

PALAEONTOLOGICAL IMPACT ASSESSMENT REPORT

THE PROPOSED REHABILITATION OF SECTION 7 OF THE N9 NATIONAL ROAD

Middelburg, Eastern Cape Province South Africa

Road reserve, Section 7 of the N9 National Road , Luxuba Yethemba
Municipality within the Chris Hani *District Municipality*

Developer: South African National Roads Agency Ltd



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EXECUTIVE SUMMARY

The upgrading of section 7 of the N9 National Road near Middelburg in the Eastern Cape is an initiative of the National Road Agency Ltd. Coastal and Environmental Services (CES) commissioned this Palaeontological Impact Assessment as part of the Heritage Impact Assessment. The purpose of the Palaeontological Impact Assessment is to identify exposed and potential palaeontological heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated.

The proposed development sites are in the road reserve of the N9 north of the town of Middelburg which is situated in the Eastern Cape Province. The proposed project is planned to upgrade the N9 National Road.

A basic assessment of the topography and geology of the area was made by using appropriate geological (1:250 000) maps in conjunction with Google Earth. A review of the literature on the geological formations exposed at surface in the development site and the fossils that have been associated with these geological strata was undertaken. A site field investigation was conducted on 18 October 2011, with the aim 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 Middelburg to Carlton Heights area consists predominantly of the Adelaide and Tarkastad Subgroups of the Beaufort Group of the Karoo Supergroup. The Tarkastad Subgroup comprises mostly of a lower sandstone rich Katberg Formation and overlying red mudstone rich Burgersdorp Formation. The Adelaide Subgroup comprises of grey and brownish-red mudstones and sandstones. Karoo Dolerite intrusions are present over the entire study area and due to its resistance to weathering, underlie most of the higher topography in the region.

The field investigation confirms that the development site is dominated by rugged hill topography with outcrops of the Katberg Formation. These outcrops consist of relatively extensive beds of yellowish-grey to light greenish-grey sandstones and bluish-grey and reddish-grey mudstones. There is a high potential for fossil material in the underlying mudstones that could be uncovered during excavations.

The Katberg Formation outcrops in the development site have a high palaeontological sensitivity rating. Through adequate monitoring and mitigation measures during excavations, the high impact severity can be lowered to beneficial. The exposure and subsequent reporting of fossils (that would otherwise have remained undiscovered) will be a beneficial palaeontological impact.

It is recommended that a collection and rescue permit be obtained from SAHRA prior to construction. That all earth-moving activities with potential impact on the Katberg formation be monitored by a resident palaeontologist. That a monitoring report be submitted to SAHRA after the completion of the earth works phase. That the resident ECO be trained by a professional palaeontologist in the recognition of fossil material. If fossil material is later discovered it must be appropriately protected and the discovery reported to a palaeontologist for the removal thereof.

SIGNIFICANCE RATING							
Rock Unit	Temporal Scale	Spatial Scale	Degree of Confidence	Impact Severity		Overall Significance	
				With mitigation	Without mitigation	With mitigation	Without mitigation
Katberg Formation	permanent	international	possible	beneficial	very severe	beneficial	High negative

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1. INTRODUCTION

The proposed upgrading of the N9 National road near Middelburg in the Eastern Cape is an initiative of National Road Agency Ltd. Coastal and Environmental Services (CES) commissioned this Palaeontological Impact Assessment as part of the Heritage Impact Assessment. The purpose of the Palaeontological Impact Assessment is to identify exposed and potential palaeontological heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated.

1.1. Legal Requirements

This report forms part of the Environmental Impact Assessment for the Upgrading of the N9 National Road and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Heritage Impact Assessment (HIA) is required to assess any potential impacts to palaeontological heritage within the development footprint of the upgrade development.

Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

2. PROPOSED DEVELOPMENT DESCRIPTION

South African National Roads Agency Ltd, builds, operates and maintains National Roads in South Africa and plans to upgrade section 7 of the N9 National Road between Middelburg and Carlton Heights to the north of the town of Middelburg in the Eastern Cape Province of South Africa (Figure 2.1)



Figure 2.1 Location and Layout of the Proposed Road Upgrade at Middelburg Eastern Cape

The proposed project involves the construction activities associated with the upgrade of the road, including construction of new bridges or widening of existing bridges and excavation into the present road reserves to widen the existing road.

3. AIMS AND METHODS

After discussions with CES a request for a Phase 1 Palaeontological Impact Assessment (PIA) was received. Following the *“SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports”* the aims of the PIA were:

- identifying exposed and subsurface rock formations that are considered to be palaeontologically significant;
- assessing the level of palaeontological significance of these formations;
- conducting fieldwork to assess the immediate risk to exposed fossils as well as to document and sample these localities;
- commenting on the impact of the development on these exposed and/or potential fossil resources;
- making recommendations as to how the developer should conserve or mitigate damage to these resources.

A basic assessment of the topography and geology of the area was made by using appropriate geological (1:250 000) maps in conjunction with Google Earth. The only limitation on this methodology is the scale of mapping, which restricts comparison of the geology to the 1:250 000 scale. This restriction only applies in areas where major changes in the geological character of the area occur over very short distances or on the geological transformation zones.

A review of the literature on the geological formations exposed at surface in the development site and the fossils that have been associated with these geological strata was undertaken.

A field investigation of the site was conducted on 18 October 2011 by Dr G Groenewald and Mr T Hugo who are both experienced fieldworkers. The aims of the fieldwork were 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.

4. GEOLOGY OF THE AREA

The Middelburg area consists predominantly of the Adelaide and Tarkastad Subgroups of the Beaufort Group of the Karoo Supergroup. The Adelaide Subgroup comprises of grey and brownish-red mudstones and sandstones. The Tarkastad Subgroup comprises mostly of a lower sandstone rich Katberg Formation and overlying red mudstone rich Burgersdorp Formation (Groenewald, 1996). Karoo Dolerite intrusions are present over the entire study area and due to its resistance to weathering, underlie most of the higher topography in the region. The larger part of the development site cuts into alluvial material (Figure 4.1).

4.1. The Katberg Formation

The study area is specifically underlain by the Katberg Formation of the Tarkastad Subgroup, Beaufort Group (shale, mudstones and sandstones). The Katberg Formation consists of relatively extensive beds of yellowish-grey to light greenish-grey sandstones and bluish-grey and reddish-grey mudstones.

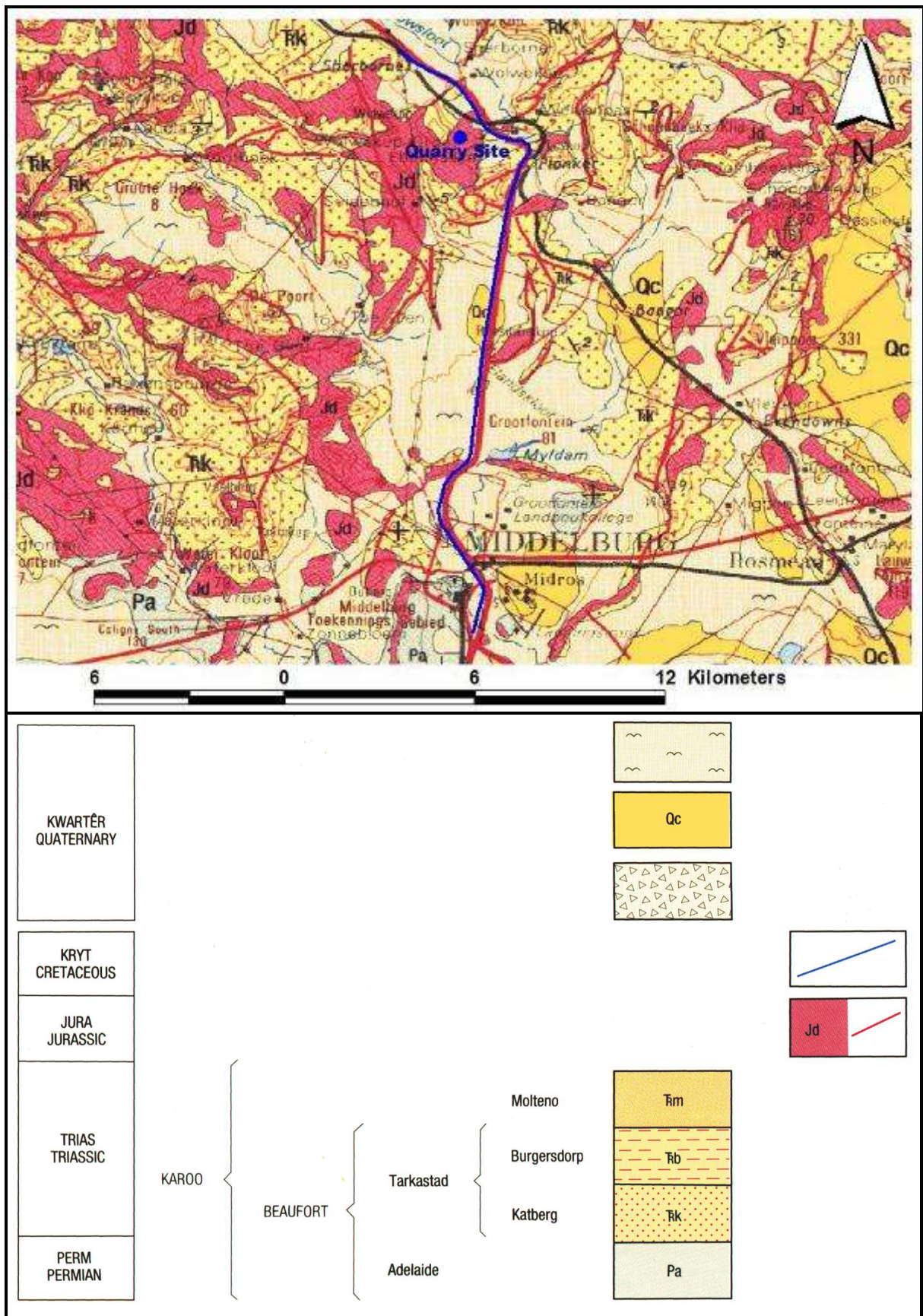


Figure 4.1 The Geology of Middelburg (Geological Map 3124)

Soils on sandstone hills are deep, freely drained and highly weathered. Soils that are derived from underlying mudstone are generally shallow and low in fertility. Due to the nature of the dispersive soils derived from the underlying mudstone, erosion of the topsoil happens fast. The erosion leads to high percentages of suspended solids in the rivers, reducing the quality of water in the rivers and dams, as well as silting up of dams.

4.2. Karoo Dolerite

Karoo Dolerite intrusions are present over the entire study area. Due to its resistance to weathering, it underlies most of the higher topography in the region.

4.3. Alluvial Deposits

Large parts of the study area are underlain by Quaternary alluvial deposits.

5. PALAEOLOGY OF THE AREA

The value of vertebrate fossils in rocks of the Beaufort Group lies in its use as distinguishable biostratigraphic criteria to refine further subdivision of the group. The biozones employed are based on the vertebrate fossil remains that are so abundant in these rocks.

5.1. The Katberg Formation

The Triassic Katberg Formation overlies the Palingkloof Member of the Balfour Formation and contains important international biostratigraphic information. The Balfour and Katberg Formations represent a time period that includes the Middle Permian to Middle Triassic and contain fossil remains of animals that transcends from reptiles to mammals. The Katberg Formation correlates with the middle and upper part of the *Lystrorhynchus* Assemblage Zone, containing fossils of both vertebrates and invertebrates of the Triassic era.

The Katberg Formation also contains some unique well-preserved vertebrate burrows (Groenewald, 1991) that are associated with the *Lystrorhynchus* and *Procolophon* fauna that dominates this stratigraphic unit.

Excavations for the foundations of the roads and other infrastructure may provide an opportunity to inspect fresh unweathered rock of this assemblage zone in the study area.

5.2. Karoo Dolerite

Due to the igneous character of this rock type it does not contain fossils.

5.3. Alluvial Deposits

No fossils are expected from the Quaternary alluvial deposits at this site.

6. FIELD INVESTIGATION

The development area is dominated level valley floors and rugged hill topography (Figure 6.1). The valley floors comprises of Quaternary alluvial deposits. The road cuttings through the hills consist of relatively extensive beds of yellowish-grey to light greenish-grey sandstones and bluish-grey and reddish-grey mudstones (Figure 6.2).

These Katberg Formation's sandstones characteristically comprise repeating, mutually truncating, trough cross-bedded channel-fill sand lenses, and mud-pebble conglomerates are often present at the base. The sandstones are by far the dominant element, with mudstones tending to be thin (2-10m) and of limited lateral extent (Groenewald, 1996).



Figure 6.1 Level valley floors with rugged hill topography of interbedded sandstone and mudstone of the Katberg Formation (S31.34467; E24.99154)



Figure 6.2 Characteristic yellowish-grey to light greenish-grey sandstones and bluish-grey and reddish-grey mudstones of the Katberg Formation (S31.35864; E25.01345)



Figure 6.3 Dolerite sill at the Quarry Site (S31.37452 E25.01846)

The ridges and higher topography of the study area consist of dolerite sills and dykes with some prominent outcrops. The quarry site is also situated in one of these sills (Figure 6.3)

Field investigations confirmed that potential fossil-rich mudstone beds are present. Sandstone outcrops are present on the steeper hill slopes and in all the road cuttings. Examination of these road cuttings revealed some fossil material, especially at GPS (WGS 84) reference S31.35864; E25.01345.

These fossil materials noted include:

- Well-preserved vertebrate burrows associated with the *Lystrosaurus* and *Procolophon* fauna (Figure 6.4)
- Trace fossils in thinly bedded siltstone in the mudstone units of the Katberg Formation (Figure 6.5)
- Desiccation crack structures at the base of clay-pellet conglomerates. Bone fragments are also present in this clay pellet conglomerate (Figure 6.5)
- A clay pellet conglomerate with small bone fragments in Katberg Formation (Figure 6.7).

The field investigations confirmed that the Katberg Formation in the area has fossil-rich mudstone beds and it can be presumed that any presently unexposed bedrock will have the potential to contain some fossil material.

The absence of fossils in the other road cuttings and outcrops examined should not be seen as an indication of the general absence of fossils from these beds, as fossils can be concentrated in specific rock units over very short distances



Figure 6.4 Well-preserved vertebrate burrows associated with the *Lystrosaurus* and *Procolophon* fauna (Road cutting ref. S31.35864; E25.01345)



Figure 6.5 Trace fossils in thinly bedded siltstone in the mudstone units of the Katberg Formation (Road cutting ref. S31.35864; E25.01345)



Figure 6.6 Desiccation crack structures at the base of clay-pellet conglomerates. Clay pellet conglomerate contains bone fragments (Road cutting ref. S31.35864; E25.01345).



Figure 6.7 Clay pellet conglomerate with small bone fragments in Katberg Formation (Road cutting ref. S31.35864; E25.01345)

7. PALAEOLOGICAL SIGNIFICANCE AND RATING

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews, as well as information gathered during the field investigation.

The palaeontological significance and rating is summarised in Table 7.1 and 7.2. For the methodology and definitions of impact rating and significance see Appendix A (CES 2011).

There is a strong possibility that fossils could be encountered during excavation of non-dolerite bedrock within the development footprint, and these fossils would be of international significance. If effective mitigation is in place at the time of exposure, and the fossils are successfully excavated for study, this would represent a beneficial palaeontological impact.

Table 7.1 Palaeontological Significance of Geological Units on Site

Geological Unit	Rock Type and Age	Fossil Heritage	Vertebrate Biozone	Palaeontological Sensitivity
Quaternary Deposits	Alluvial Sands RECENT	None	None	Nil
Drakensberg Group	Dolerite Dykes & Sills (Igneous Intrusions) JURASSIC	None	None	Nil
Katberg Formation	Medium to Coarse-Grained Sandstone EARLY TRIASSIC	Vertebrate fossils including amphibians, <i>Captorhinids</i> , <i>Eosuchids</i> , <i>Dicynodonts</i> , <i>Therocephalians</i> , <i>Cynodonts</i> and trace fossils.	<i>Lystrosaurus</i> Assemblage Zone	High sensitivity

Table 7.2 Significance Rating Table as Per CES Template

Rock Unit	Temporal Scale (duration of impact)	Spatial Scale (area in which impact will have an effect)	Degree of confidence (confidence with which one has predicted the significance of an impact)	Impact severity (severity of negative impacts, or how beneficial positive impacts would be)		Overall Significance (The combination of all the other criteria as an overall significance)	
				With mitigation	Without mitigation	With mitigation	Without mitigation
Katberg Formation	permanent	international	possible	beneficial	very severe	beneficial	High negative

Unfortunately within the Katberg Formation there is no way of assessing the likelihood of encountering fossils during excavation. As evidenced in other similar areas with exposures, fossils were apparently absent or very scarce over large areas, but locally dense accumulations were found.

Therefore, fossils within the development site could be characterised as rare but highly significant. The damage and/or loss of these fossils due to inadequate mitigation would be a highly negative palaeontological impact. The exposure and subsequent reporting of fossils (that would otherwise have remained undiscovered) to a qualified palaeontologist for excavation will be a beneficial palaeontological impact.

8. PALAEOLOGICAL IMPACT AND MITIGATION

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews as well as information gathered during the field investigation. The field investigation confirms that most of the area is underlain by the Katberg Formation with Dolerite intrusions as well as areas underlain by alluvial material.

The Katberg Formation is interbedded with mud- and siltstones that do have potential to yield fossils. The excavation of foundations as well as access roads on the slopes will have the potential to uncover the mud rock and sandstone of the Katberg Formation. Therefore monitoring and mitigation in terms of the palaeontological heritage are required.

Due to the igneous character of Dolerite it does not contain fossils and any excavations into dolerite do not require monitoring or mitigation in terms of palaeontological heritage.

The alluvial material is not expected to yield fossil material at this site.

The following colour coding method is used to classify a development area's palaeontological impact as illustrated in Figure 8.1:

- Red colouration indicates a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in all outcrops on the site/route and the chances of finding fossils during the construction phase are very high.
- Orange colouration indicates a possibility of finding fossils of a specific assemblage zone either in outcrops or in bedrock on the site/route. Fossils will probably be present on the site/route and the chances of finding fossils during the excavation phase are high.
- Green colouration indicates that there is no possibility of finding fossils in that section of the site/route development.



Figure 8.1 Palaeontological impact of the proposed rehabilitation of Section 7 of the N9 National Road



Figure 8.2 Site specific palaeontological impact of the proposed rehabilitation of Section 7 of the N9 National Road

The proposed rehabilitation of Section 7 of the N9 National Road will require excavations into the present road reserves to widen the existing road. This excavation has the potential to impact directly on fossil heritage if the Katberg Formation’s mudstone is exposed especially in the current road cuttings. From Figure 8.2 the following mitigation measures are recommended:

Table 8.1 Site Specific Mitigation Measures

Colour Coding (Figure 8.1)	Mitigation Recommended
Green Sites	Igneous/metamorphic rocks or Quaternary alluvial deposits underlie these zones, with no potential for fossils.
Orange Sites	All earth-moving activities are to be monitored by a palaeontologist. A monitoring report should be submitted to SAHRA after completion of the earth-moving activity. The resident ECO must be trained by a professional palaeontologist in the recognition of fossils. If fossil material is later discovered it must be appropriately protected and the discovery reported to a palaeontologist for the removal thereof as per SAHRA legislation
Red Sites	A permit for the collection and rescue of fossils must be obtained from SAHRA prior the construction phase. All earthworks activities are to be monitored by a resident palaeontologist. A monitoring report should be submitted to SAHRA after completing of the earth-moving activity.

9. CONCLUSION

The Section 7 of the N9 National road site between Middelburg and Carlton Heights is dominated by rugged hill topography with outcrops of the Katberg Formation. These outcrops consist of relatively extensive beds of yellowish-grey to light greenish-grey sandstones and bluish-grey and reddish-grey mudstones. There is a high potential for fossil material in the underlying mudstones that could be uncovered during excavations.

The Katberg Formation areas in the development site have a high palaeontological sensitivity rating. Through adequate monitoring and mitigation measures during excavations, the high impact severity can be lowered to beneficial. The exposure and subsequent reporting of fossils (that would otherwise have remained undiscovered) will be a beneficial palaeontological impact.

It is recommended that:

- A permit for the collection and rescue of fossils from the Katberg Formation must be obtained from SAHRA prior the construction phase.
- All earth-moving activities with potential impact on the Katberg formation are to be monitored by a resident palaeontologist. A monitoring report should be submitted to SAHRA after completion of the earth-moving activity.
- The resident ECO must also be trained by a professional palaeontologist in the recognition of fossil material. If fossil material is later discovered it must be appropriately protected and the discovery reported to a palaeontologist for the removal thereof as per SAHRA legislation.

10. REFERENCES

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11. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the Nelson Mandela Metropolitan University (1996) and the National Diploma in Nature Conservation from the University of South Africa (1990). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

Declaration of Independence

I, Gideon Groenewald, 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.

A handwritten signature in black ink, reading "Gideon Groenewald", with a horizontal line underneath it.

Dr Gideon Groenewald
Geologist

12. APPENDIX A - METHODOLOGY FOR ASSESSING THE SIGNIFICANCE OF IMPACTS

Although specialists will be given relatively free rein on how they conduct their research and obtain information, they will be required to provide their reports to the EAP in a specific layout and structure, so that a uniform specialist report volume can be produced.

To ensure a direct comparison between various specialist studies, a standard rating scale has been defined and will be used to assess and quantify the identified impacts. This is necessary since impacts have a number of parameters that need to be assessed. Four factors need to be considered when assessing the significance of impacts, namely:

1. Relationship of the impact to **temporal** scales - the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.
2. Relationship of the impact to **spatial** scales - the spatial scale defines the physical extent of the impact.
3. The severity of the impact - the **severity/beneficial** scale is used in order to scientifically evaluate how severe negative impacts would be, or how beneficial positive impacts would be on a particular affected system (for ecological impacts) or a particular affected party.

The severity of impacts can be evaluated with and without mitigation in order to demonstrate how serious the impact is when nothing is done about it. The word 'mitigation' means not just 'compensation', but also the ideas of containment and remedy. For beneficial impacts, optimization means anything that can enhance the benefits. However, mitigation or optimization must be practical, technically feasible and economically viable.

4. The **likelihood** of the impact occurs - the likelihood of impacts taking place as a result of project actions differs between potential impacts. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident), and may or may not result from the proposed development. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.

The **environmental significance** scale is an attempt to evaluate the importance of a particular impact. This evaluation needs to be undertaken in the relevant context, as an impact can either be ecological or social, or both. The evaluation of the significance of an impact relies heavily on the values of the person making the judgment. For this reason, impacts of especially a social nature need to reflect the values of the affected society.

Negative impacts that are ranked as being of "**VERY HIGH**" and "**HIGH**" significance will be investigated further to determine how the impact can be minimised or what alternative activities or mitigation measures can be implemented. These impacts may also assist decision makers i.e. lots of **HIGH** negative impacts may bring about a negative decision.

For impacts identified as having a negative impact of "**MODERATE**" significance, it is standard practice to investigate alternate activities and/or mitigation measures. The most effective and practical mitigations measures will then be proposed.

For impacts ranked as "**LOW**" significance, no investigations or alternatives will be considered. Possible management measures will be investigated to ensure that the impacts remain of low significance.

Table 9-1: Criterion used to rate the significance of an impact

Significance Rating Table	
Temporal Scale (The duration of the impact)	
Short term	Less than 5 years (Many construction phase impacts are of a short duration)
Medium term	Between 5 and 20 years
Long term	Between 20 and 40 years (From a human perspective almost permanent).
Permanent	Over 40 years or resulting in a permanent and lasting change that will always be there
Spatial Scale (The area in which any impact will have an affect)	
Individual	Impacts affect an individual.
Localised	Impacts affect a small area, often only a portion of the project area.
Project Level	Impacts affect the entire project area.
Surrounding Areas	Impacts that affect the area surrounding the development
Municipal	Impacts affect either the Local Municipality, or any towns within them.
Regional	Impacts affect the wider district municipality or the province as a whole.
National	Impacts affect the entire country.
International/Global	Impacts affect other countries or have a global influence.
Will definitely occur	Impacts will definitely occur.
Degree of Confidence or Certainty (The confidence to predicted the significance of an impact)	
Definite	More than 90% sure of a particular fact. Should have substantial supportive data.
Probable	Over 70% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Only over 40% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or of the likelihood of an impact occurring.

Table 9-2: The severity rating scale

Impact severity	
(The severity of negative impacts, or how beneficial positive impacts would be on a particular affected system or party)	
Very severe	Very beneficial
An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For example the permanent loss of land.	A permanent and very substantial benefit to the affected system(s) or party(ies), with no real alternative to achieving this benefit. For example the vast improvement of sewage effluent quality.
Severe	Beneficial
Long term impacts on the affected system(s) or party(ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming, or some combination of these. For example, the clearing of forest vegetation.	A long term impact and substantial benefit to the affected system(s) or party(ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these. For example an increase in the local economy.
Moderately severe	Moderately beneficial
Medium to long term impacts on the affected system(s) or party (ies), which could be mitigated. For example constructing the sewage treatment facility where there was vegetation with a low conservation value.	A medium to long term impact of real benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way. For example a 'slight' improvement in sewage effluent quality.
Slight	Slightly beneficial
Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example a temporary fluctuation in the water table due to water abstraction.	A short to medium term impact and negligible benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.
No effect	Don't know/Can't know
The system(s) or party(ies) is not affected by the proposed development.	In certain cases it may not be possible to determine the severity of an impact

Table 3: Overall significance appraisal

Overall Significance (The combination of all the above criteria as an overall significance)	
VERY HIGH NEGATIVE	VERY BENEFICIAL
<p>These impacts would be considered by society as constituting a major and usually permanent change to the (natural and/or social) environment, and usually result in severe or very severe effects, or beneficial or very beneficial effects.</p> <p>Example: The loss of a species would be viewed by informed society as being of VERY HIGH significance.</p> <p>Example: The establishment of a large amount of infrastructure in a rural area, which previously had very few services, would be regarded by the affected parties as resulting in benefits with VERY HIGH significance.</p>	
HIGH NEGATIVE	BENEFICIAL
<p>These impacts will usually result in long term effects on the social and/or natural environment. Impacts rated as HIGH will need to be considered by society as constituting an important and usually long term change to the (natural and/or social) environment. Society would probably view these impacts in a serious light.</p> <p>Example: The loss of a diverse vegetation type, which is fairly common elsewhere, would have a significance rating of HIGH over the long term, as the area could be rehabilitated.</p> <p>Example: The change to soil conditions will impact the natural system, and the impact on affected parties (such as people growing crops in the soil) would be HIGH.</p>	
MODERATE NEGATIVE	SOME BENEFITS
<p>These impacts will usually result in medium to long term effects on the social and/or natural environment. Impacts rated as MODERATE will need to be considered by society as constituting a fairly important and usually medium term change to the (natural and/or social) environment. These impacts are real but not substantial.</p> <p>Example: The loss of a sparse, open vegetation type of low diversity may be regarded as MODERATELY significant.</p>	
LOW NEGATIVE	FEW BENEFITS
<p>These impacts will usually result in medium to short term effects on the social and/or natural environment. Impacts rated as LOW will need to be considered by the public and/or the specialist as constituting a fairly unimportant and usually short term change to the (natural and/or social) environment. These impacts are not substantial and are likely to have little real effect.</p> <p>Example: The temporary change in the water table of a wetland habitat, as these systems is adapted to fluctuating water levels.</p> <p>Example: The increased earning potential of people employed as a result of a development would only result in benefits of LOW significance to people who live some distance away.</p>	
NO SIGNIFICANCE	
<p>There are no primary or secondary effects at all that are important to scientists or the public.</p> <p>Example: A change to the geology of a particular formation may be regarded as severe from a geological perspective, but is of NO significance in the overall context.</p>	
DON'T KNOW	
<p>In certain cases it may not be possible to determine the significance of an impact. For example, the significance of the primary or secondary impacts on the social or natural environment given the available information.</p> <p>Example: The effect of a particular development on people's psychological perspective of the environment.</p>	