HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED ESTABLISHMENT OF A 1.87 MILLION M³ DAM & THE CULTIVATION OF MULTIPLE FIELDS TOTALLING APPROXIMATELY 190ha ON REM OF EXPRESS No. 15029, REM OF HEAVITREE No. 15976, FARM PORTION No. 18322 AND FARM PORTION GS No. 17935 NEAR FRERE, INKOSI LANGALIBALELE LOCAL AND uTHUKELA DISTRICT MUNICIPALITY, KWAZULU-NATAL

Gary Trower

P.O. Box 2878

Welkom

9460

PhD candidate (Archaeology) University of the Witwatersrand

Masters (Environmental Management) University of the Free State, 2010

Honours (Palaeontology) University of the Witwatersrand, 2007

Majors (Botany, Zoology, Archaeology) University of Cape Town, 1999

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Declaration of Consultants independence

I, Gary Trower, am an independent consultant and have no business, financial, personal or other interest in the proposed development project in respect of which I was appointed to do a heritage impact assessment, other than fair remuneration for work performed. There are no circumstances whatsoever that compromise the objectivity of this specialist performing such work.

Gary Trower

Introduction

The applicant, Heavitree (Pty) Ltd, wishes to obtain environmental authorization to cultivate several fields as well as to build a dam on the Heavitree and Eden Farms near Frere, KwaZulu-Natal. The site is located to the south of Frere, across several properties to the east and west of the N3 which have been used for agricultural purposes for several decades (Figure 1 & 2). These include Rem of Express No. 15029, Rem of Heavitree No. 15976, Portion 9 of Greenford No. 2125, Farm Portion No. 18322, and Farm Portion GS No. 17935. The development will include the establishment of a large dam totalling 1.87 million m^3 with a wall height of 18.26m, as well as pipelines and pump houses to irrigate multiple cultivated fields totalling roughly 190 hectares. Most of these fields have previously been ploughed, although several hectares have not been cultivated before and will involve the removal of indigenous vegetation.

The proposed site footprint is located within an area where the underlying geology is given a high (red) and moderate (green) palaeo-sensitivity rating on the SAHRIS map (www.sahra.org.za/sahris/map/palaeo), and these deposits are very likely to contain some palaeontological material. The area also has known Iron Age sites and a rich historical background including an old railway station and Anglo-Boer War sites. A heritage impact assessment was thus necessary to evaluate whether any fossils or any other heritage-related material could be located within the boundaries of the proposed development, and whether any mitigation measures would be necessary.

In terms of the National Environmental Management Act 107 of 1998 and Section 38 (8) of the National Heritage Resources Act 25 of 1999 (sections 34-36), all aspects of heritage are protected. Proposed developments that are likely to impact on heritage resources (i.e. historical, archaeological, palaeontological & cosmological) require a desktop and/or field

assessment to gauge the importance of such resources in order to ensure that such sites are not damaged or destroyed by developments which could negatively impact them. Identified heritage resources should be recorded through detailed documentation, mitigation measures applied if resources are threatened, or collection and/or a rescue excavation carried out if necessary.

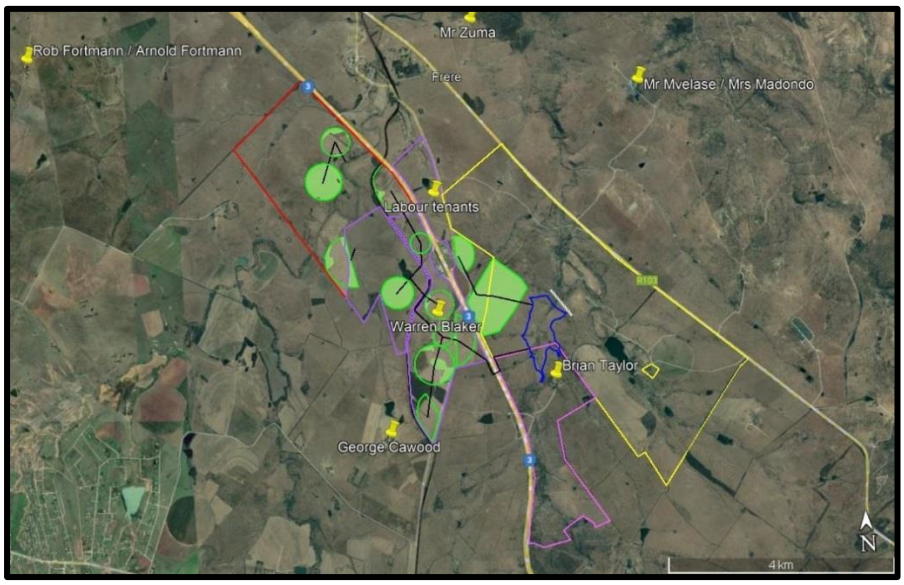

Figure 1: Satellite image showing the layout of the site footprint, located to the east and west of the N3 highway. The green patches indicate fields proposed for cultivation whereas the blue area indicates the location where the 1.87million m³ dam will be built. Modified from Google Earth, AfriGIS 2022

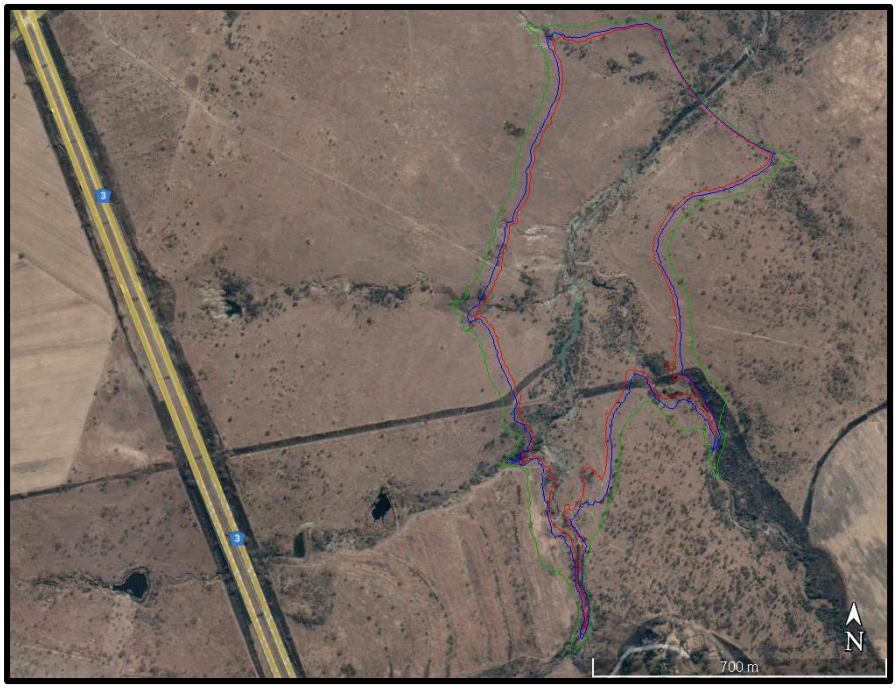

Figure 2: Satellite image showing the layout of the site footprint for the proposed dam. The blue, red and green lines indicate the different water levels of the dam. Modified from Google Earth, AfriGIS 2022

Geology

Rocks of the Karoo Basin are rich repositories for palaeontological material, necessitating measures to minimize activities which may disturb or destroy fossils preserved in underlying beds. The geology in the area of the proposed development consists of Middle to Late Permian deposits of the Adelaide Subgroup of the Beaufort Group (Figure 3). The stratigraphic sequence making up this Subgroup accumulated as sediments originating from a radial-type network of drainages spread across Gondwana entering into a giant inland sea. These sediments predominantly comprise of greenish-grey to blueish-grey mudstone, as well as silstone, sandstone and dark-grey shale (which is often carbonaceous), representing tranquil depositional settings such as an overbank or floodplain environment. These deposits could preserve trace fossils, as well as insect, plant and vertebrate fossils (especially therapsid fossils).

These deposits form an important component and subdivision of the stratigraphy of the Karoo Supergroup, an extensive inland basin which preserves a rich array of fossil plants, insects, fish and tetrapod fauna which existed through the Carboniferous, Permian, Triassic and Jurassic of southern Gondwana (Rubidge 2005, Smith *et al*. 1993). The existence of a depositional environment in this palaeo-landscape means that fossil lifeforms which flourished during the Permian may be present within these geological units, and this is also the reason why this sedimentary package has a high palaeo-sensitivity rating of red (Fig.4).

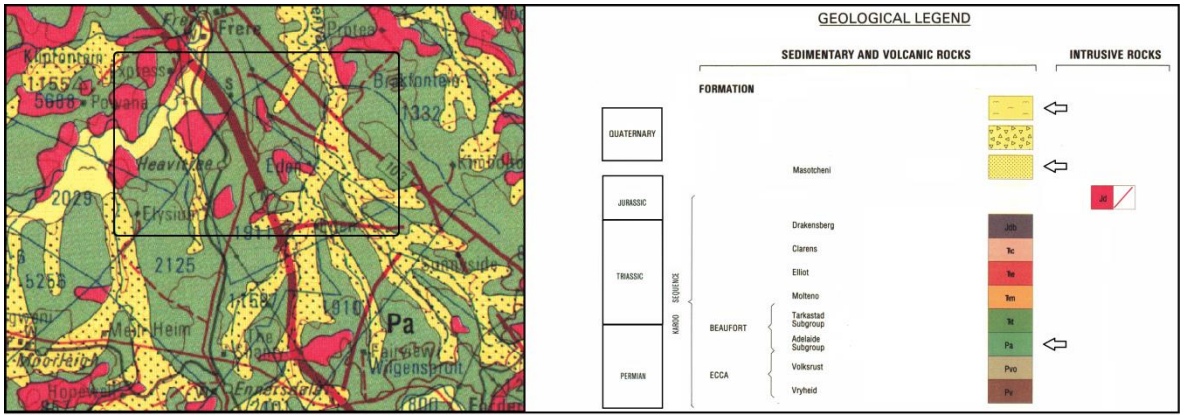

Figure 3: Map showing the geology of the region, with the location of the proposed dam and cultivated fields occurring within the inner black rectangle. The green patches represent the Adelaide Subgroup of the Beaufort Group (Pa), deposits which are Late Permian in age, whereas the yellow patches represent Quaternary deposits. The pink patches of rock represent dolerite, which are Jurassic in age. Modified from 2828 Harrismith, 1:250 000 Geological Series, Council for Geoscience, 1981

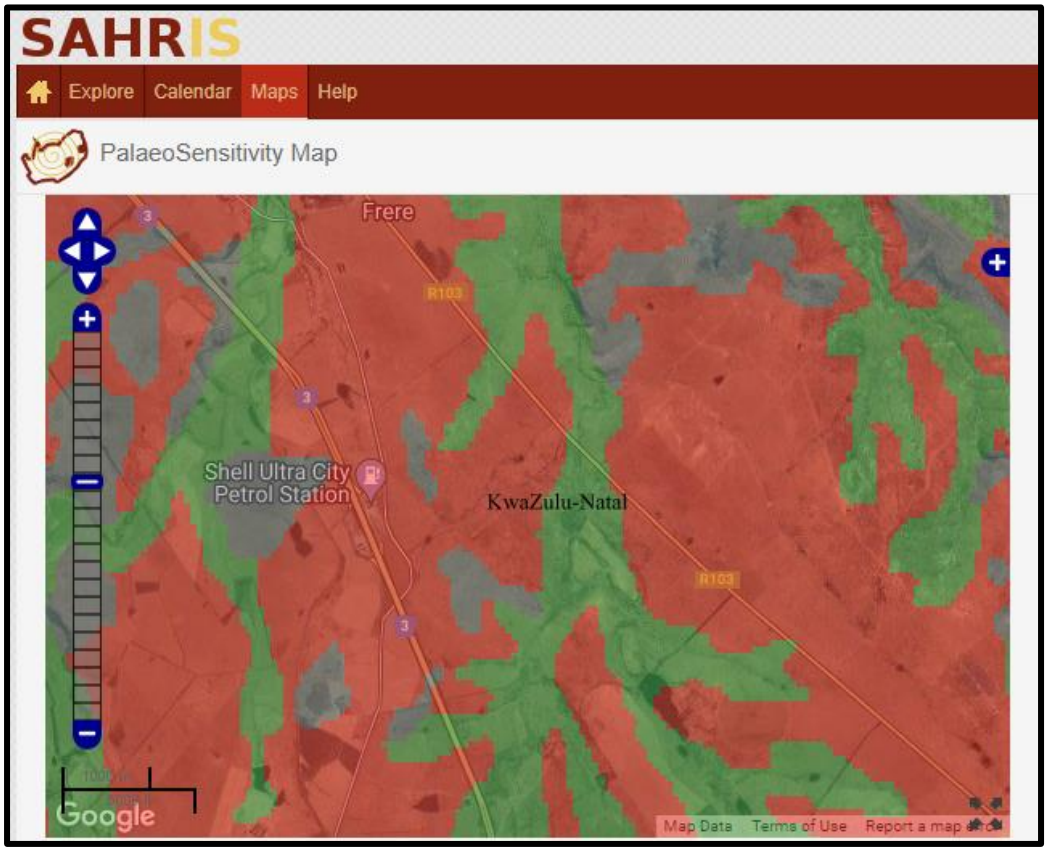

Figure 4: Map of how the geology in Fig.3 translates into palaeo-sensitivity. The geological unit which occurs beneath the site footprint has a ranking of red and corresponds to the Adelaide Subgroup of the Beaufort Group, a rock type which has a high likelihood of significant fossil occurrences. The green patches have a moderate palaeo-sensitivity and represent Quaternary alluvial deposits, whereas the blue-grey patches (dolerite) are of no palaeontological significance. Modified from the SAHRIS map, www.sahra.org.za/sahris/map/palaeo

Site observations

The site footprint is located to the east and west of N3 highway, close to the town of Frere at GPS coordinates 29º 21' 46.07" S, 29º 59' 26.73" E (Figure 1 & 2). Before the ground survey took place an aerial survey of the site was first carried out using Google Earth, and the relevant geology map of the area (2828 Harrismith) and the SAHRIS palaeo-sensitivity map were also consulted. These were all used in combination to gain an understanding of the site features, as well as the underlying bedrock within the site footprint and how it ranked in terms of possible fossil occurrences.

The area has a rich historical (railway; Anglo-Boer War) and archaeological record, increasing the chances that artefacts or built structures could be present. The site footprint comprised of flatter areas as well as gently sloping hills. Due to the fact that large portions of the footprint comprise of previously cultivated fields and that the soil column caps the bedrock, no rocks were exposed at the surface within the boundaries of the majority of site footprint and as a result, no fossil material was observed during this part of the survey (Figure 5-10). Only at the site of the proposed dam was bedrock exposed as a result of the erosional activity of the stream (Figure 11-14). The bedrock adjacent to the stream, as well as the eroding topsoil which slopes down towards the stream, were examined for fossil and archaeological material. The occasional flaked stone was noted eroding out of the small dongas adjacent to the stream but besides two blades none of these were formal tools (Figure 15-18). The concentration of lithics was very low and they were randomly scattered, and there was no evidence of any Stone Age archaeological sites.

No fossils could be located within the bedrock of the streambed. Along the river there were several dolerite sills running perpendicular to the direction of the water flow, which formed natural dam walls (Figure 14). At one such location, at the contact zone between the Permian

sedimentary rock and Jurassic igneous rock, a slab of dolerite revealed what appeared to be a fusion between cooling lavas and petrified wood (Figure 19 & 20). This could represent a trace of metamorphosed bedrock along the plane of the intrusion, or friction-welding between the intrusive lavas and the existing bedrock. The material stuck to the dolerite does however have a strong resemblance to the outer surface of petrified wood. This could therefore represent a buried petrified tree fragment within the sedimentary rock which was lying directly adjacent to the intrusive lavas.

Another feature noted during the ground survey was several rocks packed adjacent to each other, which did not appear to be natural (Figure 21 & 22). It was not clear what this feature represented, although it superficially resembled the stones packed on top of graves (GPS coordinates 28° 56' 07.4" S, 29° 47' 40.3" E). The stones were most likely used to stabilise the soil to prevent erosion or to slow the water flow and channel it down towards the river. This feature could be fairly modern and will not be affected by the proposed dam as the water level will not reach these placed stones even when the dam is filled to capacity.

Further extensive examination of the site using Google Earth revealed features not visible during the site visit. It was the rainy season during the time of the ground survey, so the grass was tall and greatly reduced the visibility of the ground surface. However, by sliding the time bar on Google Earth back to a period when the grass was short and had been burnt before the start of the summer rains (October 2009), certain landscape features became visible. The most interesting of these features was what appeared to be the remains of an Iron Age settlement, located at GPS coordinates 28° 56' 08.13" S, 29° 48' 01.46" E, comprising of several circular structures on the eastern side of the stream (Figure 23). A rectangular feature, which could be more recent in age, was noted on the western side of the stream at GPS coordinates 28° 56' 01.94" S, 29° 47' 36.45" E (Figure 24 & 25). The rectangular feature will not be affected by the dam construction, but the maximum water level (green line) proposed

in the engineer's current plans will come to within 25 metres from the possible Iron Age circular structures. One circular stone feature, possibly a kraal, will however be submerged by the water of the dam at GPS coordinates 28° 56' 00.50" S, 29° 48' 05.27" E (Figure 26).

In addition, this earlier view of the site from 2009 (when it had been burnt and was more open) revealed two rows of boulders located along the north-eastern edge of the proposed dam wall at GPS coordinates 28º 56' 00.5" S, 29º 48' 09.9" E (Figure 27 & 28). The foot survey was able to establish that this cluster of boulders contained several engraved rocks. Most of the engravings were semi-circular to circular in shape, although there were also a few that were other shapes (Figure 34-37). These appear to be Iron Age engravings as they resemble other known examples, and the sites where these have previously been found are located within the same region. Additional engravings may be located on the rocks of the hill making up the north-western corner of the dam wall (Figure 29-33), as well as on the nearby hill located in the north-eastern corner of the proposed cultivated field of 85 hectares.

Figure 5-10: Several fields showed evidence of having been previously ploughed (top left & right and centre left, Fig.5-7); with one of them being actively ploughed whilst on site (centre right, Fig.8). The satellite images reveal that a small portion of the proposed 85ha field has previously been ploughed but the majority of it comprises of indigenous vegetation (bottom left & right, Fig.9 &10)




Figure 11-14: Along the river several rock types were observed. Most of the exposed rock surfaces comprised of sandstone and mudstone, but no fossils were recorded within these strata. Several dolerite sills ran perpendicular to the river flow, creating natural dam walls (Fig.14)


Figure 15 & 16: Adjacent to the stream were small dongas containing concrete nodules. No Quaternary fossils were observed within these deposits and they were almost completely sterile except for a few flaked stones, but these were not common and were randomly scattered with few formal tools recorded

Figure 17 & 18: One flake blade (left) and a bladelet (right) were recorded. These generally serve as cutting tools (stone knives) but can also function as a scraping-type implement

Figure 19 & 20: Adjacent to the stream an unusual geological phenomenon was observed. Cooling intrusive lavas had apparently come into contact with petrified wood. Shown in the pictures is what appears to be a piece of petrified wood fused to the dolerite surface, although it could also represent a piece of metamorphosed bedrock from the contact zone

Figure 21 & 22: Several rocks were observed that were packed into a type of paving, superficially resembling graves seen on previous surveys but probably created as an anti-erosion measure to slow the water flow and channel it downhill (GPS coordinates 28° 56' 07.4" S, 29° 47' 40.3" E)

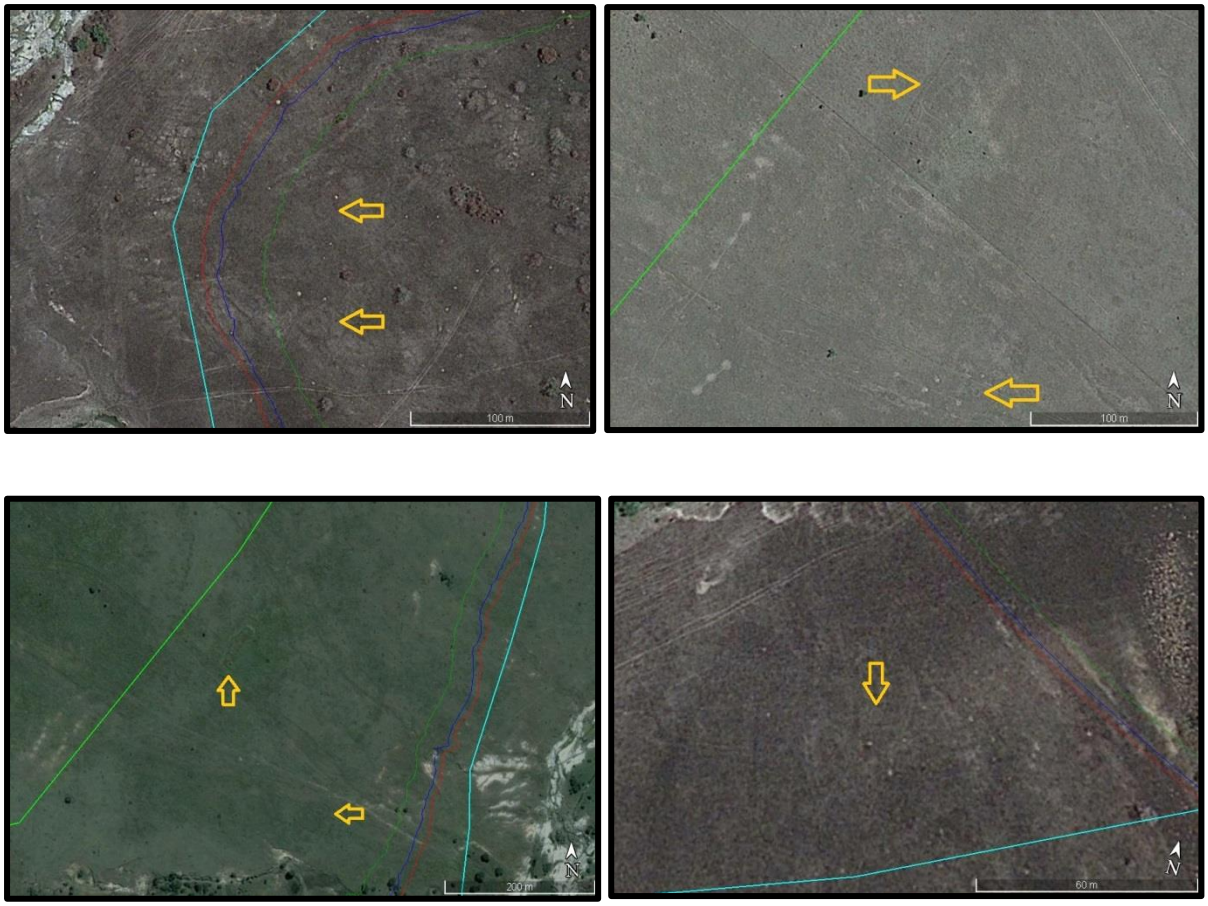

Figure 23 - 26: Various features not visible during the site survey were observed through the use of earlier satellite images (2009) taken in the dry season or after the veld had been burnt. Fig.23 appears to show the remains of an Iron Age village, with several circular stone-walled structures visible (28° 56' 08.13" S, 29° 48' 01.46" E). Fig.24 & 25 (top right, 2009 & bottom left, 2022) shows a rectangular structure, possibly historical in age (28° 56' 01.94" S, 29° 47' 36.45" E), as well as a circular feature visible in the bottom of the images (28° 56' 07.15" S, 29° 47' 37.04" E). Fig.26 (bottom right) shows another circular structure, likely a stone-walled kraal, which will be flooded by the dam (28° 56' 00.50" S, 29° 48' 05.27" E)

Figure 27 & 28: Another feature which was not easily discernible on the satellite image due to the long grass was the patch of boulders containing the petroglyphs, located at GPS coordinates 28° 56' 00.5" S, 29° 48' 09.9" E. In the current view of the landscape (2022, Fig.27), this area is marked with a yellow rectangle with the light blue line showing the original layout of the dam before building plans were revised. As can be seen in the image, with the old layout this area would have been almost completely submerged. Also visible in this image are three dolerite sills crossing the river at 90°, forming natural dam walls. Fig.28 (2009, right) shows the old dam layout (light blue), with the new layout indicated with the green, red and dark blue lines. The yellow polygon shows the patch of boulders containing the rock art clearly visible in 2009 when the grass had been burnt. The orange line shows the proposed revision of the position of the dam wall so as to avoid the petroglyphs

Figure 29 - 33: The dam will be built by incorporating an existing sill into the structure, and by connecting two hills on the opposite sides of the small valley with an arched dam wall. In Fig.29 (top left), 32, 33 (bottom left & right), the hill on the western edge of the dam wall is visible, containing scattered boulders which may also contain petroglyphs. Fig.30 & 31 (top right, centre left) shows the hill on the eastern corner of the proposed dam wall where the engravings are located. The engravings on the large boulders shown in Fig. 34 & 36 are located beneath the small tree visible in Fig.31 (left)

Figure 34 & 35: Several rocks were observed which contained Iron Age engravings. The majority of the petroglyphs were circular or semi-circular in nature, although a few depicted other shapes representing unknown symbols. Fig.34 was the largest boulder on site containing the most art, but many symbols were faded due to the weathered rock surface. Fig.35 depicts a smaller circle within a larger circle

Figure 36 & 37: A large patch of boulders, located on the north-eastern edge of the proposed dam, was examined and contained several rock engravings. The majority of these were circular or semi-circular symbols, likely representing the ground plan layout of an Iron Age village and resemble other known examples of Iron Age petroglyphs

To better evaluate the site, the table below summarizes the heritage impact significance:

Assessing Impact Significance

Criteria	without mitigation	with mitigation
Extent/spatial scale of impact	local	local
Duration of impact	permanent	permanent
Intensity/severity of impact	medium	medium
Probability of impact	possible	possible
Consequence	medium	medium
Confidence	medium	medium
Significance	low	low
Reversibility	irreversible	
Loss of resource	medium	
Mitigation potential	low	

Identified heritage resources (NHRA status)

Formal protections	
National Heritage site (Section 27)	none
Provincial Heritage site (Section 27)	none
Provisional Protection (Section 29)	none
Place listed in heritage register (Section 30)	none
General protections	
Palaeontological site or material (Section 35)	none

Contingency plan for possible heritage-related discoveries:

Chance Find Protocol

Based on the work of Almond *et al*. (2009) and Groenewald *et al*. (2014) and summarised on the SAHRIS website (www.sahra.org.za/sahris/map/palaeo), if a development occurs within a red zone a desktop study is required, as well as a phase 1 Palaeontological Impact Assessment (PIA) comprising a field survey and recording of fossils. A phase 2 PIA is also required, which entails the rescue of fossil material during construction activities, as well as the compulsory application for a collection and destruction permit. If the development occurs in an orange zone, a desktop survey as well as a phase 1 PIA comprising of a field survey and collection of fossils is compulsory. A prior application for a collection permit is therefore recommended and a phase 2 PIA may be necessary during the construction phase of the project. If the development occurs in a green zone, a desktop survey as well as phase 1 PIA comprising a field survey is recommended. Lastly developments which occur in a blue or grey zone may require a desktop survey, based on the known heritage sites in the area as well as the nature of surrounding geological units.

The normal procedure for recovering archaeological/palaeontological material would be to identify areas which show investigative potential through a concentration of fossils or artefacts, and whose recovery and preparation could address certain scientific questions. The process would then entail obtaining permission from the landowner/s and applying to SAHRA (South African Heritage Resources Agency) or another provincial heritage agency for a collection permit to excavate or remove blocks of bedrock for preparation in the lab. This is a slow and time-consuming process which requires the skills of a field archaeologist/palaeontologist to spot worthy material within geological/stratigraphic

exposures, and skilled fossil excavators and/or preparators who can successfully recover fossils from sediment or slabs of bedrock.

But in the case of developments fossils or artefacts may be exposed which were not being targeted as a part of a formal scientific investigation, which then requires intervention to ensure that such heritage resources are documented and evaluated, and possibly recovered. In this way, construction activities can provide an opportunity for scientists in that sediments or bedrock and other heritage related material will be exposed which otherwise would have gone unnoticed as it was hidden from view and would have been costly to excavate.

Heritage consultants such as archaeologists and palaeontologists are required to evaluate the sites of proposed development in the hope of recording and/or recovering important objects and artefacts before they are damaged or destroyed, but during the entire timeline of a project such a consultant is generally only on site for a few hours. Having a palaeontologist or archaeologist on site to examine every scoop of a back actor/JCB would be very costly and impractical, so additional site visits may be required for certain large-scale projects, or developments in highly sensitive areas.

If fossils are unearthed during the rest of the project timeline when no palaeontologist is on site, they may be difficult for the on-site layman to identify as many geological formations superficially resemble palaeontological material. Pseudo-fossils and certain mineral deposits often form into a variety of shapes which may closely resemble plant and animal fossils, making it more difficult for laypersons to positively identify chance finds in the field. With certain projects it is therefore recommended that training be provided to on-site staff on fossil identification in order to increase the chances of observing palaeontological material that may be present within the boundaries of the site footprint.

It is not the responsibility of site workers to keep an eye out for heritage objects neither are they likely to have always had the appropriate training on what to look for, but they are on the ground witnessing and observing. This is a helpful tool when there is a flow of information from on-site staff to management and protocol dictates that you convey when something unusual or out of the ordinary is observed during work operations. The probability of on-site foremen or construction workers operating heavy earth moving equipment and working to a strict time schedule spotting heritage objects amongst tons of bedrock or sediment is unlikely but nonetheless possible, especially after having received basic training on what to look out for. In South Africa and around the world many important archaeological and palaeontological discoveries have been made during construction projects, and companies and individuals can play their part by following the law and making the effort to report heritage resources which have been unearthed during digging operations. In so doing, developers can improve their public image and potentially contribute to a rare fossil or object reaching a museum or tertiary institution where it can studied and eventually displayed to the public as heritage belongs to the entire nation and should be preserved as best as possible.

If by chance fossils or any other heritage-related material were to be discovered which was not anticipated in this report, construction would need to cease immediately and a protocol should be followed whereby the relevant provincial or national heritage custodians in the relevant province would need to be informed. Developers would also need to acquire the services of a suitably qualified palaeontologist or archaeologist to rank the significance of the discoveries. If anything relevant is observed, mitigation measures may be necessary and an application for a collection permit may be required. A second site visit (Phase 2) may be necessary so that scientists can be given the opportunity to record and/or recover fossil material if it is ranked as significant and likely to make a positive contribution to the field of science.

Assumptions and limitations

A key assumption for this report is that the kml/kmz file sent to the heritage specialist accurately conveys the layout and nature of the development, which is not always the case as plans are often revised; because the site layout has not been accurately drawn in Google Earth; or lastly because the developers have understated and downplayed the degree, severity, nature or extent of the development so as to make it seem less impactful to the environment. A further assumption is that the geological maps used in this assessment are accurate and up to date, which may not be the case as there is a continuous refinement and revision of the geological model through new scientific research, some of which may still need to become incorporated into available maps.

A limitation with large scale maps (1:250 000) is that smaller outcrops of fossiliferous bedrock may not be indicated within the represented geological model. In addition, several potentially fossiliferous outcrops may have been weathered and eroded over millennia, buried under younger deposits such as alluvial and colluvial sediments, or capped by topsoil. Palaeontologically-sensitive bedrock may have also been metamorphosed through its contact with intrusive lavas, damaging or destroying fossil specimens along the contact zone.

The professional opinion given in this HIA report is based on the results of a site visit, which was used to gauge the fossiliferous potential of the bedrock likely to be exposed during the proposed development, and the impact significance. This process involved careful scrutiny of the best available maps and data sets as well as a ground survey, and all attempts were made to take a holistic, informed decision. Yet in spite of this, it is possible that fossils may be present somewhere along the route of the proposed development but were not visible due to their buried nature. Moreover, certain predictions about the likelihood of encountering fossils was based on all available evidence and may prove to be less or more likely than anticipated.

As a general rule direct field observations are the best method to gauge the degree to which palaeontological material may be present on site, whether eroding out or visible on the surface. As many developments require a degree of digging down into the soil and/or underlying stratigraphy, fossils will be hidden from view due to their buried nature and will only be exposed by the action of a back-actor or once they have started eroding out from the stratigraphy they are preserved in.

Lastly, it is assumed that the developers will respect the guidelines set out in the laws of South Africa with regards to good environmental management practices and policies, and will immediately cease all construction if any fossiliferous material is discovered. It is also assumed that developers will practice integrity and embrace an unwavering mind-set with regards to respecting and protecting all aspects of heritage, including due consideration for the fact that such objects cannot simply be sacrificed to meet project deadlines.

Conclusion and recommendations

Most of the fields proposed for cultivation have previously been ploughed and the bedrock is capped by an upper soil layer which acts as a kind of protective buffer for buried rock strata against farming activities happening at the surface. Sections of indigenous vegetation will need to be cleared out within the proposed 85ha field, and the hill in the north-eastern corner of this area could contain additional engravings.

Construction work required for the dam could have a negative impact on identified archaeological resources, so dam wall material should be carefully sourced. The material exposed in the dongas adjacent to the stream reveals an upper soil layer comprising of a few metres of (predominantly) sterile sediment, so this material can be used for dam wall construction. Although material will be brought in for dam wall construction, if rock is needed to be quarried to create a solid dam wall core only dolerite can be used and borrow

pits should be established on top of these outcrops (blue-grey patches in Fig.4). No boulders from the area of the rock engravings can be used for dam wall construction, nor can any rocks be sourced from the area of the possible Iron Age village for this purpose. Heavy earth-moving equipment should also avoid crossing over these areas as damage is likely to occur. In addition, any large oval or round boulders which are protruding from the ground in the general area, especially boulders on the hill making up the north-western corner of the dam wall (Fig. 22 & 23) and the small hill located in the north-eastern corner of the proposed 85ha field, could have additional engravings on them and cannot be used for dam wall construction. Furthermore, the position of the north-eastern corner of the dam wall will have to be shifted slightly south to avoid the rock engravings (orange line, Figure 28).

An additional site visit will be required in order to examine and map out the extent of the possible Iron Age village on the eastern edge of the proposed dam, and whether or not any of it could be flooded when the dam reaches its maximum capacity; to get a better understanding of the rectangular structure on the western side of the dam; to examine the circular stone-walled structure which will be submerged by the water; and to examine all large boulders in the general area for engravings not observed during the initial ground survey.

If any palaeontological or heritage-related material were to be unearthed during construction or farming activities, developers and/or landowners are reminded that according to the National Heritage Resources Act 1999 (Act No. 25) and KwaZulu-Natal Heritage Act 2008 (Act No. 4), work should immediately cease and the **Chance Find Protocol** outlined above should be followed to ensure that developments comply with the law, and to ensure that a rare object/fossil stands a good chance of being recorded and/or relocated before being damaged or destroyed by construction activities present on-site.

References

1) Almond, J.E., De Klerk, B. & Gess, R., 2009. *Palaeontological Heritage of the Eastern Cape*. Internal report, SAHRA

2) Environmental Impact Regulations of 2014, amended 2017

3) Evolutionary Studies Institute fossil collection database

4) Groenewald, G.H., Groenewald, D.P. & Groenewald, S.M., 2014. *Palaeontological Heritage of the Free State, Gauteng, Limpopo, Mpumalanga and North West provinces*. Internal Palaeotechnical Reports, SAHRA

5) Rubidge, B.S. 2005. Re-uniting lost continents - fossil reptiles from the ancient Karoo and their wanderlust. *South African Journal of Geology* 108 (1): 135-172

6) Smith, R.M.H., Eriksson, P.G. and Botha, W.J. 1993. A review of the stratigraphy and sedimentary environments of the Karoo-aged basins of Southern Africa. *Journal of African Sciences 16*: 143-169