HERITAGE SURVEY OF THE PROPOSED MKHUPHULA IRRIGATION SCHEME

FOR JG AFRIKA

DATE: 10 AUGUST 2018

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TABLE OF CONTENT

TABLE OF FIGURES

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

The Department of Rural Development and Land Reform (DRDLR) have appointed JG Afrika Pty Ltd (JG Afrika) to undertake Feasibility Assessments, Detailed Design and Construction Supervision of three irrigation schemes in KwaZulu-Natal. These three projects are the Horseshoe Irrigation Project (Horseshoe), Mkhuphula Irrigation Project (Mkhuphula) and Nkungumathe Irrigation Project (Nkungumathe) in the Ezinqoleni, Msinga and Nkandla Local Municipalities, respectively. Feasibility and preliminary design for each site have been covered in independent reports submitted. This report deals with the HIA for the Mkhuphula Irrigation Scheme

The proposed Mkhuphula Irrigation site on the Mooi River is located in KwaZulu-Natal, approximately 30 km North of Greytown and 50 km East of Weenen. The project entails:

1. Irrigations system to existing agricultural fields
2. Pump house
3. Access roads in the fields and one road to the fields
4. A storage shed

Fig.'s 1 – 4 show the location of the development.

Umlando was appointed by JG Afrika to undertake the HIA study.

FIG. 1 GENERAL LOCATION OF THE STUDY AREA

FIG. 2: AERIAL OVERVIEW OF THE STUDY AREA

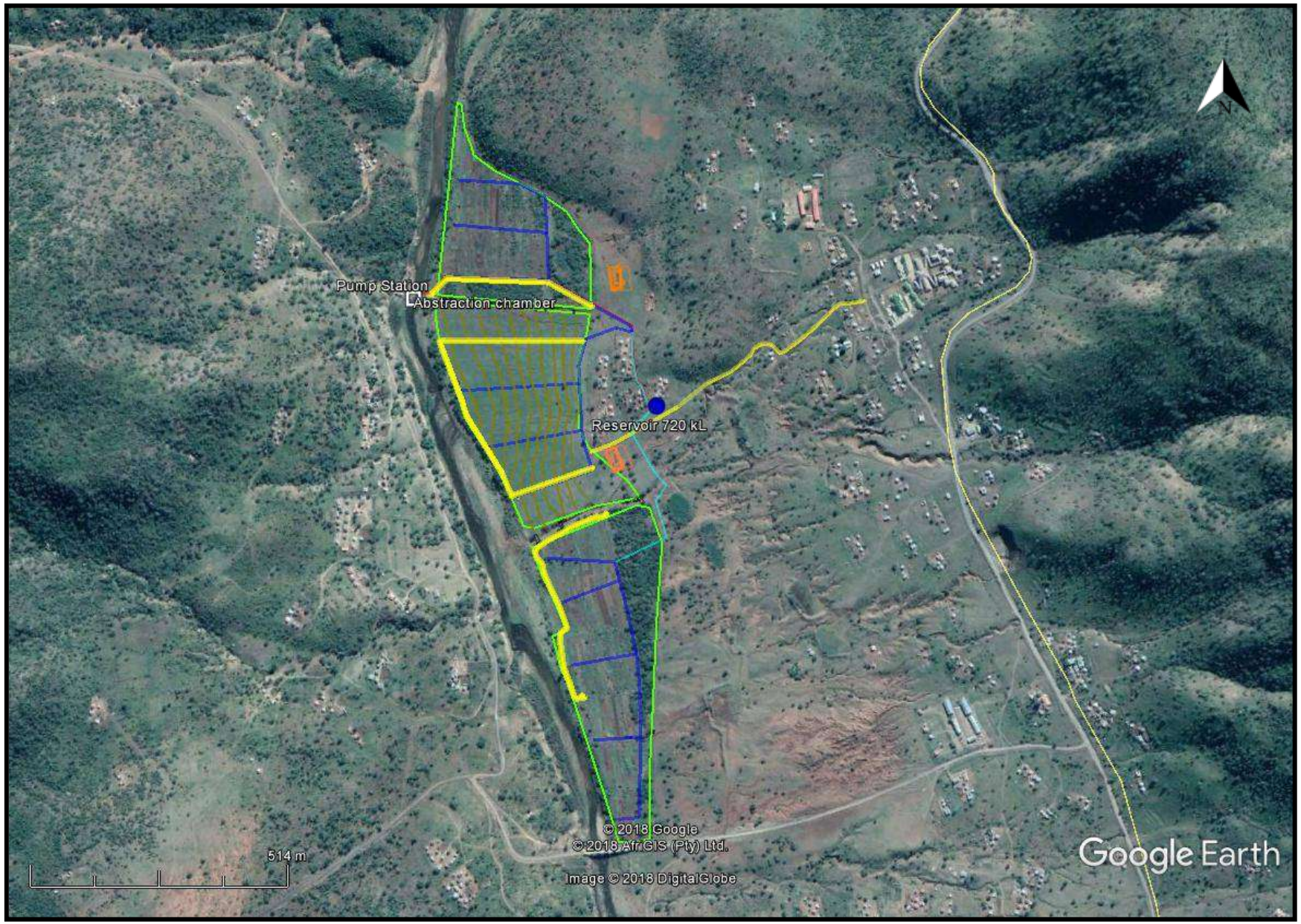


FIG. 3: TOPOGRAPHICAL OVERVIEW OF THE STUDY AREA

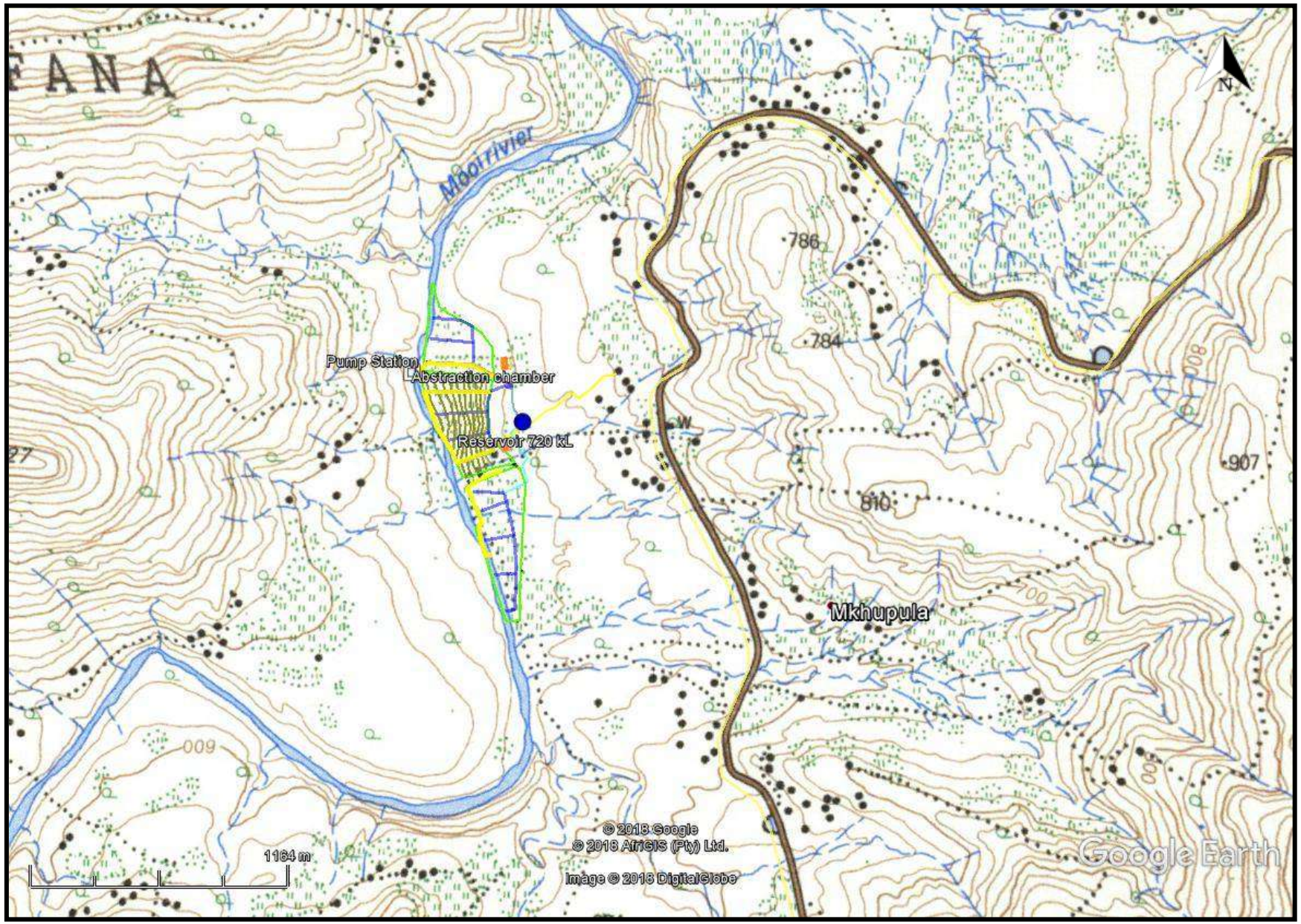
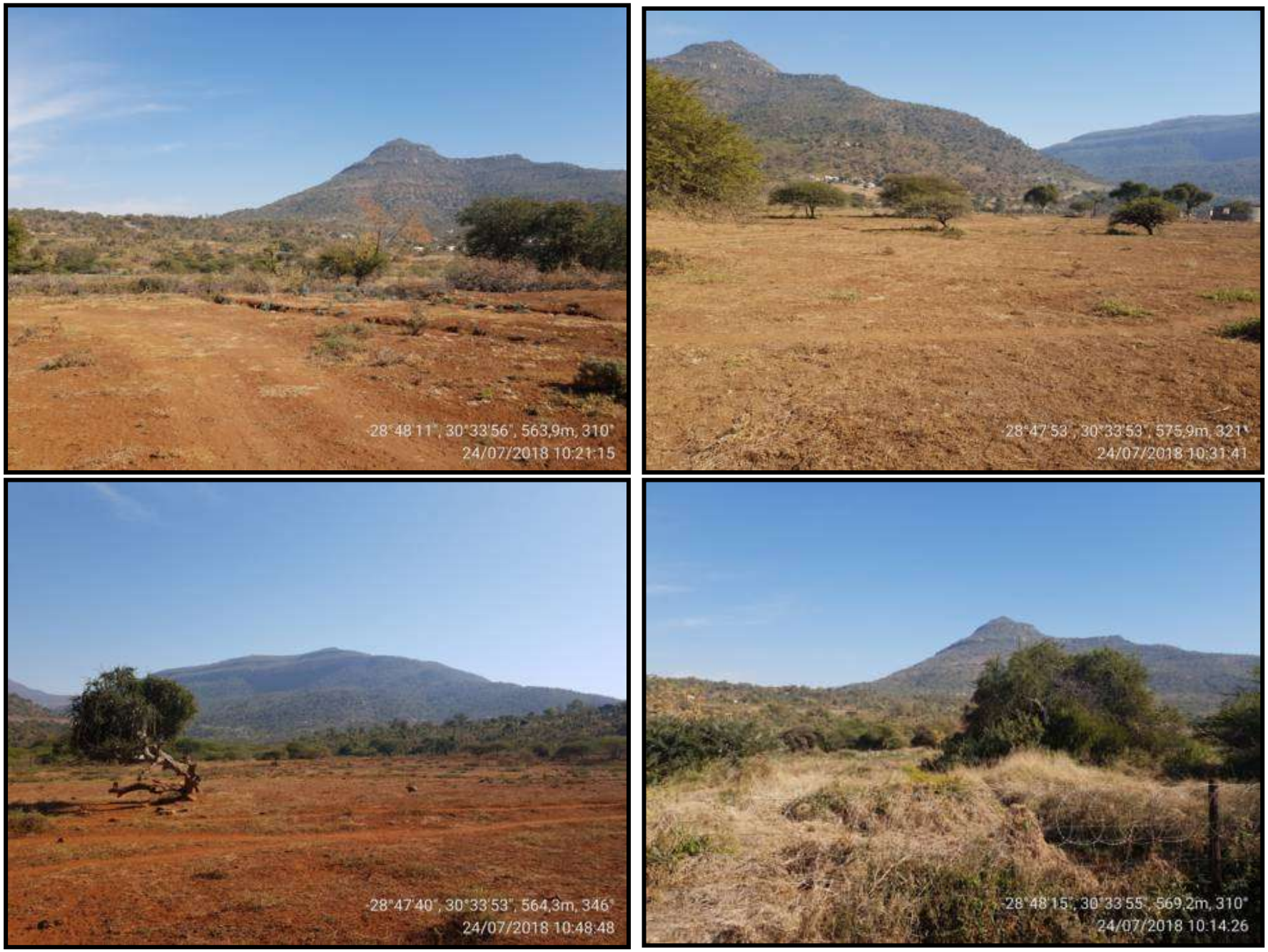


FIG. 4: SCENIC VIEWS OF THE PIPELINE ROUTE



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 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.

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

SITE SIGNIFICANCE	FIELD RATING	GRADE	RECOMMENDED MITIGATION
High Significance	National Significance	Grade 1	Site conservation / Site development
High Significance	Provincial Significance	Grade 2	Site conservation / Site development
High Significance	Local Significance	Grade 3A / 3B	
High / Medium Significance	Generally Protected A		Site conservation or mitigation prior to development / destruction
Medium Significance	Generally Protected B		Site conservation or mitigation / test excavation / systematic sampling / monitoring prior to or during development / destruction
Low	Generally		On-site sampling

Significance	Protected C	monitoring or no archaeological mitigation required prior to or during development / destruction

RESULTS

DESKTOP STUDY

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

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

The 1937 aerial photographs show that the area was already under intense cultivation and the settlements were further east near he base of the mountain. (fig. 6).

The 1963 1:50 000 topographical map indicates that the area is still an agricultural field (fig. 7). Only in 1976 (fig. 3) are there settlements in the area. Thus any graves etc will either be archaeological o r post-date 1976.

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

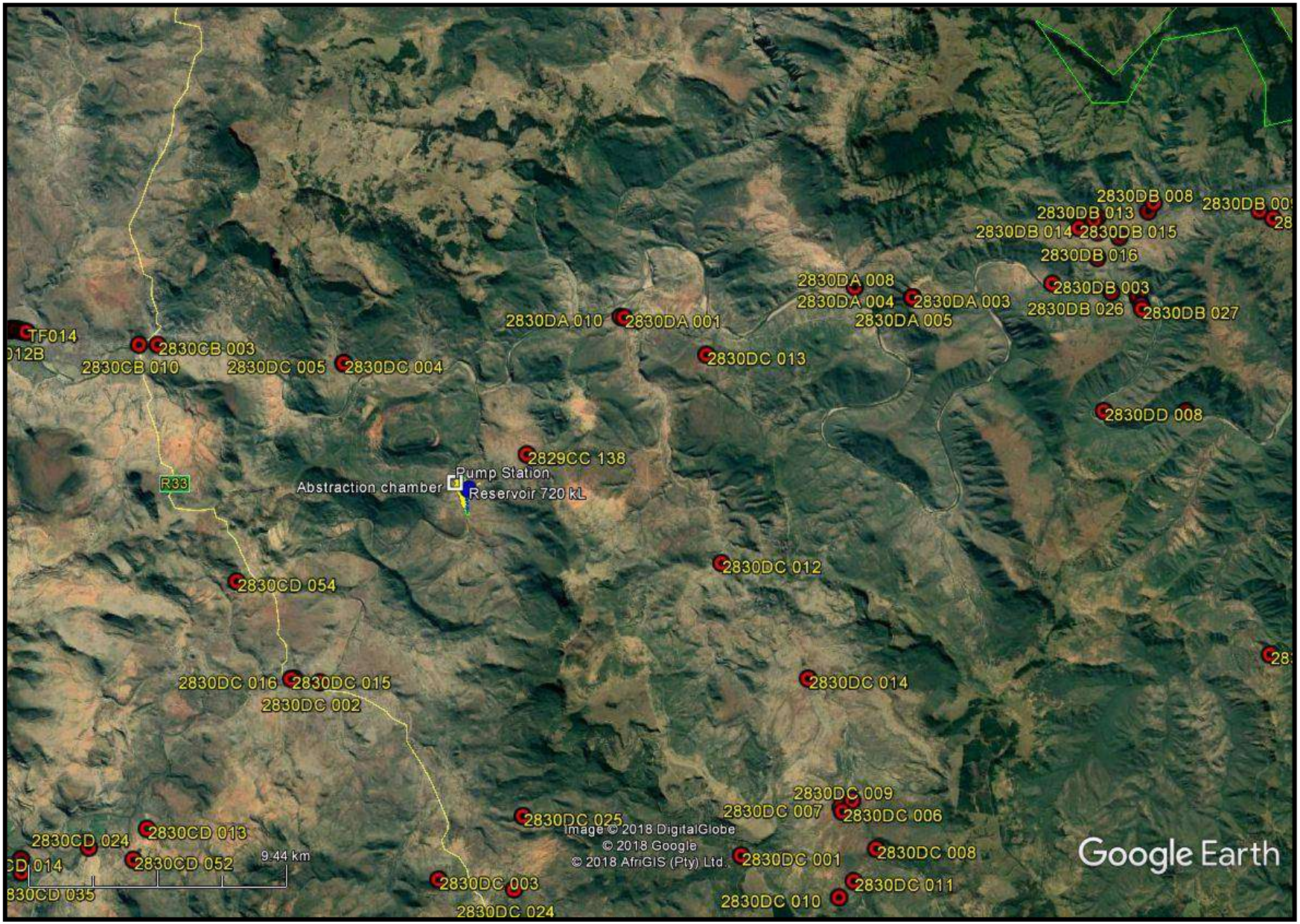
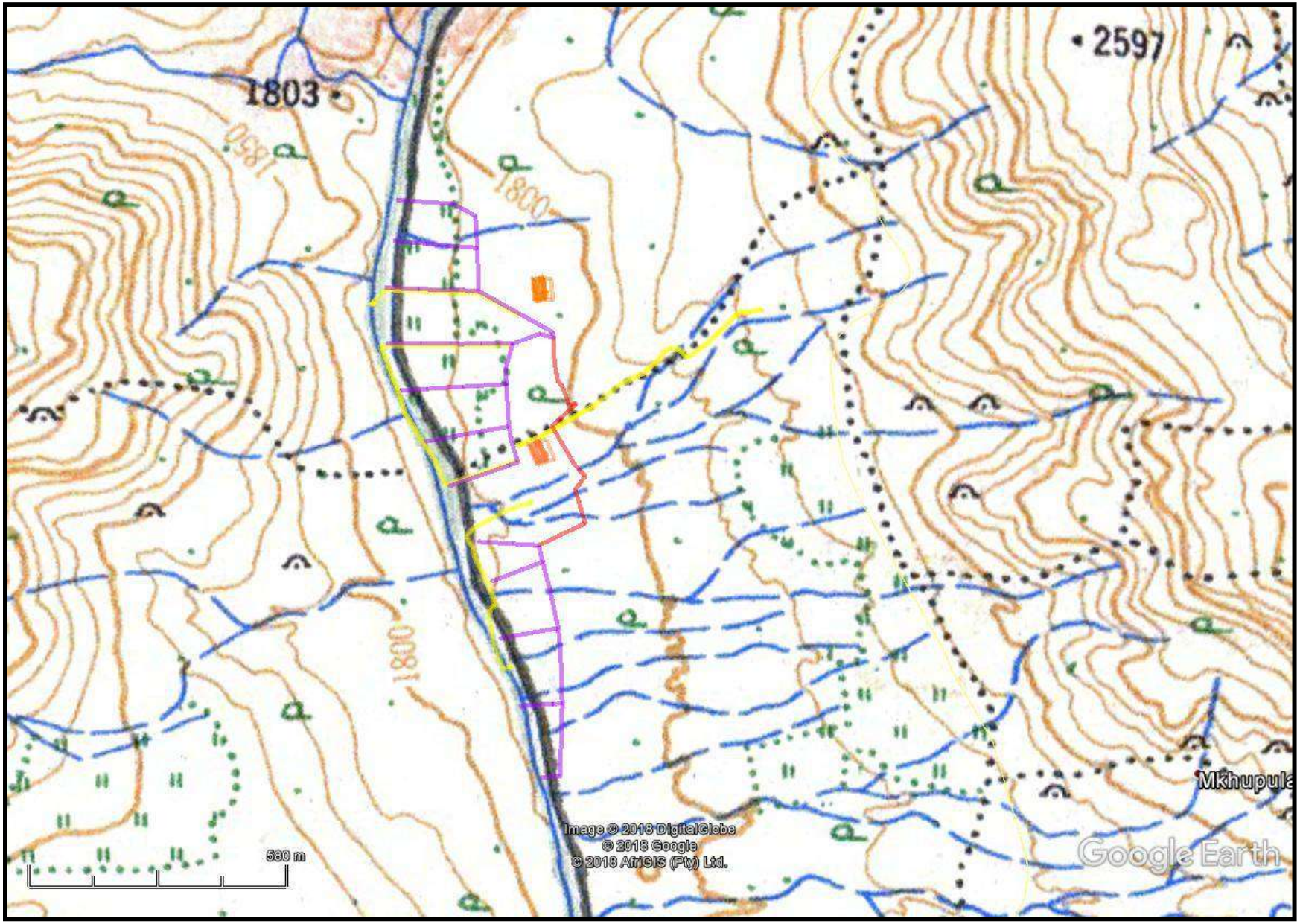


FIG. 6: STUDY AREA IN 1937

FIG. 7: STUDY AREA IN 1963



PALAEONTOLOGICAL IMPACT ASSESSMENT

The project area is underlain by Moderate sensitive rocks for Palaeontological Heritage. No significant fossils are expected in any formation at this stage of the development. However, if unweathered rocks are exposed during excavation the a qualified palaeontologist will be required to assess the area..

It is recommended that:

1. The EAP and ECO must be informed of the fact that a Moderate to Very Low sensitivity for Palaeontological sensitivity is allocated to large parts of study area underlain by Quaternary aged rocks that will most probably be very deeply weathered.
2. No further mitigation for Palaeontological Heritage is recommended for this project **before excavation of deeper than 1.5m is done**.
3. In areas where excavations **will exceed 1,5m** (see geotechnical reports) in the sections allocated a Moderate sensitivity, a suitably qualified palaeontologist must do a Phase 1 PIA and develop a “Chance Find Protocol” (CFP). This study must be done **during the first month of the planned excavation**.
4. Recommendations contained in the resultant Phase 1 PIA and CFP must be approved by AMAFA and SAHRA for inclusion in the EMPr of the project.
5. These recommendations must be included in the EMPr of this project.

FIG. 8: PALAEONTOLOGICAL SENSITIVITY MAP

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

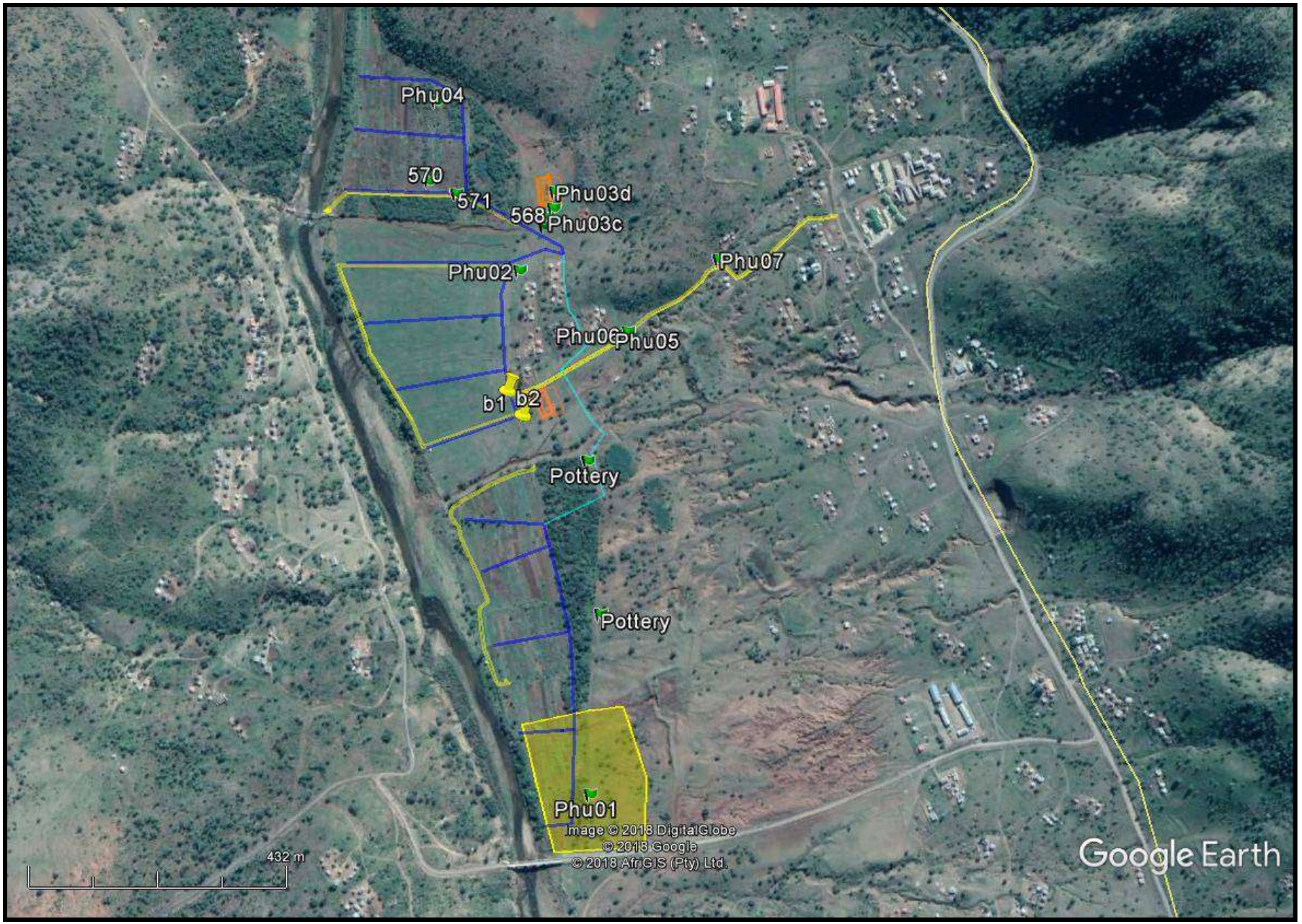
FIELD SURVEY

A field survey was undertaken in August 2018. Ground visibility was very good in most places, except on the edges of some fields that had dense thicket. Most of the agricultural fields have been systematically ploughed for several decades thus removing in archaeological or historical features that could have existed.

The entire area has a high density of stone tools that date to the MSA and LSA. All of these are in a secondary context. The stone tools are the generic stone tools for that period and no special or rare tools were noted. Similarly, pottery sherds were found scattered throughout the study area. These were thin-walled sherds with a brown to orange colour. Many of these were as single sherds and did not constitute a site. Individual upper grinding stones were located in the agricultural fields.

Only one area could be considered a site.

FIG. 9: LOCATION OF RECORDED SITES, FEATURES AND ARTEFACTS



PHU01

The site is located along the southernmost agricultural field. Although much of the site in the agricultural field has been disturbed, the area to the east appears to be less damaged. PHU01 consists of an extensive and dense scatter of artefacts over an area of ~250m x 100m (fig.10). The artefacts include:

- LIA pottery (undecorated)
    - Brown, black and orange burnish
    - undecorated
- Possible EIA pottery (thicker and more weathered than the others)
- Tuyere fragment with slag
- Upper grinding stone (for maize)
- LSA adze on MSA flake
- Utilised MSA flakes (mostly on hornfels)
- Utilised LSA flakes (on hornfels, quarts and CCS)

The high density of artefacts indicates that there will be subsurface features and an archaeological deposit.

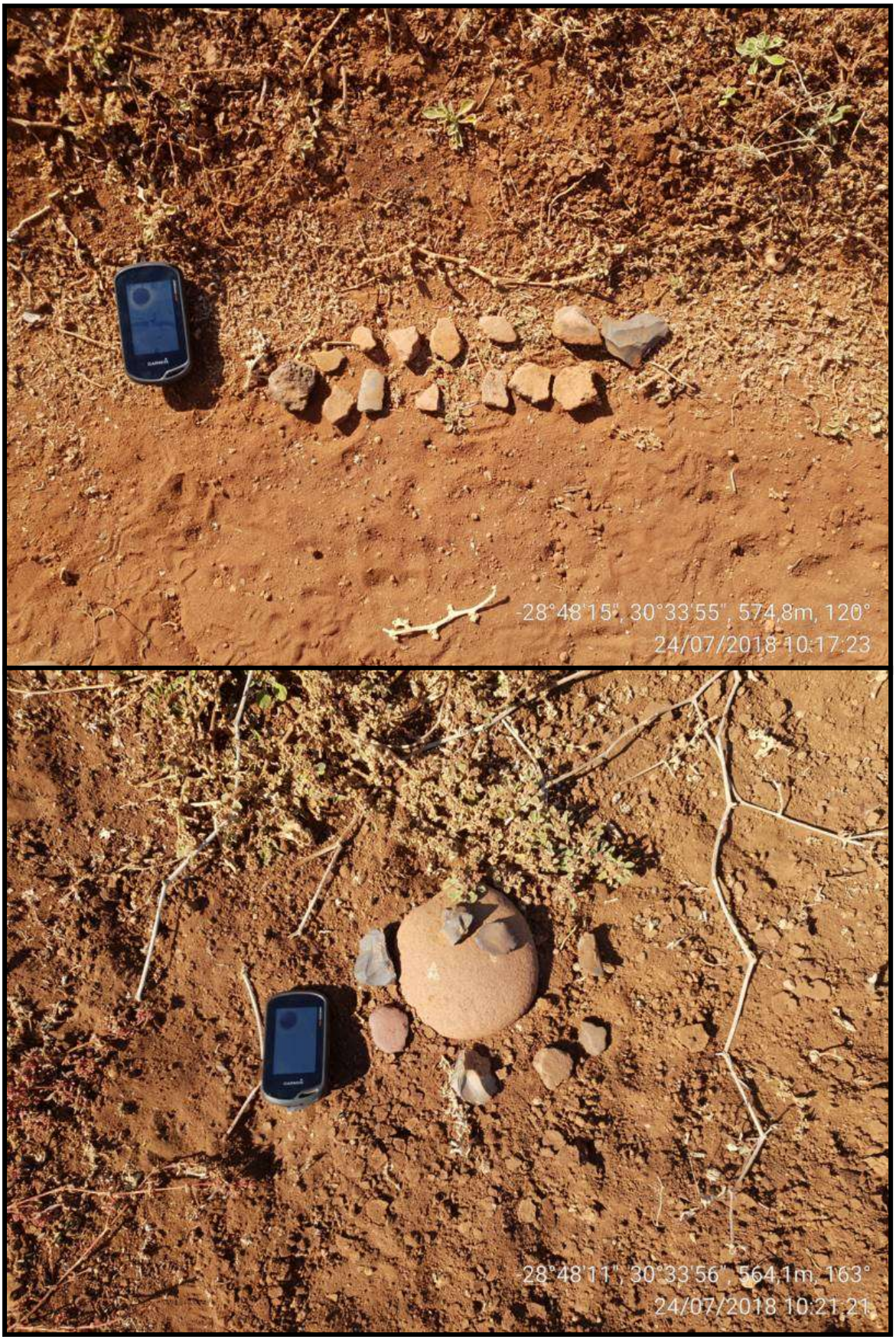
The irrigation pipeline will affect some of the site.

Significance: The site appears to be of medium significance.

Mitigation: Excavation trenches, roads, etc. that require more than 30cm of surface clearance, will need to be monitored by a qualified archaeologist. The archaeologist will need to note, and excavate, and features that occur in these trenches. A permit for sampling and excavations, as well as for partial damage to the site, will be required from Amafa KZN.

SAHRA Rating: 3B

FIG. 10: ARTEFACTS AT PHU01



PHU02

The site is located on the northern part of the study area just to the east of the central agricultural field. The site consists of two human graves in the form of stone cairns (fig.11).

The graves are ~25m away from the proposed pipeline and will not be directly be effected by the project...

Significance: The graves are of high significance.

Mitigation: The graves need to be demarcated before construction begins. There needs to be a 5m buffer between the demarcation and the edge of the grave. There needs to be a 20m buffer between the grave and any development.

SAHRA Rating: 3A

FIG. 11: TWO GRAVES AT PHU02

PHU03

The site is located t the northernmost part of the development in the location of the proposed 'Shed Option 2'. The site consists of a settlements with varies features. The site consists of a kraal (fig. 12), two possible graves (fig. 12 - 13), and a stone cairn (fig. 14). Amongst these features are pottery sherds and MSA flakes.

PHU03d will be effected by the 'Shed Option 2'. Shed Option 1 would be a better option in case the cairn is a grave.

Significance: The graves and cairn are of high significance.

Mitigation: The graves need to be demarcated before construction begins. There needs to be a 5m buffer between the demarcation and the edge of the grave. There needs to be a 20m buffer between the grave and any development. The stone cairn needs to be investigated to determine if it is indeed a grave. A Public Participation Process should assist in this. If the community does not recognise the cairn as a grave, then it needs to be monitored during construction activity.

SAHRA Rating: 3A

FIG. 12: PHU03a

FIG. 13: PHU03b

FIG. 14: PHU03c

FIG. 15: PHU03d

PHU04

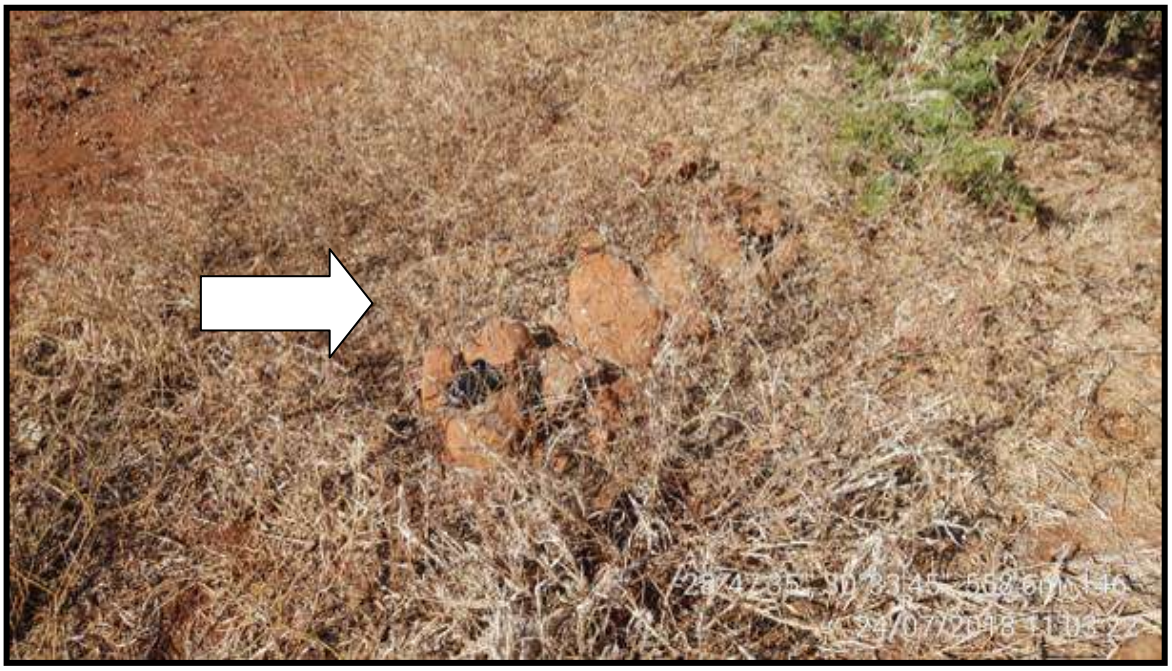
The feature is located in the northeastern section of the northern agricultural field. The feature consists of stone cairn that is either a grave or part of field clearance (fig. 16). The cairn will not be effected by the pipelines, but it might be effected by ploughing.

Significance: If the cairn is a grave then it is of high significance.

Mitigation: The graves need to be demarcated before construction begins. There needs to be a 5m buffer between the demarcation and the edge of the grave. There needs to be a 20m buffer between the grave and any development. The stone cairn needs to be investigated to determine if it is indeed a grave. A Public Participation Process should assist in this. If the community does not recognise the cairn as a grave, then it needs to be monitored during construction activity.

SAHRA Rating: 3A, if a grave

FIG. 16: STONE CAIRN AT PHU04



PHU05

The site is located on the eastern side of the study area. The site consists of five graves (fig. 17). The graves are stone cairns and in an east-west orientation.

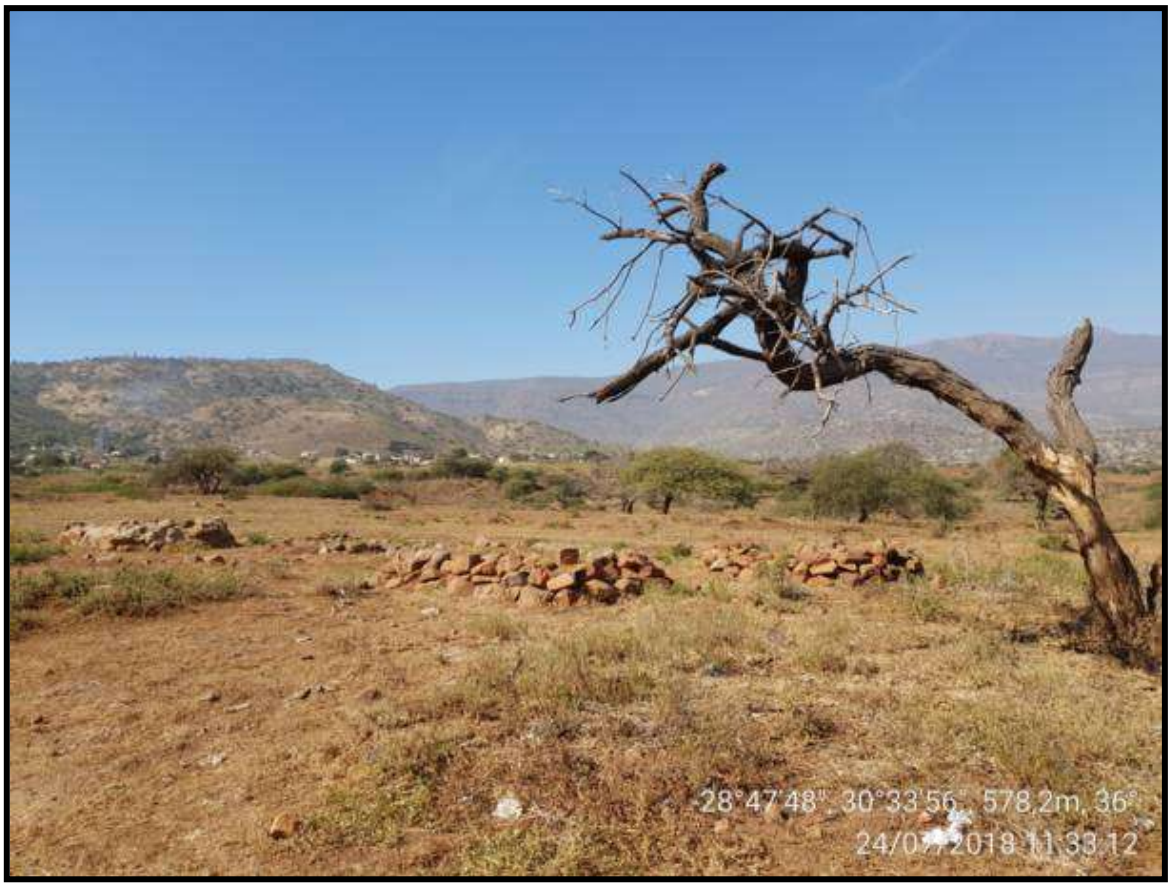
The graves will be effected by the access proposed road that occurs 2m – 5m to the south(east) of them.

Significance: The graves are of high significance.

Mitigation: The road will need to be moved to a new location or reburial is an option. There is a large erosion area and a donga to the east of the road that could be rehabilitated for the road, without effecting the graves.

SAHRA Rating: 3A

FIG. 17: GRAVES AT PHU05



PHU06

The site is located 30m northeast of PHU05. The site consists of single grave (fig. 18).

The proposed road will go through the grave.

Significance: The graves are of high significance.

Mitigation: The road will need to be moved to a new location or reburial is an option. There is a large erosion area and a donga to the east of the road that could be rehabilitated for the road, without effecting the graves.

SAHRA Rating: 3A

FIG. 18: GRAVE AT PHU06

PHU07

The site is located 30m northeast of PHU05. The site consists of single grave (fig. 19).

The road will occur 6m to the south of the grave.

Significance: The graves are of high significance.

Mitigation: The road will need to be moved to a new location or reburial is an option. There is a large erosion area and a donga to the east of the road that could be rehabilitated for the road, without effecting the graves.

SAHRA Rating: 3A

FIG. 19: GRAVE AT PHU07

MANAGEMENT PLAN

All graves that do not occur near the proposed road need to be clearly demarcated before construction begins. This should be done with the consent of living relatives and/or the Ward Councillor. The demarcation should occur 5m from the edge of the grave. There needs to be a 20m buffer between the grave and any development.

The graves that occur near the proposed road should not be damaged. The road should be relocated at least 20m from the graves. This will probably be difficult to achieve unless the donga and erosion areas are rehabilitated. Other road options will need to be assessed before grave removal is considered.

The site PHU01 needs to be monitored if any earthmoving activity occurs in the area of the site. This is where earthmoving activity, including trenching, will be deeper than 30cm. A permit from Amafa KZN will be required if this area is effected.

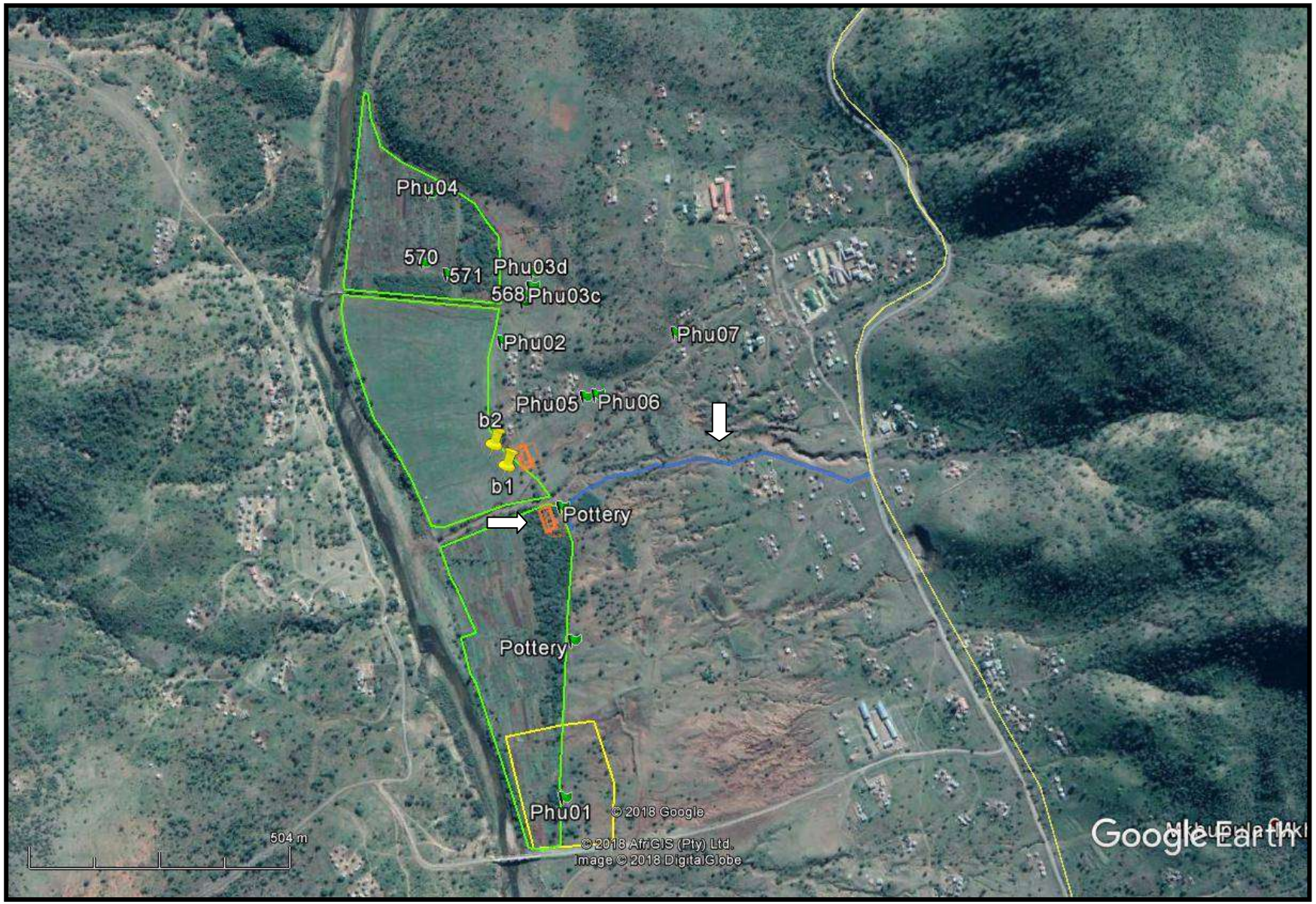
All excavations less than 1.5m in depth do not require a palaeontologist on site. However, where trenching is deeper than 1.5m, then a suitably qualified palaeontologist needs to survey the area. This is more important in the Dwyka Formations.

Subsequent to the field survey two changes were made as a result of the HIA study (fig. 20):

1. The northern shed was moved south into an area of previously cultivated land. Thus no (potential) graves will be effected.
2. The proposed road has been relocated further south to an area of a degraded, but existing, road.

These changes are accepted and do not damage archaeological sites.

FIG. 20: LOCATIONS OF RELOCATED SHED AND ROAD



CONCLUSION

A heritage survey was undertaken for the proposed Mkhuphula Irrigation Scheme, KZN. The scheme consists of supplying existing agricultural fields with a regular supply of water, and a shed for the storage of produce.

The HIA recorded seven heritage sites that occur within or near the proposed development. The site PHU01 is an extensive scatter of artefacts over a large area. This area may contain an archaeological deposit and features. A permit from Amafa KZN will be required if this area is effected.

Much of the area is in an area of moderate palaeontological sensitivity. However, the upper 1.5m of deposit is unlikely to yield fossil remains. A qualified palaeontologist will be required o inspect all trenches that exceed 1.5m in depth.

REFERENCES

Maps

75_1 of 1 Flight path 38, photo 06495

75_1 of 1 Flight path 39, photos 06507

2830DC Nadi 1963, 1980

Database

Natal Museum Site Record Database

SAHRA Database

Umlando 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.

Gavin Anderson
Archaeologist/Heritage Impact Assessor

APPENDIX A

PALAEONTOLOGICLA DESKTOP STUDY

DESKTOP PALAEONTOLOGICAL ASSESSMENT FOR THE PROPOSED MKHUPHULA IRRIGATION SCHEME DEVELOPMENT IN THE MSINGA LOCAL MUNICIPALITY, UMZINYAHTI DISTRICT MUNICIPALITY IN THE KWAZULU-NATAL PROVINCE.

FOR

Umlando

DATE: 29 August 2018

By

Gideon Groenewald
Cell: 078 713 6377

EXECUTIVE SUMMARY

Gideon Groenewald was appointed to undertake a Desktop Palaeontological Assessment survey for the proposed Mkhuphula Irrigation Scheme Development in the Msinga Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province.

The development is a well-planned irrigation scheme with water supply from the Mooi River. The main aim is to develop an intensive irrigation scheme and excavation into substrate formations will be part of the development. The entire development falls on hill wash and collovial cover of the Masotcheni Formation in KwaZulu-Natal with very deep, fertile soils, albeit enriched in some minerals due to the complex underlying geology that will not be affected by this development.

This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999 (revised 2017) as well as the KwaZulu-Natal Heritage Act No 4 of 2008. In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

The development site applicable to the application for the proposed Mkhuphula Irrigation Scheme Development in the Msinga Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province is underlain by Moderate sensitive rocks for Palaeontological Heritage.

No significant fossils are expected in any formation at this stage of the development and it is very important to note that a suitably qualified palaeontologist must visit all the sites indicated as Moderately sensitive only if obvious unweathered rocks are exposed during excavation for trenches and any suspiciously “bony” material is exposed. The Palaeontologist will depend to a large extent on the recording of Archaeological finds rather than only looking for Palaeontological Heritage.

If fossils are recorded the palaeontologist must prepare a “Chance Find Protocol” document for inclusion in the EMPr of the Project.

TABLE OF CONTENT

TABLE OF FIGURES

LIST OF TABLES

INTRODUCTION

Gideon Groenewald was appointed to undertake a Desktop Palaeontological Assessment survey for the proposed Mkhuphula Irrigation Scheme Development in the Msinga Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province.

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Legal Requirements

This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999 (revised 2017) as well as the KwaZulu-Natal Heritage Act No 4 of 2008. In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

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

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

Aims and Methodology

A 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 information (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

PALAEONTOLOGICAL SIGNIFICANCE/VULNERABILITY OF ROCK UNITS	
The following colour scheme is proposed for the indication of palaeontological sensitivity classes. This classification of sensitivity is adapted from that of Almond et al (2008) and Groenewald et al., (2014)	
RED	Very High Palaeontological sensitivity/vulnerability. Development will most likely have a very significant impact on the Palaeontological Heritage of the region. Very high possibility that significant fossil assemblages will be present in all outcrops of the unit. Appointment of professional palaeontologist, desktop survey, phase I Palaeontological Impact Assessment (PIA) (field survey and recording of fossils) and phase II PIA (rescue of fossils during construction) as well as application for collection and destruction permit compulsory.
ORANGE	High Palaeontological sensitivity/vulnerability. High possibility that significant fossil assemblages will be present in most of the outcrop areas of the unit. Fossils most likely to occur in associated sediments or underlying units, for example in the areas underlain by Transvaal Supergroup dolomite where Cenozoic cave deposits are likely to occur. Appointment of professional palaeontologist, desktop survey and phase I Palaeontological Impact Assessment (field survey and collection of fossils) compulsory. Early application for collection permit recommended. Highly likely that a Phase II PIA will be applicable during the construction phase of projects.
GREEN	Moderate Palaeontological sensitivity/vulnerability. High possibility that fossils will be present in the outcrop areas of the unit or in associated sediments that underlie the unit. For example areas underlain by the Gordonia Formation or undifferentiated soils and alluvium. Fossils described in the literature are visible with the naked eye and development can have a significant impact on the Palaeontological Heritage of the area. Recording of fossils will contribute significantly to the present knowledge of the development of life in the geological record of the region. Appointment of a

	professional palaeontologist, desktop survey and phase I PIA (ground proofing of desktop survey) compulsory.
BLUE	Low Palaeontological sensitivity/vulnerability. Low possibility that fossils that are described in the literature will be visible to the naked eye or be recognized as fossils by untrained persons. Fossils of for example small domal Stromatolites as well as micro-bacteria are associated with these rock units. Fossils of micro-bacteria are extremely important for our understanding of the development of Life, but are only visible under large magnification. Recording of the fossils will contribute significantly to the present knowledge and understanding of the development of Life in the region. Where geological units are allocated a blue colour of significance, and the geological unit is surrounded by highly significant geological units (red or orange coloured 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.

GREY	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 implacement 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.

When rock units of Moderate to Very High Palaeontological sensitivity are present within the development footprint, palaeontological mitigation measures must be incorporated into the Environmental Management Plan. A suitably qualified Palaeontologist must clear all projects falling on Low to Very Low Palaeontological sensitive geology.

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 proposed Mkhuphula Irrigation Scheme Development in the Msinga Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province is situated northwest of Mkhupula to the north of Greytown.

The development falls in undisturbed rural terrain underlain by sandy and clayey soils of mainly weathered rocks of the Masotcheni Formation.

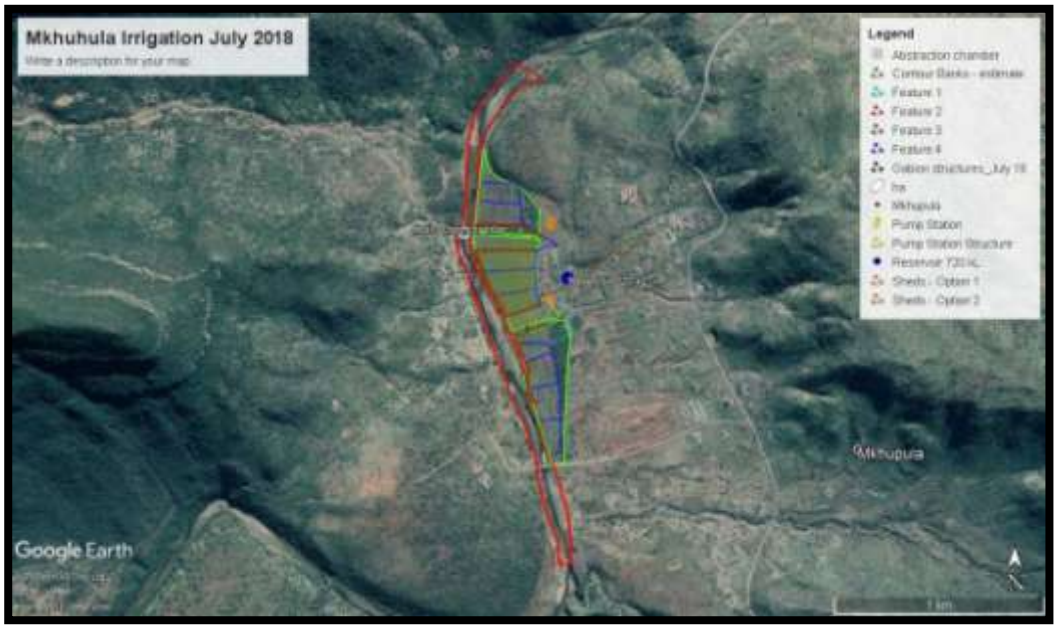

Figure 1 Locality of the Mphukhula Irrigation Development

The general proposal for the development is a dominantly small holding development with irrigation plots with intensive irrigation works (Figure 1).

GEOLOGY

The site of the development falls on very deep sand and clay from deeply weathered material of Quaternary aged Masotcheni Formation. Karoo Supergroup (Figure 3) (Johnson et al, 2009; Groenewald, 2012). The project spans a complex geology but is dominated by very large areas that are deeply weathered and that will be disturbed by agriculture.

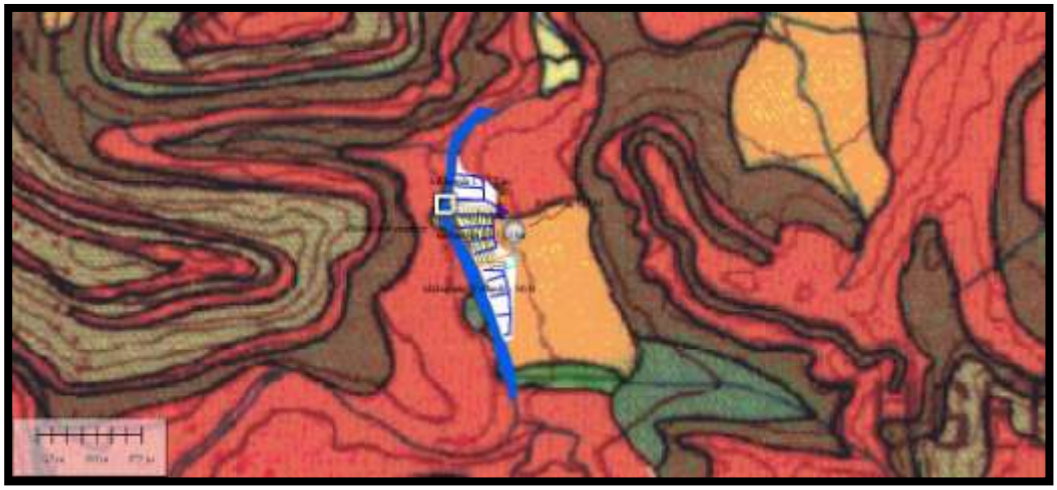

Figure 2 Geology underlying the Mkhuphula Irrigation Scheme all belongs to the Masotcheni Formation

Masotcheni Formation (Qm)

Large areas of the colluvial cover of all the footslopes in this part of KwaZulu-Natal are covered in a blanket of alluvial sand and erodedmaterial from surrounding dolerite outcrops (Figure 2) (Wolmarans and Du Preez, 1986; Johnson et al, 2006).

PALAEONTOLOGY

Masotcheni Formation (Qm)

No significant fossils have been recorded from the Masotcheni Formation to date, but in previous studies in the area the author has recorded some significant indications of dark soils and material that could contain significant Palaeontological Heritage. The best way to keep track of possible fossils in the Masotcheni Formation will be to follow very closely on the findings of the Archaeological Teams on site. The chance find of significant Quaternary aged fossils is very high if these are in association with any other more “recent” remains on the site.

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 relatively deep (>2m) clay soil associated with Quaternary aged fossilliferous units (Figure 3).

The areas underlain by Moderately sensitive rocks for Palaeontological Heritage underlies the site, whereas most of the area surrounding the actual active developement are underlain by Jurassic aged igneous rocks with a Low to Very Low significance of containing significant fossils (Figure 3).

The fact that the development entails low impact excavation for the installation of pipelines and local excavation that will exceed 1,5m, parts of the development might result in deep (>1.5m) excavations into the sandy soil that can contain fossils that have not previously been recorded in KwaZulu-Natal. It does not indicate that no fossils will be present.

It is not recommended that a phase 1 PIA be done **before** excavation exposed significant trenching deeper than 1,5m. It is however, important that the ECO reports any suspicious looking material for inspection by a suitably qualified HIA and/or PIA specialist.

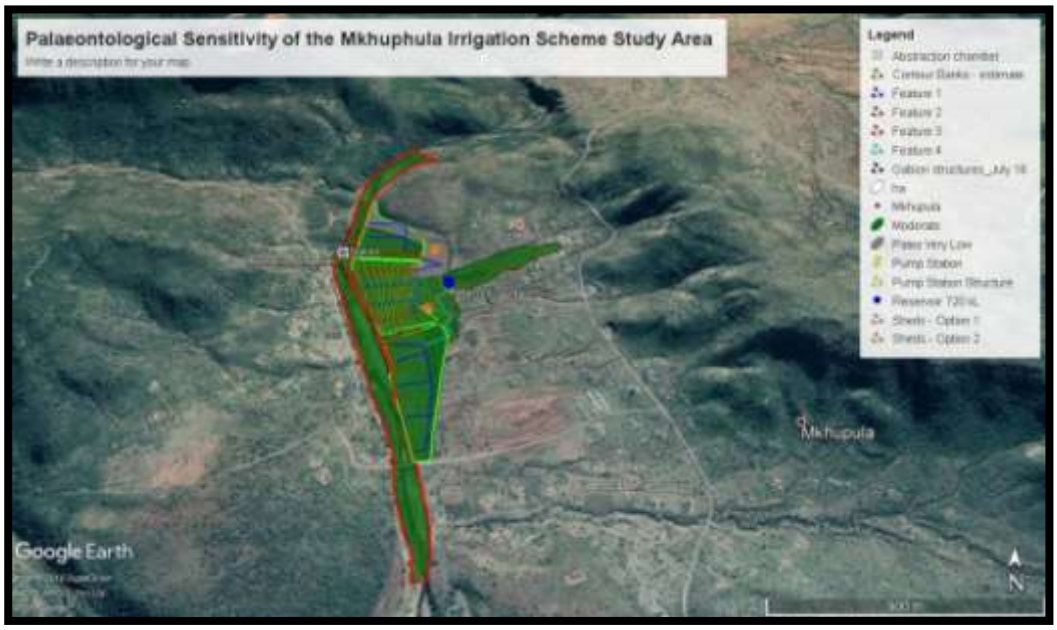

Figure 3 Palaeontological sensitivity of the material underlying the Mkhuphula Irrigation Scheme

No further mitigation for Palaeontological Heritage is recommended at this stage for this project. It is however recommended that a suitably qualified Palaeontologist be appointed to do a Phase 1 PIA during the time of excavation into the subsoils and rocks on site if suspicious looking (bony?) sediments are exposed in the Masotcheni Formation. The ECO must be vigilant and if fossils are recorded during the construction period, the appointed Palaeontologist must be on site at least **once a month during large scale excavations** into Quaternary aged formations.

If any fossils are unexpectedly recorded during excavations of more than 1.5m depth, and specifically in sections allocated a green (Moderately sensitive) color (Figure 3), the palaeontologist must prepare a "Chance Find Protocol" (CFP) within the first week of exposure of these rocks in the entire study area. This CFP report must be included into the EMPr of the project and upgraded continuously during the construction phase where excavations of deeper than 1,5m are planned for this project.

CONCLUSION

The development site applicable to the application for the proposed Mkhuphula Irrigation Scheme Development in the Msinga Local Municipality, Umzinyathi District Municipality, Kwazulu-Natal Province is underlain by Moderate sensitive rocks for Palaeontological Heritage.

No significant fossils are expected in any formation at this stage of the development and it is very important to note that a suitably qualified palaeontologist must visit all the sites indicated as Moderately sensitive only if obvious unweathered rocks are exposed during excavation for trenches and any suspiciously "osteological" material is exposed. The Palaeontologist will depend to a large extent on the recording of Archaeological finds rather than only looking for Palaeontological Heritage.

If fossils are recorded the palaeontologist must prepare a "Chance Find Protocol" document for inclusion in the EMPr of the Project.

It is recommended that:

- The EAP and ECO must be informed of the fact that a Moderate to Very Low sensitivity for Palaeontological sensitivity is allocated to large parts of study area underlain by Quaternary aged rocks that will most probably be very deeply weathered.
- No further mitigation for Palaeontological Heritage is recommended for this project **before excavation of deeper than 1.5m is done**.
- In areas where excavations **will exceed 1,5m** (see geotechnical reports) in the sections allocated a Moderate sensitivity, a suitably qualified palaeontologist must do a Phase 1 PIA and develop a "Chance Find Protocol" (CFP). This study must be done **during the first month of the planned excavation**.

Recommendations contained in the resultant Phase 1 PIA and CFP must be approved by AMAFA and SAHRA for inclusion in the EMPr of the project.

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

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QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeo-ecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

DECLARATION OF INDEPENDENCE

I, Gideon Groenewald, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of palaeontological heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

Dr Gideon Groenewald
Geologist

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