

**PHASE 2 PALAEOLOGICAL
ASSESSMENT PROGRESS REPORT AND
"CHANCE FIND PROTOCOL" (CFP) FOR
THE PROPOSED KILIMON DAM BULK
WATER SUPPLY IN THE INGWE LOCAL
MUNICIPALITY OF THE SISONKE
DISTRICT MUNICIPALITY IN THE
KWAZULU-NATAL PROVINCE.**

FOR

Terratest Environmental Consultants

DATE: 06 April 2020

By

Gideon Groenewald

Cell: 078 713 6377

EXECUTIVE SUMMARY

Gideon Groenewald was appointed to undertake a Phase 1 Palaeontological Assessment Survey and a site visit for the proposed Kilimon Bulk Water Supply Project and Construction of Ngwagwane weir; water treatment works; pumpstation; rising main; reservoirs; bulk pipelines and reticulation in the Ingwe Local Municipality of the Sisonke District Municipality in the KwaZulu-Natal Province.

This Phase 1 Survey is done to prepare a “Chance Find Protocol” (CFP) document to assist with possible future field visits and to complete a Phase 2 PIA since very large parts of this development fall in areas underlain by geological formations with a known Very High sensitivity for Palaeontological Heritage.

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 (revised 2017) 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 applicable to the application for the proposed Kilimon Bulk Water Supply Project and Construction of Ngwagwane weir; water treatment works; pumpstation; rising main; reservoirs; bulk pipelines and reticulation in the Ingwe Local Municipality of the Sisonke District Municipality in the KwaZulu-Natal Province is underlain by Permian to Triassic aged sandstone and mudstones with a Very High to High Palaeontological sensitivity. No significant fossils are expected from the Jurassic aged dolerite sill areas.

Significant fossils are expected in areas with deep exposure, and more fossils are expected during excavation for trenching in areas indicated in red and orange on the Palaeontological sensitivity map (Figure 7). It is important that a suitably qualified Palaeontologist be appointed to visit the site of the development to identify potential fossils in areas indicated as High en Very Highly significant during the first week of excavations.

The field investigation exposed fossils, and it will be very important that a suitably qualified Palaeontological Specialist be appointed to do a Phase 2 PIA and to upgrade the “Chance Find Protocol” document. The CFP document must then be included as part of the EMPr of this project, to record all unexpected fossils associated with the geological formations on site.

It is recommended that:

- The EAP and ECO must be informed of the fact that a High and Very High Palaeontological Sensitivity is allocated to the part of study area underlain by Karoo Supergroup sedimentary rocks and a Low sensitivity over the rest of the site underlain by dolerite.
- Further mitigation for Palaeontological Heritage is recommended for this project before excavation of deeper than 1.5m is done.
- A suitably qualified palaeontologist must do a Phase 2 PIA and upgrade the “Chance Find Protocol” (CFP) when fossils are recorded from any formation in this area during excavations into areas with a Very High and High Palaeontological significance.
- Recommendations contained in the resultant Phase 1 PIA must be approved by AMAFA and SAHRA for inclusion in the EMPr of the project.
- 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 Assessment Survey and a site visit for the proposed Kilimon Bulk Water Supply Project and Construction of Ngwagwane weir; water treatment works; pumpstation; rising main; reservoirs; bulk pipelines and reticulation in the Ingwe Local Municipality of the Sisonke District Municipality in the KwaZulu-Natal Province.

This Phase 1 Survey is done to prepare a “Chance Find Protocol” (CFP) document to assist with possible future field visits and to complete a Phase 2 PIA since very large parts of this development fall in areas underlain by geological formations with a known Very High sensitivity for Palaeontological Heritage.

Legal Requirements

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 (revised 2017) 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.

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 site investigation is often the only 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 a field investigation, a preliminary assessment (desktop study) of the topography and geology of the study area was made (Groenewald, 2018), using appropriate 1:250 000 geological information (2928 Drakensberg and 3028 Kokstad) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc) are identified within the study area and the known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

Priority palaeontological areas are identified within the development footprint to focus the field investigator's time and resources. The aim of the desktop survey is 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 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 minimal extent of fresh 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

	<p>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. At least one site visit by a competent palaeontologist is compulsory. Collection of a representative sample of potential fossiliferous material is recommended.</p>
<p>GREY</p>	<p>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 emplacement 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. At least one site visit by a suitably qualified palaeontologist is recommended.</p>

Rocks with Very Low to High palaeontological sensitivity are present within the development footprint and palaeontological mitigation measures are incorporated into the Environmental Management Plan for this project. Due to the fact that the 1:250 000 scale vector maps obtained from the Council for Geoscience indicates the rock unit underlying the area applicable to this Progress Report as being the Adelaide Subgroup of the Karoo Supergroup, lead to an initial assessment that very distinctive fossils will be present. Field work during this survey as well as comments by Dr Groenewald (2018) proved that the rock unit that will be exposed most of the time is the potential fossiliferous Bedford Formation, a well-known upper member of the Karoo Supergroup that contains highly significant Palaeontological Heritage.

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); where feasible, location and examination of any fossil collections from the study area (e.g. museums); and
- an on-site investigation to assess the identified palaeontological sensitive areas within the development footprint/study area, including a formal palaeontological collection if fossils are of collectable quality. The investigation focus 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 study), 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 Kilimon Bulk Water Supply Project and Construction of Ngwagwane weir; water treatment works; pumpstation; rising main; reservoirs; bulk pipelines and reticulation in the Ingwe Local Municipality of the Sisonke District Municipality in the KwaZulu-Natal Province.

. The development falls in rural undisturbed terrain underlain by sandy and clayey soils of mainly deeply weathered rocks of the Karoo Supergroup (Figure 1).

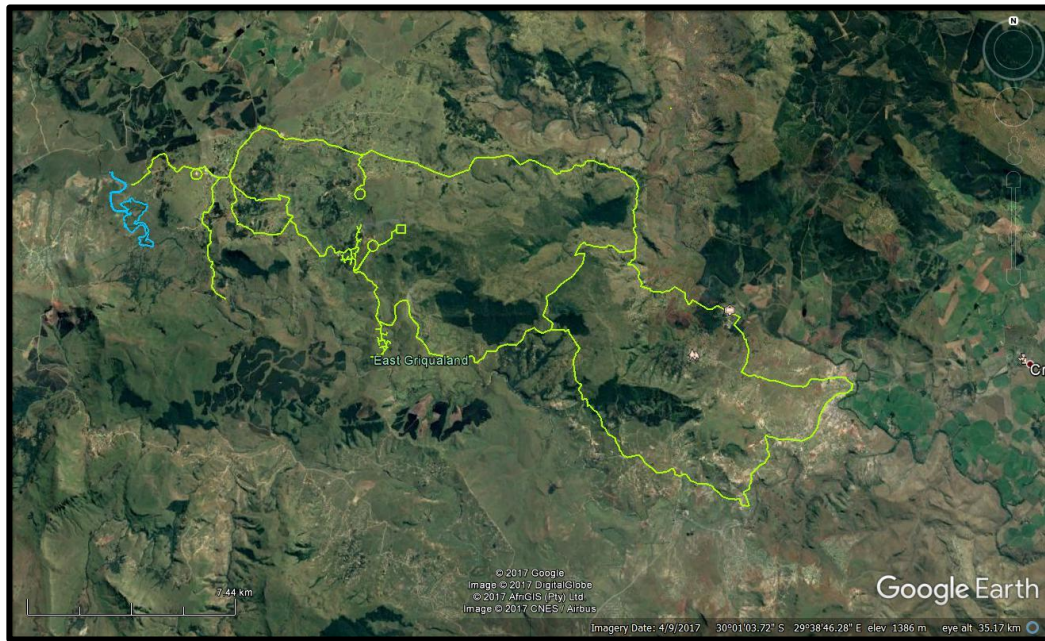


Figure 1 Locality and layout of Kilimon Project Area

GEOLOGY

The study area is underlain predominantly by Permian aged rocks of the, Ecca, and Beaufort Groups and Dolerite of the Karoo Supergroup as well as Quaternary aged sand and silt of the Masotcheni Formation and Alluvium of the local rivers (Figure 2).

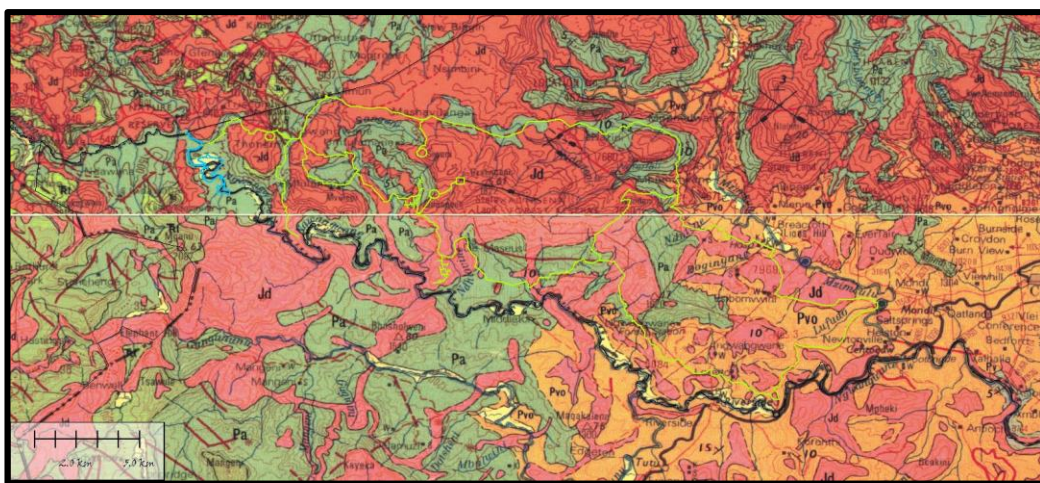


Figure 2 Geology underlying the study area includes the Volksrust Formation (Pvo) of the Ecca Group, the Adelaide Subgroup (Pa) of the Beaufort Group and Dolerite (Jd)

Karoo Supergroup

Ecce Group

Volksrust Formation (Pvo)

The Permian aged Volksrust Formation is an assemblage of fine-grained sediments, consisting mainly of dark grey mudstone and shale. The deposits represent Permian aged marine deposits that were deposited in offshore shelf, but possibly also nearshore / lacustrine / lagoonal environments in this part of Gondwanaland. The upper part of the Volksrust Formation is more sandstone rich and there is an indication that this unit might correlate with the Waterford Formation in the south of the basin (Groenewald, 2016). The new information need to be assessed by SACS (South African Committee for Stratigraphy). (Johnson et al, 2009).

Beaufort Group

The Permian to Triassic aged Beaufort Group consists of two distinct units, a lower Adelaide Subgroup and an upper Tarkastad Subgroup. The Permian aged Adelaide Subgroup, comprising the Normandien Formation (new SAKS terminology will eliminate this name and replace with Balfour Formation), consists of darker coloured mudstones and sandstone and is overlain by the Triassic aged Tarkastad Subgroup with predominantly red mudstone and sandstone.

Adelaide Subgroup. Normandien Formation (now Balfour Formation)

The Normandien Formation is a fluvial meandering river deposit (Groenewald, 1990) and comprises of a sequence of coarse and fine-grained sandstone with minor coal beds (Johnson et al 2009). SACS (South African Committee for Stratigraphy) still needs to publish a formal note on the lithostratigraphy of the Escarpment at Harrismith. Groenewald (1984, 1989) completed the most recent formal academic study of the complete section and it is was informally accepted that the Normandien Formation comprises the entire Adelaide Subgroup (Groenewald, 2016; Groenewald, 1990, 1996; Johnson et al 2009). In the future the entire Normandien Formation unit will be redefined as an extension of the Balfour Formation in the south and the lower part of the formation will be mapped as the Waterford Formation, also correlated from the southern part of the Karoo Basin (David Groenewald, pers comm, 2020).

The Tarkastad Subgroup. Katberg/Verkykerskop Formations

The Katberg Formation is defined as the lower sandstone-rich unit of the Tarkastad Subgroup and consists of fine-grained sandstone with a main provenance to the southeast. The Verkykerskop Formation is a time equivalent of the Katberg Formation, but consists predominantly of coarse-grained sandstone with a provenance to the northeast (Groenewald, 1996; Johnson et al, 2006).

Dolerite (Jd)

Large sections of the development cut into Jurassic aged dolerite sill areas and although not mapped on this scale, several dolerite dyke structures are known to be present in this study area.

PALAEONTOLOGY

The palaeontology of the study area has been discussed in detail in the Desktop Survey (Groenewald, 2018) and the reader is referred to that report if so required. For this report, the author will briefly give some reference to the usual Palaeontological Heritage treasures that are expected from this study area and then embark on a detailed Photographic report that will lead to the “Chance Find Protocol” (CFP) that will govern the future recommendations of the EMPr for this project.

Karoo Supergroup

The Eccca Group

The Volksrust Formation (Pvo)

Although no vertebrate fossils have been recorded from the Volksrust Formation, invertebrate trace fossils have been described in previous reports from KwaZulu-Natal (Figure 3).

The trace fossils are difficult to see and it will only be observed in either highly weathered shale where the bedding planes are still preserved, or in unweathered shale of the Eccca Group where excavation is up to at least 3m of shale. In all cases the trace fossils are poorly exposed and no significant trace fossils were observed during this field investigation. For the attention of the reader, an example of an observation, unfortunately with very poor lighting, is reproduced in Figure 4.



Figure 3 Reproduction of a photographic observation in the shales of the Volksrust Formation, Ecca Group. (Photo quality unfortunately not good due to bad light)

Trace fossils includes traces of the mud dwelling molluscs (Figure 4).

Beaufort Group

Adelaide Subgroup. Balfour Formation

Field observations indicate the presence of this Subgroup and the fossils observed (as reported below) indicate that this Subgroup is as important in terms of the Palaeontological Heritage of South Africa, as what is found in the southern part of the Karoo Basin (M^cCarthy and Rubidge 2005; Johnson et al 2009; Groenewald, 1996; 2012; Groenewald et al, 2014).

Dolerite

Due to the igneous character of dolerite, it will not contain fossils.

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 Very Low to Very Highly significant, due to the potential abundance of Permian aged fossils in the Ecca and Beaufort Groups.

Dolerite will not contain any significant fossil remains.

FIELD INVESTIGATIONS

Dr Gideon Groenewald and Alfred Mahlambi, experienced fieldworkers, visited the site of the proposed Kilimon Project on Saturday 22nd and Sunday 23rd February 2020. The two researchers were accompanied by students from the Engineering Company and this interaction was of critical importance for transfer of institutional memory in the fields of Stratigraphy and Palaeontology.

The topography of the area is undulating, albeit falling in a rugged river valley with dolerite batholiths and thick dolerite sills dominating the higher ground. The general landscape is dominated by extensive, deeply weathered middle slopes and limited foot slopes ending in a well-defined, albeit limited, valley floors, of the local streams and the main river (Ngwangwane River) of the area. The study area comprises a linear construction and development site that cuts the topography and follows the contours where the proposed pipeline constructions will cut the hills. The area is mostly overgrown with remains of fire-climax grass species but a very high percentage of increasers indicating extensive grazing by cattle after regular burning of the veld to try and increase the palatability of the grass during the beginning of the growing season.

Field investigation confirmed that excavations for the new developments will expose sandstone and sandy mudstone of the Balfour Formation, whilst most of the areas underlain by the Dolerite will expose deep clay-loam soil deposits.

Detailed observations were recorded in the area that will be developed and observations were recorded photographically at GPS points (Figure 5).

All recorded Photographic Recordings of vertebrate remains and imprints of fossils, including trace fossils, will be provided as a formal record of observation. Significant fossils have been recorded and the Palaeontologist recommend that the ECO be vigilant in areas where deep excavations are still planned for construction of the pipeline. This is important in all areas underlain by the Balfour Formation. No fossils are expected in areas underlain by dolerite and no fossils were observed during this field investigation.

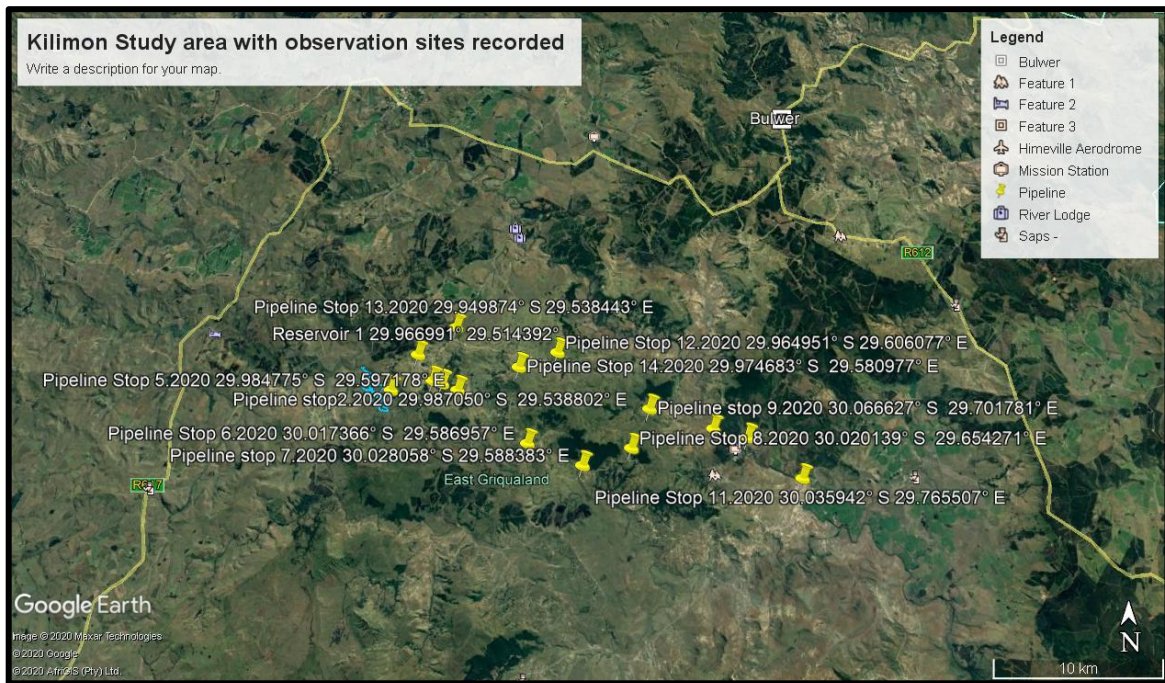


Figure 4 Stopping sites along the route of the pipelines and the proposed dam and extraction point as recorded on 22 and 23 March 2020

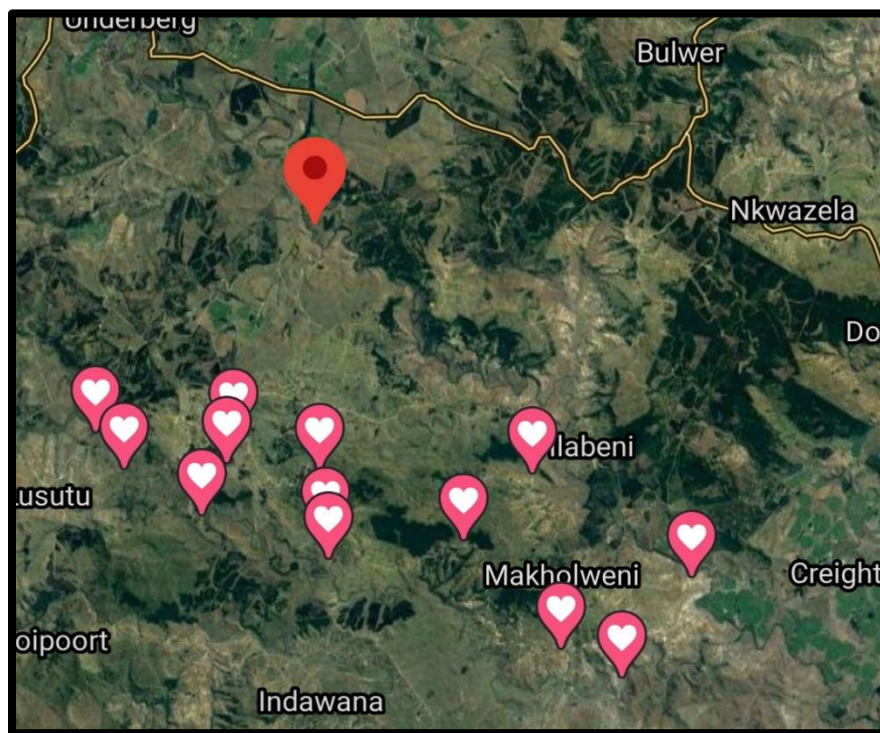

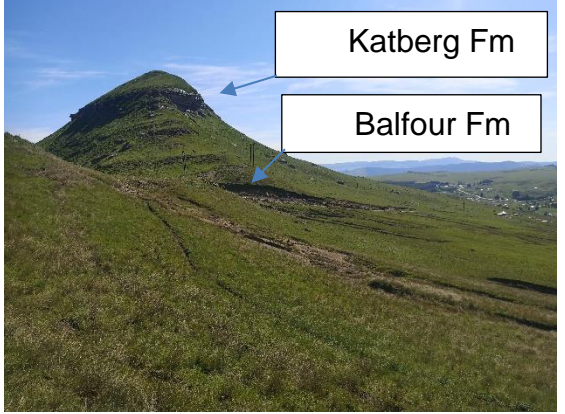



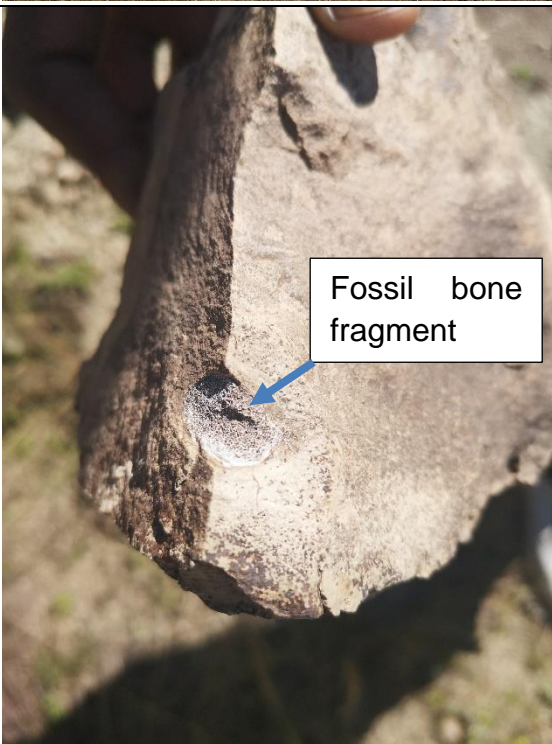
Figure 5 Points where specific recordings of fossils or unique geological features were observed as reported in Table 2




Photographic recordings of geological information and fossils occurring in the outcrops are presented in table 2 below. These Photographic recordings might be the only records of Palaeontological Heritage for this project. Due to very deep weathering of the sedimentary rocks the author expects that the chance find of well-preserved fossils in this environment is not very high.





Poorly defined trace fossils are present but these fossils did not warrant collection or a request for standing time and collection of fossils (Table 2). It is however becoming more and more likely that significant fossils will be exposed as blasting continues to open more material during the lifetime of the excavation.





Table 2 Record of Photographic Observations (See Figure 5 for GPS values of sites)





Photo	(GPS station) Coordinates	Comments	Photographic Record
1	Reservoir 1 29.966991° 29.514392°	Main exposure of Dolerite intruded into red mudstone of the Palingkloof Member, Balfour Formation. Fragments of vertebrates recorded	
2	Reservoir 1 29.966991° 29.514392°	Deeply weathered and highly fossiliferous mudstone of the Balfour Formation. <i>Lystrosaurus</i> Assemblage Zone. Numerous vertebrate fossils observed, but highly weathered and not possible to recover remains unless very deep excavations are going to be done into this mudstone..	



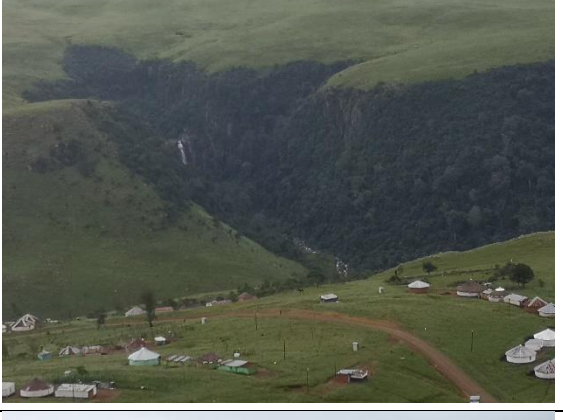

<p>3</p>	<p>Reservoir 1 29.966991° 29.514392°</p>	<p>Balfour Formation with vertebrate remains of Dicynodon lacerticeps and other fossils of the Daptocephalus Assemblage Zone in numbers. No collections were done and ECO must be vigilant and record fossils where observed during the lifetime of the project.</p>	
<p>4</p>	<p>Reservoir 1 29.966991° 29.514392°</p>	<p>Fossil bone fragments from the Daptocephalus Assemblage Zone in sandstone</p>	


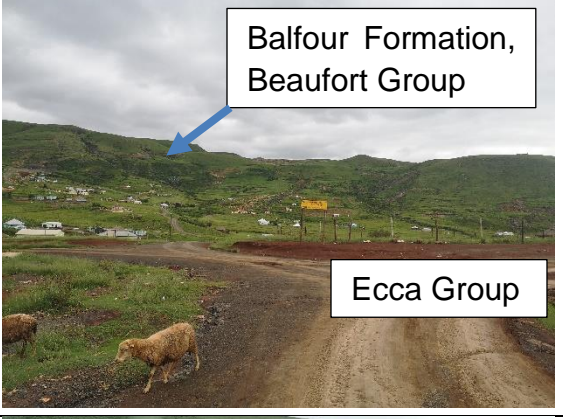
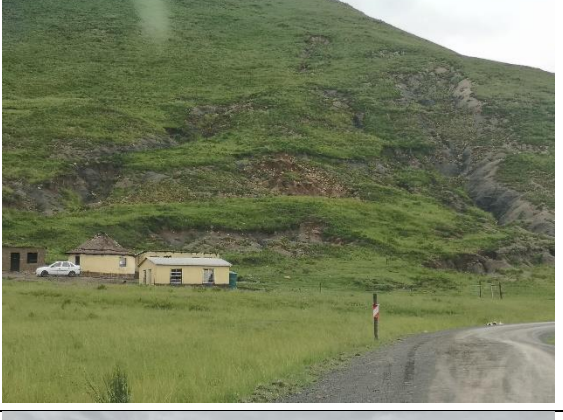

<p>5</p>	<p>Reservoir 1 29.966991° 29.514392°</p>	<p>Trace fossils of Scolithos burrows in sandstone of the Balfour Formation observed in the excavation spoils. These structures are important indicators of palaeo-environments in the study area.</p>	
<p>6</p>	<p>Reservoir 1 29.966991° 29.514392°</p>	<p>Trace fossils of Scolithos burrows in sandstone of the Balfour Formation observed in the excavation spoils. These structures are important indicators of palaeo-environments in the study area.</p>	
<p>7</p>	<p>Reservoir 1 29.966991° 29.514392°</p>	<p>Red coloured mudstone of the Palingkloof Member of the Balfour Formation in road cutting on site</p>	



<p>8</p>	<p>Reservoir 1 29.966991° 29.514392°</p>	<p>Very deeply weathered mudstone with fractured vertebrate remains of what might be a Lystrosaurus fossil in the road cuttings. The fossilized bone is highly weathered and it is not practical to collect this material.</p>	
<p>9</p>	<p>Reservoir 1 29.966991° 29.514392°</p>	<p>Very deeply weathered mudstone with fractured vertebrate remains of what might be a Lystrosaurus fossil in the road cuttings. The fossilized bone is highly weathered and it is not practical to collect this material.</p>	
<p>10</p>	<p>Pipeline stop2.2020 29.987050° S 29.538802° E</p>	<p>Deeply weathered dolerite underlies large parts of the study area. No fossils expected, no fossils observed</p>	
<p>11</p>	<p>Pipeline stop3.2020 29.975029° S 29.542075° E</p>	<p>Most of the site of the pump station and the where extraction of water is planned is underlain by dolerite. No fossils expected and no fossils observed</p>	

<p>12</p>	<p>Pipeline stop3.2020 29.975029° S 29.542075° E</p>	<p>Most of the site of the pump station and the where extraction of water is planned is underlain by dolerite. No fossils expected and no fossils observed</p>	
<p>13</p>	<p>Pipeline stop3.2020 29.975029° S 29.542075° E</p>	<p>Students overlooking the site where the Kilimon Dam is planned in the future. The view is up the valley of the Ngwangwane River</p>	
<p>14</p>	<p>Pipeline stop 4.2020 29.990012° S 29.584065° E</p>	<p>Vertebrate remains of small animals from the Permian (250 million years ago) in the Balfour Formation along the route of the Kilimon Pipeline</p>	 <p data-bbox="1149 1001 1386 1182">Bone fragment of 50mm in the mudstone</p>
<p>15</p>	<p>Pipeline stop 4.2020 29.990012° S 29.584065° E</p>	<p>Weathering of mudstone and sandstone is extensive with very few outcrops. Fossils will only be observed in deep (>1.5m) excavations for the pipeline</p>	

16	Pipeline Stop 5.2020 29.984775° S 29.597178° E	Most of the high ground in this project is underlain by deeply weathered dolerite with no fossils expected and no fossils observed	
17	Pipeline Stop 5.2020 29.984775° S 29.597178° E	Most of the high ground in this project is underlain by deeply weathered dolerite with no fossils expected and no fossils observed	
18	Pipeline Stop 5.2020 29.984775° S 29.597178° E	Most of the high ground in this project is underlain by deeply weathered dolerite with no fossils expected and no fossils observed	
19	Pipeline Stop 6.2020 30.017366° S 29.586957° E	Deep soils on deeply weathered green-grey mudstone of the Balfour Formation. Fossils of the <i>Daptocephalus</i> Assemblage Zone expected in these rocks. No fossils were observed during the field visit.	

20	Pipeline stop 7.2020 30.028058° S 29.588383° E	Deeply weathered shale of the Volksrust Formation of the Eccca Group. The upper part of the Volksrust Formation is known to contain significant trace fossils. No fossils observed during this field trip.	
21	Pipeline Stop 8.2020 30.020139° S 29.654271° E	Deeply weathered dolerite underlying the high ground of the Kilimon Project area. No fossils expected, no fossils observed.	
22	Pipeline stop 9.2020 30.066627° S 29.701781° E	Deeply weathered dolerite underlying the high ground of the Kilimon Project area. No fossils expected, no fossils observed.	
23	Pipeline Stop 10.2020 30.079053° S 29.731499° E	Deeply weathered dolerite and shale of the Volksrust Formation of the Eccca Group underlies the lower ground of the Kilimon Project. The shale is known to contain some highly significant trace fossils.	

24	Pipeline Stop 10.2020 30.079053° S 29.731499° E	Green-grey mudstone of the Balfour Formation, Adelaide Subgroup in the middle-ground of the project area. These mudstones contain very significant imprints of leaves of <i>Glossopteris</i> as well as imprints of wings of insects (Groeneald, 2012). No fossils were observed in this quarry during the field visit.	
25	Pipeline Stop 11.2020 30.035942° S 29.765507° E	Deeply weathered shale of the Volksrust Formation with overlying green mudstone of the Balfour Formation in the lower sections of the Kilimon Project.	
26	Pipeline Stop 11.2020 30.035942° S 29.765507° E	Prominent outcrops of the Volksrust Formation, Ecca Group in the study area of the Kilimon Project. The upper part of the Volksrust Formation contain some significant trace fossils. No fossils were observed during this field investigation, but the ECO must be vigilant and look out for trace fossils in all excavations deeper than 1,5m.	
27	Pipeline Stop 12.2020 29.964951° S 29.606077° E	Deeply weathered mudstone and sandstone of the Balfour Formation. No fossils observed during this field visit.	

28	Pipeline Stop 13.2020 29.949874° S 29.538443° E	General view of the outcrop of the Balfour Formation with deeply weathered mudstone and potential for vertebrate fossils high if excavation exceeds 1.5m.	
29	Pipeline Stop 14.2020 30.012603° S 29.731181° E	uMzimkulu River in flood, cutting into the mudstone of the Balfour Formation in the study area.	

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 (Table 2).

The field investigation confirms that the study area is underlain by rocks that range from the very low sensitive dolerite intrusive igneous rocks to the very highly sensitive red coloured mudstone of the Balfour Formation of the Adelaide Subgroup, Karoo Supergroup of South Africa.

The excavations for the construction of the infrastructure for the proposed developments can expose some sediments of Very Highly sensitive geological formations and some sites revealed evidence of Very Highly significant remains of fossils (Observations on site by the Palaeontologist, but not collectable samples yet). A significant part of the excavation project will cut into rocks of the Volksrust Formation of the Ecca Group that has a high sensitivity for Palaeontological Heritage and the ECO must be on the lookout for trace fossils. The high ground of the entire project cut very important areas underlain by the very highly sensitive

Balfour Formation and in the small exposure investigated during this filed survey revealed significant remains of vertebrates (Table 2).

The construction team must be aware of the sensitivity of the area and the very high potential of exposing significant fossils. If any fossils are exposed the palaeontologist must be informed and the procedures set out in the “Chance Find Protocol” (CFP) attached to this report, must be followed.

CONCLUSIONS

The development site applicable to the application for the proposed Kilimon Bulk Water Supply Project and Construction of Ngwagwane weir; water treatment works; pumpstation; rising main; reservoirs; bulk pipelines and reticulation in the Ingwe Local Municipality of the Sisonke District Municipality in the KwaZulu-Natal Province is underlain by Permian to Triassic aged sandstone and mudstones with a Very High to High Palaeontological sensitivity. No significant fossils are expected from the Jurassic aged dolerite sill areas.

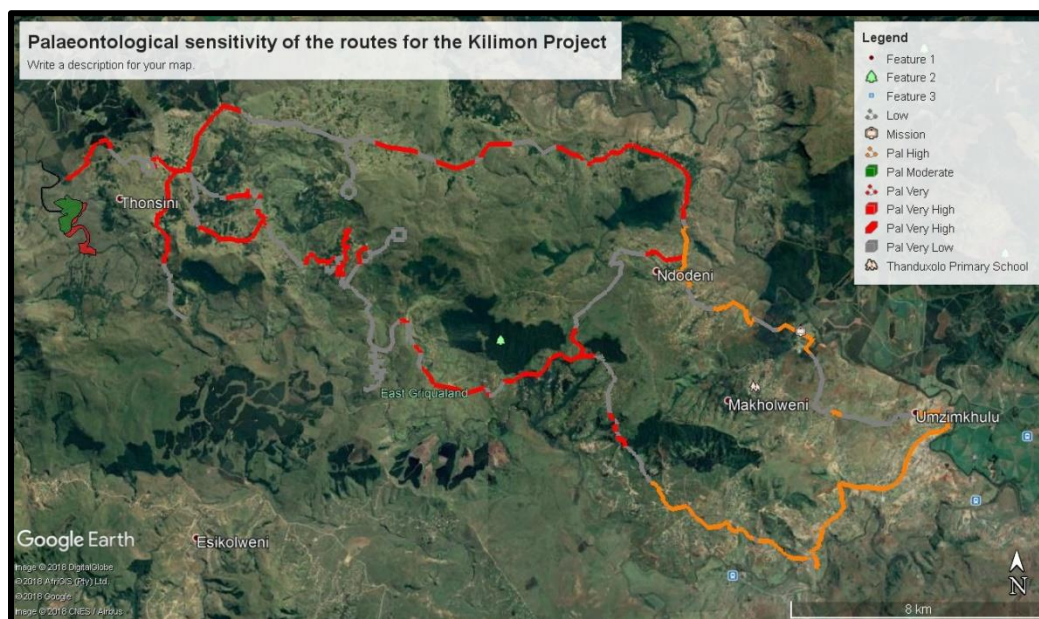


Figure 6 Palaeontological Sensitivity of the rocks underlying the Kilimon Project area. For colour codes see Table 1

Significant fossils are expected in areas with deep exposure, and more fossils are expected during excavation for trenching in areas indicated in red and orange on the Palaeontological sensitivity map (Figure 7). It is important that a suitably qualified Palaeontologist be appointed to visit the site of the development to identify

potential fossils in areas indicated as High en Very Highly significant during the first week of excavations.

The field investigation exposed fossils, and it will be very important that a suitably qualified Palaeontological Specialist be appointed to do a Phase 2 PIA and to upgrade the “Chance Find Protocol” document. The CFP document must then be included as part of the EMPr of this project, to record all unexpected fossils associated with the geological formations on site.

It is recommended that:

- The EAP and ECO must be informed of the fact that a High and Very High Palaeontological Sensitivity is allocated to the part of study area underlain by Karoo Supergroup sedimentary rocks and a Low sensitivity over the rest of the site underlain by dolerite.
- Further mitigation for Palaeontological Heritage is recommended for this project before excavation of deeper than 1.5m is done.
- A suitably qualified palaeontologist must do a Phase 2 PIA and upgrade the “Chance Find Protocol” (CFP) when fossils are recorded from any formation in this area during excavations into areas with a Very High and High Palaeontological significance.
- Recommendations contained in the resultant Phase 1 PIA must be approved by AMAFA and SAHRA for inclusion in the EMPr of the project.
- 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.



Dr Gideon Groenewald
Geologist

CHANCE FIND PROTOCOL FOR PALAEOLOGICAL HERITAGE

Kilimon Bulk Water Supply Project and Construction of Ngwagwane weir; water treatment works; pumpstation; rising main; reservoirs; bulk pipelines and reticulation in the Ingwe Local Municipality of the Sisonke District Municipality in the KwaZulu-Natal Province

Mitigation for Excavation Impact on Palaeontological Heritage Resources

It is essential that the appointed palaeontologist, in consultation with the Project Environmental Manager and the contractors and ECO's of the excavation works develop a short-term strategy for the recovery of significant fossils during the excavation operation. As part of such a strategy, the discussions with the palaeontologist must include:

- Initially, and at least for the *duration of excavation*, visit the site on request of the ECO of the specific construction site, to ensure recording of all potentially significant fossil strata. Due to the longevity of this contractual involvement it is not possible to have pre-determined timing on these visits and it is a conclusion from present excavations, that more frequent visits by the Palaeontologist during excavations into the Ecca Group and Beaufort Group sediments will most probably be required.
- Determine a short-term strategy and budget for the recording of significant fossils. This Strategy is simply an oral agreement on when the site is to be inspected and what the finds are that might be recorded. The site visit must include an introduction session with all the managers of the Project Team, including training of the ECO and site managers by the appointed palaeontologist, to basically train people to know what to look out for in terms of fossil heritage on site. This action will be required at the start of each individual construction activity for the duration of construction in the "greenfield sections" of the route.
- In the case of reporting of any unusual sedimentary structures, the Palaeontologist must be notified, and a site visit must be arranged at the earliest possible time with the Palaeontologist. In the case of the site ECO or the Site Manager becoming aware of suspicious looking material that might be a "Significant Find", the construction must be halted in that specific area and the PEM must be informed who will inform the Project Engineer. The Palaeontologist must be given enough time to reach the site and the PEM will request a Site Instruction from the Engineer to allow for removal the material before excavation continues. Although significant finds were recorded during the first site inspections (Phase 1 PIA, included in this document) the Palaeontologist foresee much more significant finds during the lifetime of the Project.

Mitigation Measures Normally Encountered

1. Mitigation of palaeontological material must begin as soon as possible and preferably when “trial excavation” takes place. The appointed specialists must acquaint themselves with the operation and determine feasible mitigation strategies.

2. A plan for systematic sampling, recording, preliminary sorting and storage of palaeontological and sedimentological samples will be developed during the early stages of the project, in collaboration with the Evolutionary Studies Institute (ESI) at WITS University, which is the closest Institute to the site. If appropriate, the Rhodes University as well as the University of KwaZulu-Natal, might be asked for their involvement in this project.

3. Mitigation will involve an attempt to capture all rare fossils and systematic collection of all fossils discovered. This will take place in conjunction with descriptive, diagrammatic and photographic recording of exposures, also involving sediment samples and samples of both representative and unusual sedimentary or biogenic features. The fossils and contextual samples will be processed (sorted, sub-sampled, labelled, boxed) and documentation consolidated, to create an archive collection from the excavated sites for future researchers.

Functional responsibilities of the Developer and Project Environmental Managers for the Project

1. Ensuring, at their cost, that a representative archive of palaeontological samples and other records is assembled to characterise the palaeontological occurrences affected by the excavation operation.

2. Provide field aid, if necessary, in the supply of materials, labour and machinery to excavate, load and transport sampled material from the excavation areas to the sorting areas, removal of overburden if necessary, and the return of discarded material to the disposal areas. In the case of this project it is foreseen that vertebrate, plant and trace fossils will be present. *(If more fossils of Permian age are exposed, it will be Very Highly significant and the Palaeontologist will obviously be in close communication with the site ECO and the PEM to act as required by AMAFA/SAHRA without causing undue standing time for the contractors).*

3. “Facilitate” systematic recording of the stratigraphic and palaeo-environmental features of exposures in the fossil-bearing excavations, by allowing time to describe and measure geological sections, and by providing aid in the surveying of positions where significant fossils are found. *(In the case of this specific development, the likelihood of such finds is Very High).*

4. Provide safe storage for fossil material found routinely during excavation operations by construction personnel. In this context, isolated fossil finds in disturbed material qualify as “normal” fossil finds.

5. Provide covered, dry storage for samples and facilities that is defined as a work area for sorting, labelling and boxing/bagging of samples.

6. Costs of basic curation and storage in the sample archive at the ESI, WITS University (labels, boxes, shelving and, if necessary, specifically-tasked temporary employees).

Documentary record of palaeontological occurrences

1. The contractors will, after consultation with the PEM and in collaboration with the Palaeontologist, make the excavation plan available to the appointed specialist, in which the following information are indicated on the plan in the site office at the excavation site. This must be done in conjunction with the appointed specialist and form part of the on-going revision of the “Chance Find Protocol” (CFP) during the excavation stage of the project:

1.1. Initially, all known specific palaeontological information will be indicated on the plan. This will be updated throughout the excavation period.

1.2 Locations of samples and measured sections are to be pegged, and routinely accurately surveyed. Sample locations, measured sections, etc., must be recorded three-dimensionally if any significant fossils are recorded during the time of excavation. This information must be recorded during the first site visit and a clearance from the Palaeontologist (e-mail message will suffice) must be followed up with subsequent e-mail communications with the Site Specific ECO, Site Manager and the PEM.

Functional responsibilities of the appointed Palaeontologist

1. Apply for a permit to collect fossils during the lifetime of the Project and establishment of a representative collection of fossils and a contextual archive of appropriately documented and sampled palaeoenvironmental and sedimentological geodata in collaboration with the ESI at WITS University, or the Rhodes University, University of KwaZulu-Natal, depending on the Expertise available at each Institute.

2. Undertake an initial evaluation of potentially affected areas and of available exposures in excavations. A short training session, inclusive of the PEM, Project Managers and the ECO’s or their representatives, was presented during the second site visit to this project.

3. On the basis of the above, and evaluation during the early stages of excavation development, in collaboration with the PEM and the contractor management team, more detailed practical strategies to deal with the fossils

encountered routinely during excavation, as well as the strategies for major finds must briefly be agreed on.

4. Informal on-site training in responses applicable to “normal” fossil finds must be provided for the PEM, ECO and environmental staff by the appointed specialist. This step is will only be arranged following the discovery of significant fossils at the time of the Phase 2 site visits.

5. Respond to significant finds and undertake appropriate mitigation.

6. Initially, for the first year of operation, and if the PEM or the appropriate ECO indicates significant “strange looking rocks” that might be similar to the fossils indicated to the staff during the information sessions, visit at least once in twelve weeks to “touch base” with the monitoring progress. Document interim “normal” finds and undertake an inspection and documentation of new excavation faces. A strategy for further visits during the life of the excavation must be discussed.

7. Transport of material from the site to the ESI, WITS University or the allocated Institute where an expert on the specific fossils discovered, is presently employed.

8. Reporting on the significance of discoveries, as far as can be preliminarily ascertained. This report is in the public domain and copies of the report must be deposited at ESI, AMAFA and the South African Heritage Resources Authority (SAHRA). It must fulfil the reporting standards and data requirements of these bodies.

9. Reasonable participation in publicity and public involvement associated with palaeontological discoveries.

Exposure of palaeontological material

1. In the event of construction exposing new palaeontological material, not regarded as normative/routine as outlined in the initial investigation, such as a major fossil find, the following procedure must be adhered to:

1.1 The appointed specialist or alternates (AMAFA; SAHRA; ESI WITS University, University of KZN; Rhodes University) must be notified by the responsible officer (e.g. the PEM, Chief Engineer, ECO or Contractor Manager), of major or unusual discoveries during excavation, found by the Contractor Staff.

1.2 Should a major *in situ* occurrence be exposed, excavation will immediately cease in that area so that the discovery is not disturbed or altered in any way until the appointed specialist or scientists from the ESI at WITS University, or its designated representatives, have had reasonable opportunity to investigate the find. Such work will be at the expense of the Developer.

Some poorly defined impressions of fossils were observed during the first site visit and the palaeontologist cleared the continued excavation on the proviso that any suspicious material will be indicated to the Palaeontologist via emailed photographic information.

CONCLUSION

The development site for the Kilimon Bulk Water Supply Project and Construction of Ngwagwane weir; water treatment works; pumpstation; rising main; reservoirs; bulk pipelines and reticulation in the Ingwe Local Municipality of the Sisonke District Municipality in the KwaZulu-Natal Province falls on Very Low to Very Highly significant sedimentary rocks (Ecca and Beaufort Groups) that contain significant fossils. No fossils were collected to date due to very deep and severe weathering of rocks. No fossils are expected in the dolerite.

Poorly preserved imprints of fossils were recorded during the first site studies in these rock formations. The potential for finding significant vertebrate, plant and trace-fossils, in any excavation into sediments of the Balfour Formation, Beaufort Group and Ecca Group is Very High and the cooperation of the entire team of engineers and contractors, is of critical importance. The interest and cooperation of the management team will be highly appreciated and it is essential that the excavations be monitored during the entire period of excavation and that this “Chance Find Protocol” be updated on a regular bases during the life-time of the excavation period for the Project. It is essential that the Palaeontologist be notified of the final sign-off of the project date, for final posting of the “Chance Find Protocol” on the SAHRIS Website for record purposes. No fossils will be associated with areas underlain by dolerite.

It is recommended that:

- The PEM and ECO's must be informed of the fact that a Very Low to Very High Palaeontological Sensitivity was allocated to the entire development and due to the highly weathered nature of the material, significant fossils is expected after the start of excavations for foundations that exceed 1.5m.
- The allocated team members in the teams of the contractor should be introduced to Palaeontological material that is likely to be found on site. A once-off information session with the Palaeontological specialist must be arranged at the start of each individual Contractual Construction Site, to present a simple and understandable (preferably audio-visual presentation) to the majority of the contractual Managers and ECO's on site during the initial site visit as is indicated in the EMPr for the Project.
- This “Chance Find Protocol” is included in the EMPr of the Project and a reasonable budget must be allocated to ensure compliance with the legal responsibility of the developer in terms of the proper conservation of and storage of Palaeontological Heritage.

- The AMAFA and SAHRA must be informed of the content of this “Chance Find Protocol” and EMPr arrangements by the PEM and the Developer, for final conclusion of the Project when completed.