PHASE 1 PALAEONTOLOGICAL ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF THE BHAZAMANI ROAD UPGRADE, MSINGA LOCAL MUNICIPALITY, UMZINYATHI DISTRICT MUNICIPALITY, KWAZULU-NATAL PROVINCE.

FOR

HIA CONSULTANTS

Active Heritage CC

DATE: 06 May 2016

By

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EXECUTIVE SUMMARY

Gideon Groenewald was appointed to undertake a Phase 1 Palaeontological field survey, assessing the potential Palaeontological Impact of the proposed construction of the Bhazamani Road (L3046) Upgrade, Msinga Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province.

The purpose of this Phase 1 Palaeontological Impact Assessment is to identify exposed and potential Palaeontological Heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated.

This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999 as well as the KwaZulu-Natal Heritage Act No 4 of 2008. In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

The development site for the proposed proposed construction of the Bhazamani Road (L3046) Upgrade, Msinga Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province is underlain by Carboniferous to Permian aged sedimentary rocks of the Dwyka Group, Pietermaritzburg and Vryheid Formations, Ecca Group and Dolerite of the Karoo Supergroup as well as sections underlain by deep boulder rich alluvium.

No significant fossils were observed during the field investigation. The potential for finding significant fossils in any excavation into sediments of the Pietermaritzburg and Vryheid Formations is high, but due to the deep weathering it is recommended that no further professional mitigation is required. If fossils are however observed during construction, the HIA consultant must be notified and the fossils collected by a suitably qualified palaeontologist. No fossils will be associated with areas underlain by dolerite.

It is recommended that:

- The EAP and ECO must be informed of the fact that a Moderate to VeryHigh Palaeontological sensitivity was allocated to the sections of the development that is underlain by shale and sandstone of the Ecca Group and although highly weathered, fossils might be recorded during the next phase of construction.
- If fossils are recorded, a suitably qualified palaeontologist must be appointed to inspect all areas where excavation of deeper than 1,5m is made into sediments of the Ecca Group and a protocol for the chance find of fossils must then be developed and discussed with the contractor on site.
- If no fossils are observed no further mitigations are required for Palaeontological Heritage.
- These recommendations must be included in the EMPr of this project.

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INTRODUCTION

Gideon Groenewald was appointed to undertake a Phase 1 Palaeontological field survey, assessing the potential Palaeontological Impact of the proposed Construction of the Bhazamani Road (L3046) Upgrade, Msinga Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province.

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Legal Requirements

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

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

Aims and Methodology

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

Following the "*SAHRA APM Guidelines: Minimum Standards for the Archaeological &*

Palaeontological Components of Impact Assessment Reports" the aims of the palaeontological impact assessment are:

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

Prior to the field investigation a preliminary assessment (desktop study) of the topography and geology of the study area was made using appropriate 1:250 000 geological maps (2830 Dundee) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc) were identified within the study area and the known fossil heritage within each rock unit was inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

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

The likely impact of the proposed development on local fossil heritage was determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the minimal extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 2.1 below.

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1 below.

Table 1 Palaeontological sensitivity analysis outcome classification

PALAEONTOLOGICAL SIGNIFICANCE/VULNERABILITY OF ROCK UNITS	
The following colour scheme is proposed for the indication of palaeontological sensitivity classes. This classification of sensitivity is adapted from that of Almond et al (2008, 2009) (Groenewald et al., 2014).	
RED	Very High Palaeontological sensitivity/vulnerability. Development will most likely have a very significant impact on the Palaeontological Heritage of the region. Very high possibility that significant fossil assemblages will be present in all outcrops of the unit. Appointment of professional palaeontologist, desktop survey, phase I Palaeontological Impact Assessment (PIA) (field survey and recording of fossils) and phase II PIA (rescue of fossils during construction) as well as application for collection and destruction permit compulsory.
ORANGE	High Palaeontological sensitivity/vulnerability. High possibility that significant fossil assemblages will be present in most of the outcrop areas of the unit. Fossils most likely to occur in associated sediments or underlying units, for example in the areas underlain by Transvaal Supergroup dolomite where Cenozoic cave deposits are likely to occur. Appointment of professional palaeontologist, desktop survey and phase I Palaeontological Impact Assessment (field survey and collection of fossils) compulsory. Early application for collection permit recommended. Highly likely that a Phase II PIA will be applicable during the construction phase of projects.
GREEN	Moderate Palaeontological sensitivity/vulnerability. High possibility that fossils will be present in the outcrop areas of the unit or in associated sediments that underlie the unit. For example areas underlain by the Gordonia Formation or undifferentiated soils and alluvium. Fossils described in the literature are visible with the naked eye and development can have a significant impact on the Palaeontological Heritage of the area. Recording of fossils will contribute significantly to the present knowledge of the development of life in the geological record of the region. Appointment of a professional palaeontologist, desktop survey and phase I PIA (ground proofing of desktop survey) recommended.
BLUE	Low Palaeontological sensitivity/vulnerability. Low possibility that fossils that are described in the literature will be visible to the naked eye or be recognized as fossils by untrained persons. Fossils of for example small domal Stromatolites as well as micro-bacteria are associated with these rock units. Fossils of micro-bacteria are extremely important for our understanding of the development of Life, but are only visible under large magnification. Recording of the fossils will contribute significantly to the present knowledge and understanding of the development of Life in the region. Where geological units are allocated a blue colour of significance, and the geological unit is surrounded by highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated

	a blue colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in larger alluvium deposits. Collection of a representative sample of potential fossiliferous material is recommended.
GREY	Very Low Palaeontological sensitivity/vulnerability. Very low possibility that significant fossils will be present in the bedrock of these geological units. The rock units are associated with intrusive igneous activities and no life would have been possible during implacement of the rocks. It is however essential to note that the geological units mapped out on the geological maps are invariably overlain by Cenozoic aged sediments that might contain significant fossil assemblages and archaeological material. Examples of significant finds occur in areas underlain by granite, just to the west of Hoedspruit in the Limpopo Province, where significant assemblages of fossils and clay-pot fragments are associated with large termite mounds. Where geological units are allocated a grey colour of significance, and the geological unit is surrounded by very high and highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a grey colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in dolerite sill outcrops. It is important that the report should also refer to archaeological reports and possible descriptions of palaeontological finds in Cenozoic aged surface deposits.

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

Scope and Limitations of the Phase 1 Investigation

The scope of a phase 1 Investigation includes:

- an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units;
- a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports;
- data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged) and

- where feasible, location and examination of any fossil collections from the study area (e.g. museums).
- an on-site investigation to assess the identified palaeontological sensitive areas within the development footprint/study area rather than formal palaeontological collection. The investigation focussed on the bedrock exposure where excavations would most probably require palaeontological monitoring.

The results of the field investigation are used to predict the potential of buried fossil heritage within the development footprint. In some investigations, this involves the examination of similar accessible bedrock exposures, such as road cuttings and quarries, along roads that run parallel to or across the development footprint.

Locality and Proposed Development

The study area is located to the east of Tugela Ferry and is new road development referred to as the Bhazamani Road (route number L3046) in the Msinga Local Municipal area (Figure 1).

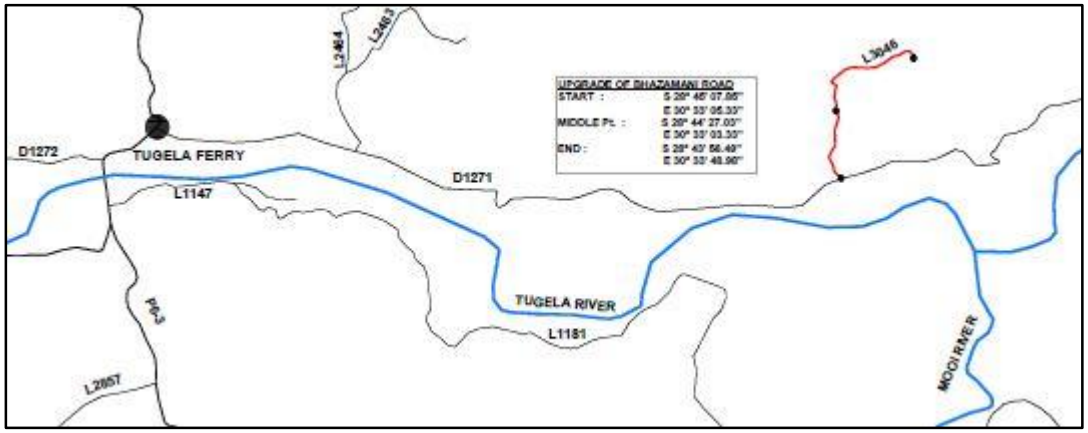
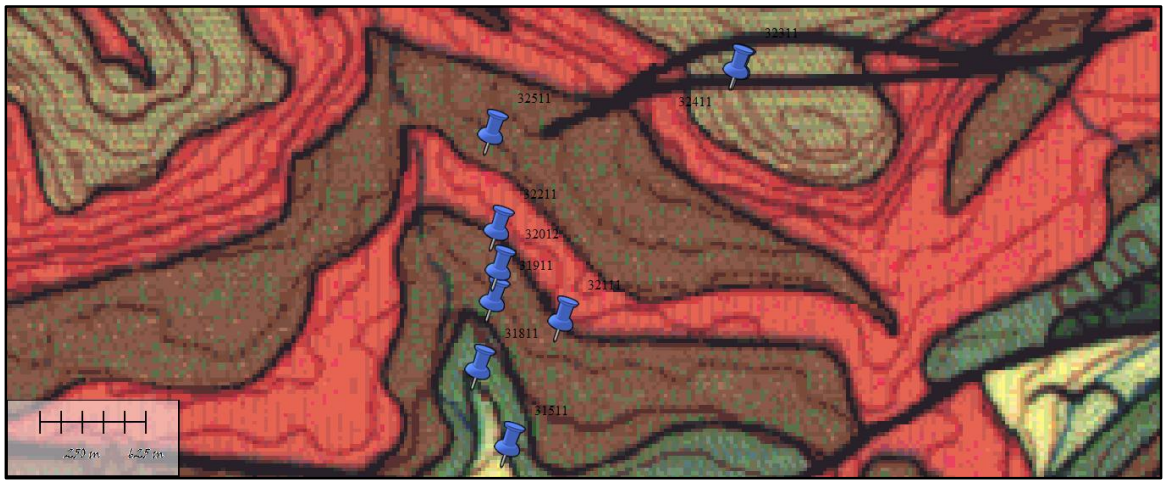


Figure 1 Locality of the Study Area. Road L3046.

The proposal for development includes the construction of the Bhazamani Road (Road L3046) east of Tugela Ferry.

GEOLOGY

The study area is underlain predominantly by Carboniferous to Permian aged rocks of the Dwyka Group, Pietermaritzburg Formation and Vryheid Formation of the Ecca Group and Jurassic aged Dolerite of the Karoo Supergroup. Alluvium is restricted to valley floors (Figure 2).



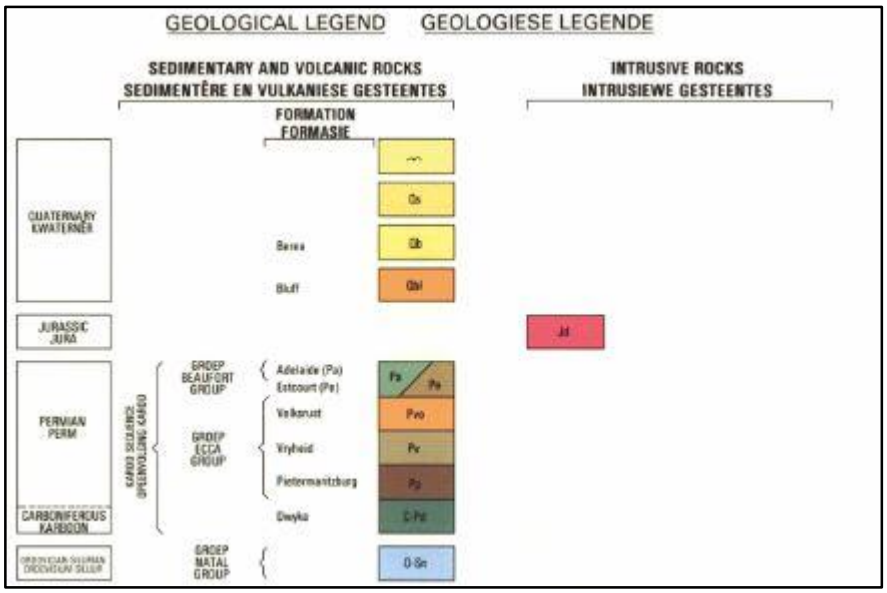


Figure 2 Geology of the Study Area

Dwyka Group

The rocks overlying the Pre-Karoo rocks in this area is a thick unit of tillite that was deposited in a glacial environment by retreating ice sheets about 300 million years ago.

At this time South Africa was part of the supercontinent Gondwana, which was situated near the South Pole and covered with ice. Rocks imbedded in the slowly moving ice sheets scoured and polished the underlying older rocks giving rise to glacial pavements. Striation directions indicate that ice flow was from north to south - valuable information when it comes to reconstructing Gondwana.

The **Dwyka Group** forms the lowermost and oldest deposit in the Karoo Supergroup basin. The Karoo Basin extended across much of southern Gondwana and records 120 million years of geological history.

The tillite in KZN often weathers to a characteristic yellowish colour. In the study area the Dwyka Group rocks are highly weathered and are mostly covered in deep soils or dolerite boulders.

Ecca Group

Pietermaritzburg Formation (Pp)

As Gondwana moved north towards the equator, thick clay and silt beds were laid down in a large sea that occupied the Karoo Basin, leading to the deposition of the Ecca Group. These sediments, deposited in deep water, now form the shales of the Pietermaritzburg Formation. The shales are easily weathered and often present slope stability problems (Johnson et al, 2009). In the study area the shale is highly micaceous and green in colour, unlike the usual dark black or grey colour of the shales from this formation.

Vryheid Formation (Pv)

The Permian aged Vryheid Formation is a thick sequence of sedimentary rocks dominated by light grey sandstones with interbedded grey shale and thick, economically important coal seams. These sandstones were deposited along ancient sandy shorelines behind which lay vast swamplands. Burial of vegetation in the swamps eventually formed coal which is mined at various localities in the outcrop areas of the formation in South Africa (Johnson et al, 2009). The Vryheid Formation forms the very steep cliffs in the study area and offers opportunities to study the palaeo-environments where cut by impressive road engineering.

Dolerite (Jd)

Jurassic aged Dolerite is associated with the breakup of Gondwanaland and outcrops in parts of the study area.

PALAEONTOLOGY

Dwyka Group

Trace fossils have been recorded from the fine-grained shales of the Dwyka Group in KwaZulu-Natal (Linstrom, 1987; MacRae, 1999). All of the following could potentially be found in KwaZulu-Natal. Trackways, produced mostly by fish and arthropods (invertebrates), have been recovered in shales from the uppermost Dwyka Group. Other trace fossils include coprolites (fossilized faeces) of chondrichthyians (sharks, skates and rays).

Body fossils include aranaceous foraminifera and radiolarians (single-celled organisms), bryozoans, sponge spicules (internal support elements of sponges), primitive starfish, orthoceroid nautiloids (marine invertebrates similar to the living *Nautilus*), goniatite cephalopods (*Eoasinites* sp.), gastropods (marine snails such as *Peruvispira viperdorfensis*), bivalves (*Nuculopsis* sp., *Phestia* sp., *Aphanaia*

haibensis, *Eurydesma mytiloides*), brachiopods (*Attenuatella* sp.) and palaeoniscoid fish such as *Namaichthys schroederi* and *Watsonichthys lotzi*.

Fossil plants have also been found, including lycopods (*Leptophloem australe*), moss, leaves and stems (possibly belonging to a proto-glossopterid flora). Fossil spores and pollens (such as moss, fern and horsetail spores and primitive gymnosperm pollens) as well as fossilized wood probably belonging to primitive gymnosperms have also been recorded from Dwyka deposits (MacRae, 1999; McCarthy and Rubidge, 2005).

Ecca Group

Pietermaritzburg Formation (Pp)

Fossils are generally absent from the Formation although trace fossils have been recorded from the upper layers of the Pietermaritzburg Formation by Linstrom (1987).

Vryheid Formation

The Vryheid Formation is well-known for the occurrence of coal beds that resulted from the accumulation of plant material over long periods of time. Plant fossils described by Bamford (2011) from the Vryheid Formation are; *Azaniodendron fertile, Cyclodendron leslii, Sphenophyllum hammanskraalensis, Annularia sp., Raniganjia sp., Asterotheca spp., Liknopetalon enigmata, Glossopteris > 20 species, Hirsutum 4 spp., Scutum 4 spp., Ottokaria 3 spp., Estcourtia sp., Arberia 4 spp., Lidgetonnia sp., Noeggerathiopsis sp. and Podocarpidites sp.*

According to Bamford (2011) “Little data have been published on these potentially fossiliferous deposits. Around the coalmines there is most likely to be good material and yet in other areas the exposures may be too poor to be of interest. When they do occur fossil plants are usually abundant and it would not be feasible to preserve and maintain all the sites, however, in the interests of heritage and science such sites should be well recorded, sampled and the fossils kept in a suitable institution.

Although no vertebrate fossils have been recorded from the Vryheid Formation, invertebrate trace fossils have been described in some detail by Mason and Christie (1985). It should be noted, however, that the aquatic reptile, *Mesosaurus*, which is the earliest known reptile from the Karoo Basin,

as well as fish (*Palaeoniscus capensis*), have been recorded in equivalent-aged strata in the Whitehill Formation in the southern part of the basin (MacRae, 1999; Modesto, 2006). Indications are that the Whitehill Formation in the main basin might be correlated with the mid-Vryheid Formation. If this assumption proves correct, there is a possibility that Mesosaurus could be found in the Vryheid Formation (Catuneanu et al 2005).

The late Carboniferous to early Jurassic Karoo Supergroup of South Africa includes economically important coal deposits within the Vryheid Formation of Natal. The Karoo sediments are almost entirely lacking in body fossils but ichnofossils (trace fossils) are locally abundant. Modern sedimentological and ichnofaunal studies suggest that the north-eastern part of the Karoo basin was marine. In KwaZulu-Natal a shallow basin margin accommodated a prograding fluviodeltaic complex forming a broad sandy platform on which coal-bearing sediments were deposited. Ichnofossils include U-burrows (formerly *Corophioides*) which are assigned to ichnogenus *Diplocraterion* (Mason and Christie, 1985).

Dolerite

Due to its igneous character dolerite will not contain fossils.

Alluvium

The alluvium in the study area consists mostly of very coarse-grained sand and boulders that indicates extreme flash-flood conditions during the rainy season. No fossils were observed.

PRELIMINARY ASSESSMENT RESULTS

The palaeontological sensitivity was predicted after identifying potentially fossiliferous rock units; ascertaining the fossil heritage from the literature and evaluating the nature and scale of the development itself. The palaeontological sensitivity was predicted as highly significant, due to the potential abundance of Carboniferous to Permian aged fossils in the Dwyka Group as well as trace and plant fossils, in the Pietermaritzburg and Vryheid Formations.

FIELD INVESTIGATION

Dr Gideon Groenewald, experienced fieldworker, visited the site of the proposed Construction of the Bhazamani Road Upgrade, Msinga Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province on Wednesday 4th May 2016. The topography of the area is very rugged with ely

limited crest, vertical cliffs, very steep middle slopes and small footslopes ending in a well-defined valley floor of the Tugela River. The study area is on the south-facing slopes of the valley and is mostly overgrown with thick woody vegetation wheras the north facing slopes of the Tugela Valley is mostly bare with virtually no soil or plant cover. This assisted in the interpretation of the geology of the region.

The site of the proposed development is on the footslope and middle slope of the Tugela Valley partly altered by human development, including the creation of local informal housing clusters with typical Zulu Kraal structures that blends in with the environment.

Excavations for the new development will expose mostly siltstone and shale of the Pietermaritzburg Formation as well as dolerite, although most of the steeper slopes are covered in dolerite scree boulders of several meters in thickness and no outcrops were observed accept where rock was quarried for road building.

Observations were recorded at different GPS stations (Figure 3 and Table 2).

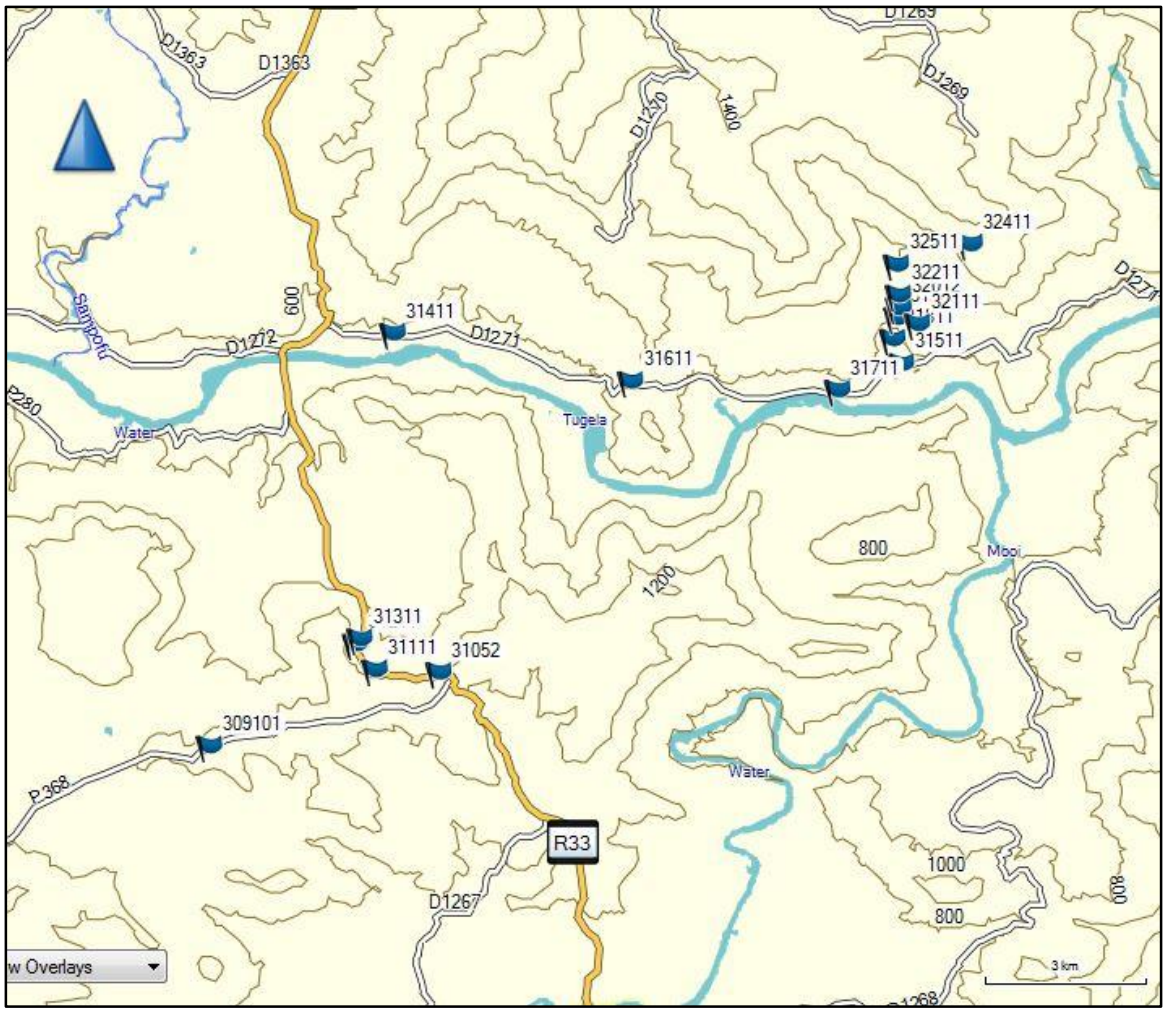


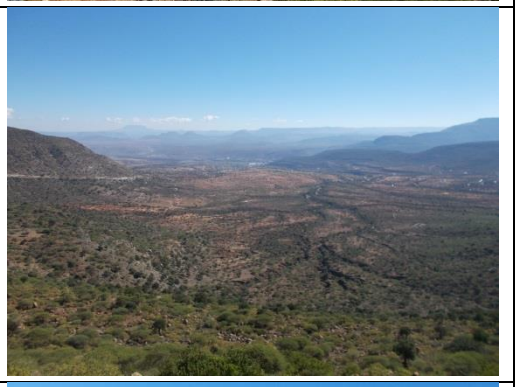
Figure 3 Observations for Palaeontological Heritage. (See Table 2)

Detail observations were recorded along the route of the new road and observations were recorded photographically at GPS points (Figure 3 and Figure 4, Table 2).

Figure 4 GPS stations in detail observations along the proposed route of road L3046

Field observations were recorded photographically (Table 2).

Table 2 Record of Photographic Observations

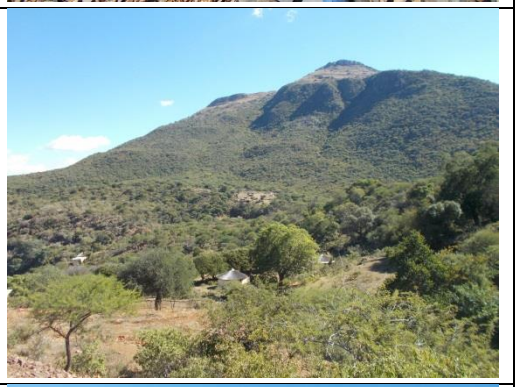
Photo	(GPS station) Coordinates	Comments	Photographic Record
1	(309101) -28° 48' 56.6" 30° 25' 46.3"	Excavation into lower part of the Volksrust Formation that is mainly a very micaceous shale with carbonaceous zones indicating similar depositional environments as that associated with the underlying shales of the Vryheid Formation	
2	(31052) -28° 48' 12.5" 30° 28' 11.8"	Road cutting into similar rock units as to what could be expected in the study area. The road cuttings provide opportunity for the observation of fossils in this region	
3	(31052) -28° 48' 12.5" 30° 28' 11.8"	Typical valley floor filled with alluvial material on Ecca Group sediments underlain by Dwyka Group tillite.	
4	(31052) -28° 48' 12.5" 30° 28' 11.8"	Dolerite fault zones in Vryheid Formation sedimentary sequenceses, highly weathered units. No fossils observed.	

5	(31111) -28° 48' 11.0" 30° 27' 31.2"	Typical steep cliffs of the Vryheid Formation cut steeply by road cuttings. Typical thick, coarse-grained sandstone bodies with thin mudstone units that contain small plant fragments. No significant fossils observed	
6	(31211) -28° 47' 55.5" 30° 27' 19.1"	Vryheid Formation outcrop in road cuttings resembling what is expected at the construction site planned for the Bhazamani Road. Thin mudstone layers very high mica content and pseudo plant fragments replaced by iron oxide	
7	(31211) -28° 47' 55.5" 30° 27' 19.1"	Rock samples with pseudo plant fossils replaced by iron oxide, indicating potential fossils in sandstone on site of development	
8	(31311) -28° 47' 52.4" 30° 27' 21.7"	Sandstone boulders in road cutting with pseudo plant remains and very coarse-grained arkosic character. Immature sandstone indicating closeness to source area and very few plant remains	

9	(31311) -28° 47' 52.4" 30° 27' 21.7"	Very thin mudstone units in mainly cross-bedded coarse-grained arkosic sandstone of the Vryheid Formation. Plant remains highly oxidized and associated with the thin clay bands. Fossils not well preserved and no collection of fossils recommended	
10	(31411) -28° 44' 49.8" 30° 27' 42.6"	Very shallow soils on Pietermaritzburg shale, dolerite and Vryheid Formation sediments along the valley of the Tugela River. Exposure on north facing slope where soil have largely been removed due to erosion. Fossils might be exposed during excavation in study area	
11	(31611) -28° 45' 18.6" 30° 30' 13.4"	Very deep (2m) cover of slopes with dolerite scree on shale of the Pietermaritzburg Formation. No fossils observed.	
12	(31711) -28° 45' 23.8" 30° 32' 24.8"	Alluvial fill in the valley floor of the Tugela River. No outcrop and no fossils observed	

13	(31511) -28° 45' 07.9" 30° 33' 05.3"	Start of the new upgrade of the Bhazamani Road on alluvial fill of a tributary of the Tugela River where the alluvium is mostly a coarse-grained sand overlying boulder beds. No fossils observed	
14	(31811) -28° 44' 53.3" 30° 32' 59.7"	Alluvium on shale of the Pietermaritzburg Formation. Alluvium mostly boulders with clayey topsoil. No outcrop and no fossils observed.	
15	(31911) -28° 44' 40.4" 30° 33' 02.5"	Deep colluvial cover on hill slopes with no outcrop of shale of the Pietermaritzburg Formation or dolerite. No fossils observed	
16	(32011) -28° 44' 34.6" 30° 33' 03.6"	Very deep soils and deeply weathered dolerite on hill slopes. Road material metamorphosed shale – no fossils observed	

17	(32111) -28° 44' 44.2" 30° 33' 15.4"	Deeply weathered dolerite on hill slopes. No fossils expected and no fossils observed	
18	(32111) -28° 44' 44.2" 30° 33' 15.4"	Shale of the Pietermaritzburg Formation with thin bedding, but highly micaceous and no fossils were observed	
19	(32211) -28° 44' 27.0" 30° 33' 03.3"	Shale of the Pietermaritzburg Formation. No fossils observed during the field investigation	
20	(32511) -28° 44' 27.0" 30° 33' 03.3"	Outcrop of dark finely laminated shale of the Pietermaritzburg Formation with typical outcrops of the Vryheid Formation sandstone cliffs in the background. No fossils were observed during the field investigation	

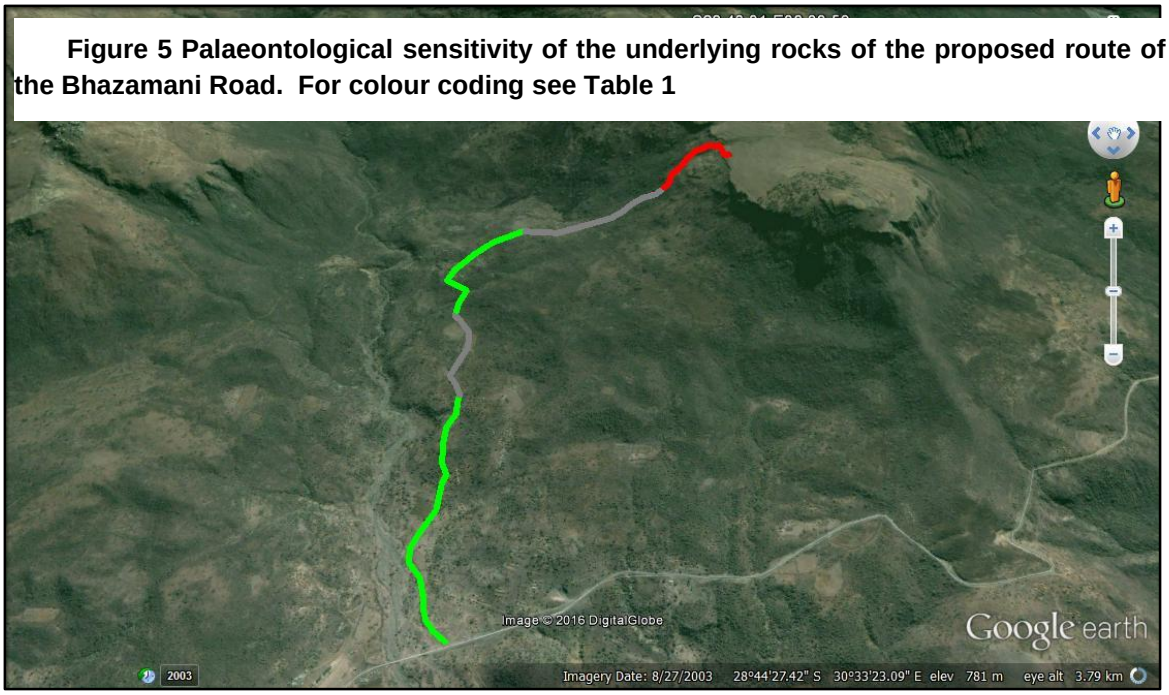
21	(32511) -28° 44' 27.0" 30° 33' 03.3"	Slightly metamorphosed shale of the Pietermaritzburg Formation. No fossils observed during the field investigation	
22	(32511) -28° 44' 27.0" 30° 33' 03.3"	Vegetated slopes of the valley and middle slopes covered in mainly dolerite scree on shale of the Pietermaritzburg Formation. No fossils were observed during the field investigation	
23	(32511) -28° 44' 27.0" 30° 33' 03.3"	Typical dwelling on the slopes of the mountain where the road is planned. The slope is covered in thick soil on dolerite and or shale of the Pietermaritzburg Formation and no fossils were observed	
24	(32511) -28° 44' 27.0" 30° 33' 03.3"	Deeply weathered dolerite and shale with no fossils obserbved. No fossils were observed in the road material that consisted of slightly metamorphosed shale	

25	(32511) -28° 44' 27.0" 30° 33' 03.3"	Dolerite outcrop at some of the dwellings on the side of the hill where the Bhazamani Road will pass. No fossils observed during the field investigation	

PALAEONTOLOGICAL IMPACT AND MITIGATION

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

Figure 5 Palaeontological sensitivity of the underlying rocks of the proposed route of the Bhazamani Road. For colour coding see Table 1



The field investigation confirms that the study area is underlain by deeply weathered tillite of the Dwyka Group, covered in deep, boulder-rich alluvial fill of the Tugela River Valley, greenish micaceous shale of the Pietermaritzburg Formation, very coarse-grained sandstone and khaki-coloured to dark grey shale beds of the Vryheid Formation of the Ecca Group and Dolerite of the Karoo Supergroup, weathering into a red vertic soils.

The excavations for the construction of the infrastructure for this development will expose some sediments of the Pietermaritzburg and Vryheid Formations. Due to weathering, no well-preserved fossils were observed during the field

investigation. Exposure of bedrock during excavation might however result in the exposure of significant plant and/or trace fossils and the medium to high palaeontological sensitivity of the site is restricted to areas underlain by Pietermaritzburg shale and coarse-grained sandstone or shale of the Vryheid Formation (Figure 5). Areas underlain by dolerite has no significant impact on palaeontological heritage.

CONCLUSION

The development site for the proposed proposed construction of the Bhazamani Road (L3046) Upgrade, Msinga Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province is underlain by Carboniferous to Permian aged sedimentary rocks of the Dwyka Group, Pietermaritzburg and Vryheid Formations, Ecca Group and Dolerite of the Karoo Supergroup as well as sections underlain by deep boulder rich alluvium.

No significant fossils were observed during the field investigation. The potential for finding significant fossils in any excavation into sediments of the Pietermaritzburg and Vryheid Formations is high, but due to the deep weathering it is recommended that no further professional mitigation is required. If fossils are however observed during construction, the HIA consultant must be notified and the fossils collected by a suitably qualified palaeontologist. No fossils will be associated with areas underlain by dolerite.

It is recommended that:

- The EAP and ECO must be informed of the fact that a Moderate to Very High Palaeontological sensitivity was allocated to the sections of the development that is underlain by shale and sandstone of the Ecca Group and although highly weathered, fossils might be recorded during the next phase of construction.
- If fossils are recorded, a suitably qualified palaeontologist must be appointed to inspect all areas where excavation of deeper than 1,5m is made into sediments of the Ecca Group and a protocol for the chance find of fossils must then be developed and discussed with the contractor on site.
- If no fossils are observed no further mitigations are required for Palaeontological Heritage.
- These recommendations must be included in the EMPr of this project.

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QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeo-ecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

DECLARATION OF INDEPENDENCE

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

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