TSIMBA

ARCHAEOLOGICAL FOOTPRINTS (PTY) LTD

HERITAGE & PALEONTOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED UPGRADE OF LOCAL ROAD 3494 (DONSAMEHLO) TO GRAVEL (KM0.00 – KM5.288)

MAY 2020

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AUTHOR'S CREDENTIALS

The report was authored by Mr. Roy Muroyi (Archaeologist) and Dr. Heidi Fourie (Palaeontologist).A holder of an Honors Degree, Archaeology, Cultural Heritage and Museum Studies (Midlands State University) an MSc Archaeology Degree candidate at the University of Witwatersrand, he attended further training as a Laboratory Specialist for Human anatomy and human skeletal analysis through the University of Cape-Town human biology department in-conjunction with Cape Archaeological Surveys. Mr Muroyi has over six years industry experience , after leaving the Department of National Museums and Monuments of Botswana where he worked as an Archaeological Impact assessments adjudicating officer Mr . Muroyi then moved to South Africa where has been involved in a range of Cultural Resources Management (CRM) projects. He has so far exhumed over 500 historical burials as a professional archaeologist and carried out close to a 100 Heritage Impact Assessments.

Dr Fourie obtained a Ph.D from the Bernard Price Institute for Palaeontological Research (now ESI), University of the Witwatersrand. Her undergraduate degree is in Geology and Zoology. She specialises in vertebrate morphology and function concentrating on the Therapsid Therocephalia. At present she is curator of a large fossil invertebrate collection, Therapsids, dinosaurs, amphibia, fish, reptiles, and plants at Ditsong: National Museum of Natural History. For the past 13 years she carried out field work in the North West, Western Cape, Northern Cape, Eastern Cape, Limpopo, Mpumalanga, Gauteng and Free State Provinces. Dr Fourie has been employed at the Ditsong: National Museum of Natural History in Pretoria (formerly Transvaal Museum) for 25 years.

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DOCUMENT INFORMATION

DOCUMENT INFORMATION ITEM	DESCRIPTION
Proposed development and location	Upgrade of local road 3494 (Donsamehlo) to gravel (km0.00 – km5.288)
Purpose of the study	To carry out a Heritage Impact Assessment to determine the presence/absence of cultural heritage and paleontological sites and the impact of the proposed road construction
Topography	The site has got a rolling terrain with grades ranging from 1% - 7%.
Municipalities	Lady Smith / uThukela District Municipalities, Kwazulu Natal Province
Predominant land use of surrounding area	Mostly Farming lands
Applicant	KwaZulu-Natal Department of Transport (KZN DoT).
Reference No.	C237/1500/S/1
EAP	Hanslab Environmental Consultants 1 Sugar Close Umhlanga Ridge Umhlanga, 4139
Heritage Consultant	Tsimba Archaeological Footprints (Pty) Ltd 24 Lawson Mansions 74Loveday Street, Johannesburg, CBD Gauteng, 2000
Author (s)	Mr. Roy Muroyi (Archaeology and Heritage Specialist) Dr. Heidi Fourie (Paleontologist)

EXECUTIVE SUMMARY

The Applicant proposes to upgrade of local road 3494 (Donsamehlo) to gravel (km0.00 – km5.288) with reference number :- ***C237/1500/S/1***.Situated in Ladysmith / DC23 uThukela District Municipality. The review of a range of cultural heritage information was undertaken. This included Amafa Research Institute and National heritage databases, lists and registers, as well as a range of other documented information (including heritage impact assessment reports and a range of ethno-historic and archaeological sources at both local and regional levels).

The scope of work for this Phase 1 HIA was to assess the footprint of the proposed development footprint as well as the identification and mapping of heritage resources around it. The length of the road upgrade is 5.288 km. The proposed development triggers section 38(1) (a) of the the National Heritage Resources Act (NHRA- Act No. 25 of 1999) as well as section 41 (1) of the KwaZulu-Natal Amafa and Research Institute Act, 2018 (Act No 5 of 2018) which lists developments or activities that may require an HIA. Section 41 *(1) :- the project involves construction of a road, wall, powerline, pipeline, canal or other simila form of linear development or barrier exceeding 300m in length.*

An archaeological and historical background study was undertaken which revealed various aspects of the archaeology and history of the study area and surrounding landscape. Although a number of archaeological and historical sites are known from the surroundings of the study area, The field survey did not reveal any such sites within the study area boundaries.

A palaeontological desktop study was also undertaken by Dr Heidi Fourie. This study revealed that the proposed development potential impact on fossil heritage is **VERY HIGH and MODERATE** and therefore a field survey will be necessary for this development (according to SAHRA protocol). A Phase 1 Palaeontological Impact Assessment: Field Study is recommended.

Conclusions

An archaeological and historical background study was undertaken which revealed various aspects of the archaeology and history of the study area and surrounding landscape. Although a number of archaeological and historical sites are known from the surroundings of the study area, this study did not reveal any such sites within the study area boundaries. Tsimba Archaeological Footprints therefore requests Amafa Research Institute to exercise their discretion and offer a positive review to the project.

A palaeontological desktop study was also undertaken by Dr Heidi Fourie. This study revealed that the proposed development potential impact on fossil heritage is **VERY HIGH and MODERATE** and therefore a field survey will

be necessary for this development (according to SAHRA protocol). A Phase 1 Palaeontological Impact Assessment: Field Study is recommended.

Recommendations

- The value- based management process proposed that the developer should be given the go ahead and continue with the proposed project under a strict periodic monitoring program by an accredited archaeologist.
- This monitoring exercise will assist in the event that stone tools are identified during the construction phase. A Chance finds procedure (CFP) should also be implemented in the event that stone tools are identified underground (See Appendix 1)
- A Phase 2 HIA is recommended where burials are reported by the local community within the homesteads along the proposed development footprint.
- Any additions to the existing study area will have to be surveyed by a suitably qualified heritage specialist.

It is the opinion of the author of this report that in terms of the heritage aspects addressed as part of the defined scope of work of this study and on the condition that the required mitigation measures and recommendations made in this report are undertaken before any development takes place, the development may be allowed to continue.

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ABBREVIATIONS

Acronyms	Description
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GIS	Geographic Information System
GPS	Global Positioning System
HIA	Heritage Impact Assessment
LSA	Late Stone Age
LIA	Late Iron Age
MIA	Middle Iron Age
MSA	Middle Stone Age
SAHRA	South African Heritage Resources Agency
KZNDOT	KwaZulu-Natal Department of Transport
PIA	Paleontological Impact Assessment

GLOSSARY

Achievement	▪ Something accomplished, esp. by valour, boldness, or superior ability
Aesthetic	▪ Relating to the sense of the beautiful or the science of aesthetics.
Community	▪ All the people of a specific locality or country
Culture	▪ The sum total of ways of living built up by a group of human beings, which is transmitted from one generation to another.
Cultural	▪ Of or relating to culture or cultivation.
Diversity	▪ The state or fact of being diverse; difference; unlikeness.
Geological (geology)	▪ The science which treats of the earth, the rocks of which it is composed, and the changes which it has undergone or is undergoing.
High	▪ Intensified; exceeding the common degree or measure; strong; intense, energetic
Importance	▪ The quality or fact of being important.
influence	▪ Power of producing effects by invisible or insensible means.
Potential	▪ Possible as opposed to actual.
Integrity	▪ The state of being whole, entire, or undiminished.
Religious	▪ Of, relating to, or concerned with religion.
Significant	▪ important; of consequence
Social	▪ Living, or disposed to live, in companionship with others or in a community, rather than in isolation.
Spiritual	▪ Of, relating to, or consisting of spirit or incorporeal being.
Valued	▪ Highly regarded or esteemed

1.0 INTRODUCTION

1.1 Project Background

Tsimba Archaeological Footprints (Pty) Ltd was requested by Hanslab Environmental Consultants (Pty) Ltd to conduct a heritage impact assessment (HIA) of the proposed upgrade of local road 3494 (Donsamehlo) to gravel (km0.00 – km5.288) with reference number :- ***C237/1500/S/1***.Situated in Ladysmith / DC23 uThukela District Municipality.

The aim of the survey was to identify and document archaeological sites, cultural resources, sites associated with oral histories (intangible heritage), graves, cultural landscapes, and any structures of historical significance (tangible heritage) that may be affected within the footprint of the proposed water reticulation network pipelines.

The findings of this report have been informed by desktop data review and impact assessment reporting which include recommendations to guide heritage authorities in making decisions with regards to the proposed project. This study was conducted as part of the specialist input for the Environmental Impact Assessment exercise. The impact assessment study also includes detailed recommendations on how to mitigate and manage negative impacts while enhancing positive effects on the project area.

The appointment of Tsimba Archaeological Footprints is in terms of the National Heritage Resources Act (NHRA), No. 25 of 1999and the KwaZulu-Natal Heritage Act (Act No 4 of 2008). The HIA is completed in accordance to requirements of Section 38 (1) (a) of the NHRA, No. 25 of 1999 :- *the project involves construction of a road, wall, powerline, pipeline, canal or other simila form of linear development or barrier exceeding 300m in length;*

1.2 Legislative Frame works used

1. ICOMOS, 1996.International Charter for the Conservation and Restoration of Monuments and sites (the Venice charter).
2. ICOMOS, 1999.The Australia ICOMOS charter for places of cultural significance (the Burra Charter).
3. ICOMOS Charter, Principles for the analysis, conservation and structural restoration of architectural heritage (2003)
4. National Heritage and Resources Act of South Africa No.25 of 1999
5. KwaZulu-Natal Heritage Act, 1997 (Act No. 4 of 2008

1.3 Scope of works

The Proposed project scope of the activities is given in the table below;

L3494: Donsamehlo Local Road Cross Section Specifications	Carriageway lane widths	Type 7A Local Road (2.5m lane widths)
Shoulders - left	0.45 m wide gravel shoulder	
Shoulders - right	0.45 m wide gravel shoulder	
Cross fall	4 %	
Super elevation	6 % maximum	
Cut / Fill	1 in 1.5 typical	
Pavement Design	Pavement Depth	300 mm
Gravel Wearing Course Layer	150 mm	
Base Layer	150 mm	

Figure 1: Road design standards adopted for the project

2.0 DESCRIPTION OF THE RECEIVING ENVIRONMENT

2.1 Location

The Project includes one Alternative (see map) a stretch of gravel road outlined in yellow (L3494) near the towns of Estcourt, Colenso and Weenen. The length of the road is 5.288 km.

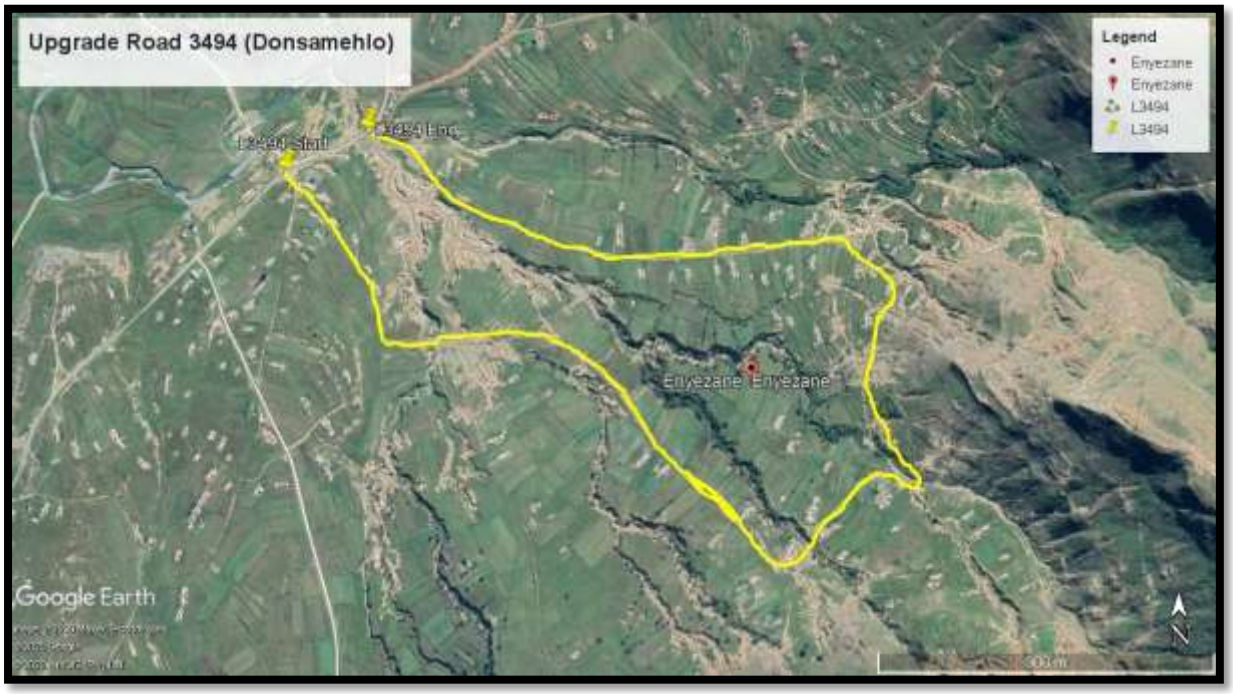

Figure 2: Map showing the proposed road

3.0 METHODOLOGY

3.1 Literature review

The methodology used in this HIA is based on a comprehensive understanding of the current or baseline situation; the type, distribution and significance of heritage resources as revealed through desk-based study and additional data acquisition, such as archaeological investigations, built heritage surveys, and recording of crafts, skills and intangible heritage. This is systematically integrated by the use of matrices with information on the nature and extent of the proposed engineering and other works to identify potential. The following tasks were also undertaken in relation to the cultural heritage and are described in this report:

The background information search of the proposed development area was conducted following the site maps from the client. Sources used in this study included:

- Published academic papers and HIA and PIA studies conducted in and around the region where the proposed infrastructure development will take place;
- Available archaeological literature covering the Kwa-Zulu Natal province area was also consulted;
- The SAHRIS website and the National Data Base was consulted to obtain background information on previous heritage surveys and assessments in the area; and the Kwa Zulu Natal Heritage Data Base.
- Map Archives - Historical maps of the proposed area of development and its surrounds were assessed to aid information gathering of the proposed area of development and its surrounds.

4.0 LEGISLATIVE FRAMEWORK

This HIA and Desktop Paleontological study is informed and conducted to fulfil the requirements of the National Heritage Resources Act (No 25 of 1999) 38 (a) and the KwaZulu-Natal Amafa and Research Institute Act, 2018 (Act No 5 of 2018) Section 41 (1) which lists developments or activities that may require an HIA. *:- the project involves construction of a road, wall, powerline, pipeline, canal or other simila form of linear development or barrier exceeding 300m in length.*

Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act No.25 of 1999): (i) (i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens.

A Phase 1 HIA is a pre-requisite for development in South Africa as prescribed by SAHRA and stipulated by legislation. The overall purpose of heritage specialist input is explained in **(Figure 3)** below;

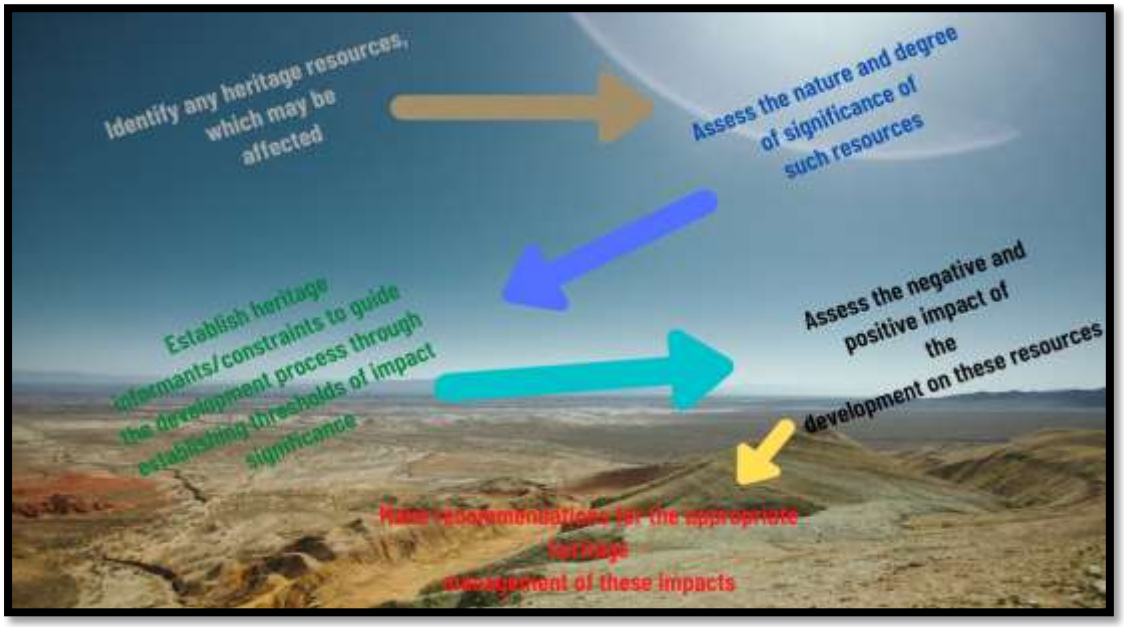

Figure 3: Heritage Impact Assessment process

5.0 ARCHEOLOGICAL AND HISTORICAL BACKGROUND

In 1900, James Dunsmuir renamed the unincorporated town of Oyster Harbor (established c. 1898) on the east coast of Vancouver Island, British Columbia, Canada, Ladysmith, in memory of the British lifting Ladysmith's siege in South Africa during the Second Boer War (28 February 1900).

- *Archaeological Sites*

There has been systematic archaeological surveys that have been carried out within the greater Ladysmith area sites in the past. Survey were mostly conducted by archaeologists attached to the Natal Museum as well as by Amafa staff. The surveys recorded sixty one sites are recorded in the data base of the KwaZulu-Natal Museum. The recorded include five Early Stone Age sites, five Middle Stone Age sites, six Later Stone Age sites, three rock art sites (two rock paintings and one rock engraving), and eleven Later Iron Age sites and twenty historical period Nguni homesteads. Most of the Later Iron Age and historical period Nguni homesteads are demarcated by characteristic stone walling. Stone walling and graves related to the Anglo-Boer War period of 1899-1901 are also abundant in the area. A further ten sites are recorded in the Natal Museum data base but many more sites belonging to this period should occur in the greater Ladysmith area. According to the Kwa Mafa Research Institute data base,the project area has not been systematically surveyed in the past and no heritage sites are known from the footprint.

Figure 4: San Rock paintings taken from the Drakensburg Mountain[1]

- *San occupation*

The lad was occupied by the San people for almost 30 000 years but the local demography started to change soon after 2000 years ago when the first Bantuspeaking farmers crossed the Limpopo River and arrived in South Africa. From 800 years ago, if not earlier, Bantu-speaking farmers also settled in the greater Ladysmith area. Although some of the sites constructed by these African farmers consisted of stone walling not all of them were made from stone. Sites located elsewhere in the KwaZulu-Natal Midlands show that many settlements just consisted of wattle and daub structures. In the Ladysimth area, Later Iron Age sites were most probably inhabited by Ngunispeaking groups such as the amaBhele and others (Bryant 1965). However, by 1820 the original African farmers were dispersed from this area due to the expansionistic policies of the Zulu Kingdom of King Shaka. Many individuals of former chiefdoms in the area became bandits and oral tradition suggests that

[1] Discovery Africa (2017) Kamberg Rock Art Centre , KZN. Retrieved from: https://www.discoverafrica.com/blog/five-destinations-to-view-rock-paintings-in-south-africa/

cannibalism may also have been practised by some of these groups. African refugee groups and individuals were given permission to settle in the area by the British colonial authorities after 1845 where most of them became farm labourers. After the Anglo-Zulu war of 1879 and the Bambatha Rebellion of 1911 many of the African people in the study area adopted a Zulu ethnic identity. The bambata rebellion was a protest against exuberant tax that was being exerted by the settler government to on the Zulu people. Given below is a table showing the amounts the settler government had made prior to the rebellion

Amounts that were collected from the poll tax between 1906 and 1909[5]			
1906	***1907***	***1908***	***1909***
	Natal		
£68,500	£49,637	£45,150	£41,498
	Zululand		
£7,990	£4,267	£3,940	£3,520
	Total		
£76,490	**£53,904**	**£49,090**	**£45,018**

Table 1: Amounts collected by the settler government leading to the culmination of the Bambatha rebellion[2]

- *European Settlement*

The rea was to be settled by white European settlers soon after 1838 when the first Voortrekker settlers marked out large farms in the area. However, most of these farms were abandoned in the 1840's when Natal became a British colony only to be reoccupied again by British immigrants. Nevertheless, a group of Dutch farmers declared an independent republic in 1847 on the banks of the Klip River and called it the Klip River Republic with Andries Spies as commandant. This pocket republic only survived for a few months before British authority over the area was declared. The British planned a town as an administrative centre for the Klip River District, proclaiming it on 20 June 1850 and called it Ladysmith. Ladysmith became world famous during the Anglo-Boer War of 1899-1901 when it was besieged by Boers from 2 November 1899 until 28 February 1900. Ghandi, Smuts and Churchill are figures of international significance who were also present during the siege of Ladysmith. During the 118 day long siege the stone Town Hall sustained considerable damage. It has since been restored to the original vision of the architects. Located next to the Town Hall the building housing the Siege Museum was erected in 1884. It was used as a rations post for civilians. The Museum displays relics from the time of the siege, including documents, uniforms and firearms. Several of the most celebrated battles of the war were fought around Ladysmith. These include the Battles of Elandslaagte, Spionkop, Wagon Hill, Caesars Camp, Lombards Kop and Umbulwana Hill. These battle field sites as well as associated graves and buildings of the era are proclaimed heritage sites and are protected by provincial heritage legislation.

[2] Wikiwand (2020).Bambatha rebellion. Retrieved from: https://www.wikiwand.com/en/Bambatha_Rebellion

6.0 DISCUSSION OF THE FINDINGS

The road to be upgraded is in-btween the Cathkin Park (West), Giants Castle Game reserve (South-Western), Emandabeni (North -West) connecting with Enyezane on the east. Because of the site's close proximity to the Giants Castle Game Reserve and the Drankesburg mountains , we expected to encounter Iron Age sites along the proposed development round. Rock Art shelters and paintings were also expected. None of the expected findings were however discovered within the proposed road upgrade route. The San believed that shamans in trance assumed special powers which they acquired from fusing with animals (the Eland in particular). The shamans believed that with these powers they could influence the 'spirit world' to bring rain, cure disease, ensure successful hunting ' and contact people far away. Many paintings show aspects of these religious beliefs. The shamans painted what they had seen and felt while in trance. The proposed route was assessed and found to be acceptable . No graves/burial grounds were discovered and no archaeological sites were discovered. It is however a possible that graves may exist around some of the homesteads that are found along the proposed route reserve.

The scenery is a little bit spectacular and rugged, but the underlying geology is simple. At lower altitudes are a series of near horizontal sedimentary sandstones, mudstones and shales, these are topped by deep basalt flows thick forming the main escarpment. Outcrops of dolerite, which have pushed through faults in molten form, are common and often occur as straight dykes across the landscape. The grasslands vary with altitude and aspect, temperate evergreen grassland characterised by the spiky Festuca costata on the moist south-facing slopes and on the scree slopes, and shorter highland sourveld grassland, with Themeda triandra which goes red in winter, covering large areas. Woody vegetation is largely confined to sheltered slopes and valleys and consists mainly of Leucosidea sericea ('umTshitshi').

This survey took a value-based management process described by Burra Charter. The value-based management process entails three stages: significance assessment, develop policy and management (ICOMOS Australia 1999). Further revisions introduced a fourth stage for assessing vulnerability into the process in order to explicitly identify threats to cultural significance (Clark 1968), or for purposely change cultural heritage, through means of implementing development projects. This value-based management process has been extensively applied in countries such as Australia and United Kingdom, either by changing the legislation or drafting new conservation guidelines (English Heritage 2008). Other researches have also focused in developing, improving and/or verifying this process, among which are the important reports produced at The Getty Conservation Institute.

Indirect impacts were expected for this project because of the nature of the landscape. They are called indirect if they are caused by an action, but occur later in time or farther removed in space.For example, removal of archaeological sediments by sheet erosion may be the direct result of an intense summer rainstorm, and an in direct result of removal of upslope vegetation due to road construction.

6.1 PHOTOGRAHIC PRESENTATION OF THE PROPOSED PROJECT SITE

Figure 5: Part of the road reserve with fields on the right side

Figure 6: A small bridge the proposed road will cross over.

Figure 7: Part of the river stream banks were Iron Age sites are usually found

Figure 8: An area of the proposed road route where ground visibility is very clear

Figure 9: The intersection were the road will connect with the main road

Figure 10: A view of the river stream the road will have to cross over.

8.0 HERITAGE ASSESSMENT OF SIGNIFICANCE

The significance of a site can be modified or added to. Its importance can be increased by communicating the significance to more people through the media or archaeological reports. Site significance classification standards prescribed by SAHRA (2006), and acknowledged by ASAPA for the SADC region, were used for the purposes of this report.

- The main aim in assessing significance is to produce a succinct statement of significance, which summarises an item's heritage values. The statement is the basis for policies and management structures that will affect the item's future.

Table 2: SAHRA's site significance classification minimum standards

Filed Rating	Grade	Classification	Recommendation
National Significance (NS)	Grade 1		Conservation; National Site nomination
Provincial Significance (PS)	Grade 2		Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)		High/ Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)		Medium Significance	Recording before destruction
Generally Protected C (GP.A)		Low Significance	Destruction

Site significance is calculated by combining the following concepts in the given formula.

S= (E+D+M) P

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

The significance weightings for each potential impact are as follows:

Table 3: The significance weightings for each potential impact are as follows

Aspect	Description	Weight
Probability	Improbable	1
	Probable	2
	Highly Probable	4
	Definite	5
Duration	Short term	1
	Medium term	3
	Long term	4
	Permanent	5
Scale	Local	1
	Site	2
	Regional	3
Magnitude/Severity	Low	2
	Medium	6
	High	8

It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. (S) is formulated by adding the sum of numbers assigned to Extent (E), Duration (D), and Intensity (I) and multiplying the sum by the Probability. S= (E+D+M) P		
<30	Low	Mitigation of impacts is easily achieved where this impact would not have a direct influence on the decision to develop in the area.
30-60	Medium	Mitigation of impact is both feasible and fairly easy. The impact could influence the decision to develop in the area unless it is effectively mitigated.
>60	High	Significant impacts where there is difficult. The impact must have an influence on the decision process to develop in the area.
Nature: During the construction phase activities resulting in disturbance of surfaces and/or sub-surfaces may destroy, damage, alter, or remove from its original position archaeological material or objects.		
	Without Mitigation	With Mitigation
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (2)	Low(2)
Probability	Not Probable (2)	Not probable (2)
Significance	Low (16)	Low(16)
Status	Negative	Negative
Reversibility	Not irreversible	Not irreversible
Irreversible loss of resources	No resources were recorded	No resources were recorded
Can impacts be mitigated?	Yes, a chance find procedure should be implemented.	Yes
Mitigation: Impacts are rated as <30 (Low) Mitigation of impacts is easily achieved where this impact would not have a direct influence on the decision to develop in the area. Due to the lack of apparent significant heritage resources no further mitigation is required prior to construction. A Chance Find Procedure should be implemented for the project should any sites be identified during the construction process.		

Table 4: Impact Significance

8.1 Conclusions

An archaeological and historical background study was undertaken which revealed various aspects of the archaeology and history of the study area and surrounding landscape. Although a number of archaeological and historical sites are known from the surroundings of the study area, the field survey did not reveal any such sites within the study area boundaries. Tsimba Archaeological Footprints therefore requests Amafa Research Institute to exercise their discretion and offer a positive review to the project.

A palaeontological desktop study was also undertaken by Dr Heidi Fourie. This study revealed that the proposed development potential impact on fossil heritage is **VERY HIGH and MODERATE** and therefore a field survey will be necessary for this development (according to SAHRA protocol). A Phase 1 Palaeontological Impact Assessment: Field Study is recommended.

8.2 Recommendations

- The value- based management process proposed that the developer should be given the go ahead and continue with the proposed project under a strict periodic monitoring program by an accredited archaeologist.
- This monitoring exercise will assist in the event that stone tools are identified during the construction phase. A Chance finds procedure (CFP) should also be implemented in the event that stone tools are identified underground (See Appendix 1)
- A Phase 2 HIA is recommended where burials are reported by the local community within the homesteads along the proposed development footprint.
- Any additions to the existing study area will have to be surveyed by a suitably qualified heritage specialist.

It is the opinion of the author of this report that in terms of the heritage aspects addressed as part of the defined scope of work of this study and on the condition that the required mitigation measures and recommendations made in this report are undertaken before any development takes place, the development may be allowed to continue.

9.0 PALEONTOLOGICAL STUDY

9.1 Summary

Over areas totalling fully 40% of Southern Africa the 'hard rocks', from the oldest to the Quaternary, are concealed by normally unconformable deposits – principally sand, gravel, sandstone, and limestone. Inland deposits are much more extensive than marine deposits and are terrestrial and usually unfossiliferous. Some of these deposits date back well into the Tertiary, whereas others are still accumulating. Owing to the all-to-often lack of fossils and of rocks suitable for radiometric or palaeomagnetic dating, no clear-cut dividing line between the Tertiary and Quaternary successions could be established (Kent 1980). The alluvium sands were deposited by a river system and reworked by wind action (Snyman 1996).

Large areas of the southern African continent are covered by the Karoo Supergroup. It covers older geological formations with an almost horizontal blanket. Several basins are present with the main basin in the central part of south Africa and several smaller basins towards Lebombo, Springbok Flats and Soutpansberg. An estimated age is 150 – 180 Ma. And a maximum thickness of 7000 m is reached in the south. Three formations overlie the Beaufort Group, they are the Molteno, Elliot and Clarens Formations. The Elliot Formation is also known as the Red Beds and the old Cave Sandstone is known as the Clarens Formation. At the top is the Drakensberg Basalt Formation with its pillow lavas, pyroclasts, etc. (Kent 1980, Snyman 1996). The Beaufort Group is underlain by the Ecca Group.

When rock units of moderate to very high palaeontological sensitivity are present within the development footprint, a desk top and or field scoping (survey) study by a professional palaeontologist is usually warranted. The main purpose of a field scoping (survey) study would be to identify any areas within the development footprint where specialist palaeontological mitigation during the construction phase may be required (SG 2.2 SAHRA AMPHOB, 2012).

9.2 Legal requirements:-

The **National Heritage Resources Act (Act No. 25 of 1999) (NHRA)** requires that all heritage resources, that is, all places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance are protected. The Republic of South Africa (RSA) has a remarkably rich fossil record that stretches back in time for some 3.5 billion years and must be protected for its scientific value. Fossil heritage of national and international significance is found within all provinces of the RSA. South Africa's unique and non-renewable palaeontological heritage is protected in terms of the National Heritage Resources Act. According to this act, palaeontological resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

The main aim of the assessment process is to document resources in the development area and identify both the negative and positive impacts that the development brings to the receiving environment. The PIA therefore identifies palaeontological resources in the area to be developed and makes recommendations for protection or mitigation of these resources.

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

For this study, resources such as geological maps, scientific literature, institutional fossil collections, satellite images, aerial maps and topographical maps were used. It provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations (if any) for further specialist palaeontological input where this is considered necessary.

A Palaeontological Impact Assessment is generally warranted where rock units of **LOW** to **VERY HIGH** palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed area is unknown. The specialist will inform whether further monitoring and mitigation are necessary.

Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act No.25 of 1999):
(i) (i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens.
This report adheres to the guidelines of Section 38 (1) of the National Heritage Resources Act (Act No. 25 of 1999).
Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as (a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length; (b) the construction of a bridge or similar structure exceeding 50 m in length; (c) any development or other activity which will change the character of a site (see Section 38); (d) the re-zoning of a site exceeding 10 000 m² in extent; (e) or any other category of development provided for in regulations by SAHRA or a PHRA authority.

This report aims to provide comment and recommendations on the potential impacts that the proposed development could have on the fossil heritage of the area and to state if any mitigation or conservation measures are necessary **(6c)**.

9.3 Outline of the geology and the palaeontology

The geology was obtained from map 1:100 000, Geology of the Republic of South Africa (Visser 1984) and 2830 Dundee, 1:250 000 geological map (Wolmarans and Linstrőm 1988). The applicant, The KZN Department of Transport proposes to upgrade three roads in the Estcourt, Colenso and Weenen areas.

The Project includes one Alternative (see map):
Alternative 1: The stretch of gravel road outlined in yellow (L3494) near the towns of Estcourt, Colenso and Weenen. The length of the road is 5.288 km.

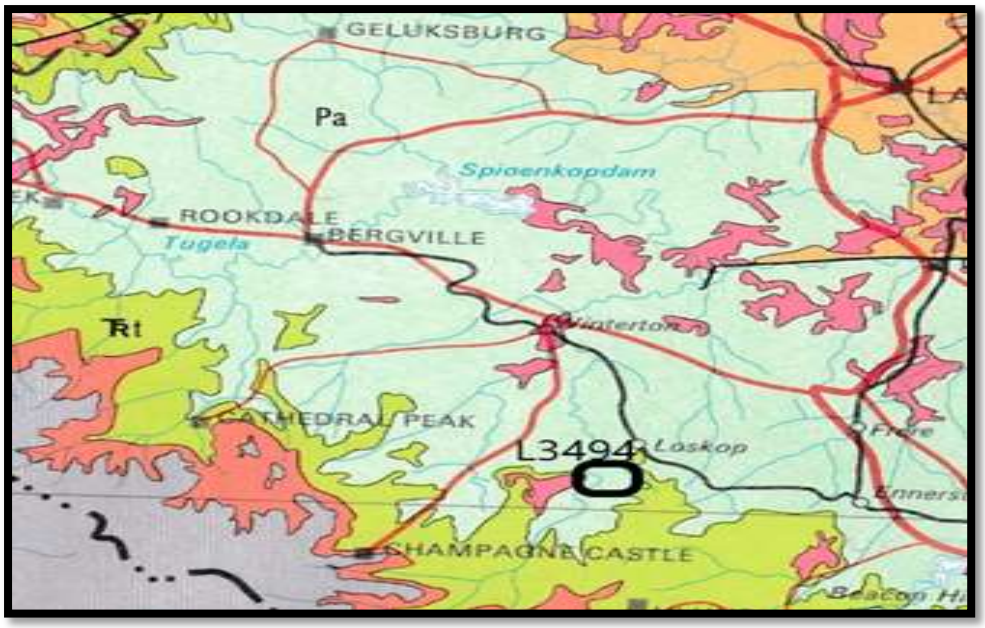

Figure 11: The geology of the development area

Legend to Map and short explanation.

Pa – Sandstone, mudstone, siltstone (green). Adelaide Subgroup, Beaufort Group, Karoo Supergroup. Early Triassic.

Pvo – Mudstone, siltstone, shale (amber). Volksrust Formation, Ecca Group, Karoo Supergroup. Permian.

Pv – Shale, shaly sandstone, grit, sandstone, conglomerate and coal in places near base and top (brown). Vryheid Formation, Ecca Group, Karoo Supergroup. Permian.

…… – (black) Lineament (Possible dyke).

--f— Fault.

⊥10˚ - Strike and dip.

□ – Approximate position of road upgrades.

The Adelaide Subgroup consists of up to three formations (Koonap, Middleton, Balfour). Mudrock predominates with subordinate sandstone and is Upper Permian in age. It overlies the Ecca Group conformably and is overlain by the Katberg Formation of the Tarkastad Subgroup. Siltstone beds are common (Cole *et al.* 2004). The Balfour Formation is distinguished from the Middleton Formation by the lack of 'red' mudstone and is ±2150 m. thick, whereas the Middleton Formation is ±1600 m. thick (sheet info, Kent 1980). The Abrahamskraal and Teekloof Formations also form part of the Adelaide Subgroup (Snyman 1996). Chert is present in the Abrahamskraal Formation. The Adelaide Subgroup has a maximum thickness of 1750 m. in the south (Visser 1989).

Kent (1980) described the Volksrust Formation as the 150-270 m of shale which overlies the Vryheid Formation. The deposition of this formation coincides with that of the Fort Brown and Waterford Formations in the south (Snyman 1996). It occurs from the south of Kwazulu-Natal into the Free State and is concordant (Visser 1989).

The Vryheid Formation is named after the type area of Vryheid-Volksrust. In the north-eastern part of the basin the Vryheid Formation thins and eventually wedges out towards the south, southwest and west with increasing distance from its source area to the east and northeast (Johnson 2009). The Vryheid Formation consists essentially of sandstone, shale, and subordinate coal beds, and has a maximum total thickness of 500 m. It

forms part of the Middle Ecca (Kent 1980). This formation has the largest coal reserves in South Africa. The pro-delta sediments are characterised by trace and plants fossils (Snyman 1996).

Palaeontology – Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity can generally be **LOW** to **VERY HIGH**, and here locally **MODERATE** for the Volksrust Formation, and **VERY HIGH** for the Adelaide Subgroup and Vryheid Formation (SG 2.2 SAHRA APMHOB, 2012).

The rocks of the Karoo Supergroup are internationally acclaimed for their richness and diversity of fossils. The rocks of the Beaufort Group of South Africa cover approximately one-third of the land surface and have yielded an abundance of well-preserved therapsids and other tetrapods which have been used to subdivide this Group into eight faunal Assemblage Zones. Fossil vertebrates are found in the thick mudrock of the Adelaide Subgroup. Fossils of *Diictodon, Ictidosuchops, Gorgonops* and the amphibian *Rhinesuchus* are frequently preserved as articulated skeletons within the mudrock present in the *Daptocephalus* Assemblage Zone (Figure 14). Fossil fish (*Atherstonia*) and the captorhinid *Pareiasaurus* have also been recorded. Other fossils that occur are *Procynosuchus, Tetracynodon, Lycaenops, Ictidorhinus, Dicynodon, Youngina,* to name but a few (Rubidge 1995).

The Volksrust Formation consists of a monotonous sequence of grey shale and fossils are significant, but very rarely recorded. Fossils include rare temnospondyl amphibian remains, invertebrates, minor coals with plant remains, fish scales, petrified wood, and low-diversity marine to non-marine trace fossil assemblages (Groenewald and Groenewald 2014).

The Ecca Group, Vryheid Formation may contain fossils of diverse non-marine trace, *Glossopteris* flora, mesosaurid reptiles, palaeoniscid fish, marine invertebrates, insects, and crustaceans (Johnson 2009). *Glossopteris* trees rapidly colonised the large deltas along the northern margin of the Karoo Sea. Dead vegetation accumulated faster than it could decay, and thick accumulations of peat formed, which were ultimately converted to coal. It is only in the northern part of the Karoo Basin that the glossopterids and cordaitales, ferns, clubmosses and horsetails thrived (McCarthy and Rubidge 2005).

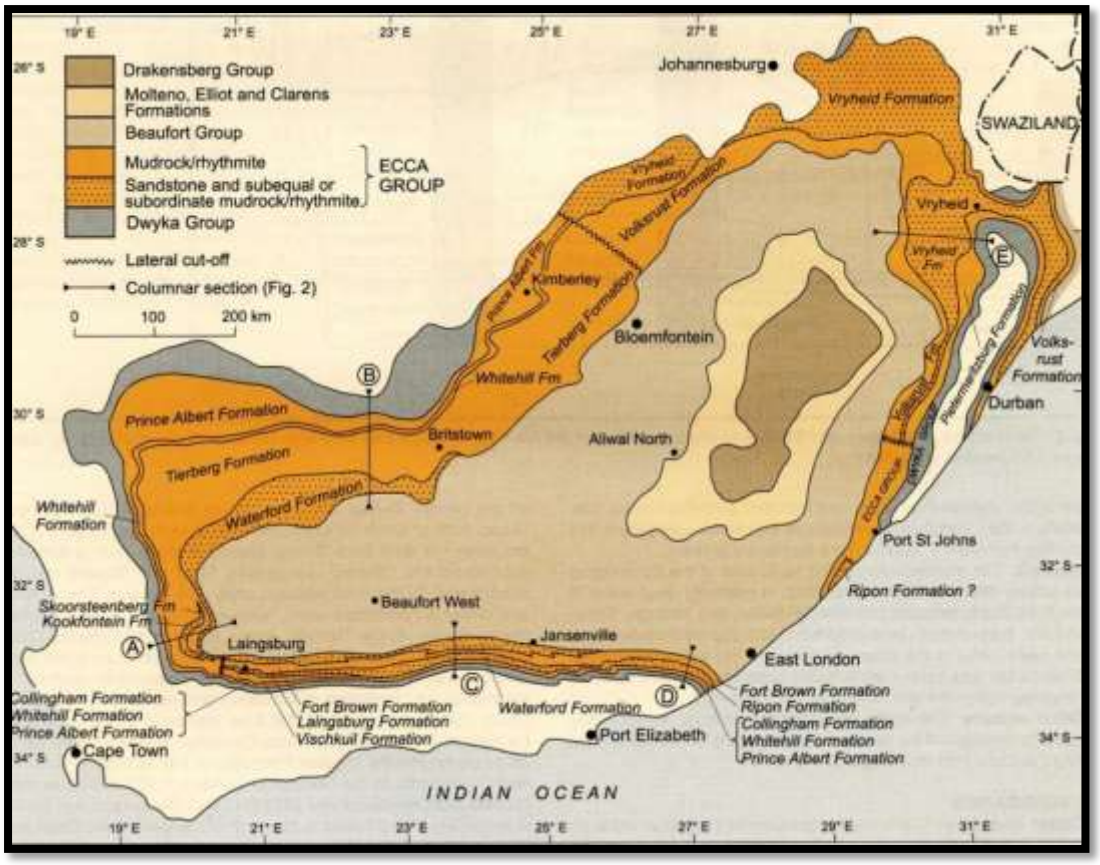

Figure 12: Extent of the Karoo Supergroup (Johnson 2009)

The rocks of the Karoo Supergroup are internationally acclaimed for their richness and diversity of fossils. The rocks of the Beaufort Group of South Africa cover approximately one-third of the land surface and have yielded an abundance of well-preserved therapsids and other tetrapods which have been used to subdivide this Group into eight faunal Assemblage Zones.

Fossil vertebrates are found in the thick mudrock of the Adelaide Subgroup. Fossils of *Diictodon, Ictidosuchops, Gorgonops* and the amphibian *Rhinesuchus* are frequently preserved as articulated skeletons within the mudrock present in the *Daptocephalus* Assemblage Zone (Figure 8). Fossil fish (*Atherstonia*) and the captorhinid *Pareiasaurus* have also been recorded. Other fossils that occur are *Procynosuchus, Tetracynodon, Lycaenops, Ictidorhinus, Dicynodon, Youngina,* to name but a few (Rubidge 1995).

Figure 13: Typical Karoo scene during the Upper Permian times (Cluver 1978)

In 1936 Mr G. Myburgh found mammalian fossil bones on the farm Rankies near Kroonstad. A Zorrilodontops fossil (Therocephalia, SAM/K 1392 cranium, postcraium) was found in Edenville, Kroonstad and Procolophon and Lystrosaurus fossils were found at Colton near Dewetsdorp. A desktop study done (Bamford 2018) south of Kroonstad (near Edenville) omits to report these finds.

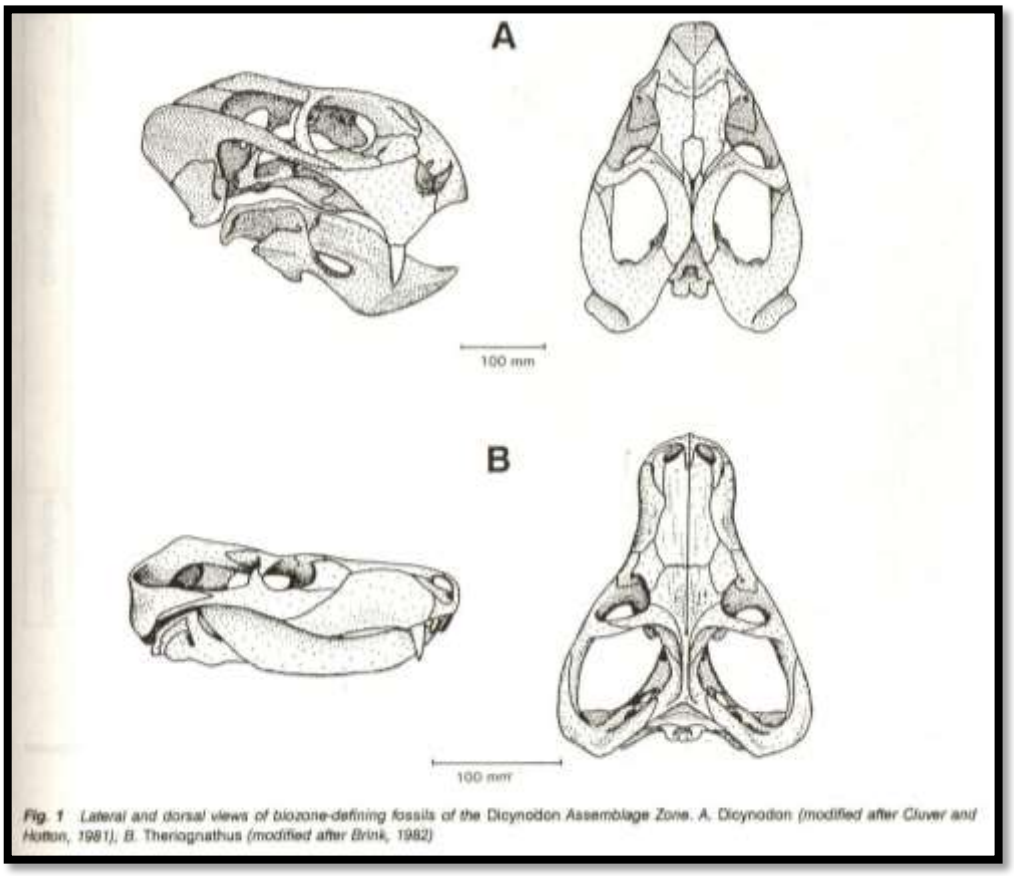

Fig. 1 Lateral and dorsal views of biozone-defining fossils of the Dicynodon Assemblage Zone. A. Dicynodon (modified after Cluver and Hotton, 1981), B. Theriognathus (modified after Brink, 1982)

Figure 14: Examples of the Zone fossils (Rubidge 1995)

The Volksrust Formation consists of a monotonous sequence of grey shale and fossils are significant, but very rarely recorded. Fossils include rare temnospondyl amphibian remains, invertebrates, minor coals with plant remains, fish scales, petrified wood, and low-diversity marine to non-marine trace fossil assemblages (Groenewald and Groenewald 2014).

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The Glossopteris flora is thought to have been the major contributor to the coal beds of the Ecca. These are found in Karoo-age rocks across Africa, South America, Antarctica, Australia and India. This was one of the early clues to the theory of a former unified Gondwana landmass (Norman and Whitfield 2006).

Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity is generally LOW to VERY HIGH, but here locally **MODERATE** for the Volksrust Formation, and **VERY HIGH** for the Adelaide Subgroup and Vryheid Formation.

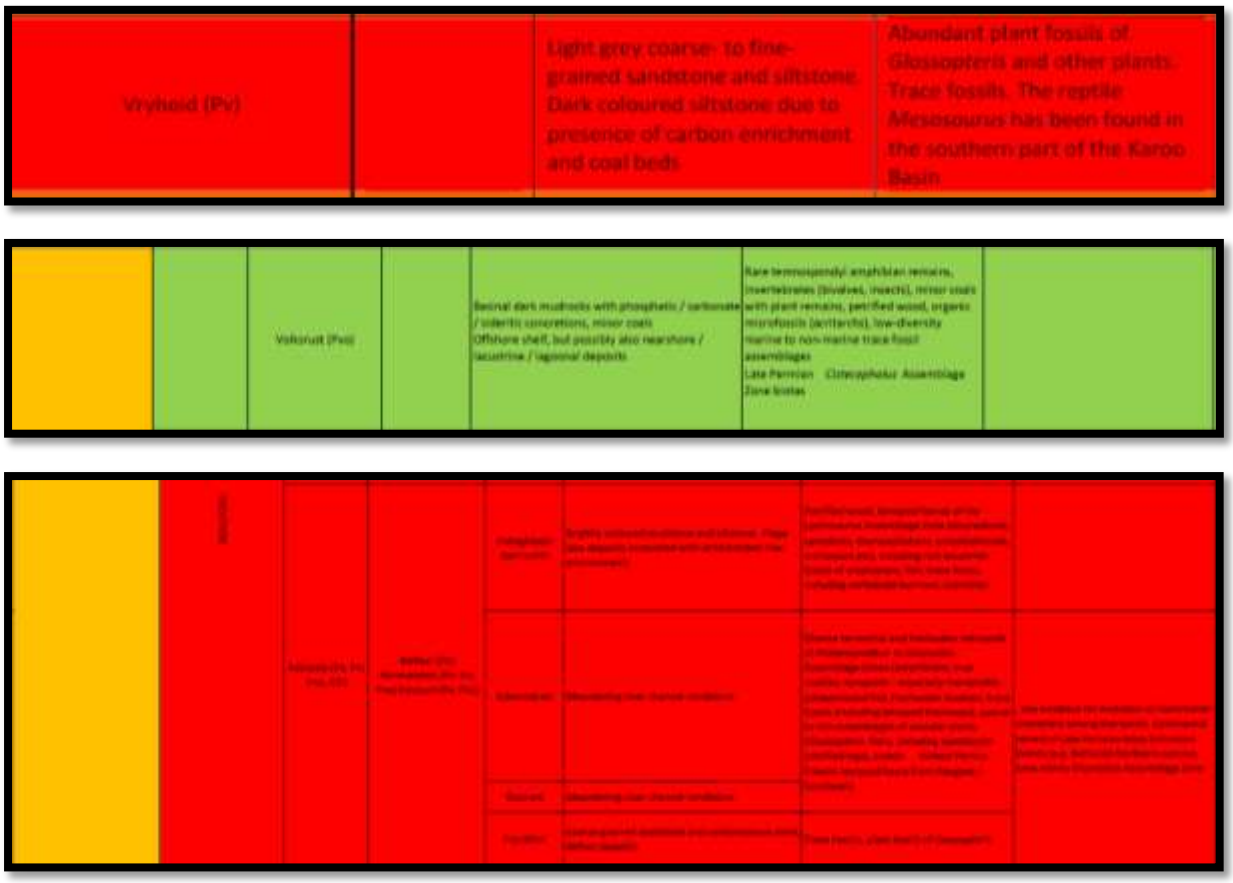

Table 5: Taken from Paleontological Report (Groenewald 2012)

Rock Unit	Significance/vulnerability	Recommended Action
Adelaide Subgroup	Very High	Field assessment and protocol for finds is required
Volksrust Formation	Moderate	Desktop survey and Phase 1 PIA is recommended
Vryheid Formation	Very High	Field assessment and protocol for finds is required

Table 6: Criteria used (Fossil Heritage Layer Browser/SAHRA)

Databases and collections: Ditsong: National Museum of Natural History. Evolutionary Studies Institute, University of the Witwatersrand (ESI).

Impact: **MODERATE**, **VERY HIGH** for the Volksrust Formation, Adelaide Subgroup and Vryheid Formation, Beaufort Group, Karoo Supergroup. There are significant fossil resources that may be impacted by the development (mudstone, shale) and if destroyed are no longer available for scientific research or other public good (Almond, *et al.* 2009).

9.3 Description of the Methodology

The palaeontological impact assessment desktop study was undertaken in April 2020. A Phase 1: Field Survey of the affected portion will include photographs (in 7.1 mega pixels) taken of the site with a digital camera (Canon PowerShot A470). Additionally, Google.maps will be accessed on a cellular phone for navigation. A Global Positioning System (GPS) (Garmin eTrex 10) is used to record fossiliferous finds and outcrops (bedrock) when

the area is not covered with topsoil, subsoil, overburden, vegetation, grassland, trees or waste. The survey did identify the Karoo Supergroup. A literature survey is included and the study relied heavily on geological maps.

SAHRA document 7/6/9/2/1 (SAHRA 2012) requires track records/logs from archaeologists not palaeontologists as palaeontologists concentrate on outcrops which may be recorded with a GPS. Isolated occurrences of rocks usually do not constitute an outcrop. Fossils can occur in dongas, as nodules, in fresh rock exposures, and in riverbeds. Finding fossils require the experience and technical knowledge of the professional palaeontologist, but that does not mean that an amateur can't find fossils. The geology of the region is used to predict what type of fossil and zone will be found in any particular region. Archaeozoologists concentrate on more recent fossils in the quaternary and tertiary deposits.

Assumptions and Limitations (**1e**):-
The accuracy and reliability of the report may be limited by the following constraints:

1. Most development areas have never been surveyed by a palaeontologist or geophysicist.
2. Variable accuracy of geological maps and associated information.
3. Poor locality information on sheet explanations for geological maps.
4. Lack of published data.
5. Lack of rocky outcrops.
6. Inaccessibility of site.
7. Insufficient data from developer and exact lay-out plan for all structures.

A Phase 2 Palaeontological Impact Assessment: Mitigation will include:

1. Recommendations for the future of the site.
2. Description of work done (including number of people and their responsibilities.
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan.
6. Possible declaration as a heritage site or Site Management Plan.

The National Heritage Resources Act No. 25 of 1999 further prescribes.

Act No. 25 of 1999. National Heritage Resources Act, 1999.
National Estate: 3 (2) (f) archaeological and palaeontological sites,
(i)(1) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens,
Heritage assessment criteria and grading: (a) Grade 1: Heritage resources with qualities so exceptional that they are of special national significance;
(b) Grade 2: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and (c) Grade 3: Other heritage resources worthy of conservation.
SAHRA is responsible for the identification and management of Grade 1 heritage resources.
Provincial Heritage Resources Authority (PHRA) identifies and manages Grade 2 heritage resources.
Local authorities identify and manage Grade 3 heritage resources.

No person may damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of a provincially protected place or object without a permit issued by a heritage resources authority or local authority responsible for the provincial protection.
Archaeology, palaeontology and meteorites: Section 35.
(2) Subject to the provisions of subsection (8) (a), all archaeological objects, palaeontological material and meteorites are the property of the State.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ,* and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

9.4 Description of significant fossil occurrences

All Karoo Supergroup geological formations are ranked as **LOW** to **VERY HIGH**, and here the impact is potentially **VERY HIGH** for the Adelaide Subgroup and Vryheid Formation and **MODERATE** for the Volksrust Formation.

Fossil vertebrates are found in the thick mudrock of the Adelaide Subgroup. Fossils of *Diictodon, Ictidosuchops, Gorgonops* and the amphibian *Rhinesuchus* are frequently preserved as articulated skeletons within the mudrock present in the *Daptocephalus* Assemblage Zone (Figure 16). Fossil fish (*Atherstonia*) and the captorhinid *Pareiasaurus* have also been recorded. Other fossils that occur are *Procynosuchus, Tetracynodon, Lycaenops, Ictidorhinus, Dicynodon, Youngina,* to name but a few (Rubidge 1995).

The Volksrust Formation consists of a monotonous sequence of grey shale and fossils are significant, but very rarely recorded. Fossils include rare temnospondyl amphibian remains, invertebrates, minor coals with plant

remains, fish scales, petrified wood, and low-diversity marine to non-marine trace fossil assemblages (Groenewald and Groenewald 2014).

Fossils likely to be found are mostly plants (Appendix 1) such as '*Glossopteris* flora' of the Vryheid Formation. The aquatic reptile *Mesosaurus* and fossil fish may also occur with marine invertebrates, arthropods and insects. Trace fossils can also be present. During storms a great variety of leaves, fructifications and twigs accumulated and because they were sandwiched between thin films of mud, they were preserved to bear record of the wealth and the density of the vegetation around the pools. They make it possible to reconstruct the plant life in these areas and wherever they are found, they constitute most valuable palaeobotanical records (Plumstead 1963) and can be used in palaeoenvironmental reconstructions.

Details of the location and distribution of all significant fossil sites or key fossiliferous rock units are often difficult to be determined due to thick topsoil, subsoil, overburden and alluvium. Depth of the overburden may vary a lot.

The threats are:- earth moving equipment/machinery (front end loaders, excavators, graders, dozers) during construction, the sealing-in or destruction of fossils by development, vehicle traffic, and human disturbance. See Description of the Geological Setting (F) above.

9.5 Recommendation

a. Since the area under study already has an existing road the landscape was already disrupted and altered during the construction of this feature. This road sits on a thin layer of top soil which can serve as a defensive buffer against the construction activities above for subterranean fossils. This therefore cannot be the same situation on other areas to be developed in relation to this road upgrade. Although there is no objection (see Recommendation B) to the development, but it is necessary to request a Phase 1 Palaeontological Impact Assessment: Field study to determine whether the development will affect fossiliferous outcrops as the palaeontological sensitivity of the shale is **VERY HIGH and MODERATE**. A Phase 2 Palaeontological Mitigation is only required if the Phase 1 Palaeontological Assessment identified a fossiliferous formation (Karoo Supergroup) and fossils or if fossils are found during construction or mining. Protocol is attached (Appendix 2).
b. This project may benefit the economy, the life expectancy of the community, the growth of the community and social development in general.
c. Preferred choice: No Alternatives are possible.
d. The following should be conserved: if any palaeontological material is exposed during clearing, digging, excavating, drilling or blasting SAHRA must be notified. All construction activities must be stopped, a 30 m no-go barrier constructed and a palaeontologist should be called in to determine proper mitigation measures. A sample of shale / mudstone should be set aside if mined.

Sampling and collecting **(6m,6k)**:
Wherefore a permit is needed from the South African Heritage Resources Agency (SAHRA / PHRA).

a. Objections: Cautious. See heritage value and recommendation.
b. Conditions of development: See Recommendation.
c. Areas that may need a permit: Yes.
d. Permits for mitigation: **Needed from SAHRA/Amafa Research Institute prior to Mitigation**.
e.

9.6 Conclusions

a. All the land involved in the development was assessed and none of the property is unsuitable for development (see Recommendation B).
b. All information needed for the Phase 1 Palaeontological Impact Assessment and Field scope was provided by the Consultant. All technical information was provided by Tsimba Archaeological Footprints.
c. Areas that would involve mitigation and may need a permit from the South African Heritage Resources Agency are discussed.
d. The following should be conserved: if any palaeontological material is exposed during digging, excavating, drilling or blasting, SAHRA must be notified. All development activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures. Especially shallow caves.
e. Condition in which development may proceed: It is further suggested that a Section 37(2) agreement of the Occupational, Health and Safety Act 85 of 1993 is signed with the relevant contractors to protect the environment (fossils) and adjacent areas as well as for safety and security reasons.

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APPENDIX 1: PROTOCOL FOR CHANCE FINDS AND MANAGEMENT PLAN

This section covers the recommended protocol for a Phase 2 Mitigation process as well as for reports where the Palaeontological Sensitivity is **LOW**; this process guides the palaeontologist / palaeobotanist on site and should not be attempted by the layman / developer. As part of the Environmental Authorisation conditions, an Environmental Control Officer (ECO) will be appointed to oversee the construction activities in line with the legally binding Environmental Management Programme (EMPr).

- The EMPr already covers the conservation of heritage and palaeontological material that may be exposed during construction activities.
- For a chance find, the protocol is to immediately cease all construction activities, construct a 30 m no-go barrier, and contact SAHRA for further investigation. Construction workers must be informed that this is a no-go area.
- It is recommended that the EMPr be updated to include the involvement of an archaeologist or palaeontologist for pre-construction training of the ECO or during the digging and excavation phase of the development or a site visit once a month during construction after drilling, excavating and blasting.
- The ECO must visit the site weekly and keep a photographic record.

The developer must survey the areas affected by the development and indicate on plan where the construction / development / mining will take place. Trenches have to be dug to ascertain how deep the sediments are above the bedrock (can be a few hundred metres). This will give an indication of the depth of the topsoil, subsoil, and overburden, if need be trenches should be dug deeper to expose the interburden.

Mitigation will involve recording, rescue and judicious sampling of the fossil material present in the layers sandwiched between the geological / coal layers. It must include information on number of taxa, fossil abundance, preservational style, and taphonomy. This can only be done during mining or excavations. In order for this to happen, in case of coal mining operations, the process will have to be closely scrutinised by a professional palaeontologist / palaeobotanist to ensure that only the coal layers are mined and the interlayers (siltstone and mudstone) are surveyed for fossils or representative sampling of fossils are taking place.

The palaeontological impact assessment process presents an opportunity for identification, access and possibly salvage of fossils and add to the few good plant localities. Mitigation can provide valuable onsite research that can benefit both the community and the palaeontological fraternity.

A Phase 2 study is very often the last opportunity we will ever have to record the fossil heritage within the development area. Fossils excavated will be stored at a National Repository.

A Phase 2 Palaeontological Impact Assessment: Mitigation will include (SAHRA) -

1. Recommendations for the future of the site.
2. Description and purpose of work done (including number of people and their responsibilities).
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan and map.
6. Possible declaration as a heritage site or Site Management Plan.
7. Stakeholders.
8. Detailed report including the Desktop and Phase 1 study information.
9. Annual interim or progress Phase 2 permit reports as well as the final report.
10. Methodology used.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction

phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ,* and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

The Palaeontological Society of South Africa (PSSA) does not have guidelines on excavating or collecting, but the following is suggested:

1. The developer needs to clearly stake or peg-out (survey) the areas affected by the mining/ construction/ development operations and dig representative trenches and if possible supply geological borehole data. When the route is better defined, it is recommended that a specialist undertake a 'walk through' of the entire road as well as construction areas, including camps and access roads, prior to the start of any construction activities, this may be done in sections.
2. Fossils likely to occur are for example the therapsids from the Middleton Formation, these are present in the mudstone (or any other fossiliferous layer ranked as VERY HIGH or HIGH) or other vertebrates from the Beaufort Group (or any other fossiliferous layer). The palaeontologist needs to survey the overburden, subsoil and topsoil at least once a week.
3. When clearing vegetation, topsoil, subsoil or overburden, hard rock (outcrop) is found, the contractor needs to stop all work.
4. A Palaeobotanist / palaeontologist (contact SAHRIS for list) must then inspect the affected areas and trenches for fossiliferous outcrops / layers. The contractor / developer may be asked to move structures, and put the development on hold.
5. If the palaeontologist / palaeobotanist is satisfied that no fossils will be destroyed or have removed the fossils, development and removing of the topsoil can continue.
6. After this process the same palaeontologist / palaeobotanist will have to inspect and offer advice through the Phase 2 Mitigation Process. Bedrock excavations for footings may expose, damage or destroy previously buried fossil material and must be inspected.

7. When permission for the development is granted, the next layer can be removed, if this is part of a fossiliferous layer, then with the removal of each layer of sediment, the palaeontologist / palaeobotanist must do an investigation (a minimum of once every week).
8. At this stage the palaeontologist / palaeobotanist in consultation with the developer / mining company must ensure that a further working protocol and schedule is in place. Onsite training should take place, followed by an annual visit by the palaeontologist / palaeobotanist.

Fossil excavation if necessary during Phase 2:

1. Photography of fossil / fossil layer and surrounding strata.
2. Once a fossil has been identified as such, the task of extraction begins.
3. It usually entails the taking of a GPS reading and recording lithostratigraphic, biostratigraphic, date, collector and locality information.
4. Using Paraloid (B-72) as an adhesive and protective glue, parts of the fossil can be kept together (not necessarily applicable to plant fossils).
5. Slowly chipping away of matrix surrounding the fossil using a geological pick, brushes and chisels.
6. Once the full extent of the fossil / fossils are visible, it can be covered with a plaster jacket (not necessarily applicable to plant fossils).
7. Chipping away sides to loosen underside.
8. Splitting of the rock containing palaeobotanical material should reveal any fossils sandwiched between the layers.

This document forms part of the Environmental Monitoring Programme. For practical reasons a palaeontologist/palaeobotanist may be required to be on site once a week. If any fossil material is discovered then a Phase 2 rescue operation may be necessary, and a permit will be required.

The South African Heritage Resources Agency has the following documents in place:
Guidelines to Palaeontological Permitting policy.
Minimum Standards: Palaeontological Component of Heritage Impact Assessment reports.
Guidelines for Field Reports.
Palaeotechnical Reports (Eastern Cape, North West, Northern Cape, Mpumalanga, Gauteng, Western Cape, Free State, Kwazulu Natal, and Limpopo).

APPENDIX 2: LISTING POINTS IN APPENDIX 6 OF THE ACT AND POSITION IN REPORT (BOLD IN TEXT).

Section in Report	Point in Act	Heading in Report
B	1(c)	Outline of development project
	1(d)	Summary of findings
	1(g)	Concerns/threats
	1(n)i	Concerns/threats
	1(n)ii	Concerns/threats
	1(o)	Concerns/threats
	1(p)	Concerns/threats
D	1(h)	Figures
	1(a)i	Terms of reference
H	1(e)	Description of Methodology
	1(i)	Assumptions and Limitations
I	1(f)	Heritage value
J	1(j)	Recommendation
	1(l)	Recommendation
	1(m)	Sampling and collecting
	1(k)	Sampling and collecting
Declaration	1(b)	Declaration
Appendix 1	1(k)	Protocol for finds
	1(m)	Protocol for finds
	1(q)	Protocol for finds