

**HERITAGE SURVEY OF THE PROPOSED N2  
UPGRADE BETWEEN PONGOLA AND MPUMALANGA  
BORDER**

**FOR SPM ENVIRONMENTAL**

**DATE: 18 June 2017**

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## Abbreviations

HP	Historical Period
IIA	Indeterminate Iron Age
LIA	Late Iron Age
EIA	Early Iron Age
ISA	Indeterminate Stone Age
ESA	Early Stone Age
MSA	Middle Stone Age
LSA	Late Stone Age
HIA	Heritage Impact Assessment
PIA	Palaeontological Impact Assessment

## **INTRODUCTION**

“SPM Environmental Consulting have been appointed to conduct the environmental services for a proposed Road Upgrade of the N2 from Pongola to the Mpumalanga border from a single carriage way (two lanes) to a double carriageway (four lanes) as well the associated upgrade of 3 bridges and 11 major culverts. SANRAL has prioritized the proposed upgrade because it is a major mobility route between Northern Zululand and Mpumalanga and ... the main abnormal load route into Southern Africa. The main objectives of the proposed road upgrade is to moderate traffic congestion and increase road user safety...

The proposed road upgrade is located within Uphongolo Local Municipality which forms part of Zululand District Municipality. The section of roadway is along the existing N2 road starting from Pongola until the Mpumalanga border. The surrounding land use is comprised of farm land, rural residential, schools, clinics and hospitals.

The proposed infrastructure will include the construction of the following:

- Horizontal and vertical realignment of section of roadways where the existing alignments are outside the acceptable geometric parameters and identification of additional land requirements.
- Improvement of the pavement structure based on projected future E80 standard axle loads for the 20-year design period and the primary pavement design calculations will be carried out in terms of the South African Mechanistic Design Method (utilizing the Rubicon design package);
- Existing intersection(s) will be reviewed for geometric and safety standards for a National Road, in terms of spacing and sight distance. This will include the development of an access management strategy to rationalise access, with the aim of reducing road conflict at existing intersections;

- Review the feasibility of grade-separated interchange(s) where high volumes of traffic warrant access;
- Widening of 3 bridges and 11 Major culverts to suit the new road cross section.
- All drainage structures and side drains shall be assessed and capacity improvements will be proposed where necessary; and
- Management of non-motorised traffic in settlement areas where large volumes of pedestrian traffic are using the roadway by providing pedestrian walkways, pedestrian bridges at high conflict zones and provision of public transport lay-bys.

Umlando was appointed by SPM to undertake the heritage survey of the proposed project.



FIG. 1 GENERAL LOCATION OF THE STUDY AREA

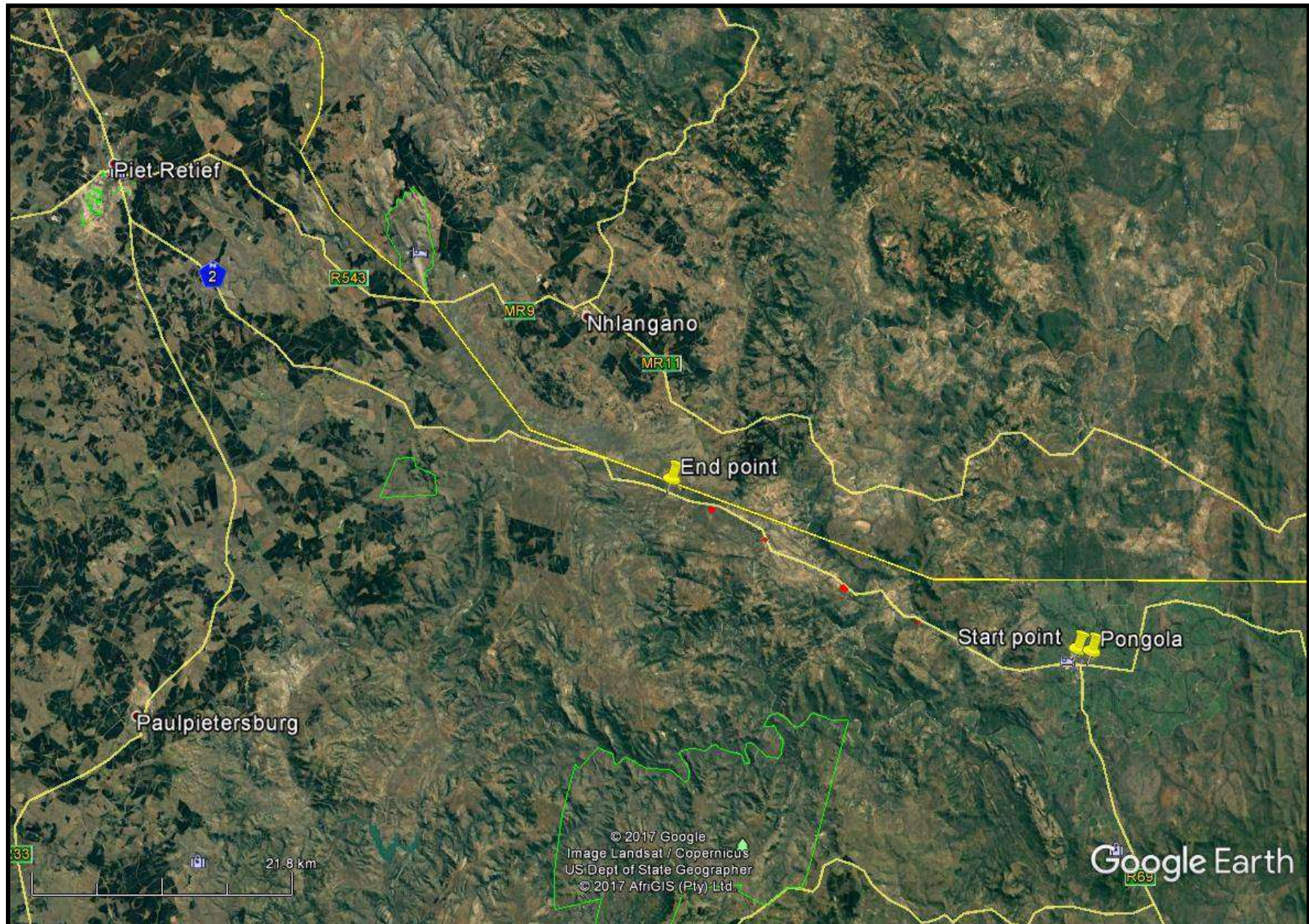




FIG. 2A: AERIAL OVERVIEW OF THE WESTERN AREA

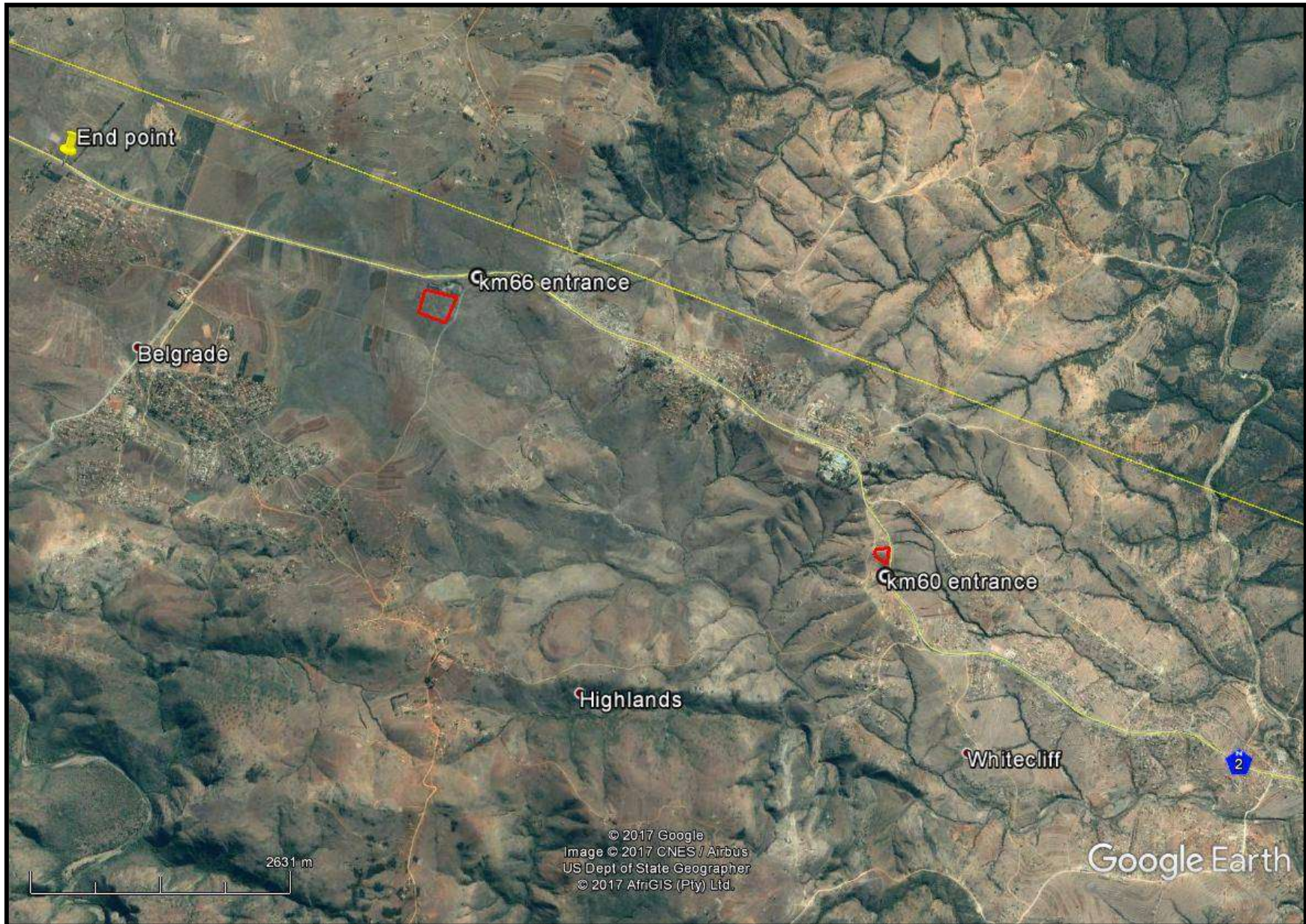




FIG. 2B: AERIAL OVERVIEW OF THE CENTRAL AREA

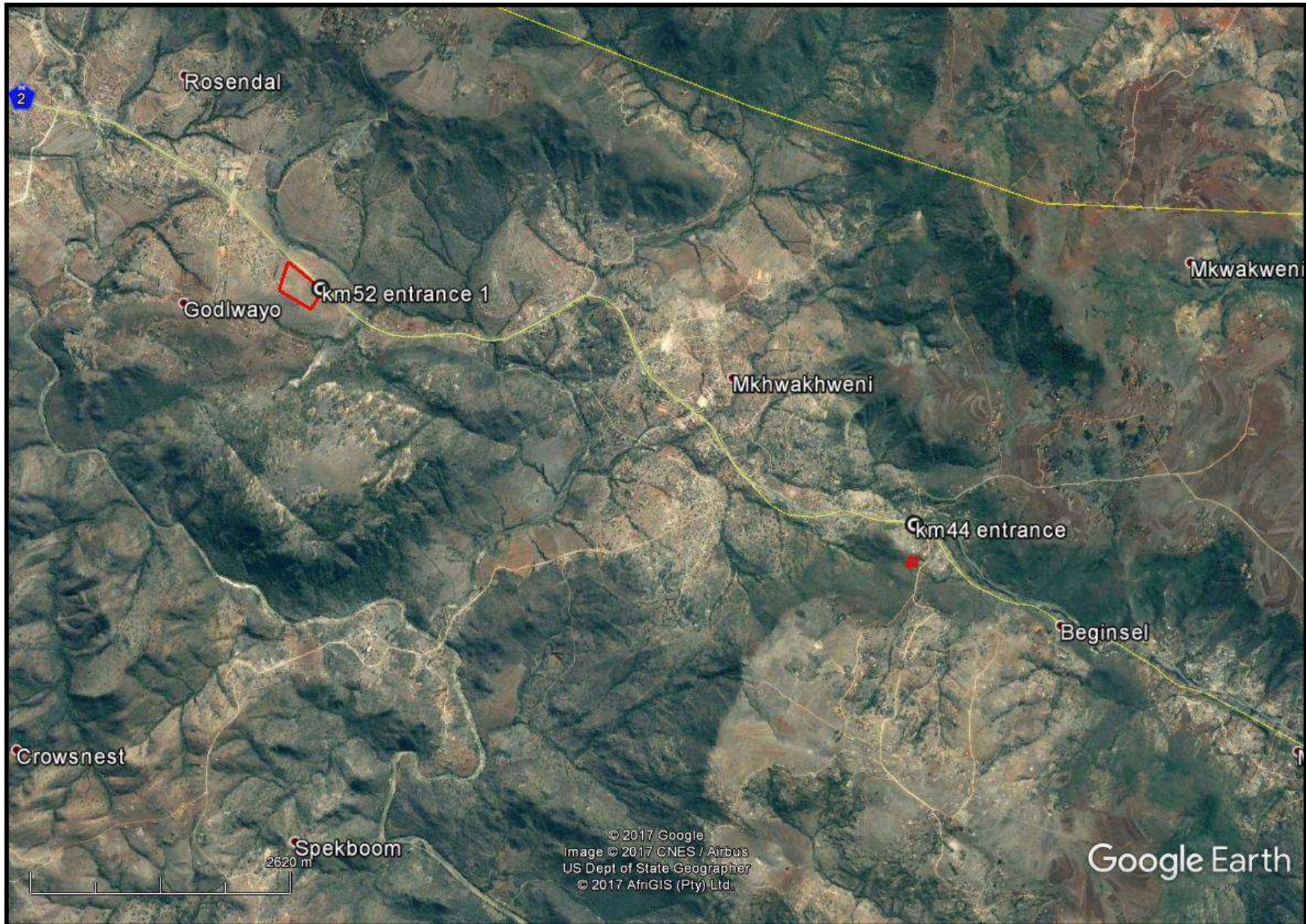




FIG. 2C: AERIAL OVERVIEW OF THE EASTERN AREA

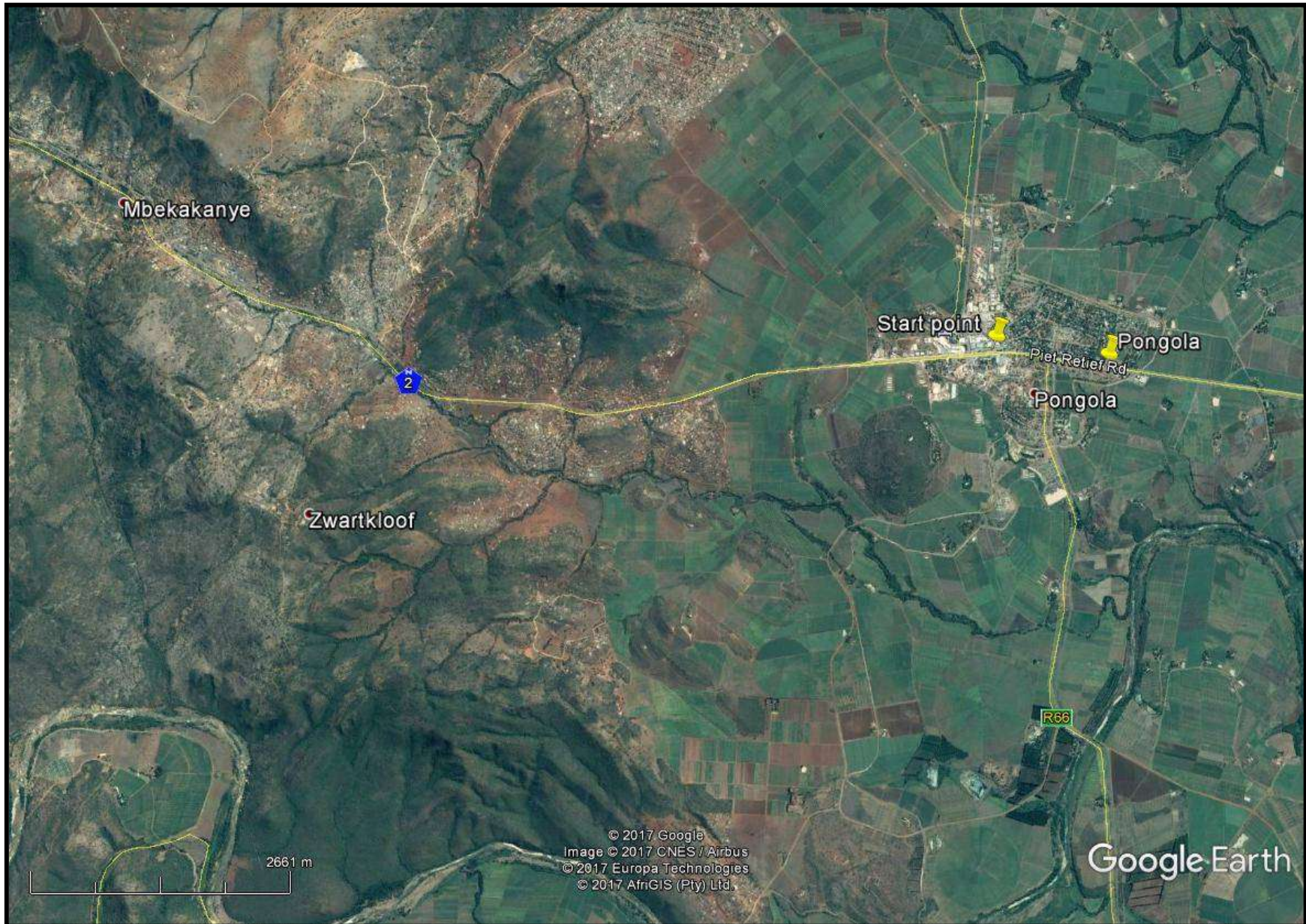




FIG. 3A: TOPOGRAPHICAL OVERVIEW OF THE WESTERN STUDY AREA

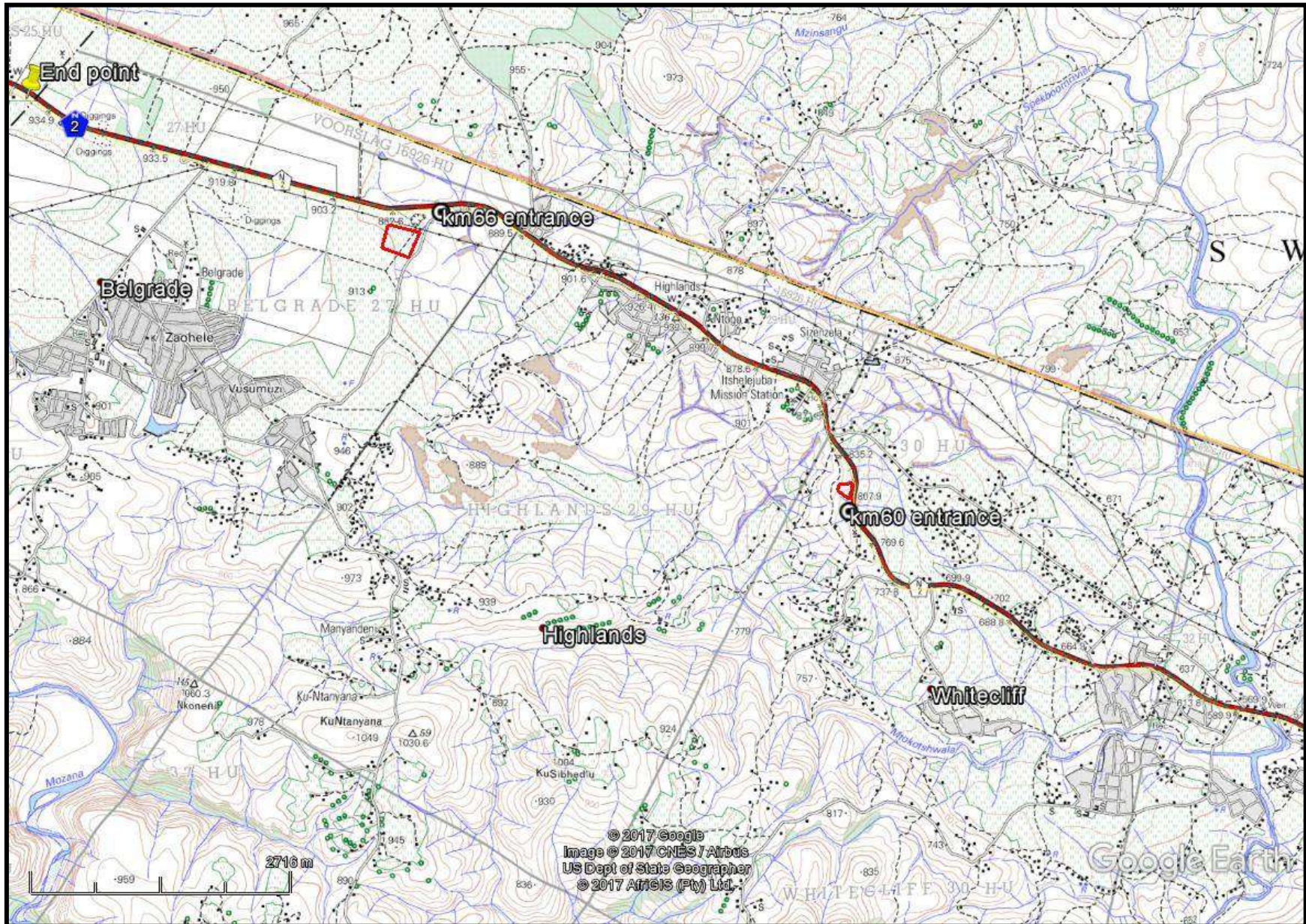




FIG. 3B: AERIAL OVERVIEW OF THE CENTRAL AREA

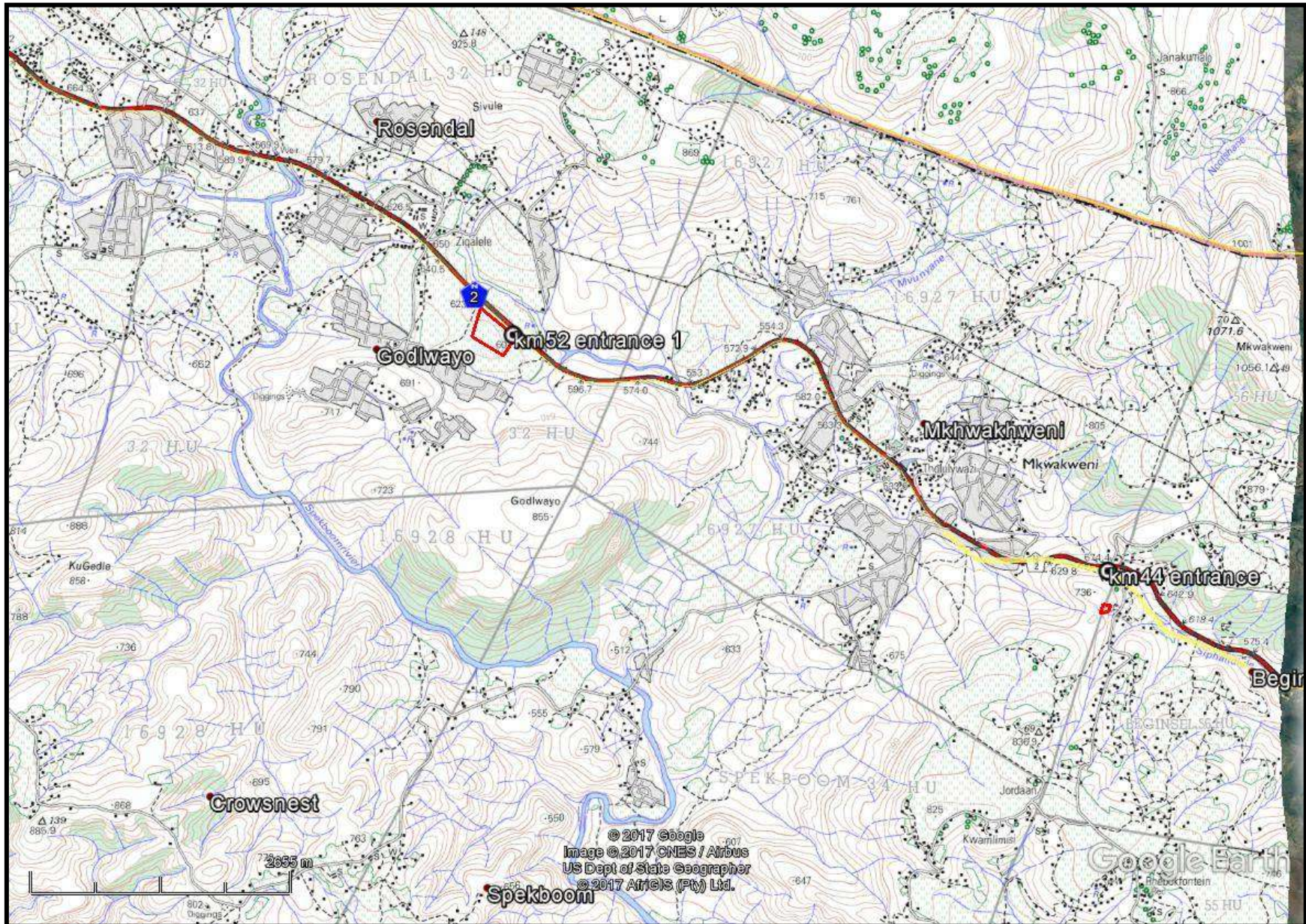
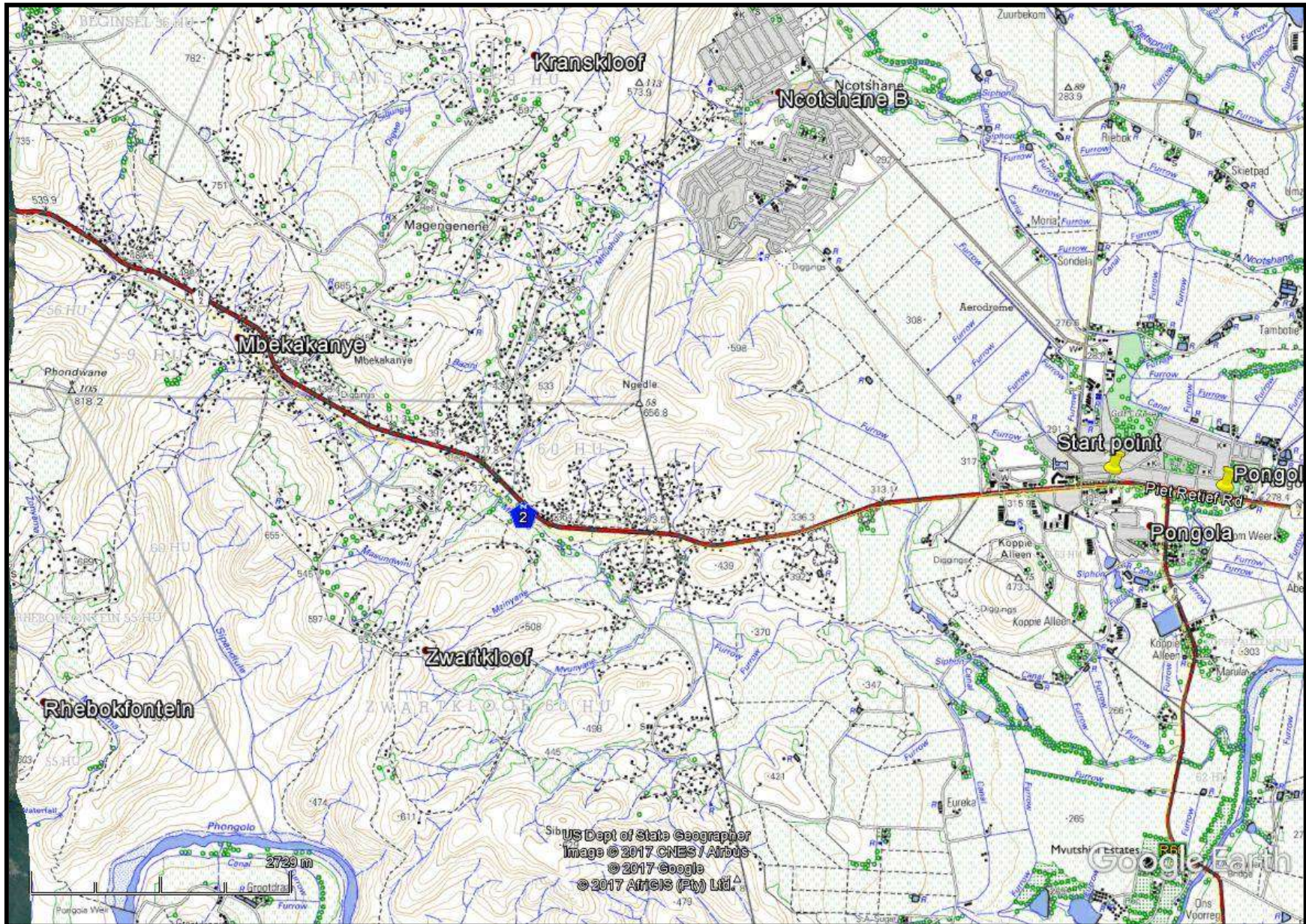


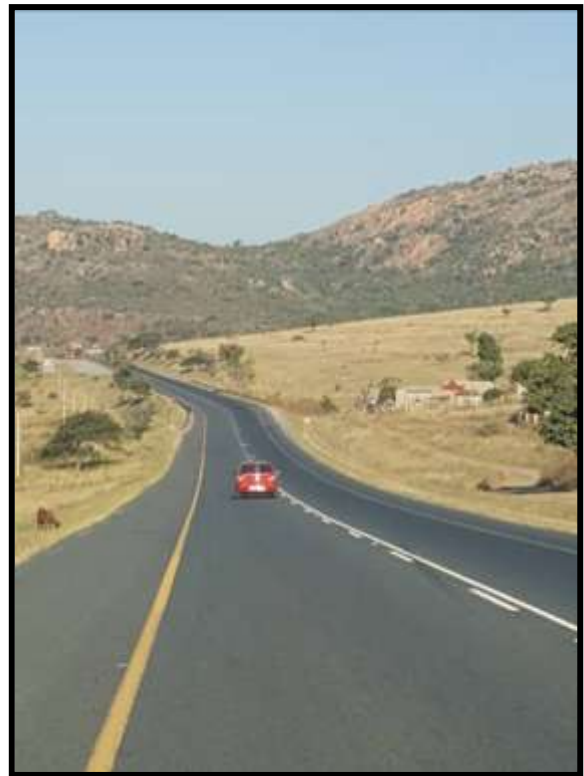
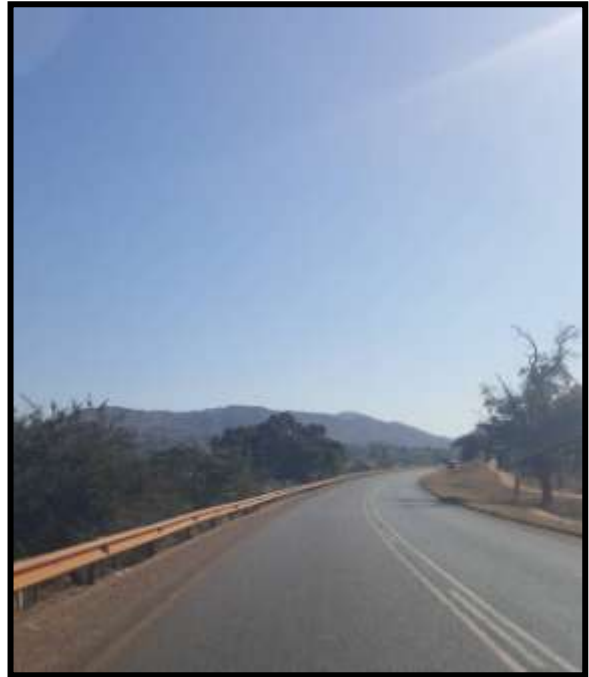


FIG. 3C: AERIAL OVERVIEW OF THE EASTERN AREA





**FIG. 4: SCENIC VIEWS OF THE PIPELINE ROUTE**



## 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.

The above significance ratings allow one to grade the site according to SAHRA's grading scale. This is summarised in Table 1.



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. 5). These sites include all types of Stone Age and Iron Age sites. No sites occur in the study area.

Only one heritage survey has been undertaken nearby the road. This was a survey for the Normandine-Pongola Transmission line. This survey noted MSA and HP sites as well as 20<sup>th</sup> century graves along the route. For example, site 2731AD 006 is a MSA and HP site besides the N2. Site 2731AD 003 is an area

of 20<sup>th</sup> century graves near borrow pit km 60.3. Any sites besides near the road would have been further damaged by the previous N2 upgrade.

No national monuments or battlefields, are known to occur in the study area. The Pongola cemetery occurs 70m south of the N2.

The 1968 1:50 000 topographical map and the 1942 map indicate that there are several built structures near the N2. These are shops, farmhouses, stock pens, a church.

More importantly, the 1968 map indicates that there are four settlements in the one borrow pit: km 52.0 (fig. 6B). The more recent Google Earth imagery suggests that this area has been ploughed and any possible graves might have been affected.



FIG. 5: LOCATION OF KNOWN HERITAGE SITES NEAR THE STUDY AREA

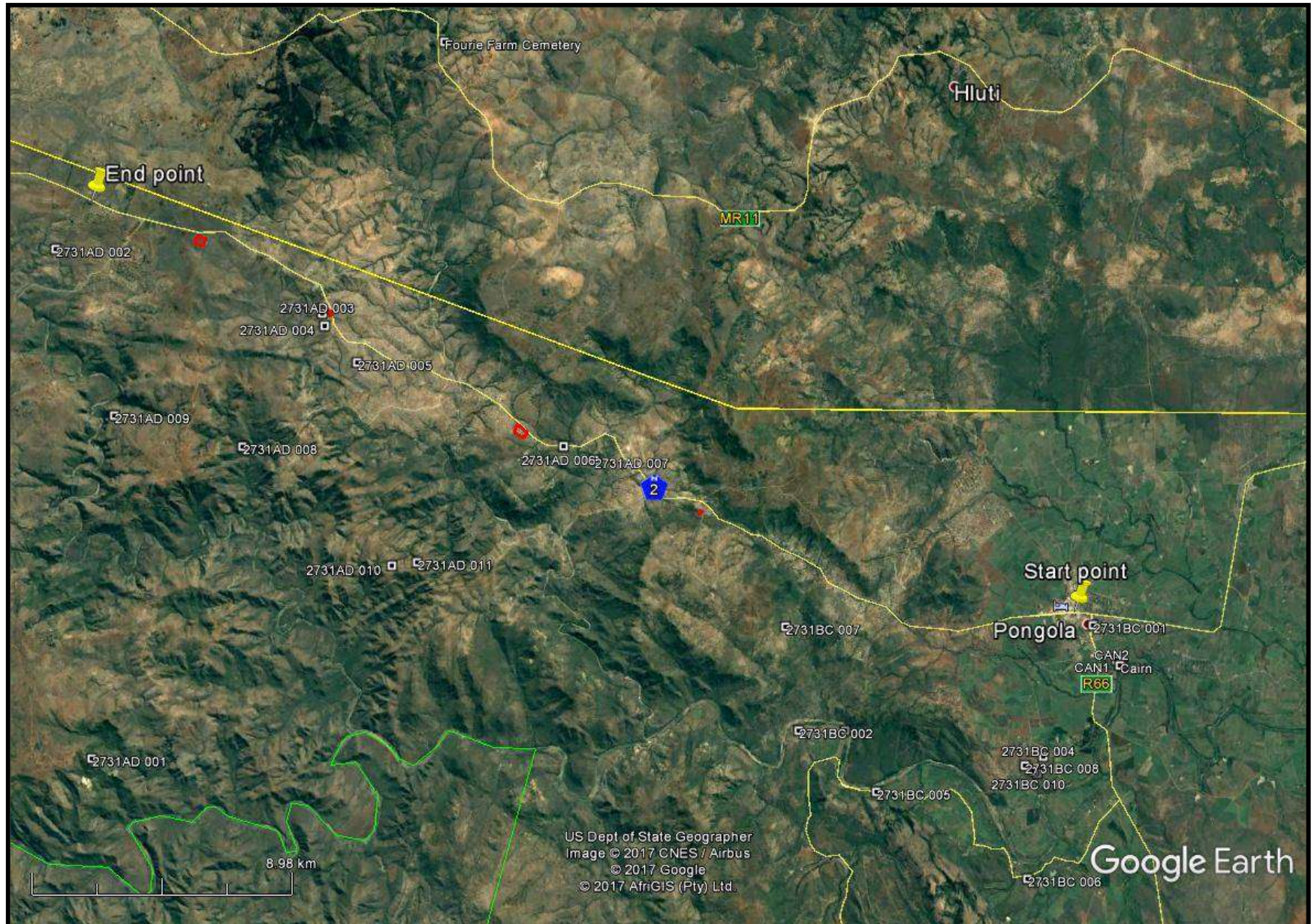




FIG. 6A: WESTERN PART OF THE ROUTE IN 1968

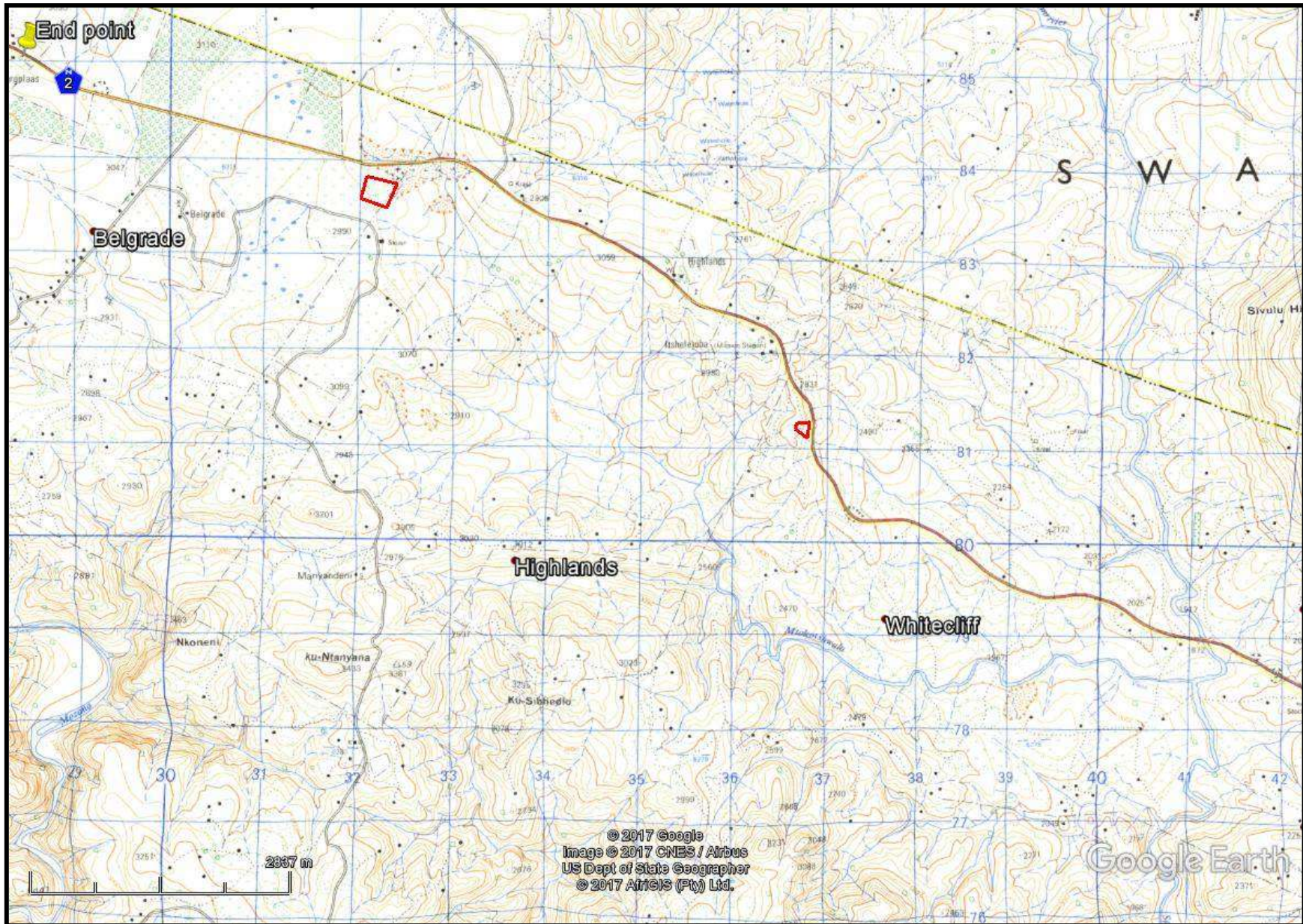




FIG. 6B: CENTRAL PART OF THE ROUTE IN 1968

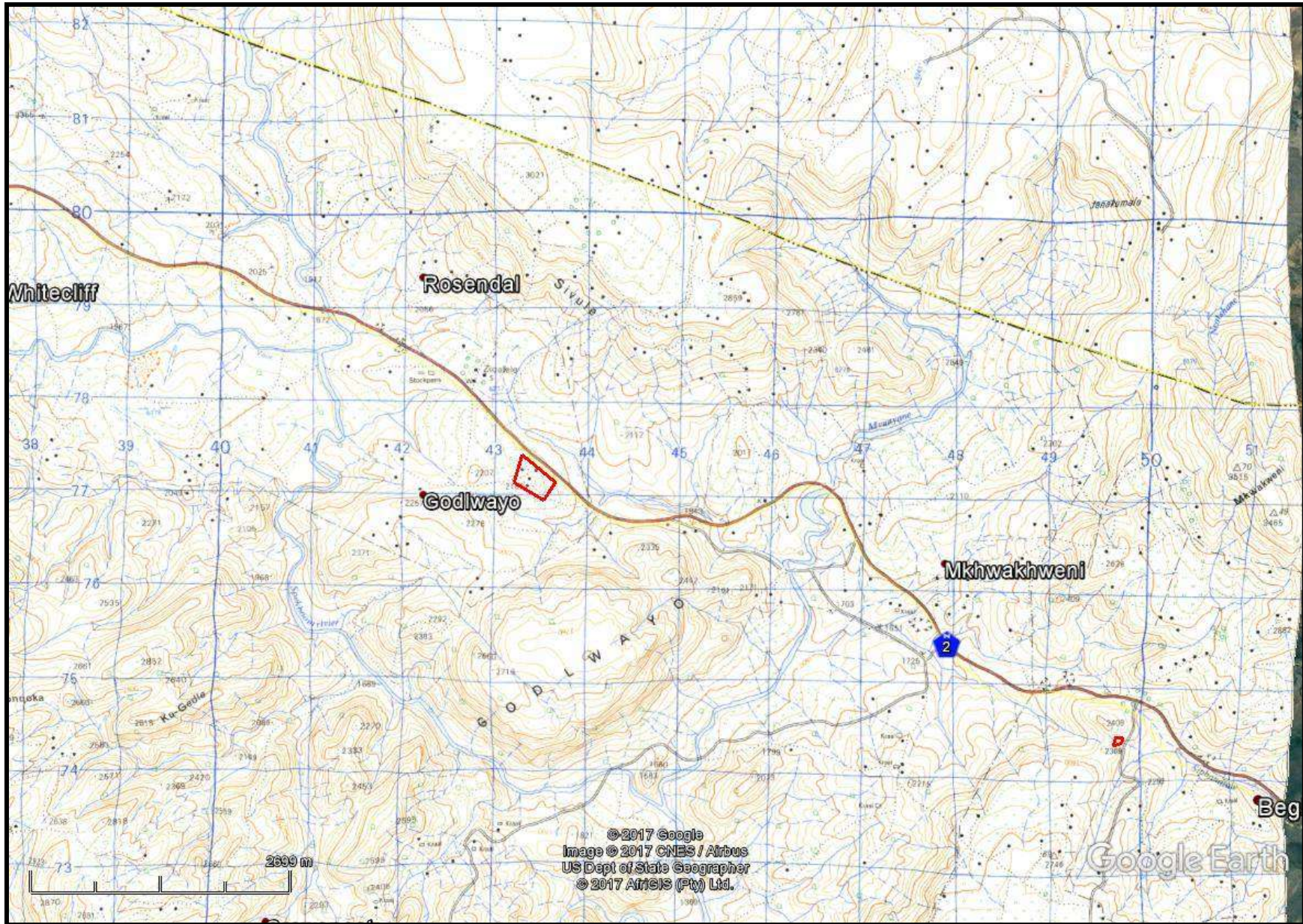
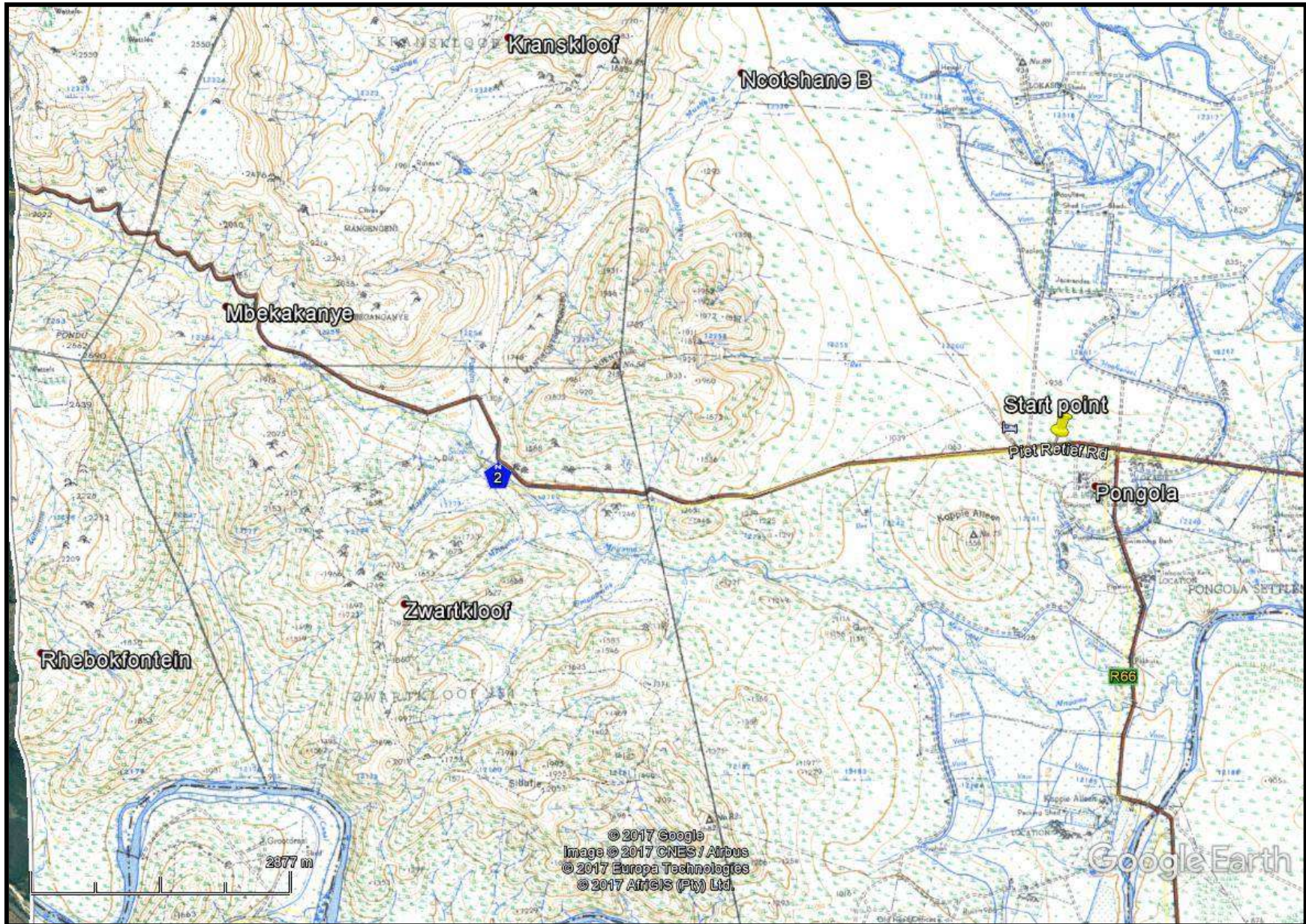




FIG. 6C: EASTERN PART OF THE ROUTE IN 1947





## **FIELD SURVEY**

The route was surveyed for heritage sites, however, the N2 has been repeatedly upgraded over the years resulting in heavy disturbance along the road reserve and several meters beyond that. 2731AD 006 no longer exists. I am aware of a human grave that was exposed during the last N2 upgrade as we were requested to quote for its removal.

The entire route was driven with the emphasis on adding an extra lane and road reserve on each side of the existing N2. We did not note any graves that could occur in existing houses if they are to be affected. The entire route footprint is now clear of any heritage sites. However, the locations of the pedestrian bridges still need to be determined. This can be assessed at a desktop level later on.

The more important aspect of the road upgrade is the four borrow pits. These tend to occur in areas where humans have and do live.

### **Borrow Pit at 44km mark**

This borrow pit is located ~400m from the N2 and is part of an existing borrow pit that will be extended (fig. 7). The area was densely vegetated but no human settlements were observed in the footprint.

No further mitigation is required.

FIG. 7: BORROW PIT 44KM





## **Borrow Pit at 52km mark**

This borrow pit occurs next to the N2 and extends up the hill (fig. 8). The 1967 map indicated that there were four settlements. Since this is in a rural landscape there should be human graves associated with each of the houses.

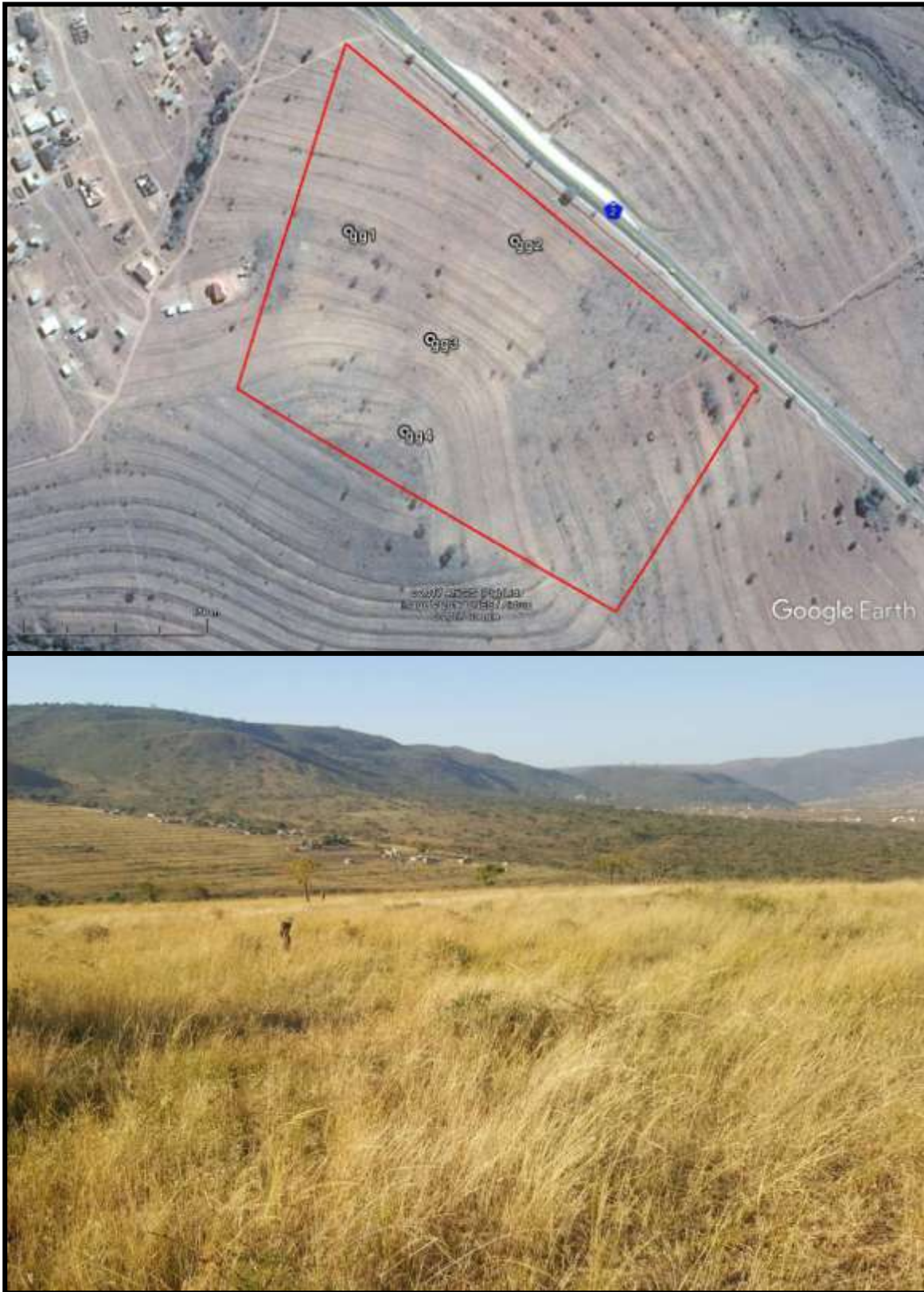
Visibility in the area was mostly good. The land has been systematically ploughed over the decades and it appears as if the houses' footprints have also been ploughed. The only remains of the houses are the Syringa trees (fig. 9). No graves, or grave markers were noted near these trees. No artefacts were observed in the area of the houses, although this would be a result of ploughing activity.

### Mitigation:

The houses do not need to be mitigated. However some form of community consultation should occur to attempt to find out where, or if, the people from these houses were buried nearby, or in a communal cemetery. If this information is not available, then we must assume that there are unmarked graves in the proposed borrow pit footprint. I suggest that a new borrow pit is located, or the borrow pit is moved southeast so that it misses the houses and potential graves. I should note that the southern side of the hill appeared to have had houses as well.

If the borrow pit is not moved there is a strong likelihood that human remains would be uncovered. If this happens, the borrow pit, or parts thereof, would be closed down while the area is investigated. This will then result in further delays to the road upgrade.

FIG. 8: BORROW PIT KM 52





**FIG. 9: SYRINGA AND AMARULA TREES INDICATING HOUSE LCOATIONS**



## BORROW PIT AT 60KM MARK

This borrow pit occurs near the N2. No modern or older houses were observed (fig. 10). There are some graves at the top of the hill, on the west of the gravel road. These will not be affected by the proposed borrow pit.

**FIG. 10: BORROW PIT 60KM**





### **BORROW PIT AT 66KM MARK**

This is the largest borrow pit and is just north of an existing borrow pit. It is situated between two transmission lines (fig. 11). The area has been systematically ploughed over the decades. There has been some earthmoving activity in a few areas. No house remains or other archaeological material was noted at this proposed borrow pit.

**FIG. 11: BORROW PIT 66KM**



## **PALAEONTOLOGICAL IMPACT ASSESSMENT**

A few sections of the proposed road upgrade are in areas of very high and moderate palaeontological sensitivity. These are near the start and end of the route (fig. 12). The full PIA desktop report is in Appendix A report.

No significant fossils are expected before deep excavation (>1.5m) are done, but if fossils are recorded during excavations into the Dwyka Group rocks, it will contribute significantly to our knowledge of the Palaeontological Heritage of the Eastern Cape Province.

It is recommended that:

The EAP and ECO must be informed of the fact that a Medium Palaeontological Sensitivity is allocated to the study sites bb3 and kr1. A Phase 1 PIA document is only applicable if significant exposures (>1.5m) of Dwyka Group sediments are foreseen.

A suitably qualified Palaeontologist must be appointed to visit the sites of borrow pits bb3 and kr1 during the first week of excavation to produce a “Chance Find Protocol” for these two sites.

No further mitigation for Palaeontological Heritage is needed for the rest of the proposed sites in this study as they fall on granitic terrains. The ECO must however be vigilant and report any unexpected exposure of deep (>1.5m) red sediments of the Masotcheni Formation (overburden) during initial excavations at these sites.

If significant fossils are exposed in borrow pits bb3 and kr1, a “Chance Find Protocol” must be compiled and included in the EMPr of the separate Projects.



FIG. 12: PALAEOANTHROPOLOGICAL SENSITIVITY



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.

### MANAGEMENT PLAN

The road upgrade and current borrow pits mostly avoid heritage sites. The borrow Pit at the 52km mark does however affect an area that had four houses, or settlements, in the 1960s, if not into the 1970s. There is a strong possibility that there are human graves in this area. Even though the land has been ploughed, the graves cairns may have sunk beneath the surface.

Any excavations in the palaeontological sensitive areas below 1.5m would require a palaeontologist on site for further mitigation.

## **CONCLUSION**

An HIA was undertaken for the proposed N2 upgrade between Pongola and the Mpumalanga border. The upgrade includes widening the road to a double carriageway, pedestrian bridges and taxi parking areas. Four borrow pits were also noted.

Most of the N2 footprint has already been disturbed by previous road upgrades. Three of the borrow pits are extensions of existing borrow pits and have been cleared from a heritage point of view. One borrow pit had four households within the proposed borrow pit. These households probably had human graves. I suggested some form of social consultation to determine if there is a possibility of a community cemetery. Otherwise, it would be better to move the proposed borrow pit southwards so as not to disturb potential graves in mid construction, that in turn would result in a stoppage of all work at the borrow pit.

## **REFERENCES**

2731AB\_AD Mkwakweni 1:50 000 topographical map 1968, 2002

2731bc Pongola 1:50 000 topographical map 1947, 2002

Natal Museum Site Record Database



## **EXPERIENCE OF THE HERITAGE CONSULTANT**

Gavin Anderson has a M. Phil (in archaeology and social psychology) degree from the University of Cape Town. Gavin has been working as a professional archaeologist and heritage impact assessor since 1995. He joined the Association of Professional Archaeologists of Southern Africa in 1998 when it was formed. Gavin is rated as a Principle Investigator with expertise status in Rock Art, Stone Age and Iron Age studies. In addition to this, he was worked on both West and East Coast shell middens, Anglo-Boer War sites, and Historical Period sites.

## **DECLARATION OF INDEPENDENCE**

I, Gavin Anderson, 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 heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

A handwritten signature in black ink, appearing to read 'Anderson', with a horizontal line underneath.

Gavin Anderson  
Archaeologist/Heritage Impact Assessor

**APPENDIX A**  
**PIA DESKTOP REPORT**



**DESKTOP PALAEOLOGICAL  
ASSESSMENT FOR THE PROPOSED  
UPGRADING OF THE N2 HIGHWAY  
ASSOCIATED BORROW PIT  
DEVELOPMENTS IN THE MKHONDO  
LOCAL MUNICIPALITY, GERT SIBANDE  
DISTRICT MUNICIPALITY, MPUMALANGA  
PROVINCE AS WELL AS THE UPHONGOLO  
LOCAL MUNICIPALITY, ZULULAND  
DISTRICT MUNICIPALITY, KWAZULU-  
NATAL PROVINCE.**

**FOR  
Umlando**

**DATE: 18 June 2017**

**By**

**Gideon Groenewald  
Cell: 078 713 6377**





## EXECUTIVE SUMMARY

Gideon Groenewald was appointed by Umlando to undertake a Desktop Survey, assessing the Potential Palaeontological Impact related to upgrading of the N2 Highway associated Borrow Pit Developments in the Mkhondo Local Municipality, Gert Sibande District Municipality, Mpumalanga Province as well as the Uphongolo Local Municipality, Zululand District Municipality, Kwazulu-Natal Province.

### 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 as well as the KwaZulu-Natal Heritage Act No 4 of 2008. In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

The development site for the proposed upgrading of the N2 Highway associated Borrow Pit Developments in the Mkhondo Local Municipality, Gert Sibande District Municipality, Mpumalanga Province as well as the Uphongolo Local Municipality, Zululand District Municipality, Kwazulu-Natal Province is underlain by Randian to Vaalian aged granites and Carboniferous to Permian aged tillites.

The Granites will not contain any fossils.

No significant fossils are expected before deep excavation (>1.5m) are done, but if fossils are recorded during excavations into the Dwyka Group rocks, it will contribute significantly to our knowledge of the Palaeontological Heritage of the Eastern Cape Province.

It is recommended that:

The EAP and ECO must be informed of the fact that a Medium Palaeontological Sensitivity is allocated to the study sites bb3 and kr1. A Phase 1 PIA document is only applicable if significant exposures (>1.5m) of Dwyka Group sediments are foreseen.

A suitably qualified Palaeontologist must be appointed to visit the sites of borrow pits bb3 and kr1 during the first week of excavation to produce a "Chance Find Protocol" for these two sites.

No further mitigation for Palaeontological Heritage is needed for the rest of the proposed sites in this study as they fall on granitic terrains. The ECO

must however be vigilant and report any unexpected exposure of deep (>1.5m) red sediments of the Masotcheni Formation (overburden) during initial excavations at these sites.

If significant fossils are exposed in borrow pits bb3 and kr1, a “Chance Find Protocol” must be compiled and included in the EMPr of the separate Projects.



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## INTRODUCTION

Gideon Groenewald was appointed by Umlando to undertake a Desktop Survey, assessing the Potential Palaeontological Impact related to upgrading of the N2 Highway associated Borrow Pit Developments in the Mkhondo Local Municipality, Gert Sibande District Municipality, Mpumalanga Province as well as the Uphongolo Local Municipality, Zululand District Municipality, Kwazulu-Natal Province.

### 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 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 Desktop 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 is made using appropriate 1:250 000 geological maps (2730 Vryheid) 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

<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) and 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

	<p>professional palaeontologist, desktop survey and phase I PIA (ground proofing of desktop survey) compulsory.</p>
<p><b>BLUE</b></p>	<p>Low Palaeontological sensitivity/vulnerability. Low possibility that fossils that are described in the literature will be visible to the naked eye or be recognized as fossils by untrained persons. Fossils of for example small domal Stromatolites as well as micro-bacteria are associated with these rock units. Fossils of micro-bacteria are extremely important for our understanding of the development of Life, but are only visible under large magnification. Recording of the fossils will contribute significantly to the present knowledge and understanding of the development of Life in the region. Where geological units are allocated a blue colour of significance, and the geological unit is surrounded by highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a blue colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in dolerite sill outcrops. Collection of a representative sample of potential fossiliferous material recommended. At least a Desktop Survey and “Chance Find Protocol” is compulsory. The Chance Find Protocol must be included in the EMPr for the project.</p>



<b>GREY</b>	<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 a Desktop Survey and “Chance Find Protocol” document is compulsory. The Chance Find Protocol must be included in the EMPr of the project.</p>
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When rock units of moderate to high palaeontological sensitivity are present within the development footprint, palaeontological mitigation measures must be incorporated into the Environmental Management Plan. All projects falling on Low to Very Low Palaeontological sensitivity geology must be discussed in either a Phase 1 PIA or Chance Find Protocol (CFP) document that must form part of the EMPr of the project.

## **Scope and Limitations of the Desktop Study**

The study will include: i) an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units; ii) a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports; iii) data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged) and iv) where feasible, location and examination of any fossil collections from the study area (e.g. museums).

The key assumption for this scoping 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. There is also an inadequate database for fossil heritage for much of the RSA, due to the small number of professional palaeontologists carrying out fieldwork in RSA and the Kingdom of Lesotho. Most development study areas have never been surveyed by a palaeontologist.

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.).

## **Locality and Proposed Development**

The N2 Highway associated Borrow Pit Developments in the Mkhondo Local Municipality, Gert Sibande District Municipality, Mpumalanga Province as well as the Uphongolo Local Municipality, Zululand District Municipality, Kwazulu-Natal Province are situated along the N2 Highway and are numbered borrow km44, burrow km52 (gg1 to gg4), borrow km60.3 (bb2&kr1) and borrow km66 (bb3) (Figure 1).

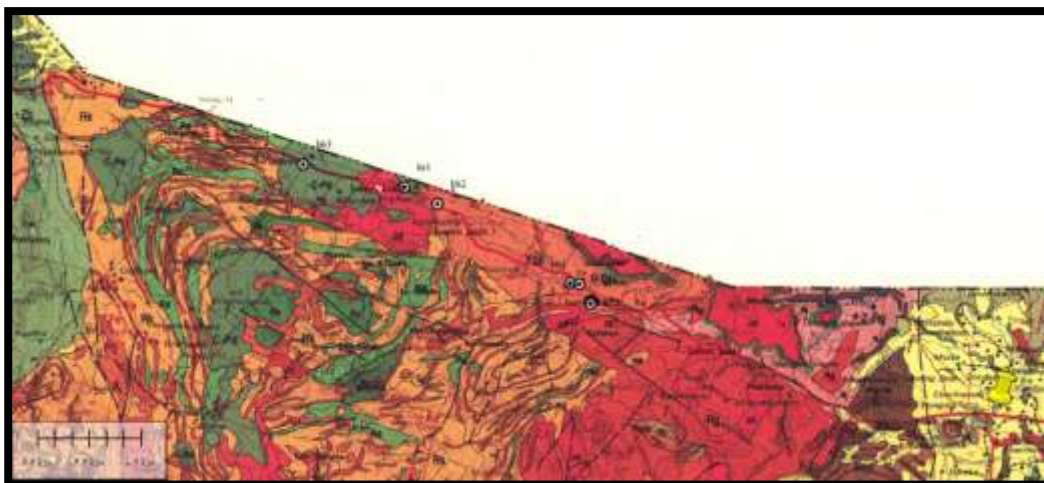


**Figure 1 Borrow Pits associated with the upgrading of the N2 Highway close to Uphongolo**

The project aims to lead to an upgrade of the N2 Highway and material from the borrow pits will be used for the filling material for road building.

## **GEOLOGY**

The study area is underlain predominantly by Randian to Vaalian aged Kwetta Granites and undifferentiated granites as well as Carboniferous to Permian aged tillites of the Dwyka Group, Karoo Supergroup (Figure 2).



**Figure 2 Geology of the area underlying the proposed borrow pits**



### **Kwetta and other Granites**

The Randian to Vaalian aged granites are dominated by medium grained and porphyritic biotite-granite.

### **Karoo Supergroup**

#### **Dwyka Group**

The Carboniferous to Permian aged Dwyka Group consist of an assemblage of fine-grained to very agglomeritic tillite and sediments, consisting mainly of dark grey shale and subordinate sandstone layers with cobble stones. The deposits represent predominantly Carboniferous to Permian aged glacial and shallow 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 formation becomes more shale rich and is indicative of a southward migration of a glacial system into the predominantly marine environments that existed during the Permian in this part of the Karoo Basin (Johnson et al, 2009).

### **PALAEONTOLOGY**

#### **Kwetta and other Granites**

The Randian to Vaalian aged granites are igneous rocks and will not contain fossils. The ECO of the project must however be vigilant and record any Quaternary cover material that might be present as overburden. Any fossils recorded in the overburden of the proposed borrow pits will be highly significant.

#### **Karoo Supergroup**

##### **Dwyka Group**

The borrow pits no bb2 and bb3 falls on Dwyka Group sediments and it is possible that exposure of these rocks can lead to the discovery of significant fossils.

Trace fossils have been recorded from the fine-grained shales of the Dwyka Group in KwaZulu-Natal (Linstrom, 1987; MacRae, 1999). All of the following could potentially be found in KwaZulu-Natal. Trackways, produced mostly by fish and arthropods (invertebrates), have been recovered in shales from the

uppermost Dwyka Group. Other trace fossils include coprolites (fossilized faeces) of chondrichthyans (sharks, skates and rays).

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

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

### **PALAEONTOLOGICAL IMPACT AND MITIGATION**

The predicted palaeontological impact of the borrow development is based on the initial mapping assessment and literature reviews as well as information gathered during the desktop investigation. The desktop investigation confirms that the study area is underlain by Randian to Vallian aged granites as well as fine-grained dark coloured to dark grey shale, sandstone beds and tillite of the Dwyka Group of the Karoo Supergroup which normally leads to the formation of either light coloured Avalon Form, or dark Vertic Arcadia Form soils or sand cover.

The borrow pits numbered km44, gg1 to gg4, bb1 and bb2 will not contain significant fossils and the ECO must only be vigilant and record any surface cover that might be present on site as part of the remnants of a geological formation known as the Masotcheni Formation as this units might not be mapped on the 1:250 000 scale geological maps used for the desktop survey. If this formation is present, fossils can be present.



**Figure 3 Palaeontological Sensitivity of the different borrow pit sites. For colour coding see Table 1.**

Burrow pits numbered bb3 and kr1 falls in the Dwyka Group of the Karoo Supergroup and it is likely that significant fossils can be present (Figure 3). The two borrow pits must be inspected and if any trace fossils are present, a suitably qualified Palaeontologist must inspect the sites within one week of the start of excavations to record the fossils and collect a representative sample of at least 1m<sup>3</sup> of rock for study purposes.

## CONCLUSION

The development site for the proposed upgrading of the N2 Highway associated Borrow Pit Developments in the Mkhondo Local Municipality, Gert Sibande District Municipality, Mpumalanga Province as well as the Uphongolo Local Municipality, Zululand District Municipality, Kwazulu-Natal Province is underlain by Randian to Vaalian aged granites and Carboniferous to Permian aged tillites.

The Granites will not contain any fossils.

No significant fossils are expected before deep excavation (>1.5m) are done, but if fossils are recorded during excavations into the Dwyka Group rocks, it will contribute significantly to our knowledge of the Palaeontological Heritage of the Eastern Cape Province.

It is recommended that:

The EAP and ECO must be informed of the fact that a Medium Palaeontological Sensitivity is allocated to the study sites bb3 and kr1. A Phase 1 PIA document is only applicable if significant exposures (>1.5m) of Dwyka Group sediments are foreseen.



A suitably qualified Palaeontologist must be appointed to visit the sites of borrow pits bb3 and kr1 during the first week of excavation to produce a “Chance Find Protocol” for these two sites.

No further mitigation for Palaeontological Heritage is needed for the rest of the proposed sites in this study as they fall on granitic terrains. The ECO must however be vigilant and report any unexpected exposure of deep (>1.5m) red sediments of the Masotcheni Formation (overburden) during initial excavations at these sites.

If significant fossils are exposed in borrow pits bb3 and kr1, a “Chance Find Protocol” must be compiled and included in the EMPr of the separate Projects.

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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