PALAEONTOLOGICAL IMPACT ASSESSMENT
for the
DE BEERS PASS ROUTE and ALTERNATIVES

Keeversfontein, KwaZulu-Natal to Warden, Free State Province.

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EXECUTIVE SUMMARY

N3TC established through the use of new road design software, an alternative geometrically compliant route in the vicinity of the existing Van Reenen's Pass, with various alternatives to re-join the current N3 at appropriate positions. The Route Location Initiative process identified that regardless of the viability of alternative routes satisfying the engineering constraints, there would be impacts on the natural, social and economic environment. In discussion with the Department of Environmental Affairs, it was agreed that when the application for Environmental Authorisation for the De Beers Pass Route was made, it should include a study of an additional alternative, referred to as Alternative A & B in this report. The route alignment alternatives which are included in this EIA process are the De Beers Pass Route and De Beers Pass Route: Alternative A & B.

This report forms part of the Environmental Impact Assessment for the De Beers Pass Route as well as the De Beers Pass Route: Alternatives A & B. The report also complies with the requirements for a Phase 0 Palaeontological Impact Report as required from SAHRA.

All the proposed routes will cut the Drakensberg Escarpment, east of Harrismith in the Free State Province, and west of Ladysmith in KwaZulu-Natal. The construction of the roads and tunnel systems for this scheme will provide a clear excavation into unweathered rock of the Karoo Supergroup in this part of South Africa. The sequence includes the deepwater shale of the Volksrust Formation in the Ecca Group, to the fluvial shale, mudstone and sandstone of the Normandien Formation, Beaufort Group.

The most significant geological event recorded in this sequence is the Permian Extinction Event of approximately 250 million years ago, when an estimated 85% of all life on Earth was terminated. The Permian Extinction Event is uniquely situated at 1 700m to 1 720m above sea level. Therefore the desk top study indicates that there is a very high possibility of finding both plant and vertebrate fossils associated with the middle and upper parts of the Normandien Formation over extensive lengths of the proposed De Beers Pass Routes.

It is recommended that a trained palaeontologist, with experience in finding fossils in the Permian extinction zone, be appointed to do a physical traverse of the final route selected before commencement of excavations for road foundations. The palaeontologist must be permitted by SAHRA to collect fossils from the *Dicynodon lacerticeps, Lystrosaurus* and *Cynognathus* assemblage zones.

It will further also be a requirement that all fossils discovered during excavation for road foundations be recorded and rescued. The palaeontologist will have to be part of the Heritage team, overseeing excavations for the road foundations on a full-time basis.

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1 INTRODUCTION

This report forms part of the Environmental Impact Assessment for the De Beers Pass Route and complies with the requirements for a Phase 0 Palaeontological Impact Report as required from SAHRA.

Palaeontological Impact Assessments are often specialist reports that form part of the wider heritage component of: i) Environmental Impact Assessments (EIAs) required in terms of the National Environmental Management Act, Act 107 of 1998, or ii) of the Environment Conservation Act (Act 73 of 1989) by the provincial Department of Environmental Affairs; or iii) Environmental Management Plans (EMPs) required by the Department of Minerals and Energy. These specialist reports may also form part of Heritage Impact Assessments (HIAs) called for in terms of Section 38 of the National Heritage Resources Act (Act No. 25, 1999) by a heritage resources authority.

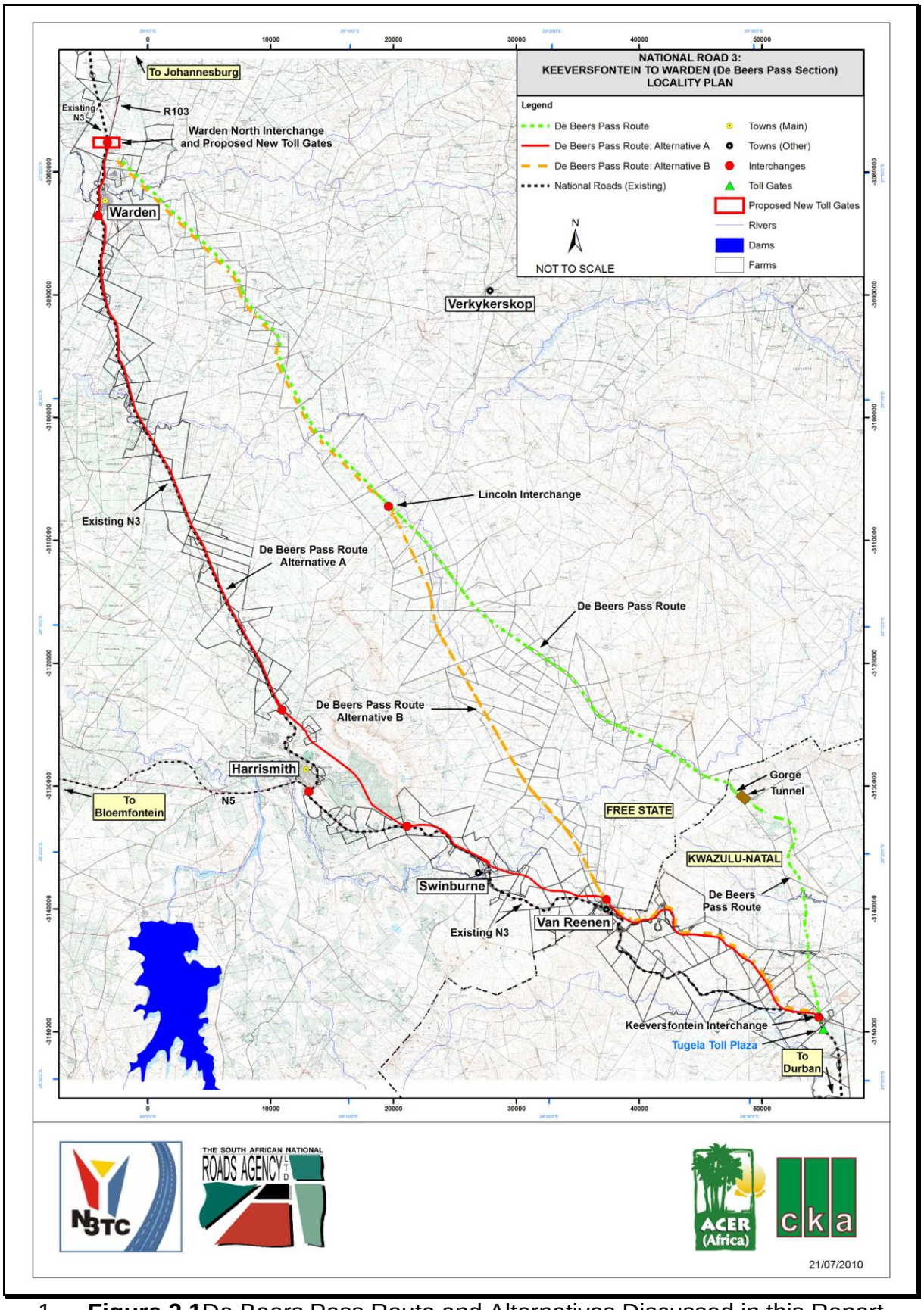
This desk top study includes all the possible alternatives of the De Beers Pass Route as proposed by the Developer N3 Toll Concession and illustrated in figure 2.1.

2 PROJECT DESCRIPTION

The following project description is as provided by eThembeni Cultural Heritage Consultants. “Following a public tender process, the South African National Roads Agency Ltd (SANRAL) appointed the N3 Toll Concession (Pty) Ltd (N3TC) as the Concessionaire responsible for the Design, Construction, Financing, Operating and Maintenance of a portion of National Route 3 from Cedara in KwaZulu Natal to the Heidelberg South Interchange in Gauteng as a Toll Highway with Developments and Associated Facilities. This 415 kilometre section of the N3 is referred to as the N3 Toll Route. The concession is for a thirty year period that commenced on 2 November 1999.

Included in the Concession Contract is the requirement to construct a new route known as the De Beers Pass Route (DBPR), between Keeversfontein and Warden. Completion of the DBPR has a completion date, linked to a traffic volume trigger, based on the annual average daily traffic (AADT) on the portion of the N3 between Keeversfontein and Harrismith. Based on the most recent AADT, the predicted commencement date of the project is 2013 and the construction period is approximately 3.5 years.

N3TC obtained environmental approval by means of a Record of Decision (ROD), issued by the Department of Environmental Affairs and Tourism, on 26 March 1999, authorising the construction and upgrading of the N3 Toll Road System from Heidelberg to Cedara, comprising of the routes: (i) Cedara to Heidelberg (via Van Reenen) and (ii) Keeversfontein to Warden (De Beers Pass Route).



1 **Figure 2.1**De Beers Pass Route and Alternatives Discussed in this Report

The ROD was issued subject to certain conditions. In order to comply with these conditions, N3TC embarked on an analysis process to compare alternative alignments with the DBPR.

During this process, N3TC established through the use of new road design software, an alternative geometrically compliant route in the vicinity of the existing Van Reenen's Pass, with various alternatives to re-join the DBPR at appropriate positions. A comparison of environmental impacts was then required. In 2008, N3TC launched a Route Location Initiative (RLI). This RLI was used to identify directly affected landowners and their concerns as they relate to the then studied alternatives to the DBPR, as well as an initial assessment to determine and rank the environmental impacts assessed.

The RLI process identified that regardless of the viability of alternative routes satisfying the engineering constraints, there would be impacts on the natural, social and economic environment. In discussion with the Department of Environmental Affairs (DEA), previously DEAT, it was agreed that when the application for Environmental Authorisation for the DBPR was made, it should include a study of an additional alternative, referred to as Alternative A & B in this report (refer to route descriptions below). The route alignment alternatives which are included in this EIA process are the De Beers Pass Route (DBPR) and De Beers Pass Route: Alternative A & B."

3 GEOLOGY

The De Beers Pass Route and Alternatives will cut the Drakensberg Escarpment, east of Harrismith in the Free State Province, and west of Ladysmith in KwaZulu-Natal. The construction of the roads and tunnel systems for this scheme will provide a clear excavation into unweathered rock of the Karoo Supergroup in this part of South Africa. The sequence includes the deepwater shale of the Volksrust Formation in the Ecca Group, to the fluvial shale, mudstone and sandstone of the Normandien Formation, Beaufort Group. Historically, detailed geological information could only be gained from sections along the few mountain passes that cut the mountain range. Due to the deep weathering of sedimentary rocks on the Drakensberg Escarpment the information on vertebrate palaeontology was not complete (Groenewald, 1984, 1989, 1990, 1996).

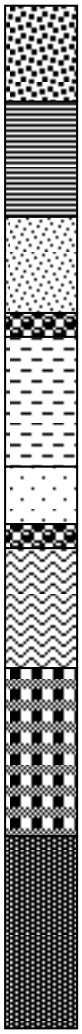
Recently excavation for the Bedford Dam wall structure, as well as the underground works for the Ingula Pumped Storage Scheme, developed by Eskom Holdings (Pty) Ltd, provided a unique opportunity to record a proper palaeontological database for this escarpment (Groenewald, 2011).

Geology of the Drakensberg Escarpment

SACS (South African Committee for Stratigraphy) still needs to publish a formal note on the lithostratigraphy of the escarpment at Harrismith. The most recent formal academic study of the complete section was done by Groenewald (1984, 1989). Correlation of the lithostratigraphy of the Tarkastad Subgroup from the Southern Karoo Basin into this northern part of the basin is contained in a comprehensive regional study of the Upper Karoo Supergroup (Groenewald,

1996). Reference to several finds related to vertebrate palaeontology, including some unique vertebrate burrows, was recorded from these geological layers (Groenewald 1991; Groenewald et al, 2001 and Rubidge (ed), 1995).

2 **Table 3.1** Summary of Geology – De Beers Pass Route and Alternatives



Verkykerskop Formation. Coarse-grained sandstone with manganese enriched conglomerates – Braided River Fluvial deposit. No record of fossil finds to date.
Harrismith Member – Normandien Formation. Brightly coloured siltstone – highly dissipating and expansive. Concretions with numerous fossils of Lystrosaurus Assemblage Zone material and vertebrate burrows. **Unique opportunity to record survivors of the Permian Extinction Event.**
Schoondraai Member – Normandien Formation. Fine- to medium-grained sandstone with prominent conglomerate of granitic pebbles at the base. Large-scale petrified tree fossils of Glossopteris and very thin coal beds.
Green and grey mudstone and siltstone with prominent concretions of calcium and gypsum. Fossils of plants and coal beds in upper layers and productive vertebrate fossil layers of the Dicynodon lacerticeps assembla
Rooinek Member – Normandien Formation. Coarse-grained fluvial feldspathic sandstone with basal conglomerates, fossil trees of Glossopteris and coal beds.
Green and grey mudstone and siltstone with thin coal beds. Fluvial creva splay deposits with micro cross-bedding in silt deposits. Trace fossils abundant on sandstone bedding planes. (*Fossil remains of Rhachioceph*
Frankfort Member – Normandien Formation. Dark grey shale and siltston interbedded with lenses of deltaic very coarse-grained feldspathic sandst deposits of up to 20m thick. Lenses of sandstone discontinuous over 500 Plant fossils of Glossopteris abundant. Prominent but discontinuous coal
Volksrust Formation – Ecca Group. Dark grey shale – deep water sedimentary deposit with very little recorded evidence of vertebrate life. Trace fossils recorded in the upper part of the formation.

The geological history of the area represents the final sedimentation into the Ecca Basin about 260 million years ago (Table 3.1). Deltaic deposits of the Frankfort Member contain evidence of an abundance of marine and probably estuarine invertebrates that left a wealth of trace fossils in the rock record. The overlying fluvial deposits of the Rooinek and Schoondraai Members represent a progressive basin-ward migration of the depositional system, culminating in the characteristic braided river fluvial deposits of the Verkykerskop Formation.

The most significant geological event recorded in this sequence is the Permian Extinction Event of approximately 250 million years ago, when an estimated 85% of all life on Earth was terminated. This event is recorded just below the Schoondraai Member and might include the Schoondraai Member. The Permian Extinction Event is uniquely situated at 1 700m to 1 720m above sea level. This

implies that most of the excavation for the footprint of the N3 Alternatives, as well as the tunnel system, will be in the Permian Extinction Zone. This provides a unique opportunity to collect fossils of vertebrates and invertebrates (trace fossils), as well as plants from the rocks that were deposited at the time of the extinction event. As far as is known, the construction of the highway will be a unique excavation operation in South Africa that will allow the inspection of fresh, unweathered rock of this extinction zone along the Drakensberg Escarpment, equalled only by the excavations that was done for the Ingula Pumped Storage Scheme. The opportunity might never be repeated.

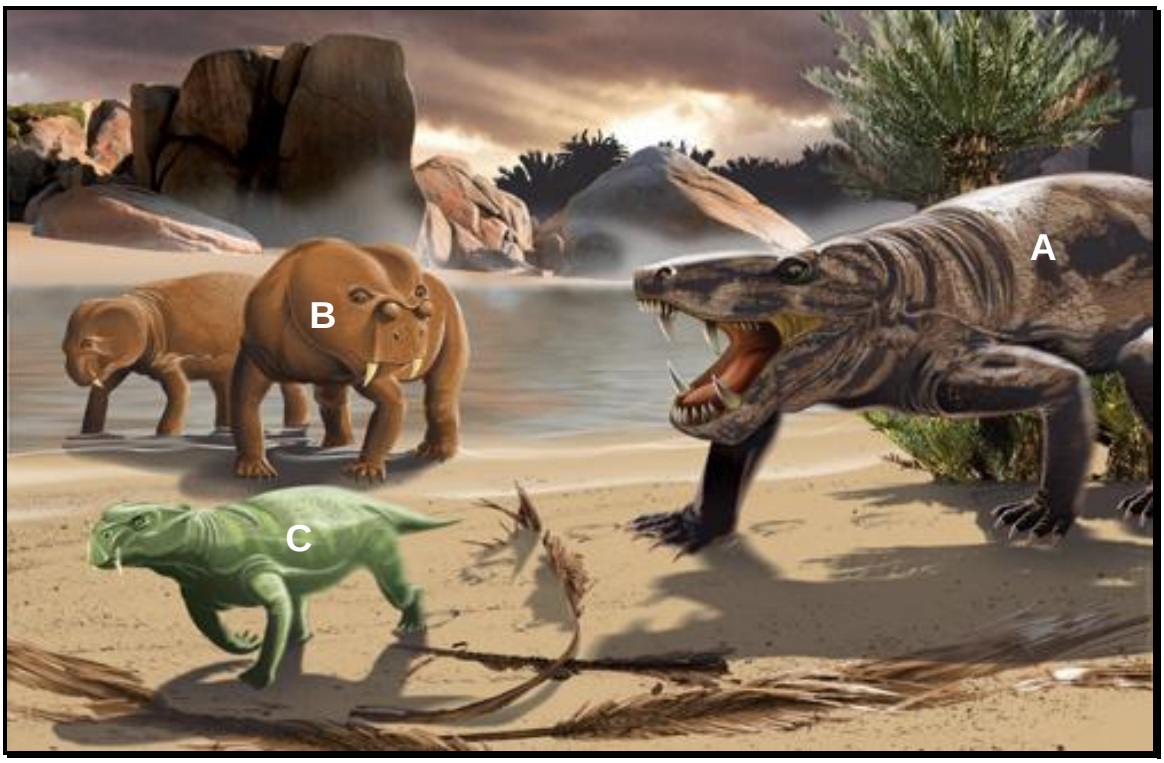
Practical implications are that the palaeontologist has to inspect the sites where blasting will be done on a daily basis for as long as it takes to penetrate the extinction zone. All the fossils found during this operation have to be recorded and rescued.

Important Fossils Expected Along the De Beers Pass Alternative Routes

The Karoo Basin in South Africa is well known for the fact that it represents the most complete sequence of sedimentary history in the Gondwana Basin and contains the remains of most of the mammal-like reptiles or therapsids that roamed the Earth during the Permian times. The Alternative Routes of the De Beers Pass Route will all present a unique opportunity to find some important fossils related to several extinction events in the history of this sedimentary basin.

Animal fossils that can be expected include therapsids; e.g. *Dicynodonts, Gorgonopsians, Lystrosaurus species* and burrowing reptiles like *Trirachodon sp.* Plant Fossils that can be expected include examples of the seeding fern *Dicroiidium sp* and fossilised tree stumps of the *Glossopteris sp*.

For an artist impression of the various therapsids found in the Karoo Basin see figure 3.1.



3 **Figure 3.1**Representations of the Animals that Roamed the De Beers Pass Routes Alternatives during the Late Permian (Metcalfe, 2001). These animals were: A: - *Gorgonopsid* B: - *Dicynodon lacerticeps* C: - *Lystrosaurus*

<u>Dicynodonts</u> from the Permian Times (255 million years ago)

Dicynodonts (two dog-toothed lizards) are well-known animals from the Permian Karoo but some of the oldest examples have never been recorded from the Harrismith escarpment due to deep weathering of the mudstones. One such animal is the big (3m long) *Rachiocephalus sp,* only recorded from Warden towards the west (Groenewald, 1984). The most important indicator of the beginning of one of the largest and most severe extinctions of life on Earth is the sudden death of millions of lizards called *Dicynodon lacerticeps* (English: two dog-toothed lizard-headed-like animal. Afrikaans: Twee hond-tandagtige likkewaan-kopagtige akkedis). These plant-eating creatures were up to 4m long with massive heads and two elephant-like tusks. They were hunted by a fearsome predator of the time – the *Gorgonopsians*.

<u>Gorgonopsians</u> from the Permian times (255 million years ago)

One of most fearsome predators that roamed the Earth, these animals had dagger-like canines of nearly 20cm long. According to Professor Peter Ward of the University of Washington, "*Gorgonopsids* were the largest predators of the late Palaeozoic, the era just before dinosaurs. They grew as large as 10 feet long and were among the most ferocious predators ever. Their heads appeared somewhat dog-like, with large, sabre-tooth upper canine teeth up to 4 inches long. Though they had a somewhat mammalian appearance, their eyes were set at the sides of the head like those of a lizard, and the body was probably covered with scales rather than hair. The gorgons would have resembled a cross

between a lion and a large monitor lizard - leading to the name science has given them. 'Gorgons' are mythical monsters with such a horrible appearance that gazing upon them turns an observer to stone."

During the excavation of a *Gorgonopsian* at Eskom's Ingula Pump Water Scheme - Bedford Dam construction site, scientists recorded what might be the skull of a small *Dicynodon lacerticeps* associated with the ribs – possibly indicating the last meal of this predator. Unique finds of this nature are only possible if the palaeontologist is on site at all times during excavation.

Survivors of the Permian Extinction – Triassic Reptiles (245 million years)

These fossils are associated with the *Lystrosaurus* Assemblage Zone, indicating that these animals are the most commonly found. The *Lystrosaurus* (English: chisel-beaked lizards. Afrikaans: beitelbek-agtige akkedisse) animals were more like pigs with two big tusks in the upper jaw. Associated with these animals are smaller predators such as *Thrinaxodon sp* (mongoose-like creatures) and *Moschorhinus* (dog-like crocodiles) and small amphibians called *Lydekkerina sp.*

The most common examples of survivors of the Permian extinction are found near Bethulie in South Africa. Due to the deep weathering on the Drakensberg Escarpment the information is incomplete and these fossils have been never recorded east of Harrismith.

The Alternative Routes of the De Beers Pass Route will present a unique opportunity to discover some of these fossils in this part of the Karoo Basin and to celebrate the survivors of the Permian extinction. Some scientists believe that these survivors guaranteed the very existence of mankind as we know the species today.

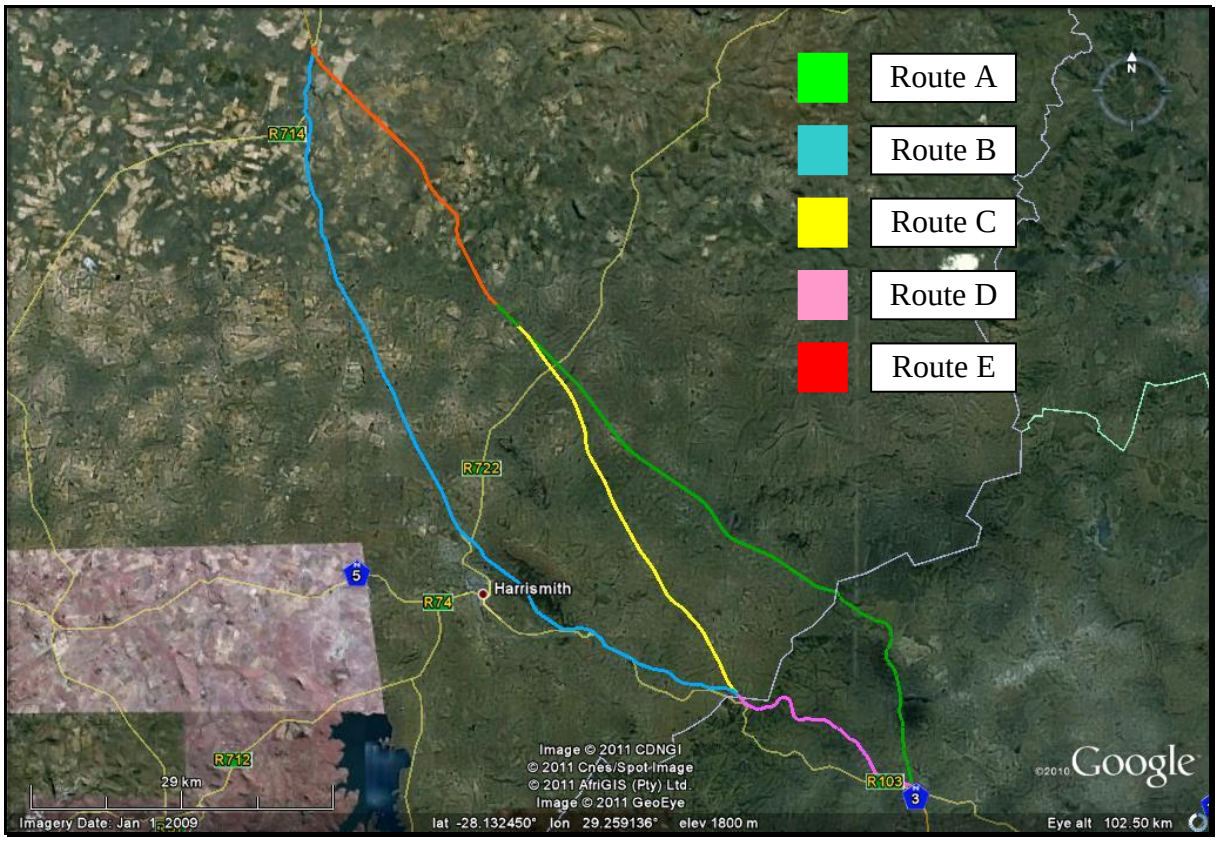
Burrowing Reptiles of the Triassic

The Burgersdorp Formation is not well developed in the Harrismith region and is represented by a relatively thin (50m thick) red mudstone unit. This unit however produced some of the most unique discoveries of vertebrate burrows in this part of the Karoo Basin (Groenewald et al, 1999). Fossils of the *Cynognathus* assemblage zone and more specifically the burrowing reptile *Trirachodon sp* occurs in this rock unit.

Plant Fossils of the First Seeding Ferns

The Molteno Formation is very poorly preserved in this part of the basin. This coarse-grained glittering sandstone with inter bedded khaki coloured mudstone contains some of the best examples of the seeding fern *Dicroiidium sp*, an indicator species for the existence of the super continent of Gondwanaland.

4 PALAEONTOLOGICAL ASSESSMENT



4 **Figure 4.1**The Various Routes for the Palaeontological Assessment

The De Beers Pass and Alternative Routes A & B was assess for possible fossil finds. The different routes outlined are according to the notation provided by eThembeni Cultural Heritage Consultants. Each selection of the proposed routes (Figure 4.1) was mapped on Google Earth and a Palaeontology sensitivity done. These sensitivity results, i.e. route A to E of figure 4.1, where further discussed according to the geological formation as well as the fossils that can be expected.

Palaeontological Sensitivity Classification

The following colours are used to indicate sensitivity for fossil finds and are based on the experience of the author in field surveys in the area.

- *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 route and the chances of finding fossils during the construction phase are very high. A trained palaeontologist must inspect the section of the route before construction starts and must be present during all excavations for road foundation.*
- *Yellow colouration indicates a possibility of finding fossils of a specific assemblage zone. Fossils might be present in outcrops on the route and the presence or absence of fossils must be confirmed by a trained palaeontologist during the construction phase when excavations are done for road construction.*
- *Green colouration indicates that there is no possibility of finding fossils in that section of the route. In most cases these zones are underlain by dolerite.*

Route A - Keeversfontein to Welgegund

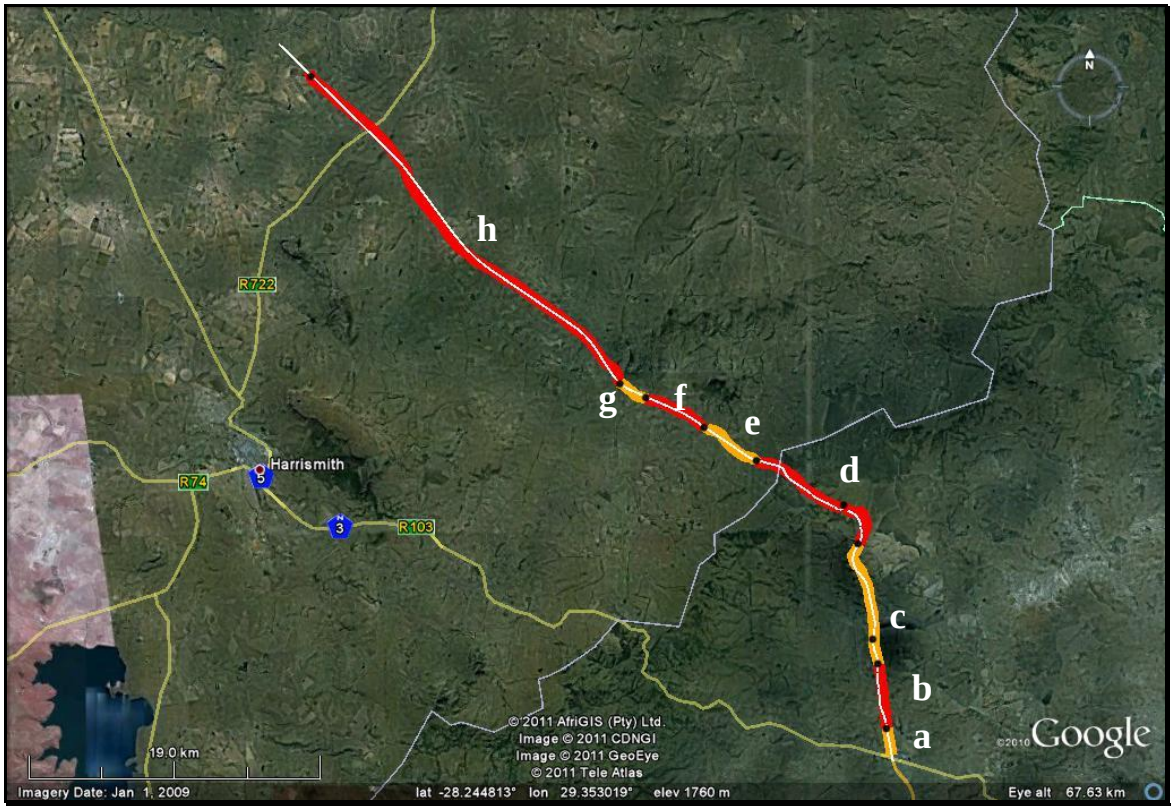


Figure 4.2 Route A: - Keeversfontein to Welgegund Palaeontological Sensitivity

From figure 4.2 the following are noted:

a. Volksrust Formation, *Ichnogenus* (trace fossils) likely to occur on bedding planes of shale.
b. Normandien Formation, Frankfort Member (some dolerite outcrops), *Ichnogenus* (trace fossils) and plant fossils (*Glossopteris sp*) highly likely to occur in outcrop regions.
c. Volksrust Formation and alluvium, *Ichnogenus* (trace fossils) likely to occur on bedding planes. Tertiary fossils in alluvial deposits.
d. Normandien Formation, Schoondraai and Harrismith Members, Permian Extinction zone. *Dicynodon lacerticeps* and *Lystrosaurus sp* highly likely to be present. Plant fossils and large tree fossils of *Glossopteris sp* highly likely to be found.
e. Alluvial deposits, tertiary fossils possibly present.
f. Normandien Formation, Harrismith Member, *Lystrosaurus* assemblage zone.
g. Verkykerskop Formation, Triassic sandstone, *Lystrosaurus sp* might be present in inter-bedded mudstone layers.
h. Normandien Formation, Schoondraai and Harrismith Members, Permian Extinction zone. *Dicynodon lacerticeps* and *Lystrosaurus sp* highly likely to be present. Plant fossils and large tree fossils of *Glossopteris sp* highly likely to be found.

Route B - Van Reenen to Warden

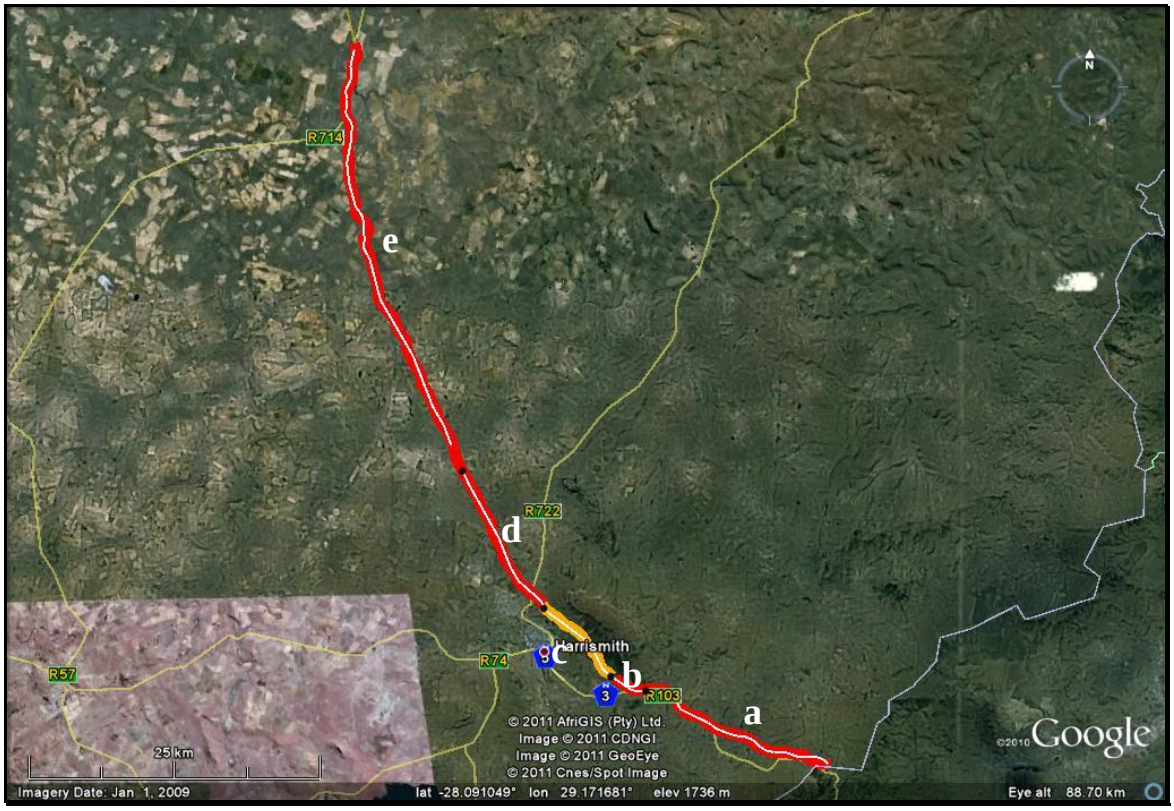


Figure 4.3 Route B: - Van Reenen to Warden Palaeontological Sensitivity

From figure 4.3 the following are noted:

a. Normandien Formation, Schoondraai and Harrismith Members, Permian Extinction zone. *Dicynodon lacerticeps* and *Lystrosaurus sp* highly likely to be present. Plant fossils and large tree fossils of *Glossopteris sp* highly likely to be found.
b. Tarkastad Subgroup, Katberg and Burgersdorp Formations, *Cynognathus* assemblage zone, vertebrate burrows of *Trirachodon sp.*
c. Mountain scree overlying Burgersdorp Formation mudstone. *Cynognathus* assemblage zone likely to be excavated during construction phase.
d. Tarkastad Subgroup, Katberg and Burgersdorp Formations, *Cynognathus* assemblage zone, vertebrate burrows of *Trirachodon sp.*
e. Normandien Formation, Schoondraai and Harrismith Members, Permian Extinction zone. *Dicynodon lacerticeps* and *Lystrosaurus sp* highly likely to be present. Plant fossils and large tree fossils of *Glossopteris sp* highly likely to be found.

Route C - Van Reenen to Welgegund

Figure 4.4 Route C: - Van Reenen to Welgegund Palaeontological Sensitivity

From figure 4.4 the following is noted:

a. Entire route: Normandien Formation, Schoondraai and Harrismith Members, Permian Extinction zone. *Dicynodon lacerticeps* and *Lystrosaurus sp* highly likely to be present. Plant fossils and large tree fossils of *Glossopteris sp* highly likely to be found.

Route D - Keeversfontein to the Top of Van Reenen's Pass

From figure 4.5 below the following are noted:

a. Volksrust Formation, *Ichnogenus* (trace fossils) likely to occur on bedding planes of shale.
b. Normandien Formation, Frankfort Member, *Ichnogenus* (trace fossils) and plant fossils *(Glossopteris sp*) highly likely to occur in outcrop regions.
c. Dolerite, no possibility of fossils.
d. Normandien Formation, Rooinek Member to base of Schoondraai Member, Permian extinction zone. *Dicynodon lacerticeps* assemblage zone and plant fossils, including large tree fossils of *Glossopteris sp*.
e. Normandien Formation, Schoondraai and Harrismith Members, Permian Extinction zone. *Dicynodon lacerticeps* and *Lystrosaurus sp* highly likely to be present. Plant fossils and large tree fossils of *Glossopteris sp* highly likely to be found.

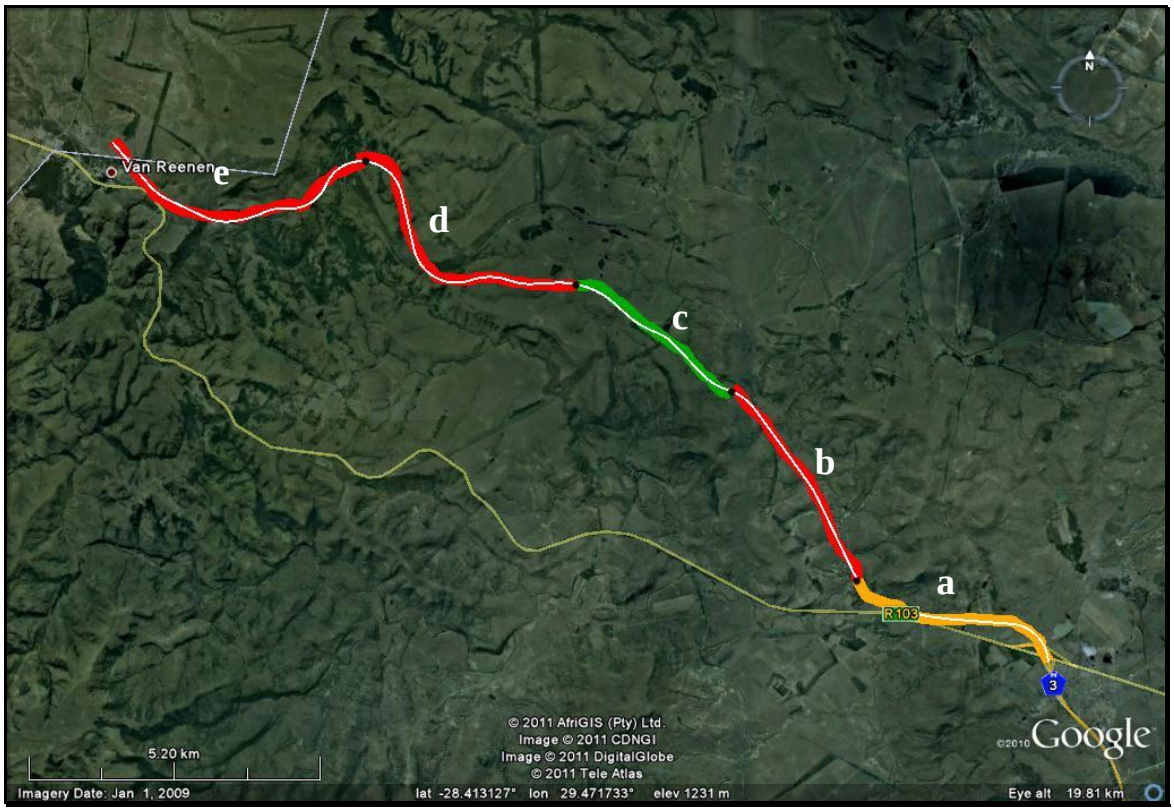


Figure 4.5 Route D: - Keeversfontein to Van Reenen Palaeontological Sensitivity

Route E – Welgegund to Warden

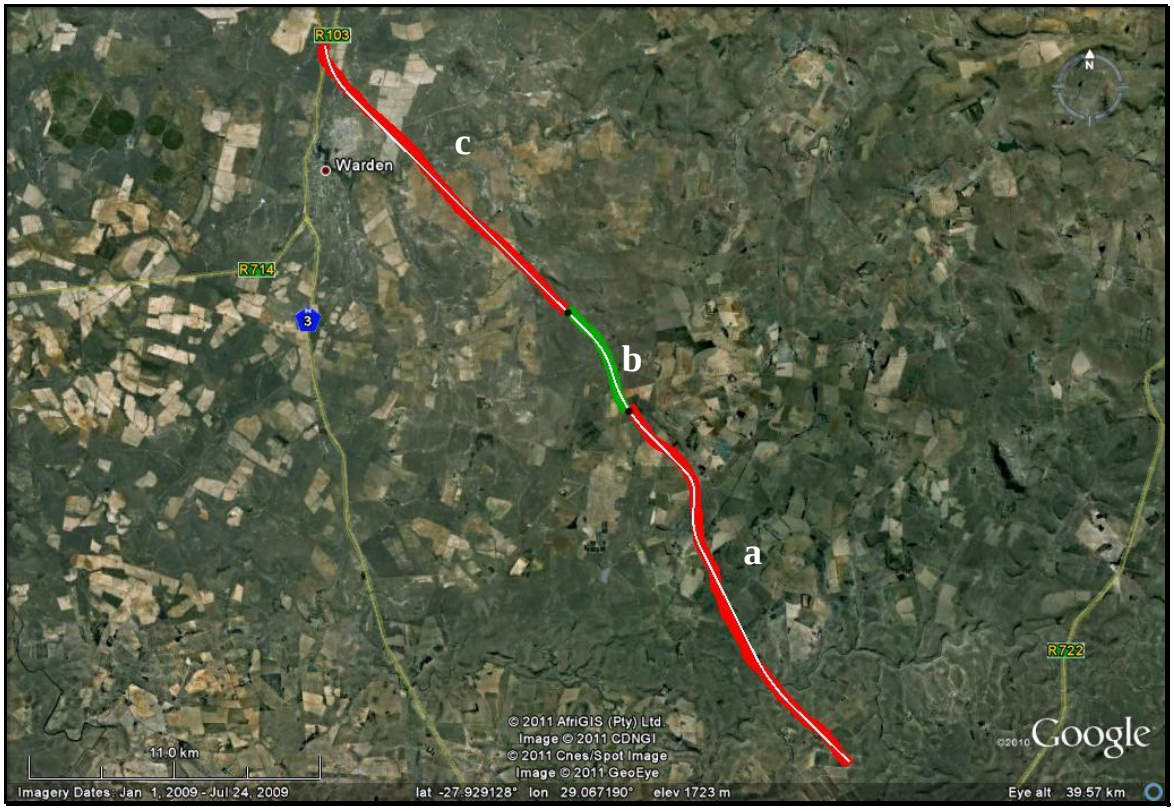


Figure 4.6 Route E: - Welgegund to Wardern Palaeontological Sensitivity

From figure 4.6 the following are noted:

a. Normandien Formation, Schoondraai and Harrismith Members, Permian Extinction zone. *Dicynodon lacerticeps* and *Lystrosaurus sp* highly likely to be present. Plant fossils and large tree fossils of *Glossopteris sp* highly likely to be found.
b. Dolerite. No possibility of fossils.
c. Normandien Formation, Schoondraai and Harrismith Members, Permian Extinction zone. *Dicynodon lacerticeps* and *Lystrosaurus sp* highly likely to be present. Unique discovery of Permian *Rachiocephalus sp* also recorded from these sediments near Warden (Groenewald, 1984). Plant fossils and large tree fossils of *Glossopteris sp* highly likely to be found.

5 CONCLUSION AND RECOMMENDATION

The Volksrust Formation of the Ecca Group occurs at the base of the escarpment at Keeversfontein and might produce some unique *Ichnogenus* (trace fossils). The base of the Normandien Formation overlying the above mentioned geology is interpreted as a fluvio-deltaic environment (Frankfort Member), will produce mostly plant fossils that belong to the *Glossopteris* fauna of the Permian. Trace fossils are known from this group of rocks along the Drakensberg Escarpment.

The desk top study indicates that there is a very high possibility of finding both plant and vertebrate fossils associated with the middle and upper parts of the Normandien Formation over extensive lengths of the proposed De Beers Pass Routes. The base of the Schoondraai Member is associated with the Permian extinction zone that possibly falls within the *Dicynodon lacerticeps* assemblage zone, whereas the Triassic Harrismith Member is known to contain large numbers of *Lystrosaurus sp* fossils which are survivors of the Permian extinction event.

The Normandien Formation is also well-known for the presence of very large fossils of *Glossopteris sp* plants and extensive deposits of leaves of these plants in some areas.

Very few outcrops of the Burgersdorp Formation are known from this region and the excavation for construction of the road foundation will expose large tracts of this rock unit. This will provide an opportunity to find some of the unique burrows and fossils of *Trirachodon sp.* presently only known from outcrops in the Golden Gate Highlands National Park.

It is recommended that a trained palaeontologist, with experience in finding fossils in the Permian extinction zone, be appointed to do a physical traverse of the final route of the De Beers Pass Alternatives before commencement of excavations for road foundations. The palaeontologist must be permitted by SAHRA to collect fossils from the *Dicynodon lacerticeps, Lystrosaurus* and *Cynognathus* assemblage zones.

It will further also be a requirement that all fossils discovered during excavation for road foundations be recorded and rescued, similar to the rescue of fossils during the construction of the Bedford Dam at the Ingula Pumped Storage Scheme

(Groenewald, 2011). The palaeontologist will have to be part of the Heritage team, overseeing excavations for the road foundations on a full-time basis.

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APPENDIX D

METHODOLOGY

Site survey

eThembeni staff members inspected the area on 19 September 2007, 28 to 30 October 2008, 17 to 19 August 2010, 24 to 25 January 2011, 14 to 16 February 2011, 14 to 16 March 2011, 03 to 05 June and 28 to 29 July 2011. We completed controlled-exclusive surface surveys, where 'sufficient information exists on an area to make solid and defensible assumptions and judgements about where [heritage resource] sites may and may not be' and 'an inspection of the surface of the ground, wherever this surface is visible, is made, with no substantial attempt to clear brush, turf, deadfall, leaves or other material that may cover the surface and with no attempt to look beneath the surface beyond the inspection of rodent burrows, cut banks and other exposures that are observed by accident' (King 1978; see bibliography for other references informing methodological approach).

Photographs were taken with a Panasonic Lumix DMC FX07 camera and a representative selection is included in Appendix D. Geographic coordinates were obtained using a handheld Garmin GPSMAP 62S global positioning unit set at WGS 84.

Database and literature review

Archaeological site data was obtained from the Natal Museum. A concise account of the pre and postcolonial history of the broader study area was compiled from sources including those listed in the bibliography. The current socio-economic context is based on field observations and experience.

Assessment of heritage resource value and significance

Heritage resources are significant only to the extent that they have public value, as implicitly demonstrated by the following guidelines for determining site significance developed by the South African Heritage Resources Agency and utilised during this assessment.

Type of Significance

1. Historical Value: It is important in the community, or pattern of history

- Importance in the evolution of cultural landscapes and settlement patterns.
- Importance in exhibiting density, richness or diversity of cultural features illustrating the human occupation and evolution of the nation, Province, region or locality.
- Importance for association with events, developments or cultural phases that have had a significant role in the human occupation and evolution of the nation, Province, region or community.
- Importance as an example for technical, creative, design or artistic excellence, innovation or achievement in a particular period
- It has strong or special association with the life or work of a person, group or organisation of importance in history

- Importance for close associations with individuals, groups or organisations whose life, works or activities have been significant within the history of the nation, Province, region or community.
- Importance for a direct link to the history of slavery in South Africa.

2. Aesthetic Value: It is important in exhibiting particular aesthetic characteristics valued by a community or cultural group

- Importance to a community for aesthetic characteristics held in high esteem or otherwise valued by the community.
- Importance for its creative, design or artistic excellence, innovation or achievement.
- Importance for its contribution to the aesthetic values of the setting demonstrated by a landmark quality or having impact on important vistas or otherwise contributing to the identified aesthetic qualities of the cultural environs or the natural landscape within which it is located.
- In the case of an historic precinct, importance for the aesthetic character created by the individual components which collectively form a significant streetscape, townscape or cultural environment.

3. Scientific Value: It has potential to yield information that will contribute to an understanding of natural or cultural heritage

- Importance for information contributing to a wider understanding of natural or cultural history by virtue of its use as a research site, teaching site, type locality, reference or benchmark site.
- Importance for information contributing to a wider understanding of the origin of the universe or of the development of the earth.
- Importance for information contributing to a wider understanding of the origin of life; the development of plant or animal species, or the biological or cultural development of hominid or human species.
- Importance for its potential to yield information contributing to a wider understanding of the history of human occupation of the nation, Province, region or locality.
- It is important in demonstrating a high degree of creative or technical achievement at a particular period.
- Importance for its technical innovation or achievement.

4. Social Value: It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons

- Importance as a place highly valued by a community or cultural group for reasons of social, cultural, religious, spiritual, symbolic, aesthetic or educational associations.
- Importance in contributing to a community's sense of place.

Degrees of Significance

Rarity: It possesses uncommon, rare or endangered aspects of natural or cultural heritage

- Importance for rare, endangered or uncommon structures, landscapes or phenomena.

Representivity: It is important in demonstrating the principal characteristics of a particular class of natural or cultural places or objects

- Importance in demonstrating the principal characteristics of a range of landscapes or environments, the attributes of which identify it as being characteristic of its class.
- Importance in demonstrating the principal characteristics of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, Province, region or locality.

Sphere of Significance: High, Medium, Low

- International; National; Provincial; Regional; Local

Assessment of impacts

A heritage resource impact may be defined broadly as the net change, either beneficial or adverse, between the integrity of a heritage site with and without the proposed development. Beneficial impacts occur wherever a proposed development actively protects, preserves or enhances a heritage resource, by minimising natural site erosion or facilitating non-destructive public use, for example. More commonly, development impacts are of an adverse nature and can include:

- destruction or alteration of all or part of a heritage site;
- isolation of a site from its natural setting; and / or
- introduction of physical, chemical or visual elements that are out of character with the heritage resource and its setting.

Beneficial and adverse impacts can be direct or indirect, as well as cumulative, as implied by the aforementioned examples. Although indirect impacts may be more difficult to foresee, assess and quantify, they must form part of the assessment process. The following assessment criteria have been used to assess the impacts of the proposed development on identified heritage resources:

Criteria	Rating Scales	Notes
Nature	Positive	An evaluation of the type of effect the construction, operation and management of the proposed development would have on the heritage resource.
	Negative	
	Neutral	
Extent	Low	Site-specific, affects only the development footprint.
	Medium	Local (limited to the site and its immediate surroundings, including the surrounding towns and settlements within a 10 km radius);
	High	Regional (beyond a 10 km radius) to national.
Duration	Low	0-4 years (i.e. duration of construction phase).

Criteria	Rating Scales	Notes
	Medium	5-10 years.
	High	More than 10 years to permanent.
Intensity	Low	Where the impact affects the heritage resource in such a way that its significance and value are minimally affected.
	Medium	Where the heritage resource is altered and its significance and value are measurably reduced.
	High	Where the heritage resource is altered or destroyed to the extent that its significance and value cease to exist.
Potential for impact on irreplaceable resources	Low	No irreplaceable resources will be impacted.
	Medium	Resources that will be impacted can be replaced, with effort.
	High	There is no potential for replacing a particular vulnerable resource that will be impacted.

Consequence (a combination of extent, duration, intensity and the potential for impact on irreplaceable resources).	Low	A combination of any of the following: - Intensity, duration, extent and impact on irreplaceable resources are all rated low. - Intensity is low and up to two of the other criteria are rated medium. - Intensity is medium and all three other criteria are rated low.
	Medium	Intensity is medium and at least two of the other criteria are rated medium.
	High	Intensity and impact on irreplaceable resources are rated high, with any combination of extent and duration. Intensity is rated high, with all of the other criteria being rated medium or higher.
Probability (the likelihood of the impact occurring)	Low	It is highly unlikely or less than 50 % likely that an impact will occur.
	Medium	It is between 50 and 70 % certain that the impact will occur.
	High	It is more than 75 % certain that the impact will occur or it is definite that the impact will occur.
Significance (all impacts including potential cumulative impacts)	Low	Low consequence and low probability. Low consequence and medium probability. Low consequence and high probability.
	Medium	Medium consequence and low probability. Medium consequence and medium probability. Medium consequence and high probability. High consequence and low probability.
	High	High consequence and medium probability. High consequence and high probability.

Assumptions and limitations of this heritage impact assessment

- The description of the proposed project, provided by the client, is assumed to be accurate.
- The public consultation process undertaken as part of the Environmental Impact Assessment is sufficient and adequate and does not require repetition as part of the heritage impact assessment.
- Soil surface visibility was moderate overall. Heritage resources might be present below the surface or in areas of dense vegetation and we remind the client that the Act requires that a developer cease all work immediately and notify Amafa or SAHRA should any heritage resources, as defined in the Act, be discovered during the course of development activities.
- No subsurface investigation (including excavations or sampling) were undertaken, since a permit from SAHRA or Amafa is required to disturb a heritage resource.

- A key concept in the management of heritage resources is that of non-renewability: damage to or destruction of most resources, including that caused by bona fide research endeavours, cannot be reversed or undone. Accordingly, management recommendations for heritage resources in the context of development are as conservative as possible.
- Human sciences are necessarily both subjective and objective in nature. eThembeni staff members strive to manage heritage resources to the highest standards in accordance with national and international best practice, but recognise that their opinions might differ from those of other heritage practitioners.
- Staff members involved in this project have no vested interest in it; are qualified to undertake the tasks as described in the terms of reference (refer to Appendix E); and comply at all times with the Codes of Ethics and Conduct of the Association of Southern African Professional Archaeologists.
- eThembeni staff members take no personal or professional responsibility for the misuse of the information contained in this report, but take all reasonable measures to prevent such misuse.

7 APPENDIX D
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PHOTOGRAPHS

Plate 1.

Plate 2.

Plate 3.

Plate 4. The landscape towards the east of the proposed development area.

APPENDIX E

SPECIALIST COMPETENCY AND DECLARATION OF INDEPENDENCE

Specialist competency

Len van Schalkwyk is accredited by the Cultural Resources Management section of the Association of South African Professional Archaeologists (ASAPA) to undertake Heritage Impact Assessments in South Africa. Mr van Schalkwyk has a master's degree in archaeology (specialising in the history of early farmers in southern Africa) from the University of Cape Town and 25 years' experience in heritage management. He has worked on projects as diverse as the establishment of the Ondini Cultural Museum in Ulundi, the cultural management of Chobe National Park in Botswana, various archaeological excavations (notably the Iron Age site of Ndondondwane in the Thukela Valley) and oral history recording projects. He was part of the writing team that produced the KwaZulu-Natal Heritage Act 1997. He has worked with many rural communities to establish integrated heritage and land use plans and speaks good Zulu.

Mr van Schalkwyk left his position as assistant director of Amafa aKwaZulu-Natali, the provincial heritage management authority, to start eThembeni in partnership with Beth Wahl, who was head of archaeology at Amafa at the time. Over the past decade they have undertaken almost 1000 heritage impact assessments throughout South Africa, as well as in Mozambique.

Beth Wahl has a BA Honours in African Studies from the University of Cape Town and has completed various Masters courses in Heritage and Tourism at the University of KwaZulu-Natal. She is currently studying for an MPhil in the Conservation of the Built Environment at UCT, and is also a member of ASAPA.

Ms Wahl was an excavator and logistical coordinator for Glasgow University Archaeological Research Division's heritage programme at Isandlwana Battlefield; has undertaken numerous rock painting surveys in the uKhahlamba/Drakensberg Mountains, northern KwaZulu-Natal, the Cederberg and the Koue Bokkeveld in the Cape Province; and was the principal excavator of Scorpion Shelter in the Cape Province, and Lenjane and Crystal Shelters in KwaZulu-Natal. Ms Wahl compiled the first cultural landscape management plan for the Mnweni Valley, northern uKhahlamba/Drakensberg, and undertook an assessment of and made recommendations for heritage resource databases and organisational capacity in parts of Lesotho and South Africa for the Global Environment Facility of the World Bank for the Maloti Drakensberg Transfrontier Conservation and Development Area. She developed the first cultural heritage management plan for the uKhahlamba Drakensberg Park World Heritage Site, following UNESCO recommendations for rock art management in southern Africa.