

**HERITAGE SURVEY OF THE PROPOSED THE LOWER
THUKELA BULK WATER SUPPLY SCHEME OFFTAKE
3, ILEMBE DISTRICT MUNICIPALITY, KWAZULU-
NATAL**

FOR TRIPLO4

DATE: 24 June 2014

By Gavin Anderson

**Umlando: Archaeological Surveys and Heritage
Management**

PO Box 102532, Meerensee, 3901

Phone/fax: 035-7531785 Fax: 0865445631

Cell: 0836585362



TABLE OF CONTENT

INTRODUCTION	3
KWAZULU-NATAL HERITAGE ACT NO. 4 OF 2008	7
METHOD	9
Defining significance.....	10
RESULTS	12
DESKTOP STUDY	12
FIELD SURVEY.....	17
PALAEONTOLOGICAL IMPACT ASSESSMENT	19
CONCLUSION.....	20
APPENDIX A	21
PALAEONTOLOGICAL IMPACT ASSESSMENT	21

TABLE OF FIGURES

FIG. 1 GENERAL LOCATION OF THE STUDY AREA.....	4
FIG. 2: AERIAL OVERVIEW OF THE STUDY AREA.....	5
FIG. 3: TOPOGRAPHICAL MAP OF THE STUDY AREA	6
TABLE 1: LOCATION OF HERITAGE SITES IN 1937 & 1963.....	13
FIG. 4: LOCATION OF KNOWN HERITAGE SITES NEAR THE STUDY AREA.....	14
FIG. 5: STUDY AREA IN 1937.....	15
FIG. 6: STUDY AREA IN 1963.....	16
FIG 7: SCENIC VIEW OF THE STUDY AREA	18

INTRODUCTION

The proposed construction for Offtake 3 forms part of the Lower Thukela Bulk Water Supply Scheme which is a project of the Ilembe District Municipality and co-funded by the Department of Water Affairs. The construction of Offtake 3 is part of the sections of the potable water pipeline that forms part of the broader Bulk Water Supply Scheme in the lower Thukela Region. The proposed pipeline is located immediately outside the road reserve and is approximately 9km in length with an internal diameter of 315mm. The proposed Offtake 3 bulk water pipeline feeds into the existing Sakhamakhanya reservoir as the project makes provision for Bulk Supply of Potable water to communities that currently do not have access to reticulated potable water in the Lower Thukela Region.

Figures 1 – 3 show the location of the proposed Bulk Water Supply Scheme.

FIG. 1 GENERAL LOCATION OF THE STUDY AREA

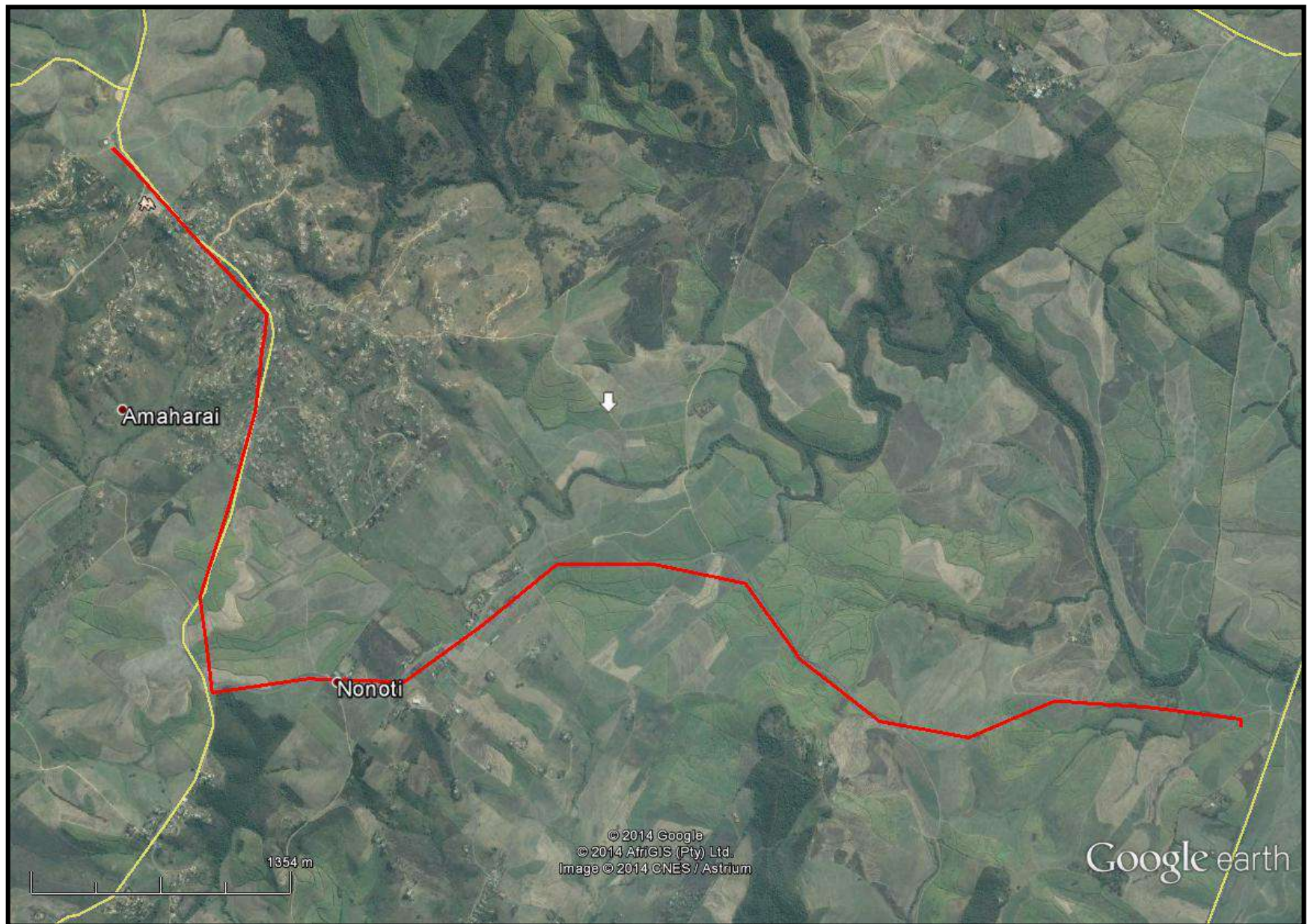


FIG. 2: AERIAL OVERVIEW OF THE STUDY AREA

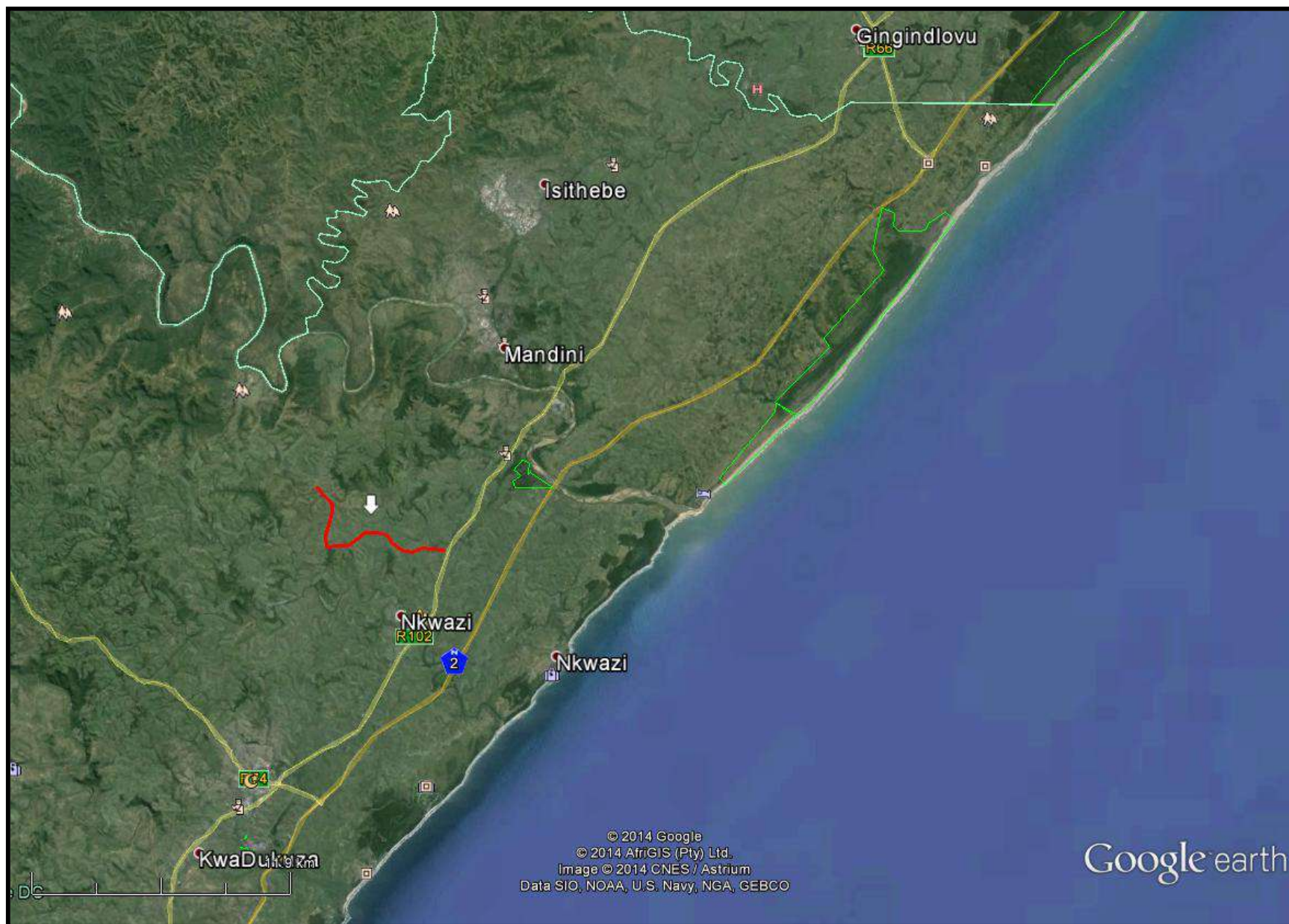
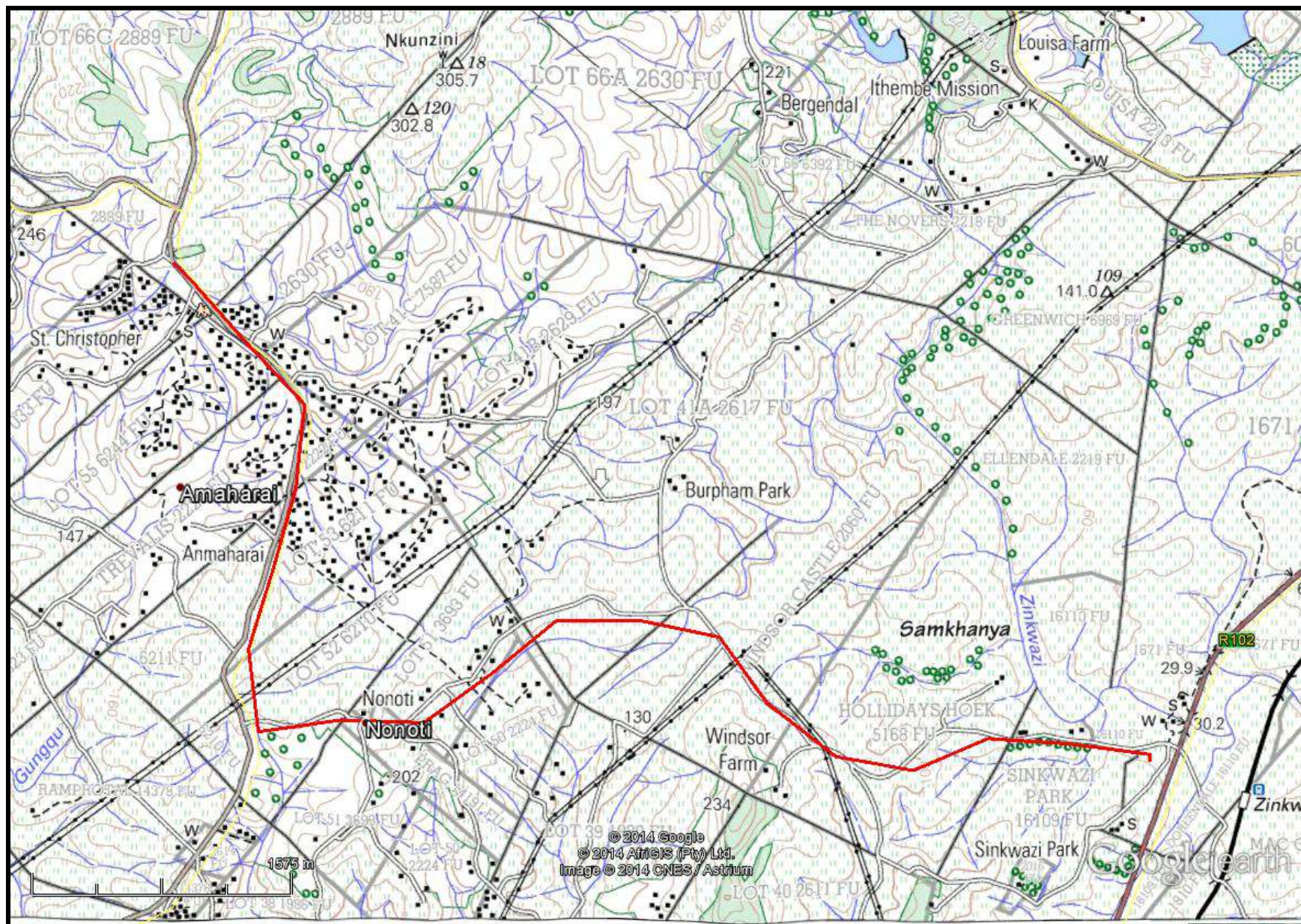


FIG. 3: TOPOGRAPHICAL MAP OF THE STUDY AREA



KWAZULU-NATAL HERITAGE ACT NO. 4 OF 2008

“General protection: Structures.—

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

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

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

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

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

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

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

- use similar detection or excavation equipment for the recovery of meteorites, without the prior written approval of the Council having been obtained on written application to the Council.
- The ownership of any object or material associated with any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site, on discovery, vest in the Provincial Government and the Council is regarded as the custodian on behalf of the Provincial Government.” (KZN Heritage Act of 2008)

METHOD

The method for Heritage assessment consists of several steps.

The first step forms part of the desktop assessment. Here we would consult the database that has been collated by Umlando. These databases contain 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 1st and 2nd 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.

RESULTS

DESKTOP STUDY

The desktop study consisted of analysing various maps for evidence of prior habitation in the study area, as well as for previous archaeological surveys. The archaeological database indicates that there are archaeological sites in the general area (fig. 4). These sites include all types of Stone Age and Iron Age sites. No archaeological sites occur in the study area.

No national monuments, battlefields, or historical cemeteries are known to occur in the study area. There are several monuments, war graves, battlefields and cemeteries outside of the study area.

The 1937 aerial photographs indicate that there are four buildings near the pipeline (fig. 5). The Nonoti farm complex also occurs near the pipeline. Table 1 lists these sites and their locations: these are denoted with the prefix of 'a'.

TABLE 1: LOCATION OF HERITAGE SITES IN 1937 & 1963

NAME	LATITUDE	LONGITUDE	DESC
A01	-29.239252092	31.333290528	building
A02	-29.239547269	31.337643193	buildings
A03	-29.237762981	31.338667990	buildings
A04	-29.236724907	31.340859304	buildings
B01	-29.239751225	31.379539091	compound
B02	-29.237603845	31.340840170	building
B03	-29.238288242	31.339741385	building
B04	-29.238520023	31.339435084	building
B05	-29.238948450	31.338845266	building
B06	-29.238090479	31.337982351	building
B07	-29.239057452	31.333863401	buildings (Nonoti)
B08	-29.239719411	31.330214553	2x building/compound
B09	-29.228510288	31.329096907	settlement
B10	-29.227796720	31.329481178	settlement
B11	-29.229180576	31.329901918	settlement
B12	-29.225091593	31.329923034	settlement
B13	-29.219936851	31.327751859	2 x buildings
B14	-29.218575384	31.328352798	settlement
Nonoti	-29.238487996	31.333771384	Farm complex

The 1963 1:50 000 topographical map indicates that there is an increase in buildings and settlements near the line (fig. 6). Table 1 lists these sites and their locations: these are denoted with the prefix of 'b'. Many of these buildings still exist on the 2006 Google Earth aerial photography.

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

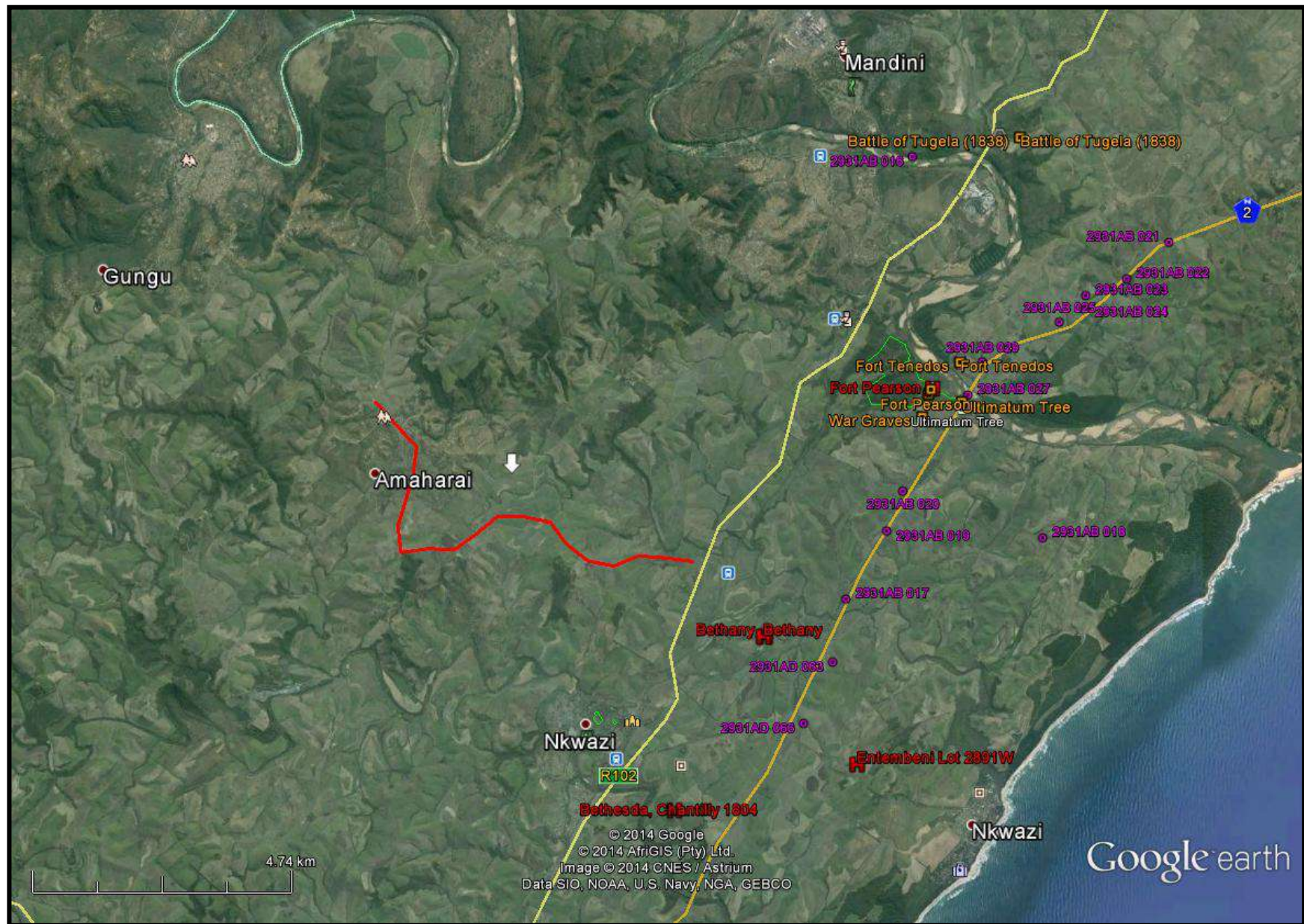


FIG. 5: STUDY AREA IN 1937

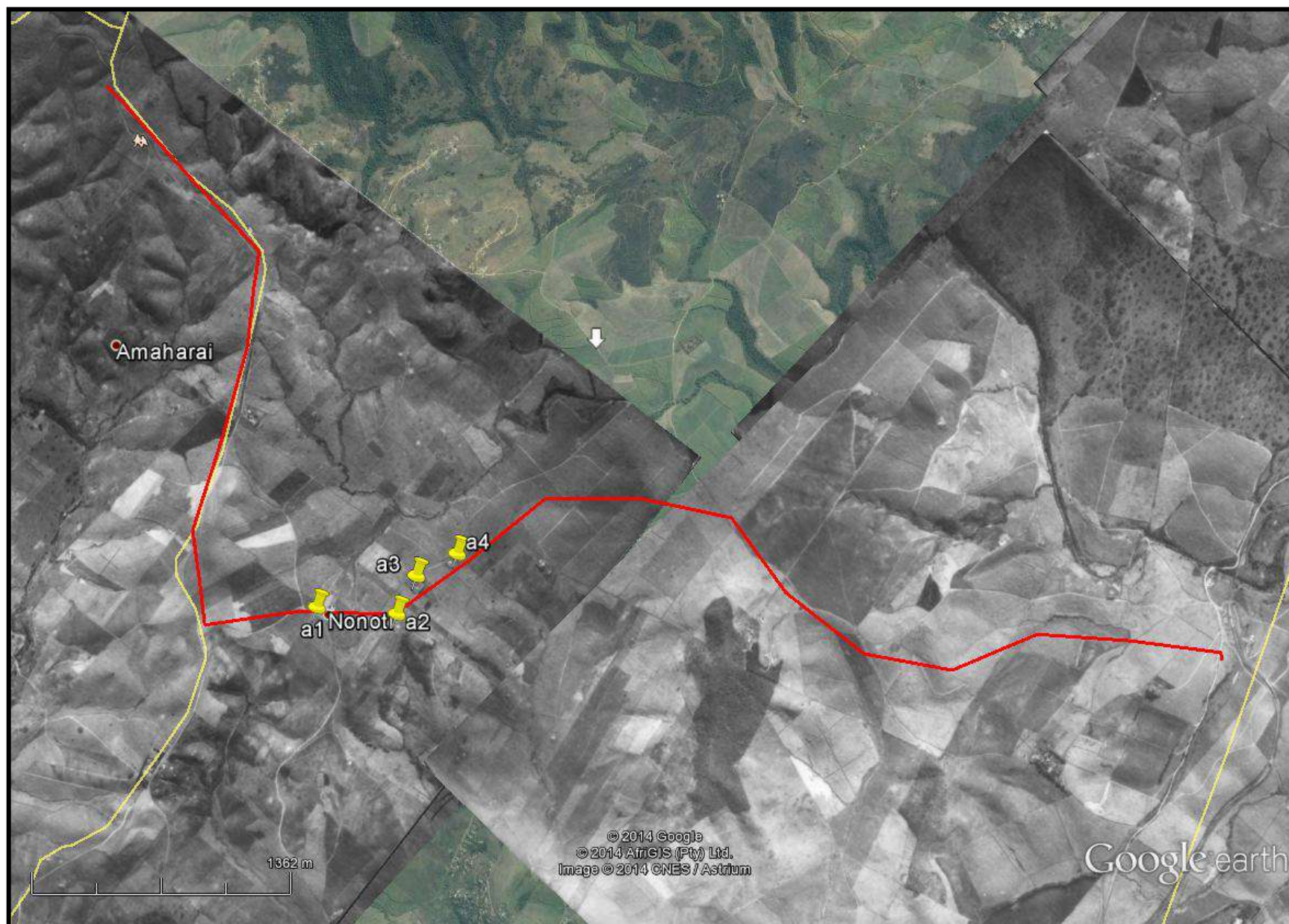
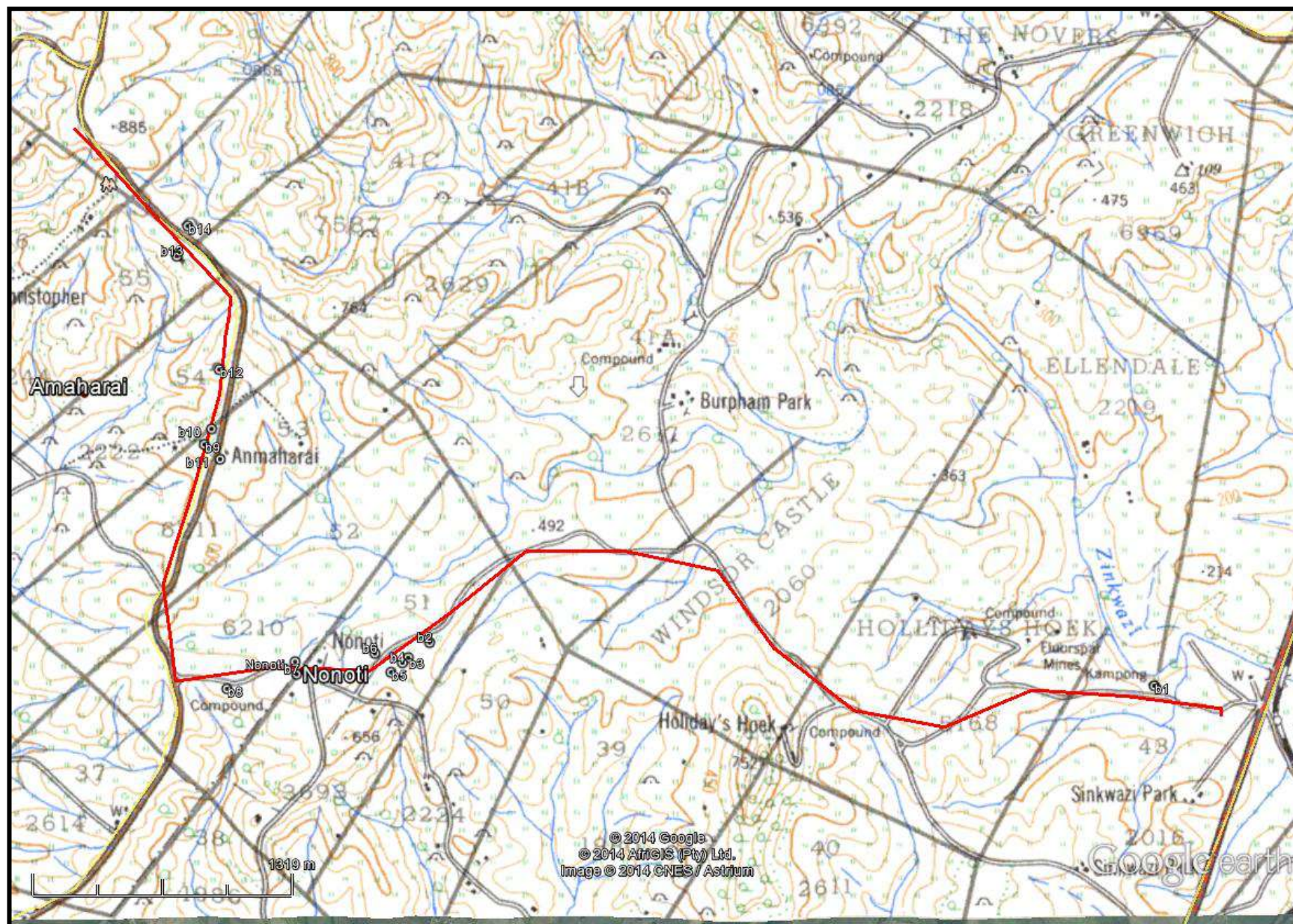


FIG. 6: STUDY AREA IN 1963



FIELD SURVEY

No heritage sites were observed along the route. This is because much of the development is in already disturbed land or road reserves. The pipeline goes through dense sugar cane fields, and in areas where the soil is rocky and not very deep.

Most of the features noted in the 1937 aerial photographs no longer exist, or have been built over. Many of the buildings noted in Table 1 still exist. Buildings such as 'b2' has been demolished (fig. 6, top right). The following buildings still exist"

- Nonoti farm complex (now a school)
- A3
- B3
- B4
- B6
- Possibly:
 - B9
 - B10
 - B12
 - B13
 - B14

Figure 7 shows some of the areas along the route. The route given for the survey did however go through some houses; however, this is probably an error. If any buildings or ruins are to be affected by the pipeline, then Amafa will need to be informed.

FIG 7: SCENIC VIEWS OF THE STUDY AREA



PALAEONTOLOGICAL IMPACT ASSESSMENT

A desktop palaeontological assessment was undertaken, as the area was coded 'green' on the SAHRIS paleosensitivity map. This means that the area was of medium significance, and that a desktop would determine the full potential of palaeontological remains. The full desktop PIA is given in Appendix A.

"The route of the proposed pipeline for the Offtake 3 section of the Lower Thukela Bulk Water Supply Scheme is underlain by Carboniferous to Permian aged tillites, diamictites and shale of the Dwyka Formation, as well as dark grey shale of the Permian Pietermaritzburg Formation. Numerous fossils have been described from the Dwyka Formation and the Pietermaritzburg Formation yielded some trace fossils. A Moderate Palaeontological sensitivity is allocated to areas underlain by these formations on the assumption that fresh outcrops area available, or that excavation activity will expose fresh bedrock.

The recording of significant fossils will most likely be restricted to exposure of fresh bedrock. Trenching for the pipeline will generally be restricted to a depth of 2m and geotechnical surveys should provide information on the potential for excavating into fresh bedrock along the route.

Recommendations:

1. The EAP and ECO of the project must be informed of the fact that fossils have been described from the geological formations that underlies the pipeline route.
2. All sections of the pipeline route where bedrock is exposed due to erosion or where geotechnical surveys indicate that bedrock will be exposed during excavation, must be inspected by a Professional Palaeontologist and fossils collected according to SAHRA and AMAFA specifications as part of a Phase 1 Palaeontological Impact Assessment." (Groenewald – Appendix A)

3. Geotechnical data should be able to determine which areas will expose bedrock before the construction phase begins. This will allow for the palaeontologist to be on site at the appropriate times.

CONCLUSION

A heritage survey was undertaken for the proposed construction for Offtake 3 forms part of the Lower Thukela Bulk Water Supply Scheme, Ilembe District Municipality, KZN. The construction forms part of the broader Bulk Water Supply Scheme in the lower Thukela Region.

The 1937 aerial photographs of the area and 1968 topographical map indicate that several structures existed near the pipeline route. Many of these structures no longer exist and have been demolished or built over. A few structures from 1937 still exist. It is unlikely that the pipeline route will affect any built structures.

No heritage sites were observed along the route and no further mitigation is required. However, a qualified palaeontologist will be required to be on site whenever bedrock is exposed along the route. This will require planning

APPENDIX A
PALAEONTOLOGICAL IMPACT ASSESSMENT

**DESKTOP PALAEOONTOLOGICAL
ASSESSMENT FOR THE PROPOSED
OFFTAKE 3 SECTION OF THE LOWER
THUKELA BULK WATER SUPPLY SCHEME,
ILEMBE DISTRICT MUNICIPALITY,
KWAZULU-NATAL PROVINCE.**

**FOR
Umlando**

DATE: 8 JULY 2014

By

**Gideon Groenewald
Cell: 082 339 9202**

EXECUTIVE SUMMARY

Gideon Groenewald was appointed to undertake a desktop survey, assessing the potential Palaeontological Impact of the proposed construction for Offtake 3, which forms part of the Lower Thukela Bulk Water Supply Scheme. This is a project of the Ilembe District Municipality and is co-funded by the Department of Water Affairs. The construction of Offtake 3 is part of the sections of the potable water pipeline that forms part of the broader Bulk Water Supply Scheme in the lower Thukela Region of KwaZulu-Natal.

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. In accordance with Section 38 (Heritage Resources Management), a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

The study area is underlain by Carboniferous to Permian aged rocks of the Dwyka Formation and Permian aged rocks of the Pietermaritzburg Formation, Ecca Group, Karoo Supergroup.

The route of the proposed pipeline for the Offtake 3 section of the Lower Thukela Bulk Water Supply Scheme is underlain by Carboniferous to Permian aged tillites, diamictites and shale of the Dwyka Formation, as well as dark grey shale of the Permian Pietermaritzburg Formation. Numerous fossils have been described from the Dwyka Formation and the Pietermaritzburg Formation yielded some trace fossils. A Moderate Palaeontological sensitivity is allocated to areas underlain by these formations on the assumption that fresh outcrops area available, or that excavation activity will expose fresh bedrock.

The recording of significant fossils will most likely be restricted to exposure of fresh bedrock. Trenching for the pipeline will generally be restricted to a depth of 2m and geotechnical surveys should provide information on the potential for excavating into fresh bedrock along the route.

Recommendations:

1. The EAP and ECO of the project must be informed of the fact that fossils have been described from the geological formations that underlies the pipeline route.
2. All sections of the pipeline route where bedrock is exposed due to erosion or where geotechnical surveys indicate that bedrock will be exposed during excavation, must be inspected by a Professional Palaeontologist and fossils collected according to SAHRA and AMAFA specifications as part of a Phase 1 Palaeontological Impact Assessment.

TABLE OF CONTENT

EXECUTIVE SUMMARY	23
TABLE OF CONTENT	24
INTRODUCTION	25
SOUTH AFRICAN NATIONAL HERITAGE RESOURCE ACT NO 25/1999	25
METHODOLOGY	26
GEOLOGY	28
Dwyka Formation (C-Pd)	28
Pietermaritzburg Formation (Pp)	28
PALAEONTOLOGY	28
Dwyka Formation (C-Pd)	28
Pietermaritzburg Formation (Pp)	30
DISCUSSION	30
MANAGEMENT PLAN	31
CONCLUSION AND RECOMMENDATIONS	32
REFERENCES	33
QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR	34
DECLARATION OF INDEPENDENCE	34

TABLE OF FIGURES

Figure 1 Locality of the proposed Offtake 3 development route	25
Figure 2 Geology of the Outtake 3 pipeline route	29
Figure 3 Palaeontological Sensitivity of the Offtake 3 development	32

LIST OF TABLES

Table 1 Palaeontological sensitivity analysis outcome classification	27
Table 2 Palaeontological significance of geological units on site	31

INTRODUCTION

Gideon Groenewald was appointed to undertake a desktop survey, assessing the potential Palaeontological Impact of the proposed construction for Offtake 3, which forms part of the Lower Thukela Bulk Water Supply Scheme. This is a project of the Ilembe District Municipality and is co-funded by the Department of Water Affairs. The construction of Offtake 3 is part of the sections of the potable water pipeline that forms part of the broader Bulk Water Supply Scheme in the lower Thukela Region. The proposed pipeline is located immediately outside the road reserve and is approximately 9km in length with an internal diameter of 315mm. The proposed Off-Take 3 bulk water pipeline feeds into the existing Sakhamakhanya reservoir as the project makes provision for Bulk Supply of Potable water to communities that currently do not have access to reticulated potable water in the Lower Thukela Region in KwaZulu-Natal (Figure 1).

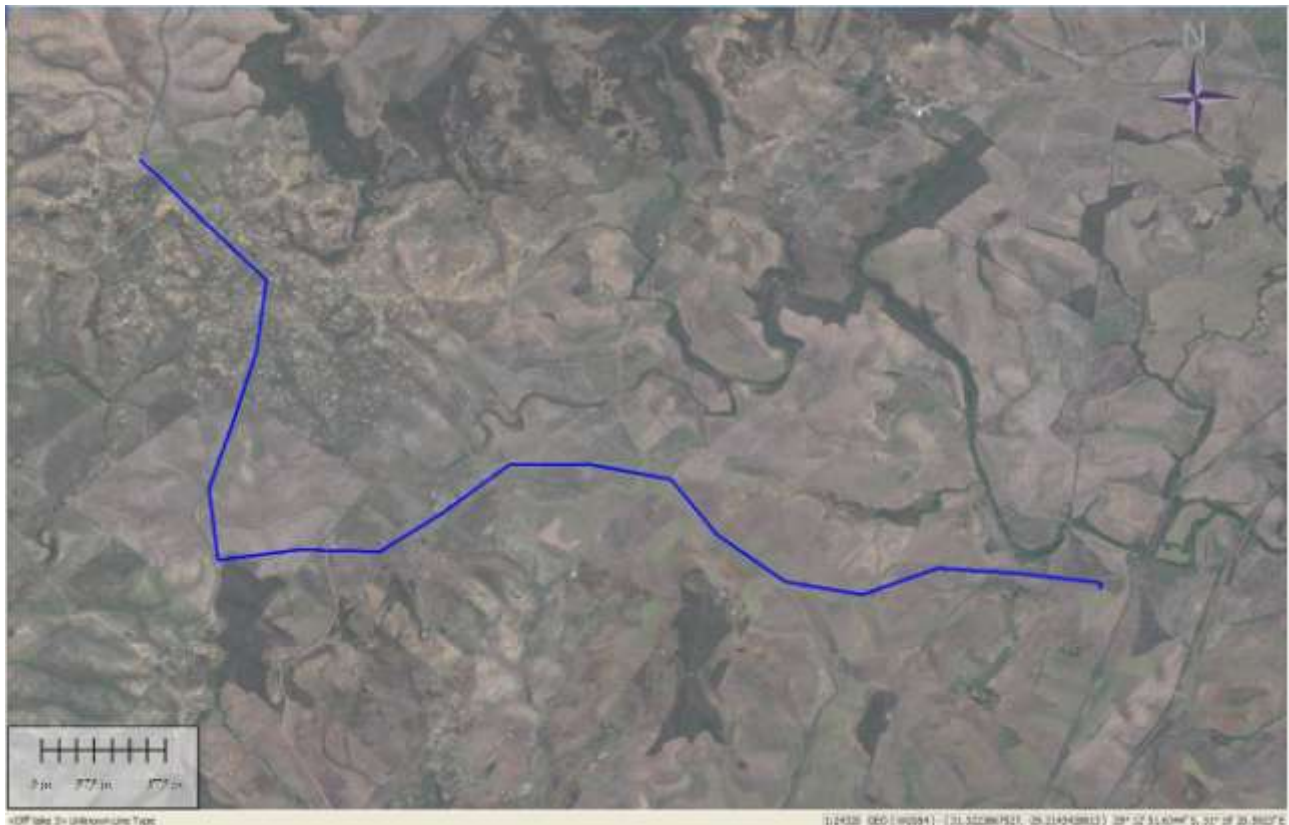


Figure 1 Locality of the proposed Offtake 3 development route

SOUTH AFRICAN NATIONAL HERITAGE RESOURCE ACT NO 25/1999

This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African

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

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

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

METHODOLOGY

Following the "SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports" the aims of the palaeontological impact assessment are:

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

to assess the level of palaeontological significance of these formations;

to comment on the impact of the development on these exposed and/or potential fossil resources and

to make recommendations as to how the developer should conserve or mitigate damage to these resources.

In preparing a palaeontological desktop study the potential fossiliferous rock units (groups, formations etc) represented within the study area are determined from geological maps and Google Earth imagery. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the

extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1 below.

Table 1 Palaeontological sensitivity analysis outcome classification

Sensitivity	Description
Low Sensitivity	Areas where there is likely to be a negligible impact on the fossil heritage. This category is reserved largely for areas underlain by igneous rocks. However, development in fossil bearing strata with shallow excavations or with deep soils or weathered bedrock can also form part of this category.
Moderate Sensitivity	Areas where fossil bearing rock units are present but fossil finds are localised or within thin or scattered sub-units. Pending the nature and scale of the proposed development the chances of finding fossils are moderate. A field-based assessment by a professional palaeontologist is usually warranted.
High Sensitivity	Areas where fossil bearing rock units are present with a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in all outcrops and the chances of finding fossils during a field-based assessment by a professional palaeontologist are very high. Palaeontological mitigation measures need to be incorporated into the Environmental Management Plan

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

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

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

- an underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
- an overestimation of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by weathering, or are

buried beneath a thick mantle of unfossiliferous “drift” (soil, alluvium etc).

GEOLOGY

The study area is underlain by Carboniferous to Permian aged rocks of the Dwyka Formation and Permian aged rocks of the Pietermaritzburg Formation, Eccca Group, Karoo Supergroup (Figure 2).

Dwyka Formation (C-Pd)

The Carboniferous to Permian aged Dwyka Formation is an assemblage of diamictites and glacial sediments, consisting of a mixture of fine-grained, poorly sorted sediments ranging from fine-grained silts and shales to sandy shales, with larger dropstones and angular cobbles in places. The deposits represent glacial activity in this part of Gondwanaland during the Carboniferous and Early Permian (Johnson et al, 2006).

Pietermaritzburg Formation (Pp)

The Permian aged Pietermaritzburg Formation is mainly a sequence of monotonous dark grey to black shale that overlies the Dwyka Formation. The Formation is interpreted as a marine deposit that represents a deeper water deposit after melting of the Dwyka glaciers (Johnson et al, 2006).

PALAEONTOLOGY

Dwyka Formation (C-Pd)

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

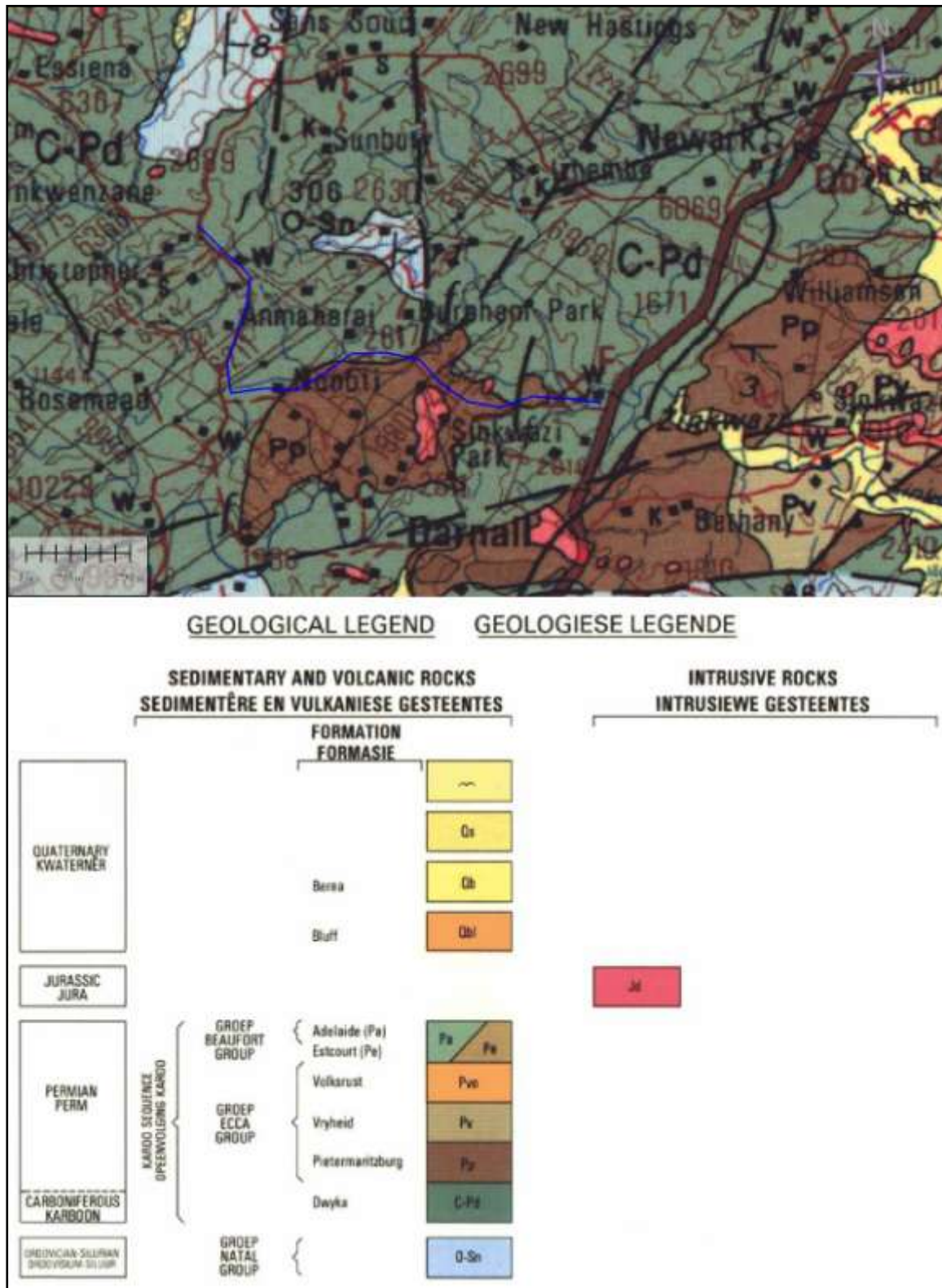


Figure 2 Geology of the Offtake 3 pipeline route

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).

Pietermaritzburg Formation (Pp)

Although trace fossils have been recorded from the upper layers of the Pietermaritzburg Formation by Linstrom (1987), fossils are generally not abundantly present in this Formation.

DISCUSSION

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews.

A variety of fossils have been described from the Carboniferous to Permian aged Dwyka Formation and includes trace fossils and fossils of invertebrates and plants. The fossils are normally associated with fresh bedrock exposures where topsoil has been removed by erosion or during trenching operations. In the case of this development trenching will generally be restricted to a depth of 2m, and geotechnical surveys will provide information on the likelihood of exposing fresh bedrock during the construction phase.

Trace fossils have been recorded from the Permian aged Pietermaritzburg Formation. Significant fossils will be associated with bedding planes of the shale and recording of these fossils will be of significance to our understanding of the palaeo-environments in which these sediments were deposited. Geotechnical

surveys will give an indication of the possibility of exposing fresh bedrock during the construction phase.

The palaeontological significance is summarised in Table 2.

Table 2 Palaeontological significance of geological units on site

Geological Unit	Rock Type and Age	Fossil Heritage	Vertebrate Biozone	Palaeontological Sensitivity
Dwyka	Diamictite and Tillite CARBONIFEROUS/PERMIAN	Trace fossils and coprolites of chondrichthyans. Foraminifera, radiolarians, bryozoans, sponge spicules, primitive starfish, orthoceroid nautiloids, goniatite cephalopods, gastropods, bivalves, brachiopods, palaeoniscoid fish. Plant fossils, including lycopods, moss, leaves and stems of <i>Glossopteris</i> flora, spores and pollens	None	Moderate Sensitivity
Pietermaritzburg Formation	Dark grey shale PERMIAN	Trace fossils	None	Moderate sensitivity

MANAGEMENT PLAN

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

The palaeontological sensitivity of the development is related to the specific geology that underlies the development footprints. For the sake of this desktop survey it is assumed that trenching of up to 2m depth will in fact expose fresh bedrock. In areas underlain by rocks of the Dwyka and Pietermaritzburg Formations and specifically where trenching will potentially expose fresh bedrock, a Moderate Palaeontological sensitivity is allocated to the pipeline route. The likelihood of the trenching reaching fresh bedrock should be deduced from the results of the geotechnical surveys.

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

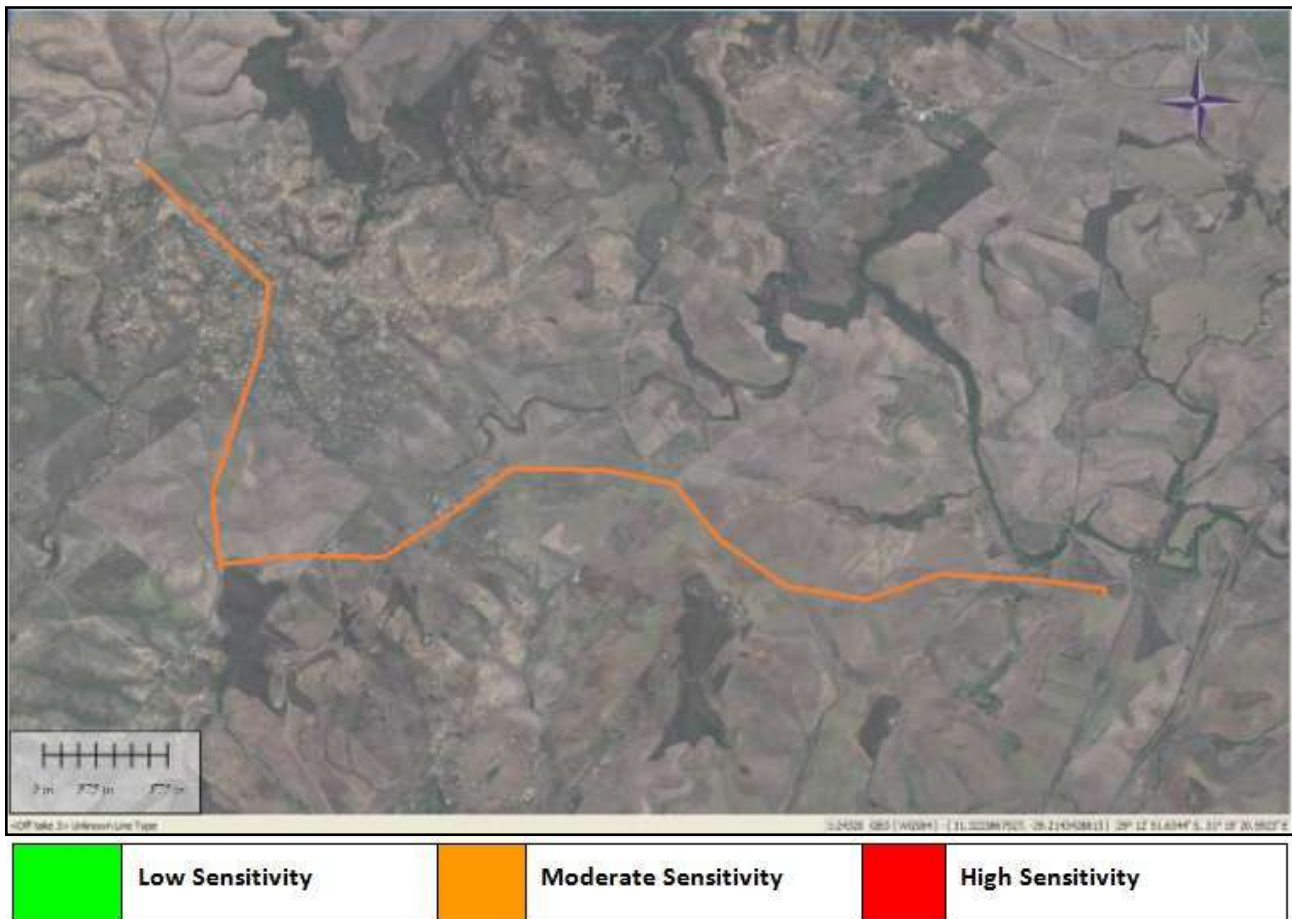


Figure 3 Palaeontological Sensitivity of the Offtake 3 development

CONCLUSION AND RECOMMENDATIONS

The route of the proposed pipeline for the Offtake 3 section of the Lower Thukela Bulk Water Supply Scheme is underlain by Carboniferous to Permian aged tillites, diamictites and shale of the Dwyka Formation, as well as dark grey shale of the Permian Pietermaritzburg Formation. Numerous fossils have been described from the Dwyka Formation and the Pietermaritzburg Formation yielded some trace fossils. A Moderate Palaeontological sensitivity is allocated to areas underlain by these formations on the assumption that fresh outcrops area available, or that excavation activity will expose fresh bedrock.

The recording of significant fossils will most likely be restricted to exposure of fresh bedrock. Trenching for the pipeline will generally be restricted to a depth of 2m and geotechnical surveys should provide information on the potential for excavating into fresh bedrock along the route.

Recommendations:

1. The EAP and ECO of the project must be informed of the fact that fossils have been described from the geological formations that underlies the pipeline route.
2. All sections of the pipeline route where bedrock is exposed due to erosion or where geotechnical surveys indicate that bedrock will be exposed during excavation, must be inspected by a Professional Palaeontologist and fossils collected according to SAHRA and AMAFA specifications as part of a Phase 1 Palaeontological Impact Assessment.

REFERENCES

Johnson MR , Anhaeusser CR and Thomas RJ (Eds). 2006. The Geology of South Africa. GSSA, Council for Geosciences, Pretoria.

Linstrom W. 1987. Die Geologie van die gebied Durban. Explanation Sheet 2930 (1:250 000). Geological Survey of South. Africa.

MacRae C. 1999. Life Etched in Stone. GSSA Publication.

McCarthy T and Rubidge B. 2005. The Story of Earth and Life. Struik Publishers.

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