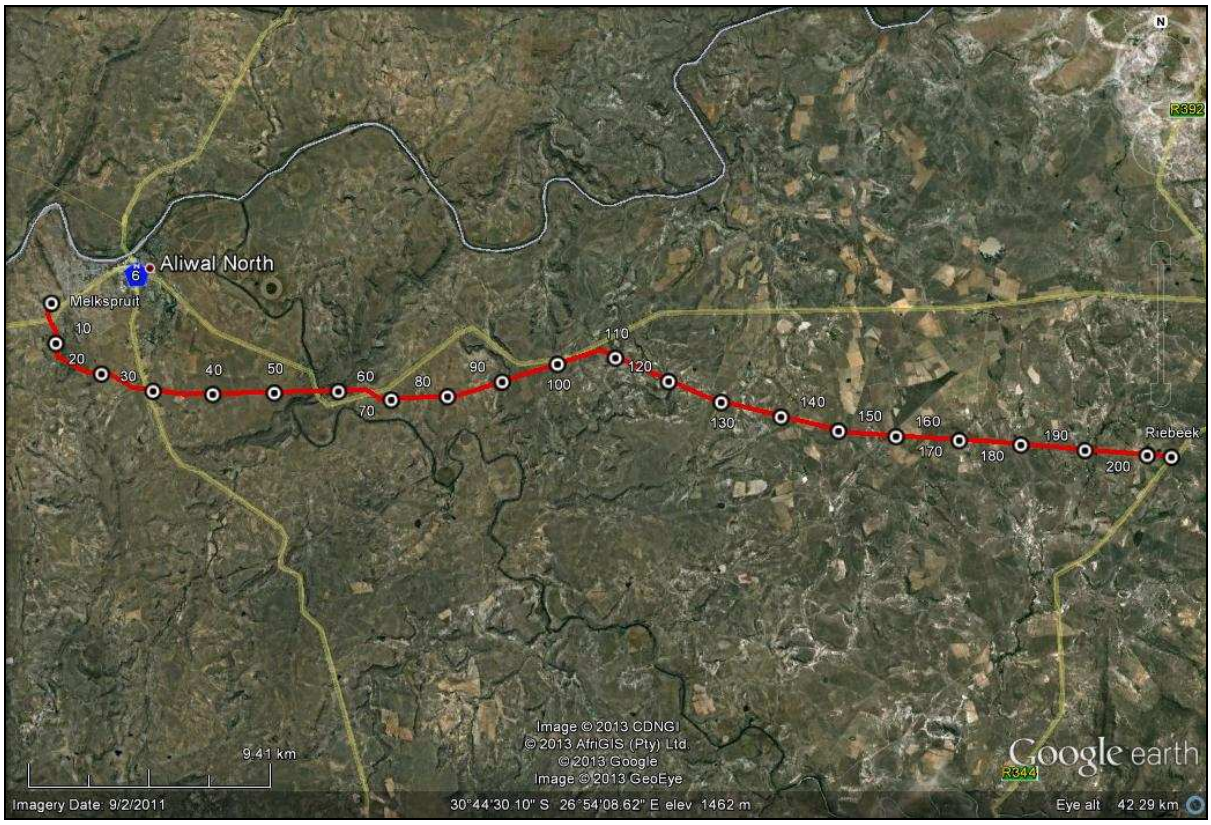

Figure 5.1 Proposed pylon placement of the Melkspruit-Riebeek powerline

5.1. Melkspruit Substation to Pylon 18

The alignment is underlain by fairly deep alluvium sediments (Figure 5.2), sandstone of the lower Burgersdorp and higher Molteno Formations where outcrops are covered by scree on the hill slopes (Figure 5.3) and finally crossing a dolerite intrusion onto fluvial plain (Figure 5.4).

Figure 5.2 Alluvium sediments at the Melkspruit Substation (S30.70251° E26.67607°)

Figure 5.3 Burgersdorp Formation hill slopes covered by scree (S30.70895° E26.67379°)

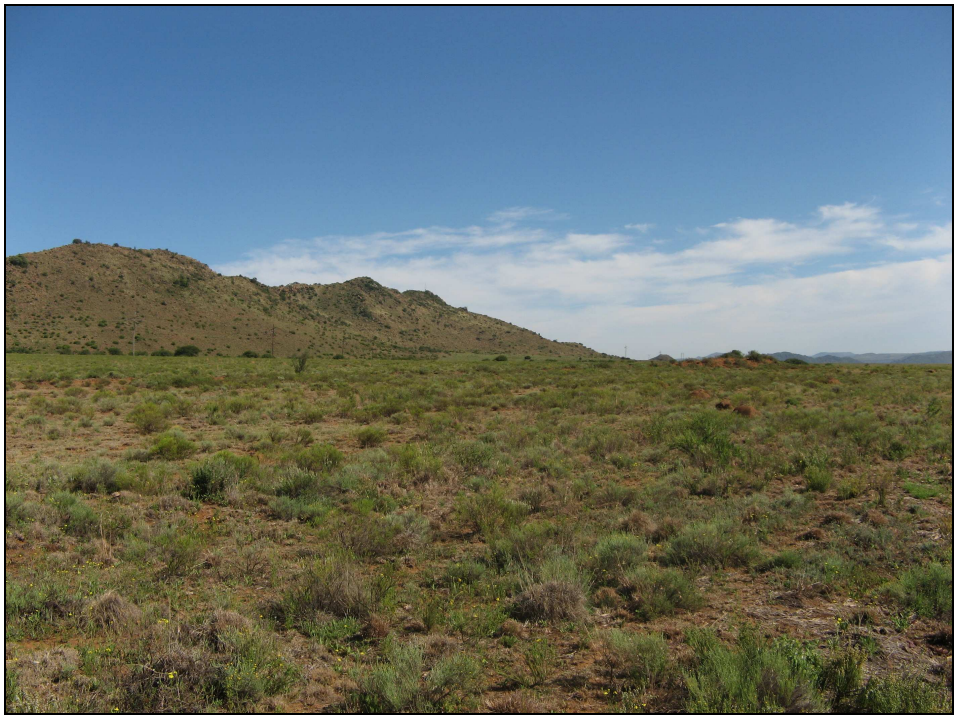

Figure 5.4 Dolerite intrusion with fluvial plain (S30.72742° E26.69380°)

No fossil material were recorded or is expected in this section due to the deep alluvium sedimentation, the scree covered hill slopes as well as the sandstone and dolerite hill crests.

5.2. Pylon 18 to Pylon 50

The alignment crosses ancient Orange River System fluvial deposits on an old terrace (Figure 5.5 and 5.6). No fossil material is expected due to the recent Quaternary Deposits.

Figure 5.5 Deep fluvial deposits on the old terrace (S30.71112° E26.73434°)

Figure 5.6 Fluvial plains of the ancient Orange River System (S30.73445° E26.74932°)

5.3. Pylon 50 to Pylon 70

Proposed alignment is underlain by dolerite intrusion and Burgersdorp Sandstone on the western side of the Kraai River crossing. Dense vegetation and scree cover any potential mudstone outcrops (Figure 5.7). The eastern side is underlain by a thick layer of Burgersdorp sandstone followed by fluvial gravel deposits of the ancient Kraai River system (Figure 5.8). No fossil material was recorded due to the dense vegetation cover, and thick layered sandstone.

Figure 5.7 Western slope at the Kraai River crossing (S30.73397° E26.78296°)

Figure 5.8 Eastern side of the Kraai River crossing (S30.73805° E26.79398°)

5.4. Pylon 70 to Pylon 90

The alignment crosses shallow soil covered Burgersdorp sandstone (Figure 5.9). No fossil material is expected due to the thick top sandstone layer and absence of mudstones outcrops.

Figure 5.9 Shallow soil covered sandstone plains (S30.72976° E26.86249°)

5.5. Pylon 90 to Pylon 200

The area is underlain by the Molteno Formation. Initially the alignment crosses a deep colluvial intermediate valley up to pylon 110 (Figure 5.10), followed by an area where the fossil bearing mudstone strata has been weathered away onto course sandstone beds with shallow soils up to pylon 140 (Figure 5.11). Most of the area from pylon 140 to 200 is deep colluvial intermediate valleys intruded by dolerite dykes (Figure 5.12). No fossil material is expected due to deep soils or thick exposed top sandstone layer and absence of mudstones.

Figure 5.10 Deep colluvial intermediate valley (S30.72751° E26.87227°)

Figure 5.11 Exposed Molteno sandstone beds (S30.73077° E26.93085°)

Figure 5.12 Deep soil colluvial valleys intruded by dolerite dykes (S30.74509° E26.98351°)

5.6. Pylon 200 to Riebeek Substation

The area is underlain by sandstone and maroon mudstone of the Elliot Formation. Outcrop is limited to road cuttings. The alignment is traversing an area of deep soils (Figure 5.13). No fossils are expected.

Figure 5.13 Deep soils on Elliot Formation (S30.75668° E27.12968°)

6. PALAEONTOLOGICAL SENSITIVITY AND SIGNIFICANCE

The desktop study suggests that the area underlain by the Burgersdorp, Molteno and Elliot Formations will be highly sensitive for palaeontological heritage.

However, the field investigation results indicate that for areas underlain by the Burgersdorp Formation, the hill tops are sandstone and hill slopes are covered in scree. The intermediate valleys are covered in deep soils deposited from ancient rivers or from weathering hills.

For areas underlain by the Molteno Formation the potential fossil bearing strata has been weathered away onto sandstone beds covered by shallow soils on the hills and hill slopes. The intermediate valleys are covered in deep transported soils. The small area underlain by the Elliot Formation is also covered in deep transported soils

The known vertebrates and plant fossil bearing strata in the Burgersdorp and Molteno Formations where found in a more aired area south of the current area investigated (Kitching, 1977).

The shallow sandstone hilltop, scree covered slopes and the deep bedrock in the intermediate valleys limit the potential for finding fossils on the powerline route. The small construction footprint of the pylons together with the existing maintenance road already developed (as part of the current powerline) further lower the potential for finding fossils.

Therefore, the palaeontological sensitivity will be low with no significant heritage impact as illustrated in Figure 6.1.

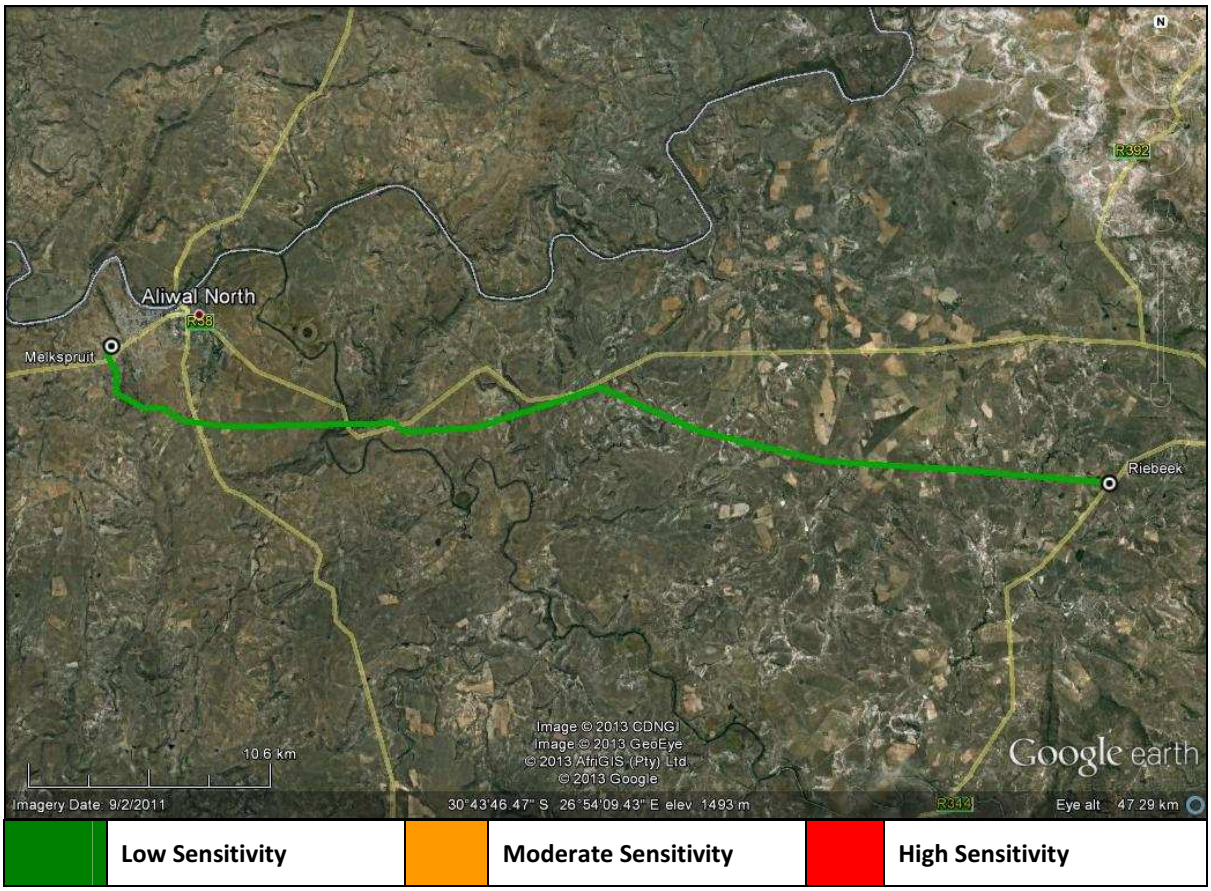

Figure 6.1 Palaeontological Sensitivity Localities

7. CONCLUSION AND RECOMMENDATIONS

The study area is mainly underlain by Triassic sedimentary rocks of the Karoo Supergroup. The western part is underlain by the sediments of the Burgersdorp Formation, of the Tarkastad Subgroup, Upper Beaufort Group, of the Karoo Supergroup. This formation is intruded by Karoo Dolerite and overlain by more recent Quaternary alluvial deposits of the Orange and Kraai River drainage systems. The eastern part is underlain by the Molteno and Elliot Formations of the Stormberg Group, which are lightly intruded by Karoo Dolerite Suite.

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8. REFERENCES

Groenewald. GH & Kitching, JW 1995. Biostratigraphy of the Lystrosaurus Assemblage Zone. In: Rubidge, B.S. (Ed.) Biostratigraphy of the Beaufort Group (Karoo Supergroup), South African Committee for Stratigraphy, Biostratigraphic Series, No. 1. 46 pp.

Groenewald GH 1996. Stratigraphy and Sedimentology of the Tarkastad Subgroup, Karoo Supergroup, South Africa. Unpubl PhD Thesis, University of Port Elizabeth.

Kitching JW 1977. The distribution of the Karroo Vertebrate fauna Memoir No 1, Bernard Price Institute for Palaeontological Research University of the Witwatersrand 131pp.

Johnson MR , Anhaeusser CR and Thomas RJ (Eds) (2006). The Geology of South Africa. GSSA, Council for Geoscience, Pretoria.

Rubidge BS (ed) 1995. Biostratigraphy of the Beaufort Group (Karoo Supergroup), South Africa. Biostratigraphic Series No.1, South African Committee for Stratigraphy.

9. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Johan Loock has a PhD (hc) from the University of the Orange Free State in Bloemfontein. He specialises in research on the Karoo and has 40 years of experience and reaches of the stratigraphy and sedimentology. He is a member of the Palaeontological, Geological and Archeologically Societies of Southern Africa. His publication records include multiple articles in international and national recognised journals, books and popular articles.

10. DECLARATION OF INDEPENDENCE

I, Johan Loock, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of palaeontological heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

Dr Johan Loock
Geologist