

**SURVEY OF THE EKUVUKENI SHOPPING CENTRE,  
KWAZULU-NATAL**

**FOR TRIPLO4**

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## **INTRODUCTION**

Benezone Pty (Ltd) proposes the construction of a Shopping Centre in Ekuvakeni, Indaka Local Municipality, KwaZulu-Natal, comprising of food outlets, retail stores, etc., as per the proposed layout. The proposed development is situated on Portion 6 of the Farm Uitvlugt No. 1156 within Ekuvakeni which is currently vacant land and not zoned as it is currently not within the town-planning scheme. The total size of the site is 5.2 Hectares.

All bulk services (water, electricity) are available within close proximity to the site and the development will be linked with the existing infrastructure. A Lilliput Package Plant is proposed (for the treatment of sewage) and will be confirmed, following discussions and negotiations with the Municipality regarding planning requirements.

The Ekuvakeni area currently has no large shopping centre. The major retail stores that do operate are located within Ladysmith and Dundee which is unfavourable as it is inconvenient due to the distance, making them less frequented by shoppers. The construction of the Ekuvakeni Shopping Centre will provide the surrounding area with a central retail shopping centre. In addition, the retail and commercial opportunities will create new temporary and permanent employment opportunities for the residents from surrounding communities.

Figures 1 – 3 indicate the location of the proposed site.

FIG. 1 GENERAL LOCATION OF THE STUDY AREA

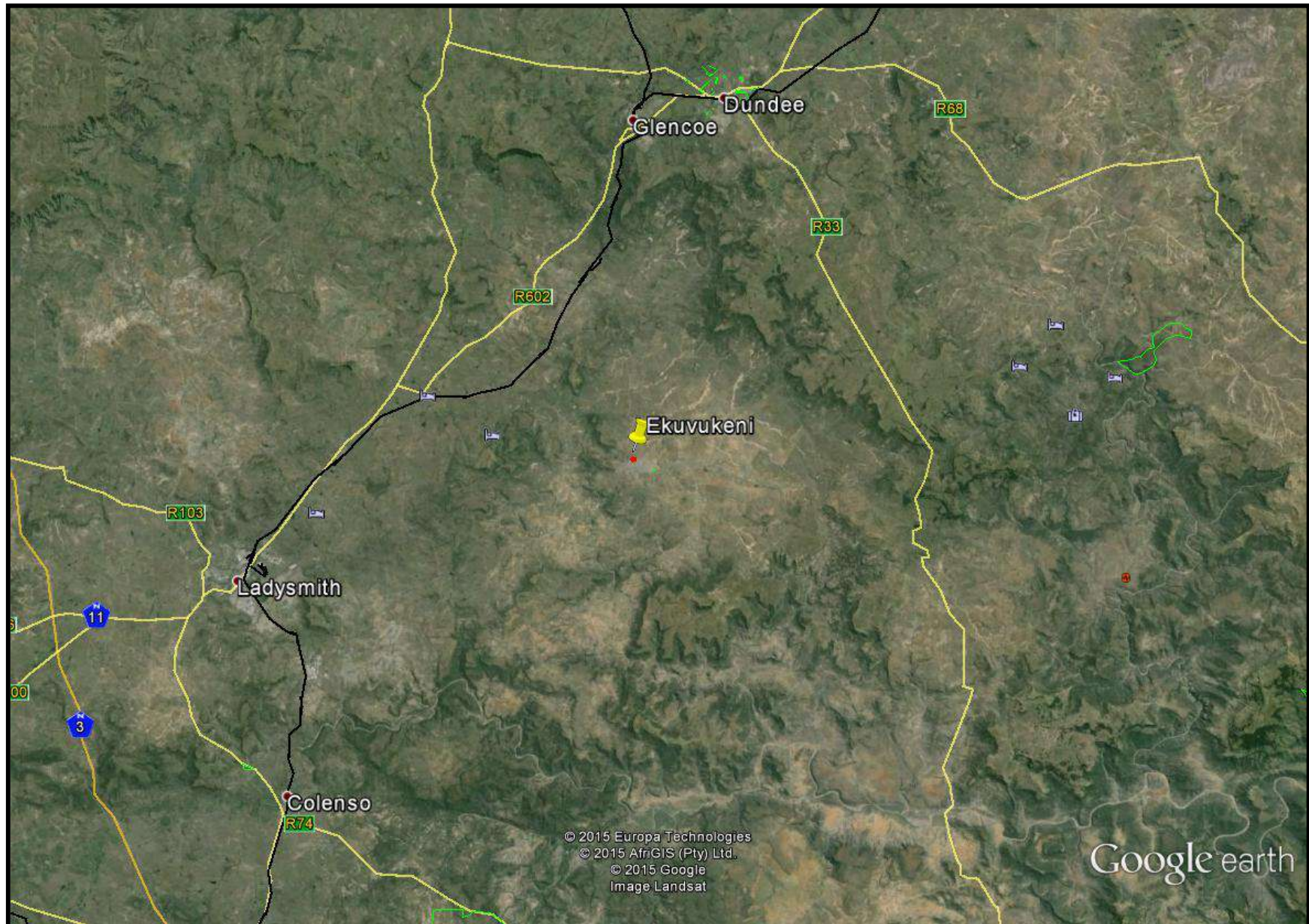


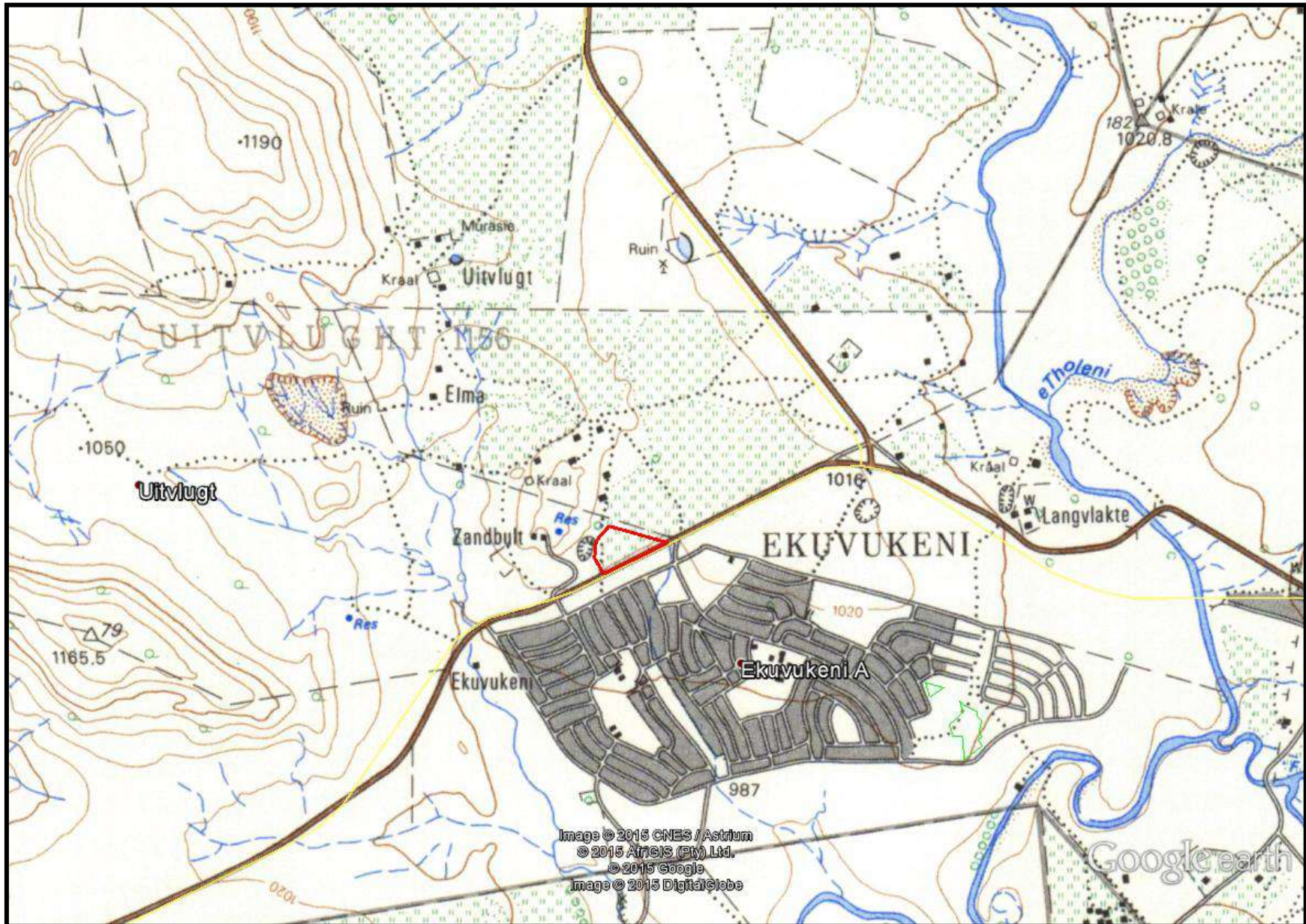


FIG. 2: AERIAL OVERVIEW OF THE STUDY AREA





FIG. 3: TOPOGRAPHICAL OVERVIEW OF THE STUDY AREA



## KWAZULU-NATAL HERITAGE ACT NO. 4 OF 2008

“General protection: Structures.—

- No structure which is, or which may reasonably be expected to be older than 60 years, may be demolished, altered or added to without the prior written approval of the Council having been obtained on written application to the Council.
- Where the Council does not grant approval, the Council must consider special protection in terms of sections 38, 39, 40, 41 and 43 of Chapter 9.
- The Council may, by notice in the *Gazette*, exempt—
- A defined geographical area; or
- defined categories of sites within a defined geographical area, from the provisions of subsection where the Council is satisfied that heritage resources falling in the defined geographical area or category have been identified and are adequately protected in terms of sections 38, 39, 40, 41 and 43 of Chapter 9.
- A notice referred to in subsection (2) may, by notice in the *Gazette*, be amended or withdrawn by the Council.

General protection: Graves of victims of conflict.—No person may damage, alter, exhume, or remove from its original position—

- the grave of a victim of conflict;
- a cemetery made up of such graves; or
- any part of a cemetery containing such graves, without the prior written approval of the Council having been obtained on written application to the Council.
- General protection: Traditional burial places.—
- No grave—
- not otherwise protected by this Act; and
- not located in a formal cemetery managed or administered by a local authority, may be damaged, altered, exhumed, removed from its original position, or otherwise disturbed without the prior written approval of the Council having been obtained on written application to the Council.

The Council may only issue written approval once the Council is satisfied that—

- the applicant has made a concerted effort to consult with communities and individuals who by tradition may have an interest in the grave; and
- the applicant and the relevant communities or individuals have reached agreement regarding the grave.

General protection: Battlefield sites, archaeological sites, rock art sites, palaeontological sites, historic fortifications, meteorite or meteorite impact sites.—

- No person may destroy, damage, excavate, alter, write or draw upon, or otherwise disturb any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site without the prior written approval of the Council having been obtained on written application to the Council.
- Upon discovery of archaeological or palaeontological material or a meteorite by any person, all activity or operations in the general vicinity of such material or meteorite must cease forthwith and a person who made the discovery must submit a written report to the Council without delay.
- The Council may, after consultation with an owner or controlling authority, by way of written notice served on the owner or controlling authority, prohibit any activity considered by the Council to be inappropriate within 50 metres of a rock art site.
- No person may exhume, remove from its original position or otherwise disturb, damage, destroy, own or collect any object or material associated with any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site without the prior written approval of the Council having been obtained on written application to the Council.
- No person may bring any equipment which assists in the detection of metals and archaeological and palaeontological objects and material, or excavation equipment onto any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, or meteorite impact site, or



use similar detection or excavation equipment for the recovery of meteorites, without the prior written approval of the Council having been obtained on written application to the Council.

- The ownership of any object or material associated with any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site, on discovery, vest in the Provincial Government and the Council is regarded as the custodian on behalf of the Provincial Government.” (KZN Heritage Act of 2008)

## **METHOD**

The method for Heritage assessment consists of several steps.

The first step forms part of the desktop assessment. Here we would consult the database that has been collated by Umlando. These databases contains archaeological site locations and basic information from several provinces (information from Umlando surveys and some colleagues), most of the national and provincial monuments and battlefields in Southern Africa (<http://www.vuvuzela.com/googleearth/monuments.html>) and cemeteries in southern Africa (information supplied by the Genealogical Society of Southern Africa). We use 1<sup>st</sup> and 2<sup>nd</sup> edition 1:50 000 topographical and 1937 aerial photographs where available, to assist in general location and dating of buildings and/or graves. The database is in Google Earth format and thus used as a quick reference when undertaking desktop studies. Where required we would consult with a local data recording centre, however these tend to be fragmented between different institutions and areas and thus difficult to access at times. We also consult with an historical architect, palaeontologist, and an historian where necessary.

The survey results will define the significance of each recorded site, as well as a management plan.

All sites are grouped according to low, medium, and high significance for the purpose of this report. Sites of low significance have no diagnostic artefacts or features. Sites of medium significance have diagnostic artefacts or features and these sites tend to be sampled. Sampling includes the collection of artefacts for future analysis. All diagnostic pottery, such as rims, lips, and decorated sherds are sampled, while bone, stone, and shell are mostly noted. Sampling usually occurs on most sites. Sites of high significance are excavated and/or extensively sampled. Those sites that are extensively sampled have high research potential, yet poor preservation of features.

### **Defining significance**

Heritage sites vary according to significance and several different criteria relate to each type of site. However, there are several criteria that allow for a general significance rating of archaeological sites.

These criteria are:

#### **1. State of preservation of:**

- 1.1. Organic remains:
  - 1.1.1. Faunal
  - 1.1.2. Botanical
- 1.2. Rock art
- 1.3. Walling
- 1.4. Presence of a cultural deposit
- 1.5. Features:
  - 1.5.1. Ash Features
  - 1.5.2. Graves
  - 1.5.3. Middens
  - 1.5.4. Cattle byres
  - 1.5.5. Bedding and ash complexes

**2. Spatial arrangements:**

- 2.1. Internal housing arrangements
- 2.2. Intra-site settlement patterns
- 2.3. Inter-site settlement patterns

**3. Features of the site:**

- 3.1. Are there any unusual, unique or rare artefacts or images at the site?
- 3.2. Is it a type site?
- 3.3. Does the site have a very good example of a specific time period, feature, or artefact?

**4. Research:**

- 4.1. Providing information on current research projects
- 4.2. Salvaging information for potential future research projects

**5. Inter- and intra-site variability**

- 5.1. Can this particular site yield information regarding intra-site variability, i.e. spatial relationships between various features and artefacts?
- 5.2. Can this particular site yield information about a community's social relationships within itself, or between other communities?

**6. Archaeological Experience:**

6.1. The personal experience and expertise of the CRM practitioner should not be ignored. Experience can indicate sites that have potentially significant aspects, but need to be tested prior to any conclusions.

**7. Educational:**

- 7.1. Does the site have the potential to be used as an educational instrument?
- 7.2. Does the site have the potential to become a tourist attraction?
- 7.3. The educational value of a site can only be fully determined after initial test-pit excavations and/or full excavations.

**8. Other Heritage Significance:**

- 8.1. Palaeontological sites
- 8.2. Historical buildings



- 8.3. Battlefields and general Anglo-Zulu and Anglo-Boer sites
- 8.4. Graves and/or community cemeteries
- 8.5. Living Heritage Sites
- 8.6. Cultural Landscapes, that includes old trees, hills, mountains, rivers, etc related to cultural or historical experiences.

The more a site can fulfill the above criteria, the more significant it becomes. Test-pit excavations are used to test the full potential of an archaeological deposit. This occurs in Phase 2. These test-pit excavations may require further excavations if the site is of significance (Phase 3). Sites may also be mapped and/or have artefacts sampled as a form of mitigation. Sampling normally occurs when the artefacts may be good examples of their type, but are not in a primary archaeological context. Mapping records the spatial relationship between features and artefacts.

**TABLE 1: SAHRA GRADINGS FOR HERITAGE SITES**

<b>SITE SIGNIFICANCE</b>	<b>FIELD RATING</b>	<b>GRADE</b>	<b>RECOMMENDED MITIGATION</b>
<b>High Significance</b>	National Significance	Grade 1	Site conservation / Site development
<b>High Significance</b>	Provincial Significance	Grade 2	Site conservation / Site development
<b>High Significance</b>	Local Significance	Grade 3A / 3B	
<b>High / Medium Significance</b>	Generally Protected A		Site conservation or mitigation prior to development / destruction
<b>Medium Significance</b>	Generally Protected B		Site conservation or mitigation / test excavation / systematic sampling / monitoring prior to or during development / destruction
<b>Low Significance</b>	Generally Protected C		On-site sampling monitoring or no archaeological mitigation required prior to or during development / destruction

## RESULTS

### DESKTOP STUDY

The desktop study consisted of analysing various maps for evidence of prior habitation in the study area, as well as for previous archaeological surveys. The archaeological database indicates that there are archaeological sites in the general area (fig. 4). These sites include all types of Stone Age and Iron Age sites. No sites occur in the study area. Prins (2013) undertook a survey to the west of the study area that ended at the reservoir on the hill. No sites were found near this study area during his survey.

No national monuments, battlefields, or historical cemeteries are known to occur in the study area.

The 1937 aerial photograph indicates that the area had been ploughed since at least 1944 (fig. 6). There are no sites within the study area, however a settlement occurs to the west.

The 1968 topographical map indicates that the area is still under cultivation; however, the site noted from the 1937 map does not occur anymore.

### FIELD SURVEY

The field survey was undertaken in September 2015. The archaeological visibility was good. Fig. 8 shows the general view of the study area. The location of the sites is given in Table 2 and shown in fig. 9.

FIG. 4: LOCATION OF KNOWN HERITAGE SITES NEAR THE STUDY AREA

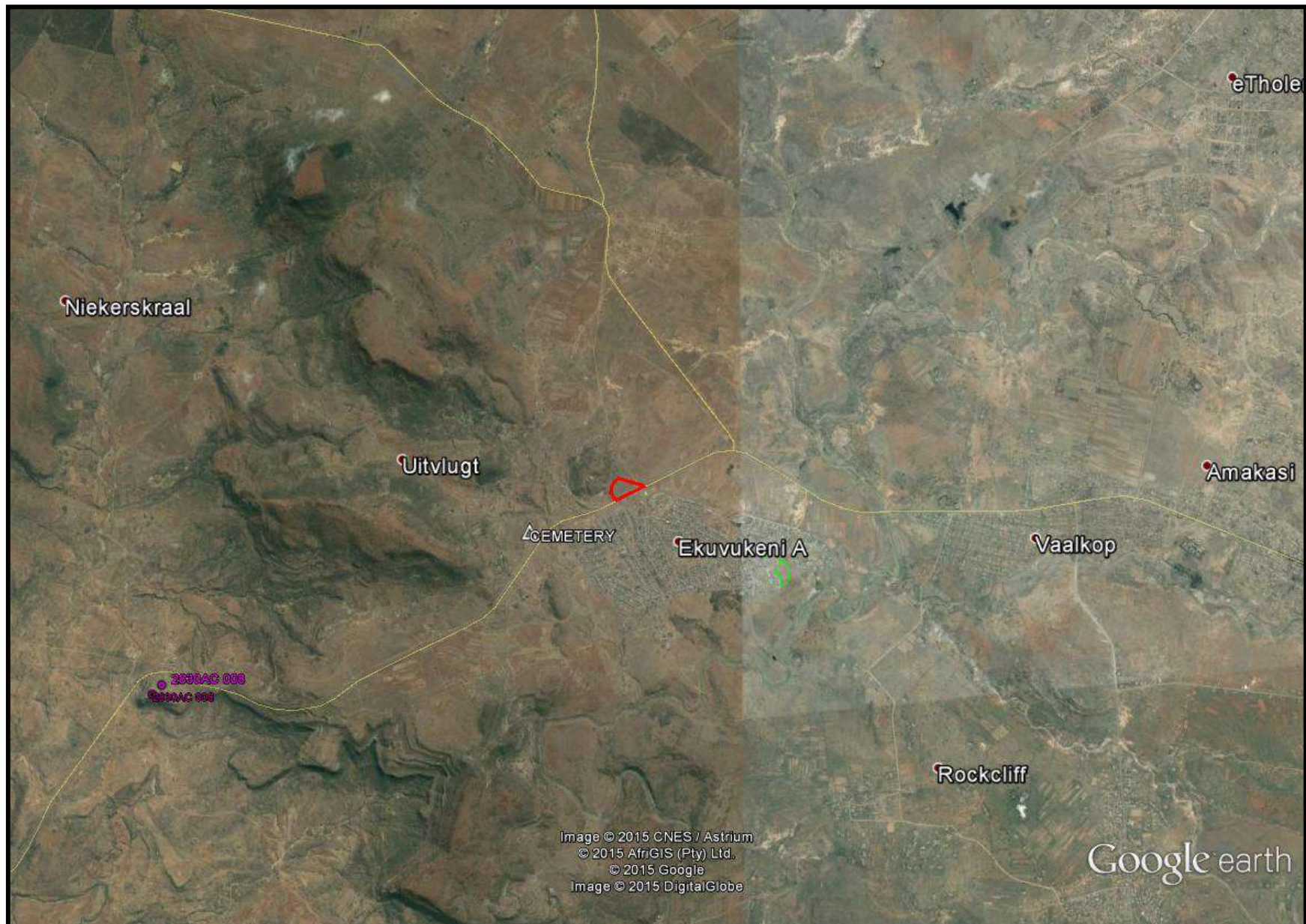




FIG. 5: SURVEYOR GENERAL DIAGRAM OF FARM UITVLUGHT (1852)

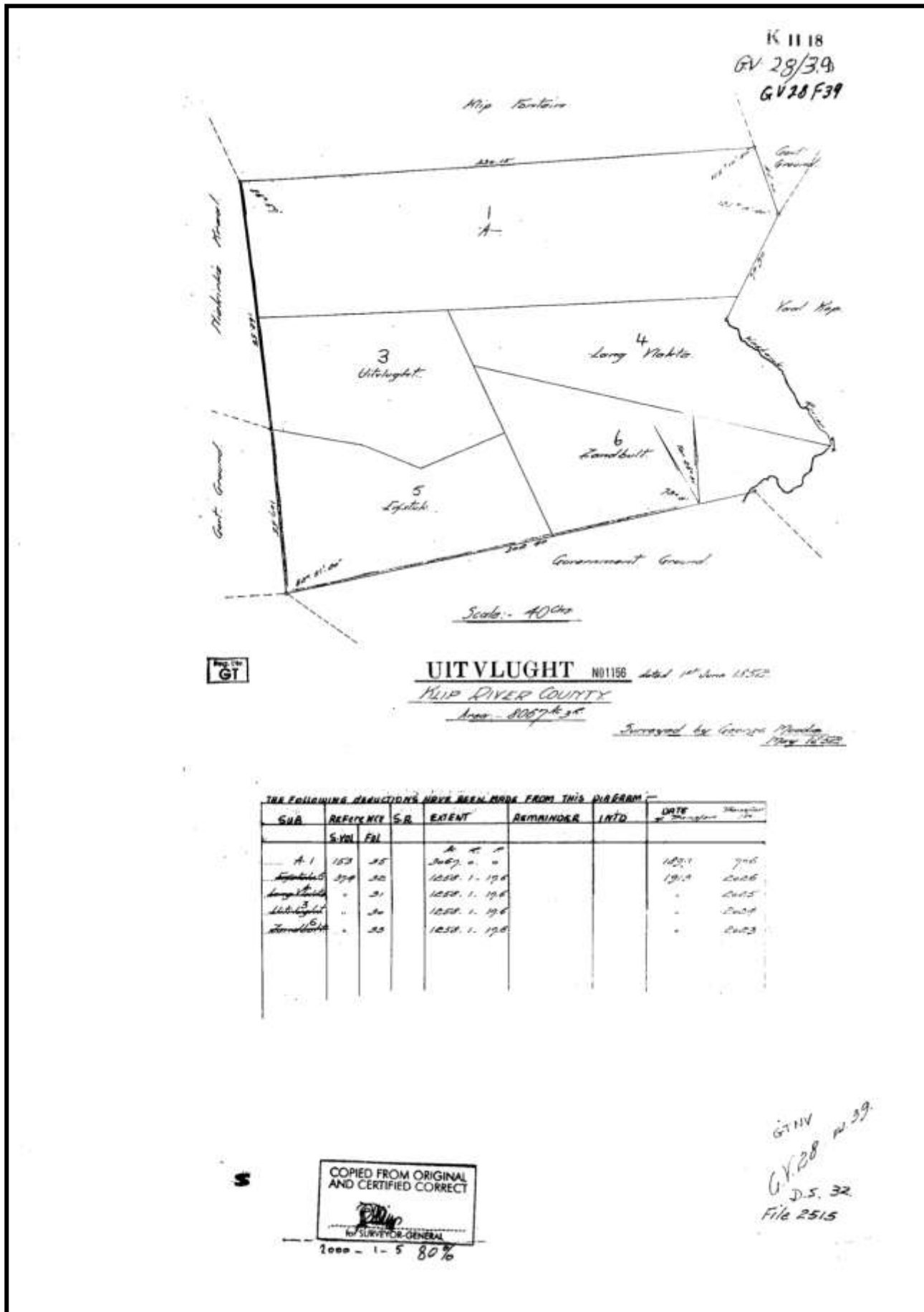


FIG. 6: STUDY AREA IN 1944





FIG. 7: STUDY AREA IN 1968

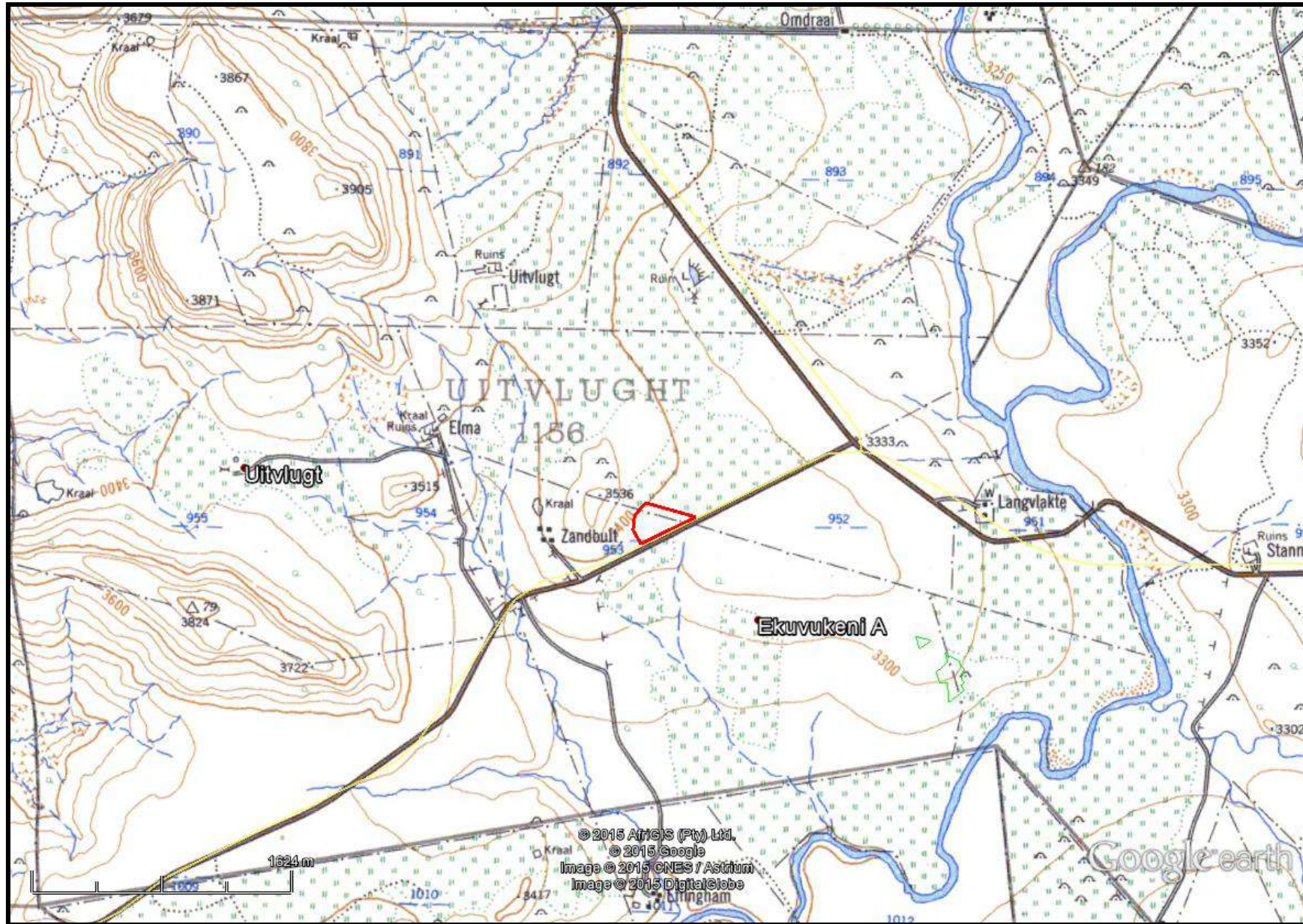




FIG. 8: GENERAL VIEW OF THE STUDY AREA



FIG. 9: LOCATION OF RECORDED SITES





**TABLE 2: LOCATION OF RECORDED SITES**

NAME	DESCRIPTION	LATITUDE	LONGITUDE
EKU1	Shembe circle	-28.461913029	30.147695979
EKU2	Start of graves	-28.461701972	30.148014994
EKU2C	End of graves	-28.461613040	30.148072997
EKU3	Grave	-28.459697021	30.149969989

**EKU01**

EKU01 is a Shembe circle located on the outskirts of the quarry (fig. 10). The site falls just outside of the study area. EKU01 is a religious site and therefore local participants would need to be consulted if it was to be affected.

**Significance:** The site is of high significance.

**Mitigation:** No mitigation is currently required.

**SAHRA Rating:** 3A

**FIG. 10: FEATURES AT EKU01**



## EKU02

EKU02 is situated about 30m east of EKU01. The site consists of three stone cairns, sisal plants and at least one house foundation/terrace (fig. 11). The graves are stone cairns that have an *Acacia spp.* tree planted on the western side. The graves are in an east-west orientation. This site was noted in the desktop study and thus the graves predate 1968.

The site is just outside of the study area.

**Significance:** The grave is of high significance.

**Mitigation:** No mitigation is currently required.

**SAHRA Rating:** 3A

## EKU03

EKU03 is a contemporary settlement with a possible human grave in the front of the house (fig. 12).

The settlement occurs in the northern section of the study area.

**Significance:** The grave is of high significance.

**Mitigation:** The shopping centre footprint will need to be altered so that it does not disturb the grave. Alternatively, a grave relocation will need to occur if the descendants consent to this. There will need to be a 20m buffer between the grave and the footprint.

**SAHRA Rating:** 3A

FIG. 11: FEATURES AT EKU02



**FIG. 12: FEATURES AT EKU03**

### **PALAEONTOLOGICAL IMPACT ASSESSMENT**

A desktop palaeontological impact assessment was undertaken by Dr. Gideon Groenewald (Appendix A). According to the SAHRIS, palaeontological sensitivity map the area is of very high significance (fig. 13).

“The study area is underlain by sedimentary rocks of the Permian-aged Vryheid Formation of the Ecca Group, where fossils are associated with the sandstone as well as bedding planes of shales exposed during excavation of trenches or foundations deeper than 1,5m. A Very High Palaeontological Sensitivity is allocated to these rocks. A very rich assemblage of plant fossils, coal beds and significant trace fossils have been described from the Vryheid Formation. Interpretation of the Google images indicates that the study area is mostly underlain by deeply weathered soil. A phase 1 PIA is therefore recommended during excavations of infrastructure deeper than 1,5m during the initial phases of the construction” (Groenewald 2015 Appendix A)



FIG. 13: PALAEOONTOLOGICAL SENSITIVITY MAP



COLOUR	SENSITIVITY	REQUIRED ACTION
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

**Significance:** The area is of very high significance

**Mitigation:**

- The EAP and ECO of the projects must be informed of the fact that significant plant fossils have been described from the Vryheid Formation. Chance recording of fossils will contribute significantly to our understanding of the palaeoenvironments of this region.
- All sections of the development are allocated a Very High Palaeontological sensitivity and areas where trenching or excavation

for infrastructure will be deeper than 1,5m, must be identified during geotechnical surveys. Where the trenches and excavations will reach this depth, a suitably qualified Palaeontologist must be appointed to record and collect the fossils according to SAHRA and AMAFA specifications as part of a Phase 1 Palaeontological Impact Assessment during the initial stages of excavation at each individually proposed development node on this property.

- These recommendations must form part of the EMP for the project.

## **MANAGEMENT PLAN**

The footprint will need to be modified for the human grave, or the grave could be relocated. If the grave is to be relocated then a social consultation process will be required with the descendents (who live near the grave).

If the excavations for the shopping centre are deeper than 1.5m, then a palaeontologist will be required to monitor the excavations. Buildings plans will need to be submitted as proof of the required depth. A permit from Amafa KZN will be required to damage palaeontological sites.

## **CONCLUSION**

A heritage survey was undertaken for the proposed Ekuvukeni shopping centre. One heritage site was located in the northern footprint. The grave will need to be relocated or the development footprint will need to be modified. The study area is an area of very high palaeontological significance. A palaeontologist will need to be consulted if the construction levels exceed 1.5m in depth.

## **REFERENCES**

Prins, F. 2013. Cultural heritage impact assessment of the proposed Driefontein pipeline development. Report for SiVest.

**APPENDIX A**  
**PALAEONTOLOGICAL IMPACT ASSESSMENT**



**DESKTOP PALAEOLOGICAL  
ASSESSMENT FOR THE PROPOSED  
EKUVUKENI SHOPPING CENTRE  
DEVELOPMENT, INDAKA LOCAL  
MUNICIPALITY, UTHUKELA DISTRICT  
MUNICIPALITY, KWAZULU-NATAL  
PROVINCE.**

**FOR  
Umlando**

**DATE: 23 September 2015**

**By**

**Gideon Groenewald  
Cell: 078 713 6377**

## EXECUTIVE SUMMARY

Gideon Groenewald was appointed to undertake a desktop survey, assessing the potential palaeontological impact of the proposed development of the Ekuvukeni Shopping Centre Development, Indaka Local Municipality, Uthukela District Municipality, KwaZulu-Natal Province.

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 study area is underlain by sedimentary rocks of the Permian-aged Vryheid Formation of the Ecca Group, where fossils are associated with the sandstone as well as bedding planes of shales exposed during excavation of trenches or foundations deeper than 1,5m. A Very High Palaeontological Sensitivity is allocated to these rocks. A very rich assemblage of plant fossils, coal beds and significant trace fossils have been described from the Vryheid Formation. Interpretation of the Google images indicates that the study area is mostly underlain by deeply weathered soil. A phase 1 PIA is therefore recommended during excavations of infrastructure deeper than 1,5m during the initial phases of the construction.

### Recommendations:

1. The EAP and ECO of the projects must be informed of the fact that significant plant fossils have been described from the Vryheid Formation. Chance recording of fossils will contribute significantly to our understanding of the palaeoenvironments of this region.
2. All sections of the development are allocated a Very High Palaeontological sensitivity and areas where trenching or excavation for infrastructure will be deeper than 1,5m, must be identified during geotechnical surveys. Where the trenches and excavations will reach this depth, a suitably qualified Palaeontologist must be appointed to record and collect the fossils according to SAHRA and AMAFA specifications as part of a Phase 1 Palaeontological Impact Assessment during the initial stages of excavation at each individually proposed development node on this property.

These recommendations must form part of the EMP for the project.

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## INTRODUCTION

Gideon Groenewald was appointed to undertake a desktop survey, assessing the potential palaeontological impact of the proposed development of the Ekuvukeni Shopping Centre Development, Indaka Local Municipality, Uthukela District Municipality, KwaZulu-Natal Province (Figure 1).



Figure 1 Locality of the proposed site

### **SOUTH AFRICAN NATIONAL HERITAGE RESOURCE ACT NO 25/1999 AND KWAZULU-NATAL HERITAGE ACT NO 4/2008**

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.

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

- geological sites of scientific or cultural importance;

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

## **METHODOLOGY**

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 identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess 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.

In preparing a palaeontological desktop study the potential fossiliferous rock units (groups, formations etc) represented within the study area are determined from geological maps and Google Earth imagery. 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.

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**

<b>PALAEONTOLOGICAL SIGNIFICANCE/VULNERABILITY OF ROCK UNITS</b>	
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).	
<b>RED</b>	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.
<b>ORANGE</b>	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.
<b>GREEN</b>	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.
<b>BLUE</b>	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,

	<p>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.</p>
<p><b>GREY</b></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.</p>

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a field-based assessment by a professional palaeontologist is usually warranted.

The key assumption for this desktop study is that the existing geological maps and datasets used to assess site sensitivity are correct and reliable. However, the geological maps used were not intended for fine scale planning work and are largely based on aerial photographs alone, without ground-truthing.



These factors may have a major influence on the assessment of the fossil heritage significance of a given development and, without supporting field assessments, may lead to either:

- an underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
- an overestimation of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by weathering, or are buried beneath a thick mantle of unfossiliferous “drift” (soil, alluvium etc).

## GEOLOGY

The study area is underlain by Permian-aged rocks of the Vryheid Formation of the Eccca Group, Karoo Supergroup (Figure 2).



Figure 2 Geology of the study area. The entire site is underlain by sedimentary rocks of the Vryheid Formation

### Eccca Group

#### 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).

## PALAEONTOLOGY

### Ecca Group

#### Vryheid Formation (Pv)

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.*, *Lidgettonia sp.*, *Noeggerathiopsis sp.* and *Podocarpidites sp.*

According to Bamford (2011) "Little data have been published on these potentially fossiliferous deposits. Around the coal mines 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.

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).

## DISCUSSION

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews. Significant fossils have been recorded from the Vryheid Formation and the recording of plant and trace fossils from this part of the Karoo Basin will contribute significantly to our understanding of the palaeo-environments that existed during the Permian times in this part of KwaZulu-Natal.

## MANAGEMENT PLAN

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 unweathered bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1.

The palaeontological sensitivity of the development is related to the specific geology that underlies the development footprints. For the sake of this desktop survey it is assumed that there are no significant outcrops on site, but that trenching of up to 1.5m depth will expose bedrock of all the Vryheid Formation during excavation for foundations and infrastructure. Due to the fact that the recording of fossils will have a significant impact on our understanding of the palaeo-environments in this part of the basin, a Very High Palaeontological sensitivity is allocated to the entire study area.

The palaeontological sensitivity of the study area is shown in Figure 3.



Figure 3 Palaeosensitivity of the proposed development sites. Colour coding is explained in Table 1

## CONCLUSION AND RECOMMENDATIONS

The study area is underlain by sedimentary rocks of the Permian-aged Vryheid Formation of the Ecca Group, where fossils are associated with the sandstone as well as bedding planes of shales exposed during excavation of trenches or foundations deeper than 1,5m. A Very High Palaeontological Sensitivity is allocated to these rocks. Very rich assemblages of plant fossils, coal beds and significant trace fossils have been described from the Vryheid Formation. Interpretation of the Google images indicates that the study area is mostly underlain by deeply weathered soil. A phase 1 PIA is therefore recommended during excavations of infrastructure deeper than 1,5m during the initial phases of the construction.

### Recommendations:

3. The EAP and ECO of the projects must be informed of the fact that significant plant fossils have been described from the Vryheid Formation. Chance recording of fossils will contribute significantly to our understanding of the palaeoenvironments of this region.
4. All sections of the development are allocated a Very High Palaeontological sensitivity and areas where trenching or excavation for infrastructure will be deeper than 1,5m, must be identified during geotechnical surveys. Where the trenches and excavations will reach this depth, a suitably qualified Palaeontologist must be appointed to record and collect the fossils according to SAHRA and AMAFA specifications as part of a Phase 1 Palaeontological



Impact Assessment during the initial stages of excavation at each individually proposed development node on this property.

5. These recommendations must form part of the EMP for the 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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