

**HERITAGE SURVEY FOR THE MANTULI ROAD  
UPGRADE**

**FOR AFZELIA ENVIRONMENTAL CONSULTING**

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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**

Umlando was appointed by Afzelia Environmental Consulting to undertake a heritage survey of the proposed Mantuli Road upgrade, Nqutu Municipality, Ward 8, Reserve 18 7636, KwaZulu-Natal.

The proposed road is 6.6km long and situated in the Nqutu district. The first part of the proposed new road alignment follows an existing track from the D1301 to the proposed causeway. From the proposed causeway/river-crossing the alignments will transverse though open cultivated land until it reaches the L1970. The last portion of the proposed Mantuli road consists of the upgrading of about 1.0 km of the existing L1970.

## **TERMS OF REFERENCE**

The terms of reference for the project were to:

- Undertake a heritage survey of the proposed road form the given kml file
- Undertake a desktop PIA

Figures 1 – 3 indicate the location of the road.

On arrival to undertake the HIA survey, I noted that the road upgrade had already started and that the given route had a new deviation. Amafa KZN and Afzelia Environmental Consulting were informed of this. The roadworks had damaged some settlements and affected two graves.

FIG. 1 GENERAL LOCATION OF THE STUDY AREA

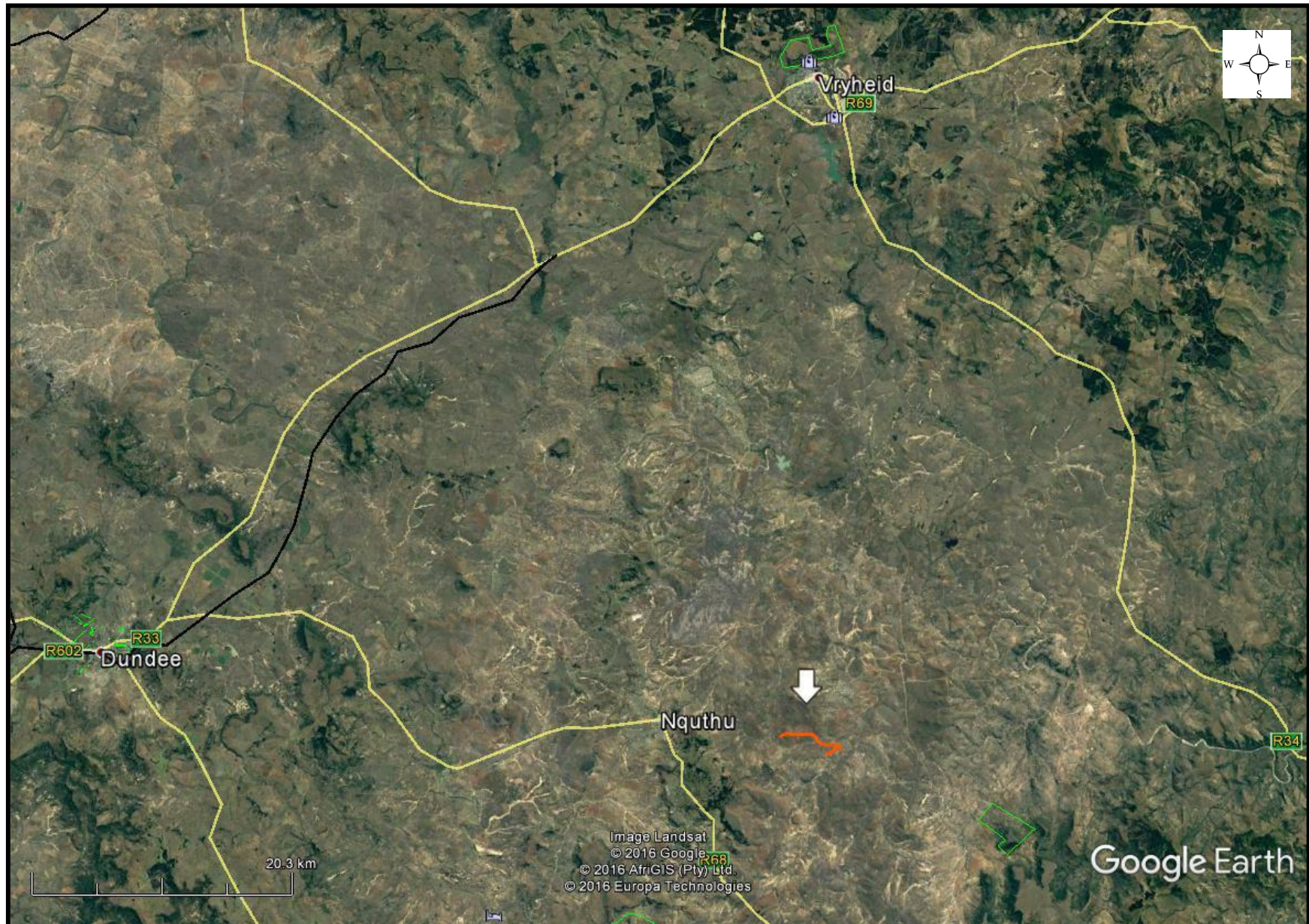


FIG. 2: AERIAL OVERVIEW OF THE STUDY AREA<sup>1</sup>



<sup>1</sup> Red line = given location; yellow line = new deviation

FIG. 3: TOPOGRAPHICAL OVERVIEW OF THE STUDY AREA

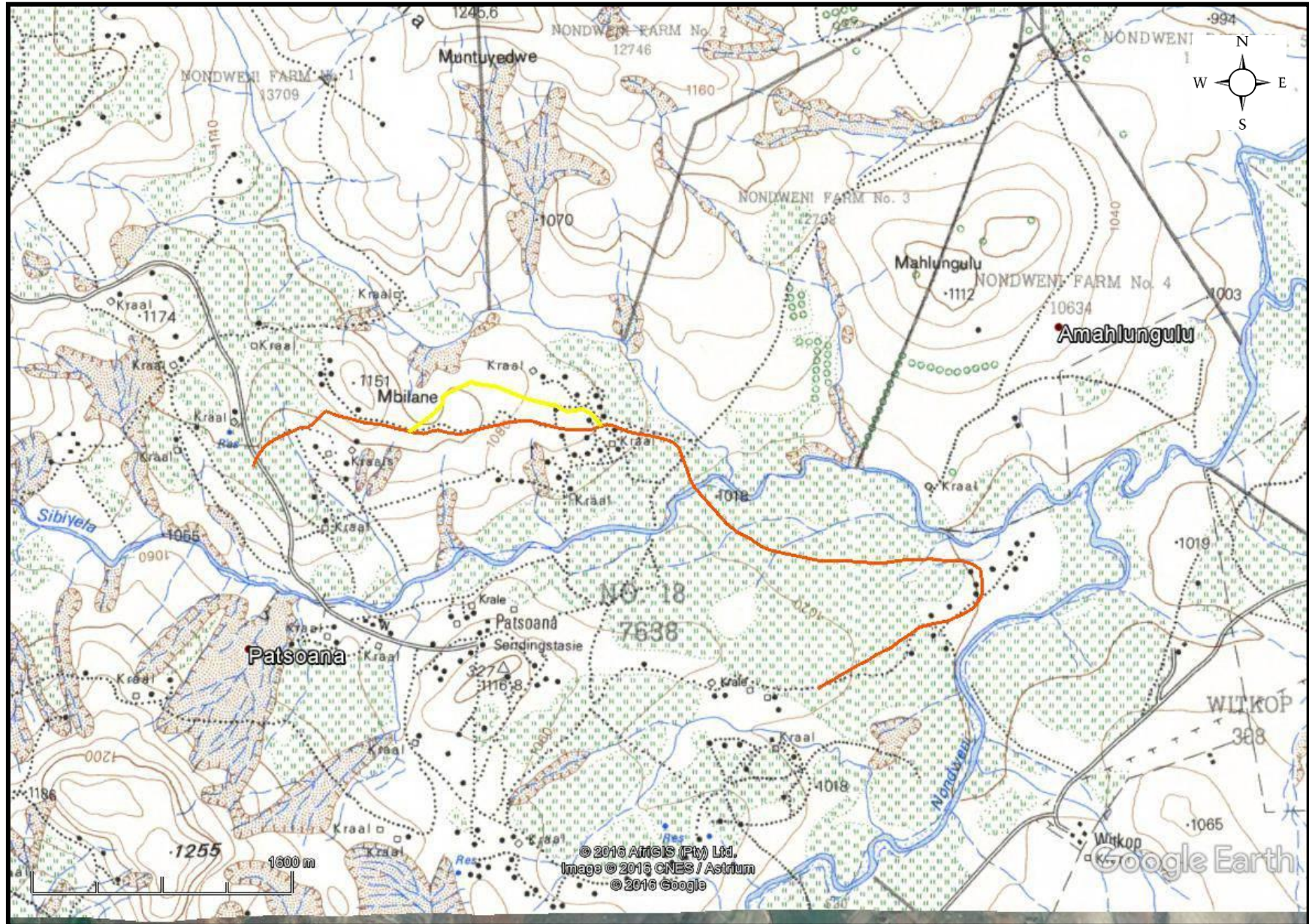


FIG. 4: SCENIC VIEWS OF THE PIPELINE ROUTE





## 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 Middle and Late Stone Age and Late Iron Age sites. Two sites occur nearby the study area: 2830BB 035 and 2830BB 036. These are sites noted by Prof. M Hall in 1979 from the 1970 orthophotos (Natal Museum Site Records). The sites are stone walled settlements.

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

The 1944 aerial photographs (fig. 6) indicate that the area is less occupied by humans and that the current agricultural fields predate 1944. Four settlements are located near the proposed road.

The 1968 1:50 000 topographical map indicates that there are several settlements near the proposed road upgrade (fig. 7). These settlements, and others, are clearly visible on the Google Earth map as well (fig. 8). The coordinates for these sites are given in Table 2. Two settlements overlap with the 1944 aerial photographs.

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

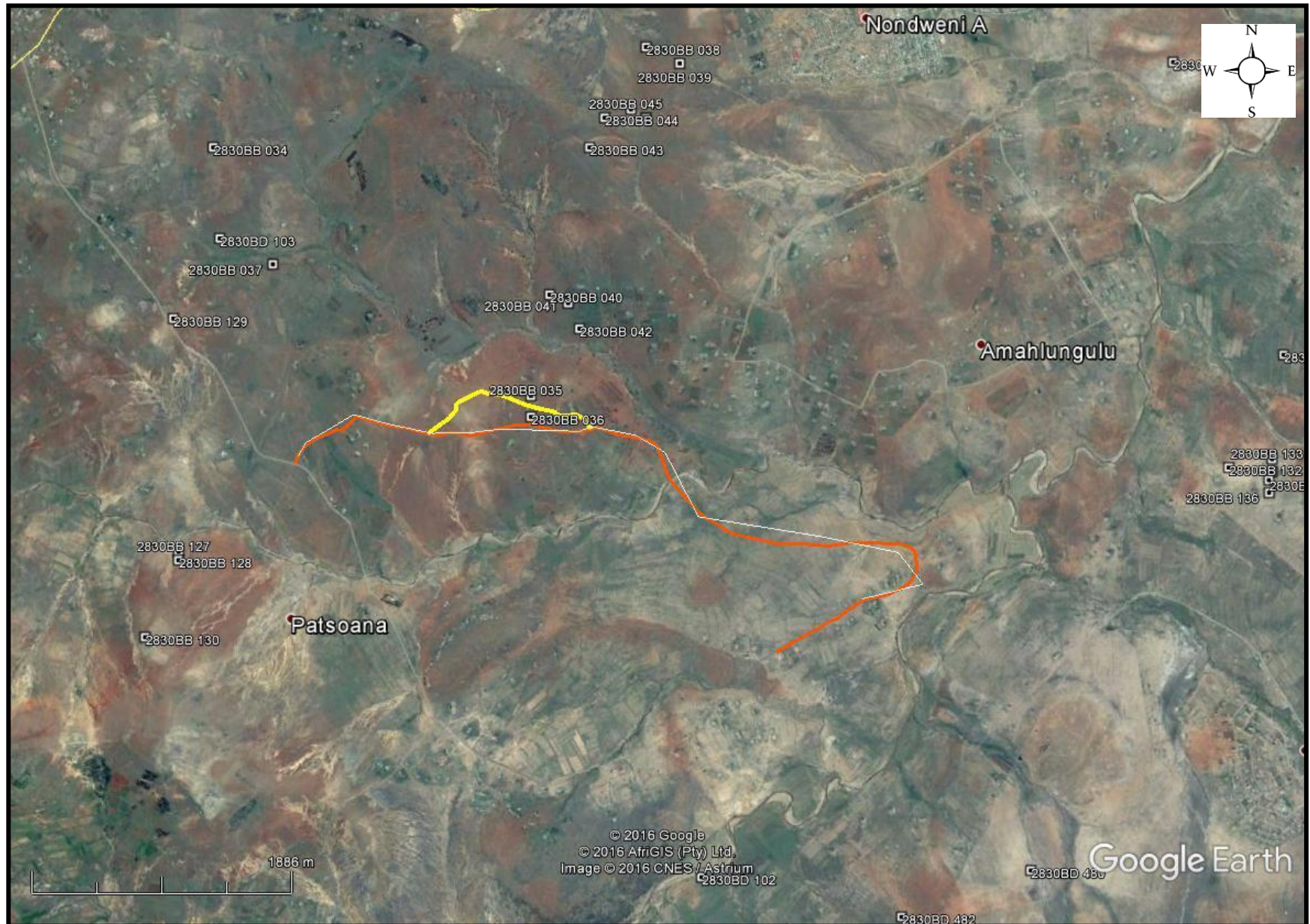




FIG. 6: STUDY AREA IN 1944

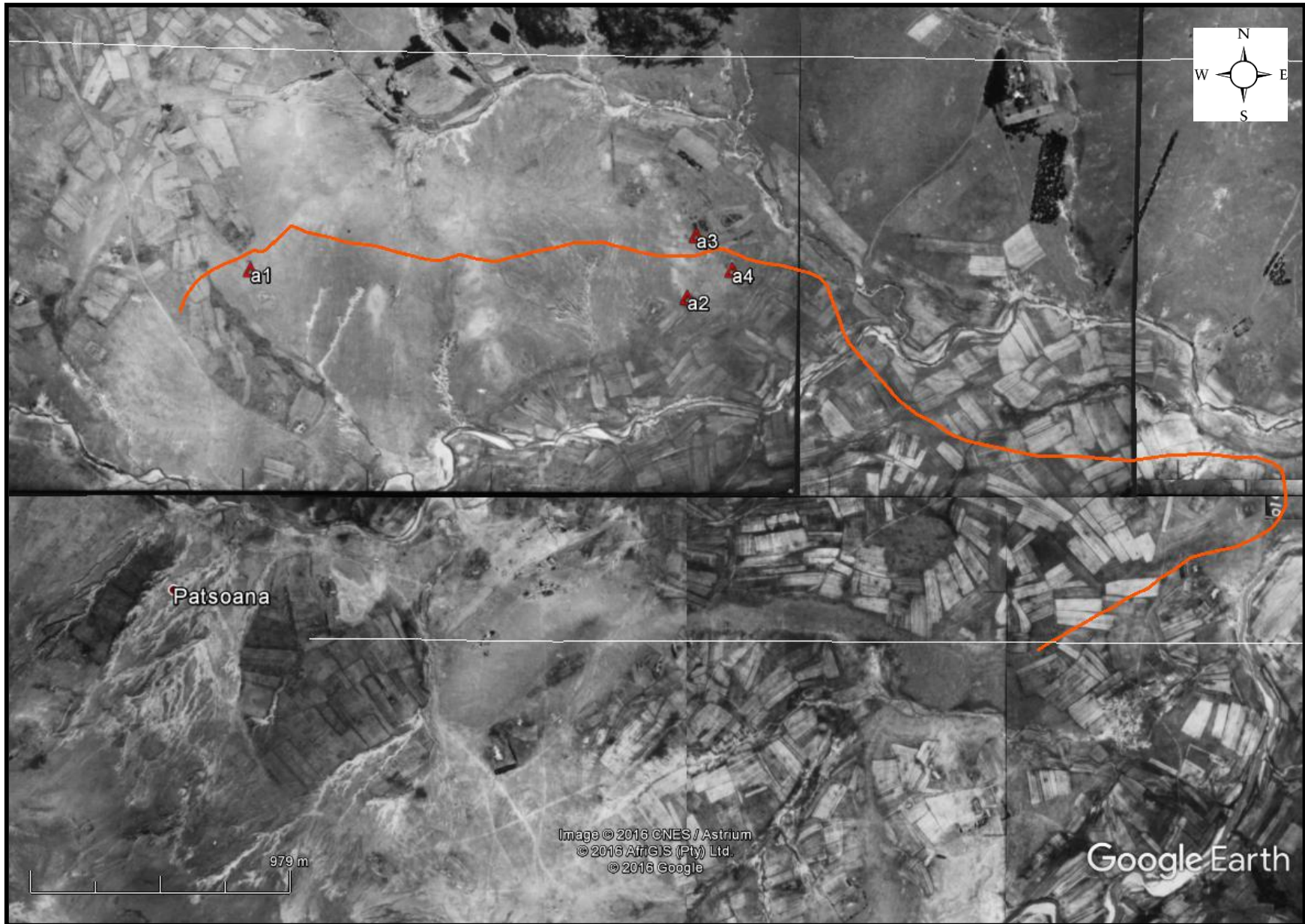


FIG. 7: STUDY AREA IN 1968

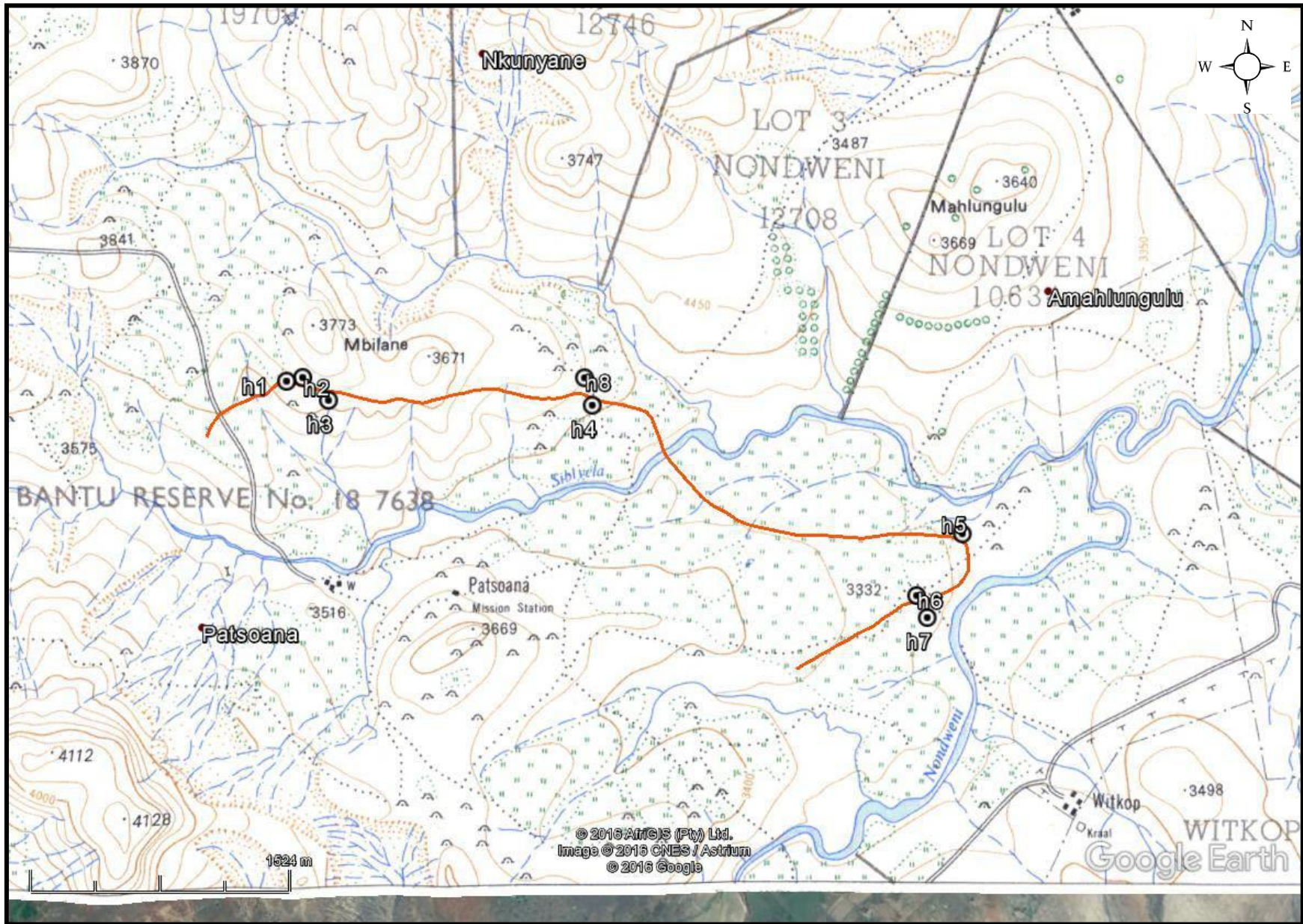
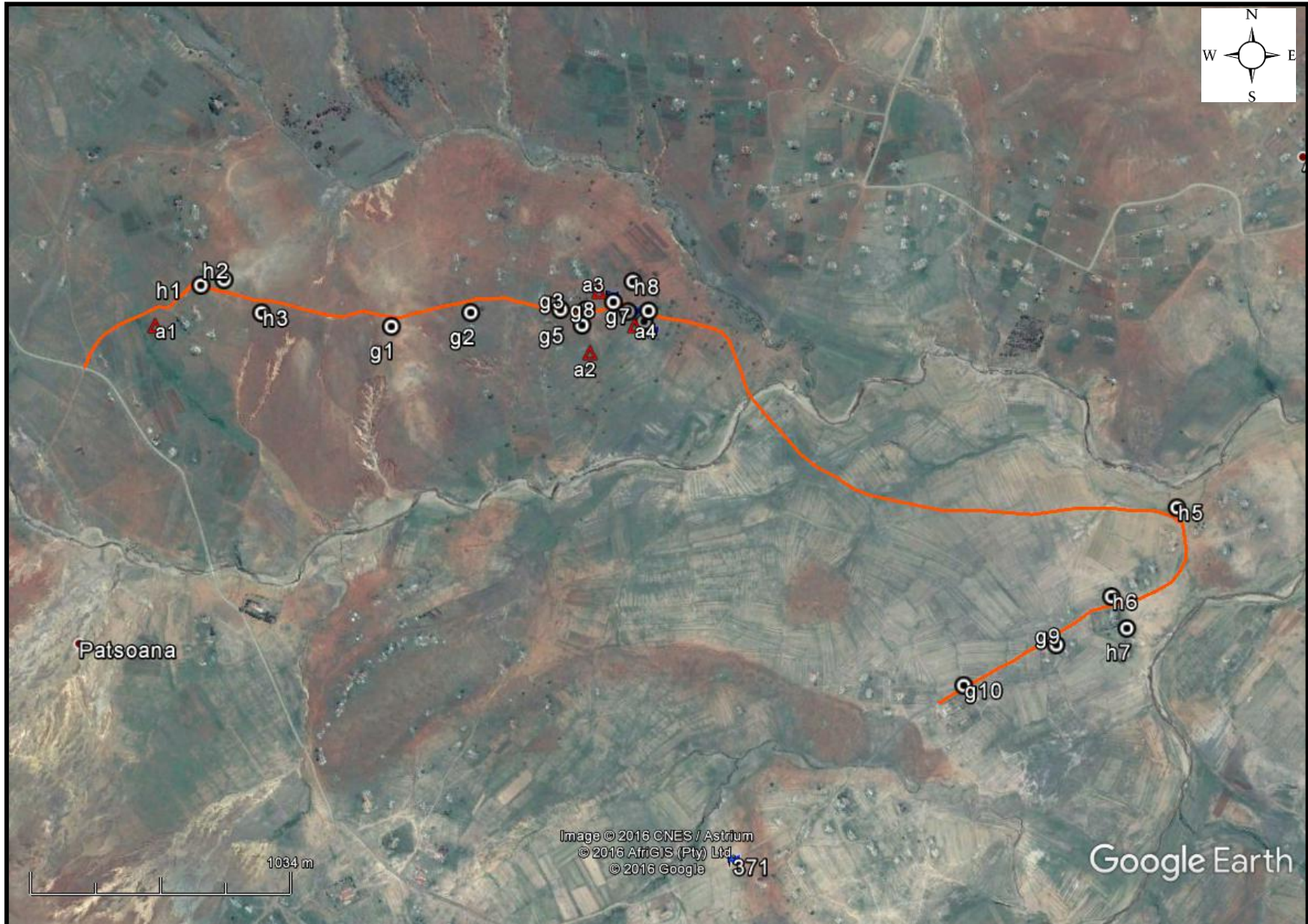


FIG. 8: LOCATION OF 20<sup>TH</sup> CENTURY SETTLEMENTS NEAR THE PROPOSED ROAD UPGRADE



**TABLE 2: LOCATION OF HERITAGE SITES NEAR THE ROAD UPGRADE**

NAME	LATITUDE	LONGITUDE	DESC
a1	-28.223801	30.772820	settlement
a2	-28.224766	30.791028	Settlement
a3	-28.222496	30.791409	Settlement
a4	-28.223754	30.792914	settlement
g1	-28.223801368	30.782789986	settlement
g10	-28.237170314	30.806952844	Settlement
g2	-28.223258194	30.786065118	Settlement
g3	-28.223138664	30.789834558	graves?
g4	-28.223135559	30.790901989	Settlement
g5	-28.223710156	30.790739221	Settlement
g6	-28.223190895	30.792675376	Settlement
g7	-28.223161012	30.793546858	Settlement
g8	-28.222845308	30.792059216	1968 settlement
g9	-28.235663512	30.810918383	Settlement
h1	-28.222307834	30.774895726	1968 settlement
h2	-28.222116436	30.775900000	1968 settlement
h3	-28.223321611	30.777420985	1968 settlement
h4	-28.223554760	30.793357673	1968 settlement
h5	-28.230514624	30.816144805	1968 settlement
h6	-28.233854456	30.813296394	1968 settlement
h7	-28.235051212	30.813959520	1968 settlement
h8	-28.222073794	30.792884258	1968 settlement
MANT367	-28.222703000	30.791964000	Settlement, cemetery, kraals
MANT368	-28.223217000	30.792939000	Grave
MANT369	-28.223303000	30.792844000	Grave
MANT370	-28.223993000	30.793634000	Grave
MANT371	-28.243728000	30.797089000	Cemetery

## PALAEONTOLOGICAL IMPACT ASSESSMENT

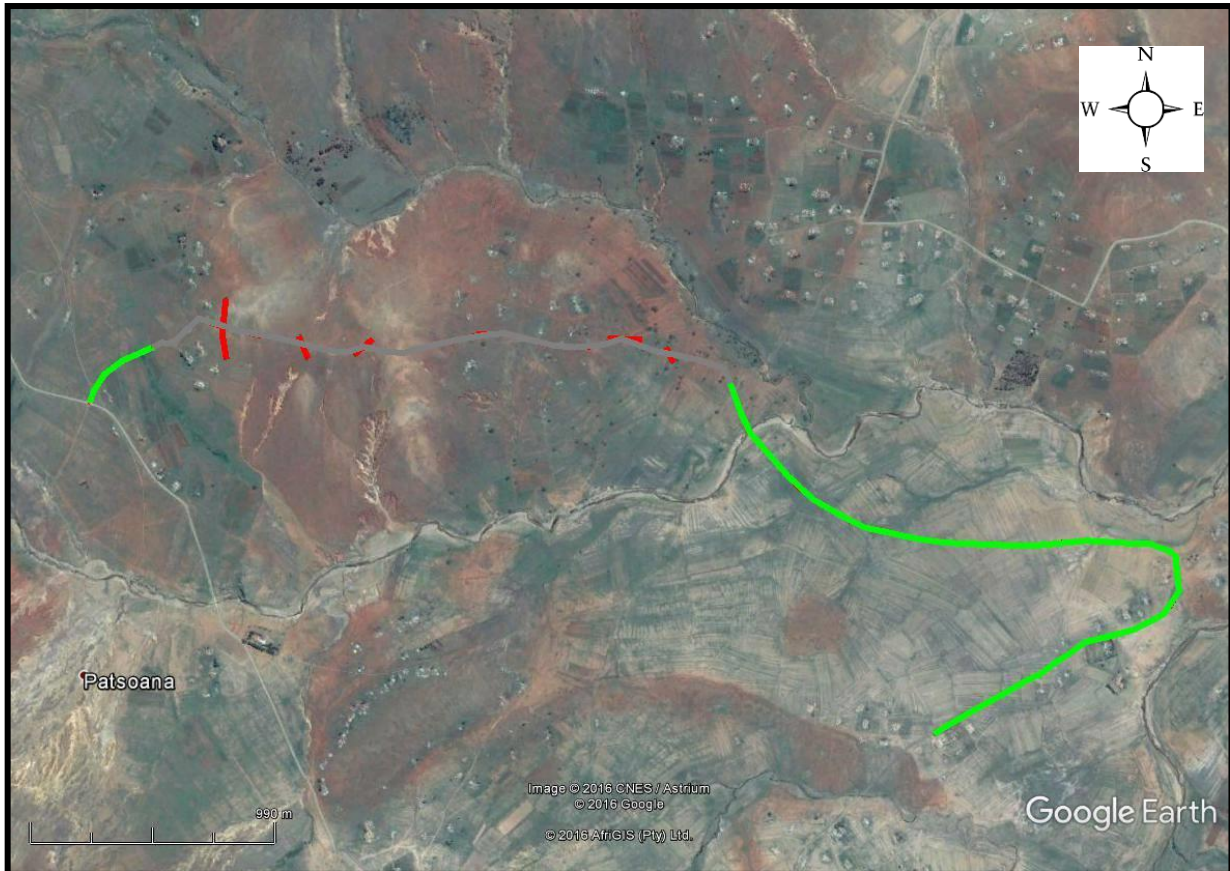
Dr. Gideon Groenewald (Appendix A) undertook the PIA desktop. The area ranges from low to very high palaeontological sensitivity (fig. 9). The excavations for the construction of the infrastructure for this development will expose some sediments of the Dwyka Group. Due to weathering, no well-preserved fossils are expected to be found before 1.5m from the surface... Exposure of bedrock during excavation might however result in the exposure of significant plant and trace fossils in the shale as well as possible invertebrate fossils in the Dwyka Group.

### Management plan:

It is unlikely that the road upgrade will remove more than 1.5m of surface deposit. However, any culverts and stormwater drains might require further

palaeontological assessments. If the proposed bridge exposes fresh bedrock, then a PIA survey will be required as well.

**FIG.9: LOCATION OF SENSITIVE PALAEOLOGICAL AREAS**



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.

## FIELD SURVEY

A field survey was undertaken on 2 December 2016. On arrival, I noticed that the road upgrade had already begun: 2.7km of earthmoving activity had already occurred (see fig. 4). In addition to this, the provided Google Earth kml file did not correspond with the existing road upgrade. The existing road upgrade was surveyed. Four clusters of settlement ruins were noted near the road. In addition to this, the top of the hill has an ephemeral scatter of MSA tools. Figure 10 shows the location of these sites and/or features.

The MSA scatter consisted of two weathered flakes on dolerite. More artefacts probably occur on the hill. These are in a secondary context and of no significance.

### MANT367

MANT367 relates to site 'h8' from the 1968 topographical. The site consists of several stone house foundations and a rectangular kraal over a 50m radius (fig. 11). There is a cemetery further down the hill. House foundations are important in that they may have human and/or stillborn burials underneath them.

The road upgrade has removed at least one of the house foundations and damaged the half of another. The settlement is of medium significance until social consultation has occurred to determine the occurrence of graves.

Mitigation: A social impact assessment consisting of community participation regarding these houses, should have occurred. This would determine if any graves were associated with the house foundations. The foundations should have been mapped. More of the site might be affected by drainage infrastructures.

FIG. 10: LOCATION OF RECORDED SITES AND FEATURES



FIG. 11: MANT367





## **MANT368 & MANT369**

MANT368 and MANT369 are graves on a general settlement. This settlement was labelled as 'h4' on the 1968 topographical map. The site consists several house foundations, kraals and graves.

The road upgrade has impacted on two stone cairns that are probably graves. MANT368 is a stone cairn that has had road rubble pushed up against it (fig. 12). It occurs on the side of the road and will be affected if any further earthmoving or drainage lines occurs.

MANT369 occurs a ~10m southwest of MANT368. This feature is a grave (fig. 13). A water culvert/diversion has been graded into the site and it has damaged part of the grave.

**Mitigation:** The graves should have had a 20m buffer around them as per normal management plan. The settlement should have been surveyed for more graves. A social consultation process should have occurred to determine living descendants related to the grave. This should still occur. The graves need to be clearly demarcated with a 5m buffer between the grave and the demarcation.

**Significance:** Human graves are of high significance.

## **MANT370**

MANT370 is a stone cairn downhill from MANT368/MAN369. The cairn has the appearance of a human grave (fig. 14).

**Mitigation:** A 20m buffer around the cairn must occur. The grave needs to be clearly demarcated with a 5m buffer between the grave and the demarcation.

FIG. 12: MANT368



FIG. 13: MANT369



**FIG. 14: MANT370**



### **GENERAL COMMENTS**

The two archaeological sites noted by Hall (see DESKTOP) are not clearly visible and have been partially affected by existing settlements. They do not occur near the road upgrade.

There are several stone cairns in the agricultural fields. These are not graves but part of field clearance. A qualified heritage practitioner should assess these cairns if they are to be affected. If the existing road alignment is adhered to, then there are only field clearance cairns in the path of the road.

There are three cemeteries ~100m from the road. These will not be affected by the road upgrade.

## **MANAGEMENT PLAN**

The norm for all graves is a 20m buffer between the grave and the development footprint. Furthermore, grave(s) need to be clearly demarcated with a 5m buffer from the edge of the grave. If graves are to be effected by a development, then public participation is required where the local community, in this case, is approached regarding the graves. None of the above was undertaken by the construction company.

This was brought to the attention of Afzelia Environmental Consultancy and Amafa KZN. The construction company was requested to halt all work until an investigation was undertaken regarding the damage to heritage sites.

If any excavations are deeper than 1.5m, then a palaeontological assessment will be required on site. The same will occur if fresh bedrock is exposed by the causeway. The depth of the causeway and road infrastructures needs to be confirmed.

## **CONCLUSION**

The Mantuli Road upgrade is to link to District roads via an upgrade of a footpath and a connecting causeway. The roadworks had started before the HIA was undertaken. The road upgrade had affected one settlement and two graves. Mitigation was thus not undertaken and the roadworks have been requested to stop all activity until further notice.

## **REFERENCES**

75\_1 of 1 Flight path 11, photos 5000 – 5010

75\_1 of 1 Flight path 12, photos 5045 - 5035

2830BB Nondweni 1:50 000 topographical map 1968

2830BB Nondweni 1:50 000 topographical map 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 large, stylized initial 'A' that loops around the rest of the name.

Gavin Anderson  
Archaeologist/Heritage Impact Assessor

**APPENDIX A**  
**PIA DESKTOP ASSESSMENT**



**PHASE 1 PALAEOLOGICAL  
ASSESSMENT FOR THE PROPOSED  
UPGRADING OF THE MANTULI ROAD,  
NQUTU LOCAL MUNICIPALITY,  
UMZINYATHI DISTRICT MUNICIPALITY,  
KWAZULU-NATAL PROVINCE.**

**FOR  
Umlando**

**DATE: 03 December 2016**

**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 an Application for Upgrading of the Mantuli Road, Nqutu Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province.

This report forms part of the Environmental Impact Assessment 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 (Heritage Resources Management), a Heritage Impact Assessment (HIA) is required to assess any potential impacts to palaeontological heritage within the development footprint of the development. Geological structures associated with groundwater are mapped as well as known and potential spring sites that are part of the National Heritage of this area.

The development site for the proposed Upgrading of the Mantuli Road, Nqutu Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province is underlain by Swazian aged volcanic and sedimentary rocks of the Nondweni Group, Carboniferous to Permian aged sedimentary rocks of the Dwyka Group and Permian aged Dolerite of the Karoo Supergroup.

No significant fossils are expected before deep excavation (>1.5m) are done into the sediments of the Dwyka Group and if fossils are recorded it will contribute significantly to our knowledge of the Palaeontological Heritage of KwaZulu-Natal. The chances of recording significant fossils has a Moderate Significance and it is recommended that a suitably qualified Palaeontologist inspects the excavated material for trace fossils as these opportunities to see deeply excavated rocks of the Dwyka Group are very rare.

Significant Primary Groundwater Aquifers are associated with the alluvium on site and design of all water distribution and treatment works for potential polluted water must ensure that no polluted water reach these important National Heritage Sites.

It is recommended that:

The EAP and ECO must be informed of the fact that a Moderate Palaeontological Sensitivity is allocated to the Dwyka Group rocks in the study area. Fossils will be observed during construction and the HIA specialist and Palaeontologist must be informed when these rocks are exposed to take immediate and appropriate action to preserve the fossils.

The recommendations for mitigation for prevention of groundwater pollution as discussed in the Groundwater Impact Assessment Report must be adhered to.

These recommendations must be included in the EMP of this project.

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## **INTRODUCTION**

Gideon Groenewald was appointed by Umlando to undertake a Desktop Survey, assessing the potential Palaeontological Impact related to an Application for Upgrading of the Mantuli Road, Nqutu Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province.

This report forms part of the Environmental Impact Assessment 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 (Heritage Resources Management), a Heritage Impact Assessment (HIA) is required to assess any potential impacts to palaeontological heritage within the development footprint of the development. Geological structures associated with groundwater are mapped as well as known and potential spring sites that are part of the National Heritage of this area.

### **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 last opportunity to record the fossil heritage within the development footprint. These records are very important to understand the past and form an important part of South Africa's National Estate.

Following the “SAHRA APM Guidelines: Minimum Standards for the Archaeological &

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

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

Prior to 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 (2830 Dundee) 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. All groundwater resources, present and potential are included in this category for Palaeontological Sensitivity
<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.

<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 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. At least a Desktop Survey is recommended.</p>



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

### **Scope and Limitations of the 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.).
- All existing information on groundwater aquifers were recorded during this desktop survey but it is by far not a representative picture of the extent or the number of linear aquifers present in the study area. The total picture must be gained from the Specialist Report on potential impact of this project on the groundwater resources for the project.

## Locality and Proposed Development

The Unzinyathi District Municipality plans to upgrade the MaNtuli Road also known as the Manthuli Road Track in the Nqutu Local Municipal Area to a higher status (Figure 1).



Figure 1 Locality of the MaNtuli Road Track in KwaZulu-Natal Province

## GEOLOGY

The study area is underlain predominantly by Swazian aged rocks of the Nondweni Group, Carboniferous to Permian aged Dwyka Group and Jurassic aged Dolerite of the Karoo Supergroup (Figure 2).

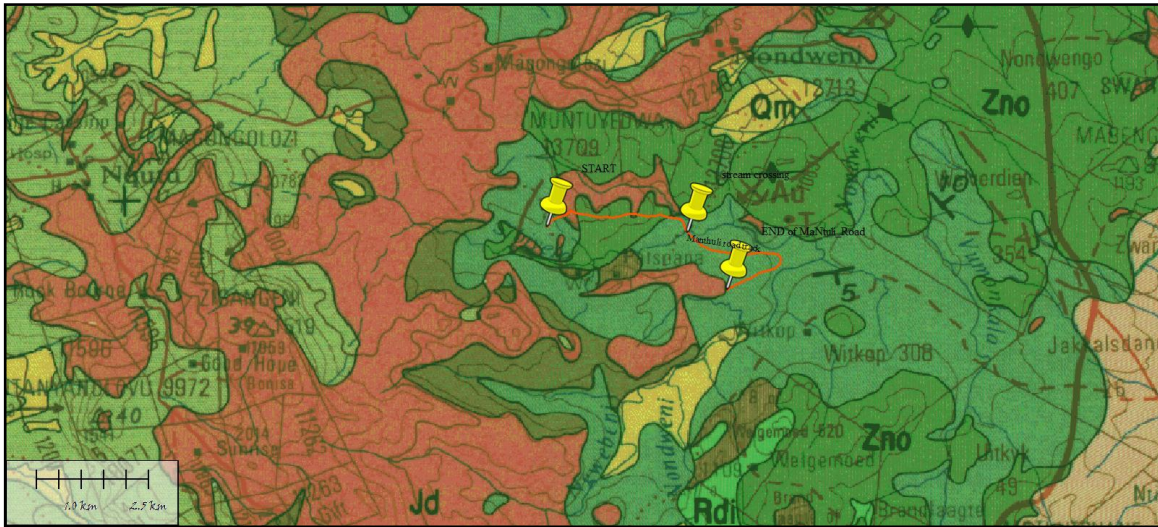


Figure 2 Geology of the study area. Zno – Nondweni Group, Jd – Dolerite, rest Dwyka Group

### Nondweni Group

The Swazian aged Nondweni Group consists primarily of basic lava, banded chert and calc-silicate rocks, belonging to the very ancient basement rocks of the South African landscape.

### Dwyka Group

The Carboniferous to Permian aged rocks overlying the Nondweni Group is a thick unit of tillite that was deposited in a glacial environment by retreating ice sheets about 300 million years ago.

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

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

The tillite in KZN often weathers to a characteristic yellowish colour. In the study area, cliffs near the rivers, and road quarries area offer the best exposures of tillite.

### **Dolerite**

Jurassic aged Dolerite intruded the geological sequence as sills or dykes. In the study area a prominent dolerite sill underlies the road area and the most significant points for concern is the contact zones of the dolerite with surrounding country rock. These zones form important aquifers in the study area.

## **PALAEONTOLOGY**

### **Nondweni Group**

Although no fossils have as yet been described from the chert beds of the Nondweni Group, these very old deposits can reveal interesting facts about the history of Life on Earth.

For example, some limestone units in the **Nsuze Group** (Chobeni Formation, Linstrom, 1987 or White Mfolozi Formation, Johnson et al, 2006) contain beautifully preserved stromatolites - fossils of 2900 million year old algal colonies which thrived in a shallow, warm ocean (Johnson et al, 2006).

The photosynthesing bacteria (cyanobacteria) consumed carbon dioxide and caused the precipitation of calcium carbonate from the sea water, which stuck to the bacterial colonies. Gradually, layer upon layer of calcium carbonate was added, forming stromatolites.

The shape (cones, domes etc.) assumed by stromatolites depends on water depth, tidal range, and wave and current activity (MacRae, 1999).

Recording of similar structures from the Nondweni Group can be interesting. No further mitigation for Palaeontological Heritage is recommended.

### **Dwyka Group**

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

uppermost Dwyka Group. Other trace fossils include coprolites (fossilized faeces) of 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).

Trace fossils as well as poorly-defined plant fossils have been described from the upper layers of the Formation (Johnson et al. 2009).

Fossils are rare and it is unlikely that the excavations for this upgrading process will expose significant remains of trace fossils that were not described before. If the ECO recognise any potential trace fossils the HIA specialist and palaeontologist must be informed to take appropriate action to preserve this information.

### **Dolerite**

Dolerite is an igneous rock and will not contain fossils. The contact zones of dolerite sills with other geological formations are very important aquifer rocks and these areas must be identified by the ECO for special caution regarding groundwater pollution.

## **GROUNDWATER AQUIFERS AND HERITAGE ITEMS**

The groundwater heritage items are related to known and potential groundwater resources such as recorded natural spring sites as well as potential linear aquifers that can be affected by the proposed development.

No significant spring sites are recorded on the present edition (2830 Dundee) geological map and no obviously important potential linear aquifers cut the study area, save some important contact zones of the dolerite sill with surrounding rocks. The potential pollution of groundwater resources should be discussed in detail in the Groundwater Impact Assessment Report and, if the recommendations of that report are followed, no further significant influence on this National Heritage Item is foreseen by the Palaeontological Impact Specialist.

## **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 desktop investigation. The desktop investigation confirms that the study area is underlain by ancient rocks of the Nondweni Group, Carboniferous to Permian aged Dwyka Tillites and Jurassic aged Dolerite (Figure 4).

The excavations for the construction of the infrastructure for this development will expose some sediments of the Dwyka Group. Due to weathering, no well-preserved fossils are expected before deep (>1.5m) excavations are completed. Exposure of bedrock during excavation might however result in the exposure of significant plant and trace fossils in the shale as well as possible invertebrate fossils in the Dwyka Group. Recording of fossils will contribute significantly to our understanding of previous eco-systems and must be reported to the HIA specialist for appropriate action.



**Figure 3 Palaeontological Sensitivity of the Study Area. A Moderate Palaeontological sensitivity is allocated to area underlain by the Dwyka Tillite. The contacts zones of dolerite are allocated Very High Impact values. For colour coding see Table 1.**

## CONCLUSION

The development site for the proposed Upgrading of the Mantuli Road, Nqutu Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province is underlain by Swazian aged volcanic and sedimentary rocks of the Nondweni Group, Carboniferous to Permian aged sedimentary rocks of the Dwyka Group and Permian aged Dolerite of the Karoo Supergroup.

No significant fossils are expected before deep excavation (>1.5m) are done into the sediments of the Dwyka Group and if fossils are recorded it will contribute significantly to our knowledge of the Palaeontological Heritage of KwaZulu-Natal. The chances of recording significant fossils has a Moderate Significance and it is recommended that a suitably qualified Palaeontologist inspects the excavated material for trace fossils as these opportunities to see deeply excavated rocks of the Dwyka Group are very rare.

Significant Primary Groundwater Aquifers are associated with the alluvium on site and design of all water distribution and treatment works for potential polluted water must ensure that no polluted water reach these important National Heritage Sites.

It is recommended that:

The EAP and ECO must be informed of the fact that a Moderate Palaeontological Sensitivity is allocated to the Dwyka Group rocks in the study area. Fossils will be observed during construction and the HIA specialist and Palaeontologist must be informed when these rocks are exposed to take immediate and appropriate action to preserve the fossils.

The recommendations for mitigation for prevention of groundwater pollution as discussed in the Groundwater Impact Assessment Report must be adhered to.

These recommendations must be included in the EMP 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