

HERITAGE SURVEY OF AFRIMAT BETHLEHEM QUARRY

FOR

AFRIMAT (PTY) LTD

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EXECUTIVE SUMMARY

This Phase 1 Heritage Impact Assessment (HIA) for the proposed extension of the Afrimat Bethlehem quarry was undertaken. This was to update the EMPr for the Department of Mineral Resources. There was no previous HIA.

The Scope of work of work was to undertake a Phase 1 HIA to assess heritage sites for significance and provide management plans for each recorded feature. The desktop study reviewed of historical maps, aerial photos and local databases. The study area lies near farms registered in the late 19th century (e.g., Zuid Wolhuters Kop 670) and within the broader landscape associated with the 2nd Anglo-Boer War (Battle of Wolhuters Kop / Battle for Bethlehem). General De Wet's diary is cited to demonstrate battlefield relevance.

The 1947 aerial imagery shows grassland with no visible features in the study area; a 1979 map indicates an existing quarry within the broader boundary.

The Palaeontological desktop assessment notes that most of the area is of low palaeontological sensitivity, but the southern section is flagged as having high sensitivity and requires a Phase 1 palaeontological survey.

Fieldwork was undertaken on 1 April 2026 where several heritage features were noted. The field survey recorded eight discrete features; coordinates and significance are provided in the report.

Key features and their assessments:

Sangar 1 (medium significance; SAHRA 3B) — 4 m diameter defensive stone walling on a hill edge; likely a Boer sangar/observation point. *Mitigation:* Prefer preservation in-situ; if unavoidable, record and rebuild; metal-detector survey around the feature.

Stone Cairn (medium significance; SAHRA 3B) — ~1 m diameter pile of dolerite stones ~3.6 m west of Sangar 1; likely associated with the sangar. *Mitigation:* Preserve or rebuild nearby; metal-detector survey.

Sangar 2 (medium significance; SAHRA 3B) — 5 m diameter defensive walling ~163 m south of Sangar 1; similar mitigation to Sangar 1.

Grave 1 and Grave 2 (high significance; SAHRA 3A) — two well-defined oval stone mounds between the sangars, close to the western fence and perimeter track; dimensions suggest possible juvenile burials. *Mitigation:* Treat as graves until proven otherwise; demarcate and protect; realign the fence track to avoid damage; consider GPR or partial excavation only under permit and specialist supervision.

Kraal 1 (low significance; SAHRA 3C) — 8 m × 10 m cattle kraal on a ridge; likely farm-related. *Mitigation:* Record and photograph if impacted.

Isolated LSA artefacts (low significance) — a single Late Stone Age flake and core on the hilltop; part of an open scatter. *Mitigation:* On-site sampling or monitoring only.

Mitigation

Graves are of high significance. The report recommends a reduced buffer to 10 m (from the usual 20 m) because of site constraints, plus a visible demarcation with a 5 m exclusion zone to stop vehicle traffic. Ground penetrating radar and/or limited excavations could be used to determine if these are graves or random stone piles.

Sangars and the stone cairn are of medium significance. These should be preserved where possible and include 5 m demarcation buffers. If quarrying necessitates removal, the report recommends careful documentation, stone-by-stone recording and professional rebuilding outside the quarry boundary.

The kraal and isolated artefacts have low significance. Mapping, photography and limited sampling are sufficient mitigation.

Palaeontology: Southern high-sensitivity area requires palaeontological protocols and possibly monitoring during earthworks.

Chance-find protocol: A comprehensive protocol for archaeological, palaeontological and human remains finds is included (Appendix A), with clear stop-work and specialist notification procedures and SAHRA permitting requirements.

Practical management actions to include in the EMPr

Demarcation and exclusion: Mark sangars and graves with visible barriers and a 5 m buffer; realign the perimeter track to avoid graves.

Monitoring and survey: Metal-detector survey around sangars/cairn; GPR or specialist assessment for graves before any groundworks; palaeontological monitoring in the southern high-sensitivity zone.

Recording and salvage: If removal of the sangars is unavoidable, undertake detailed recording, 3D surveying and stone-by-stone relocation/reconstruction under archaeological supervision; obtain SAHRA permits where required.

Training and chance-find procedures: Include the report's Chance Find Protocol in the EMPr and train contractors to recognise and report finds; establish contact lines to the appointed archaeologist and SAHRA.

Conclusion and consultant confidence

Overall recommendation: The activity can be authorised **provided the recommended mitigation measures are implemented** (demarcation, monitoring, chance-find procedures, and specialist interventions where necessary).

Confidence: The consultant states a **high confidence level** in the findings, subject to the limitations noted (areas of dense vegetation, inability to detect subsurface features without testing).

Next steps suggested in the report: Confirm that the sangar/grave areas will remain outside active quarrying; implement the Chance Find Protocol in the EMPr; commission further palaeontological or Phase 2 archaeological testing if development plans encroach on sensitive areas.

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Abbreviations

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

INTRODUCTION

Afrimat (Pty) Ltd been instructed by DMPR in the Free State to amend the Bethlehem Quarry EMPr, as the current EMPr is outdated and does not reflect on-site conditions or recent observations, in accordance with the National Environmental Management Act (Act No. 107 of 1998, as amended). The mine will be extended. Part of this amendment is to undertake a HIA for the rest of the mine area as there was no previous HIA.

Umnlando was contracted to undertake the heritage impact assessment of the proposed mining area.

ASSUMPTIONS AND LIMITIATIONS

- The footprint of the proposed development will remain within the site boundary provided to Umnlando by the client.
- The vegetation in some areas was too dense to survey, however circuituous walks around various paths allowed for an adequate assessment of the area. All sensitive areas from the desktop were accessible and visited.

ASSUMPTIONS AND LIMITIATIONS

- The footprint of the proposed development will remain within the site boundary provided to Umnlando by the client.
- The site falls in the general pattern of archaeological scatters noted from previous archaeological and heritage surveys.
- The survey cannot locate subsurface features that do not leave visible marks observable from aerial photographs.

SCOPE OF WORK

- Undertake a Phase 1 study of the proposed development.
- Assess heritage sites in terms of significance.
- Provide a management plan for each site.

SITE SENSITIVITY SCREENING

No Site Sensitivity Screening was undertaken.

FIG. 1 GENERAL LOCATION OF THE SITE



FIG. 2: AERIAL OVERVIEW OF THE STUDY AREA



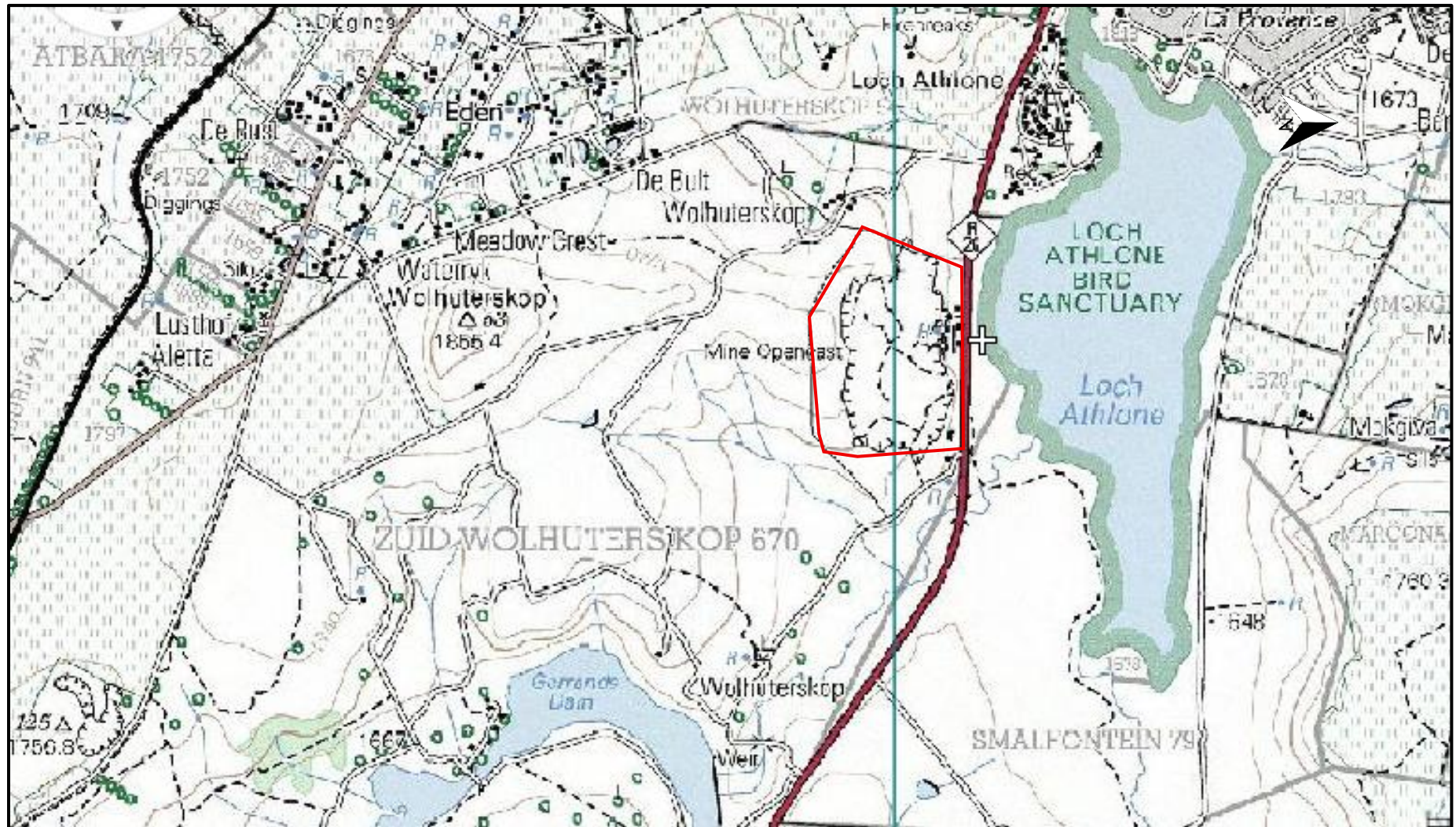
FIG. 3: 1:50 000 TOPOGRAPHICAL MAP OF THE STUDY AREA¹¹ 2828DA

FIG. 4: SCENIC VIEWS OF THE STUDY AREA



NATIONAL HERITAGE RESOURCES ACT OF 1999

The National Heritage Resources Act of 1999 (pp 12-14) protects a variety of heritage resources. These are resources are defined as follows:

1. “For the purposes of this Act, those heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations must be considered part of the national estate and fall within the sphere of operations of heritage resources authorities.
2. Without limiting the generality of subsection (1), the national estate may include—
 - 2.1. Places, buildings, structures and equipment of cultural significance.
 - 2.2. Places to which oral traditions are attached or which are associated with living heritage.
 - 2.3. Historical settlements and townscapes.
 - 2.4. Landscapes and natural features of cultural significance.
 - 2.5. Geological sites of scientific or cultural importance.
 - 2.6. Archaeological and palaeontological sites.
 - 2.7. Graves and burial grounds, including—
 - 2.7.1. Ancestral graves.
 - 2.7.2. Royal graves and graves of traditional leaders.
 - 2.7.3. Graves of victims of conflict.
 - 2.7.4. Graves of individuals designated by the Minister by notice in the Gazette.
 - 2.7.5. Historical graves and cemeteries; and
 - 2.7.6. Other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983).
3. Sites of significance relating to the history of slavery in South Africa.
 - 3.1. Movable objects, including—

4. Objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens.
 - 4.1. Objects to which oral traditions are attached or which are associated with living heritage.
 - 4.2. Ethnographic art and objects.
 - 4.3. Military objects.
 - 4.4. objects of decorative or fine art.
 - 4.5. Objects of scientific or technological interest; and
 - 4.6. books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).
5. Without limiting the generality of subsections (1) and (2), a place or object is to be considered part of the national estate if it has cultural significance or other special value because of—
 - 5.1. Its importance in the community, or pattern of South Africa's history.
 - 5.2. Its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.
 - 5.3. Its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.
 - 5.4. Its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects.
 - 5.5. Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.
 - 5.6. Its importance in demonstrating a high degree of creative or technical achievement at a particular period.
 - 5.7. Its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.
 - 5.8. Its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and

5.9. sites of significance relating to the history of slavery in South Africa”

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.

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	3A	Site conservation or mitigation prior to development / destruction
Medium Significance	Generally Protected B	3B	Site conservation or mitigation / test excavation / systematic sampling / monitoring prior to or during development / destruction
Low Significance	Generally Protected C	3C	On-site sampling monitoring or no archaeological mitigation required prior to or during development / destruction

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. There are no known heritage surveys near the study area.

The general area is not known for heritage sites (fig. 5). However, this is due to a lack of systematic surveys as opposed to a lack of sites. Fig. 6 shows known heritage surveys in the general area. The town of Bethlehem has several listed buildings including the Farm buildings of Wolhuters Kop.

The Farm Zuid Wolhuters Kop 670 was registered in 1888 with the Surveyor General (fig. 7). It was subdivided later to become Wolhuters Kop 94. However, Bethlehem was first formed c. 1864 and declared a town in 1884 (<https://sahistory.org.za/place/bethlehem-free-state>). The farms were thus already established before the Surveyor General maps were produced. Regardless, any structures on the farm could date back to the mid to late 19th century.

Bethlehem played an active role in the 2nd Anglo-Boer War. General De Wet's diary specifically mentions Wolhuters Kop:

"Our line of defence began at the south of Wolhuterskop (a kop to the south-west of Bethlehem) and extended from there to the north-west of the town.

When I had given my instructions to the officers, they returned to their commandos, which were stationed behind the first ridges to the south of Bethlehem, and brought them to the positions I had assigned to them.

So many of the horses were exhausted, that a large number of the burghers had to go on foot. Such of these *Voetgangers*[58] as were not required to attend to the waggons, I placed at Wolhuterskop.

When I had done this I gave notice to the inhabitants of Bethlehem, that as the dorp would be defended, I must insist on the women and children leaving it at once. It was not long before a number of women and children, and even a few men, started out on their way to Fouriesburg. The prisoner Vilonel, also, was conducted to this town.

At four o'clock that afternoon the advance guards of the enemy approached; and fifteen of their scouts made their appearance on the ridge to the north of the town. The burghers reserved their fire until these men were almost upon them. Then they let their Mausers speak, and in a moment there were nine riderless horses. The other six English made their escape, although they must have had wounds to show for their rashness.[59]

Only a few moments had passed before the roar of guns was mingled with the crack of rifles, and the whole air was filled with the thunder of battle.

Everywhere the burghers fought with the utmost valour; the Voetgangers on Wolhuterskop were perhaps the bravest of them all. Whenever the enemy approached our positions, they were met by a torrent of bullets. And thus the day came to a close.

But the next day a large force of English appeared from the direction of Reitz. This had come from the Transvaal, and, if I remember rightly, was commanded by General Sir Hector Macdonald. He had come up and joined Generals Clements, Hunter, Broadwood and Paget, with the object of once and for all making an end of the Free-Staters.

Our positions were now exposed to a most terrific bombardment, but fortunately without any serious consequences. I must describe here the fearful havoc that one lyddite shell wrought. It fell into the position held by Commandant Steenekamp, to the north-west of Bethlehem, and struck a rock behind which twenty-five of our horses were standing. Without a single exception every horse was killed!

The attack was pressed with the greatest vigour on the positions held by Commandants Van Aard and Piet Fourie. It became impossible for these officers to maintain their ground; and, at about twelve o'clock, before I was able to send them any reinforcements, they were compelled to give way.

Thus retreat became inevitable, and the enemy entered Bethlehem" (<https://www.angloboerwar.com/books/74-de-wet-three-years-war/1529-de-wet-chapter-xvi-bethlehem-is-captured-by-the-english#:~:text=It%20became%20impossible%20for%20these,%5B60%5D%20Precipice.>).

Wolhuters Kop has relevance to the Anglo-Boer War and was part of a skirmish.

The 1947 aerial photograph indicates the area as being grassland (fig. 8). The southern part of the study area was not available on the government portal site, or the image has been misaligned. No features are visible in the study area.

In 1979 topographical map indicate that there is a quarry within the study area (fig. 9).

PALAEONTOLOGICAL SENSITIVITY

The area is mostly in an area of mostly no palaeontological sensitivity; however, the southern area is of high sensitivity (fig. 10). Dr Gideon Groenwald undertook a Phase 1 survey of the proposed housing area (Appendix A). The geology underlying the study area comprises of Mesozoic to Cenozoic aged sedimentary rocks of the Karoo Supergroup, as well as Quaternary alluvial deposits. It is underlain by deeply weathered Karoo dolerite with minor outcrops of sandstone and shale of the Molteno, Formation of the Karoo Supergroup.

The Afrimat Bethlehem Quarry is underlain by rocks with a very low to very high sensitivity for palaeontological heritage. Following the site visits on Friday 17th April 2026, it is the professional opinion of Dr Gideon Groenewald that the chance-find of significant fossils in study area is very low.

A “Chance Find Protocol” has been incorporated into this document to cover this eventuality (Appendix B).

FIG. 5: LOCATION OF RECORDED SITES WITHIN THE GENERAL AREA

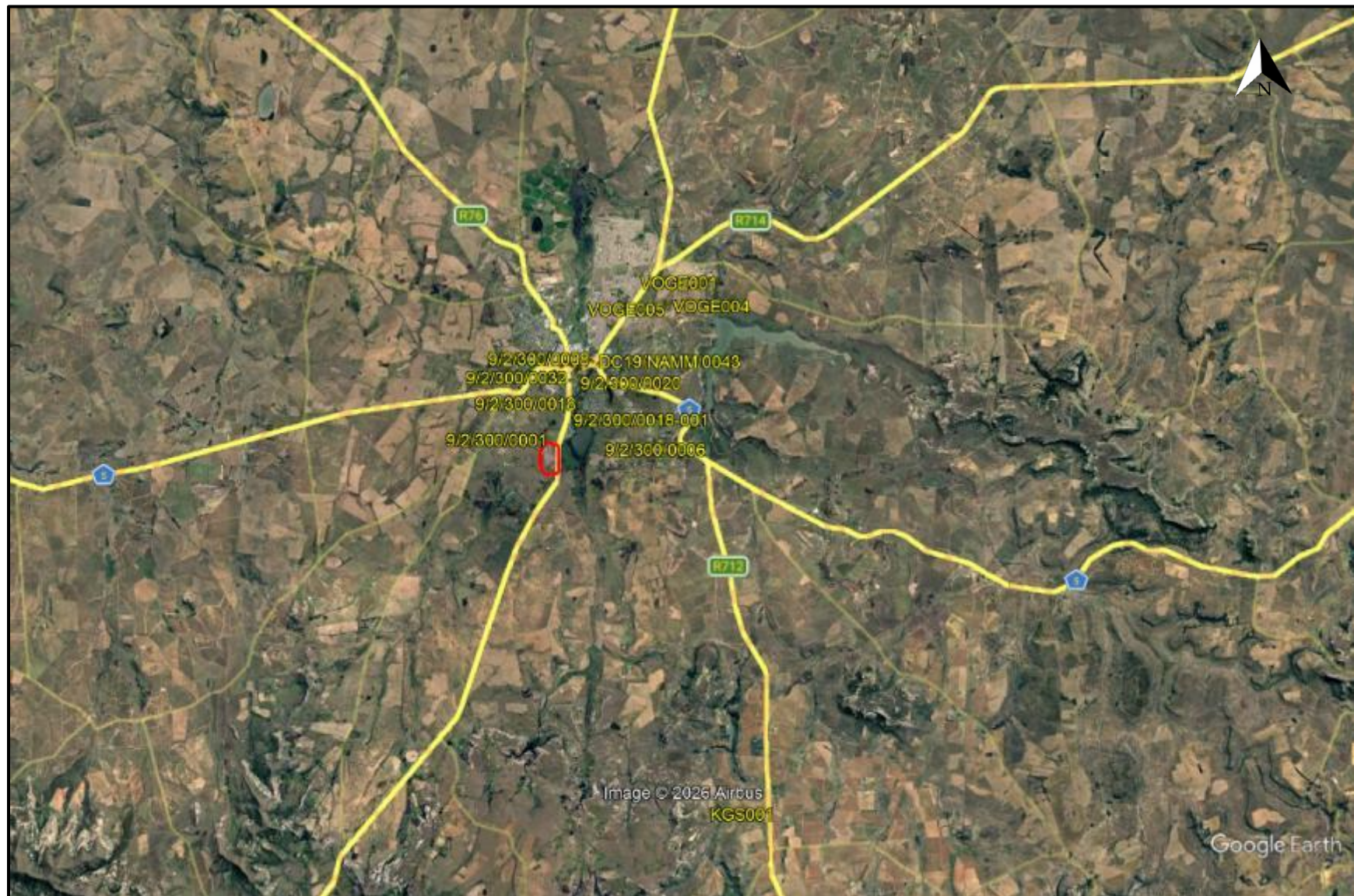


FIG. 6: KNOWN HERITAGE SURVEYS OF THE AREA

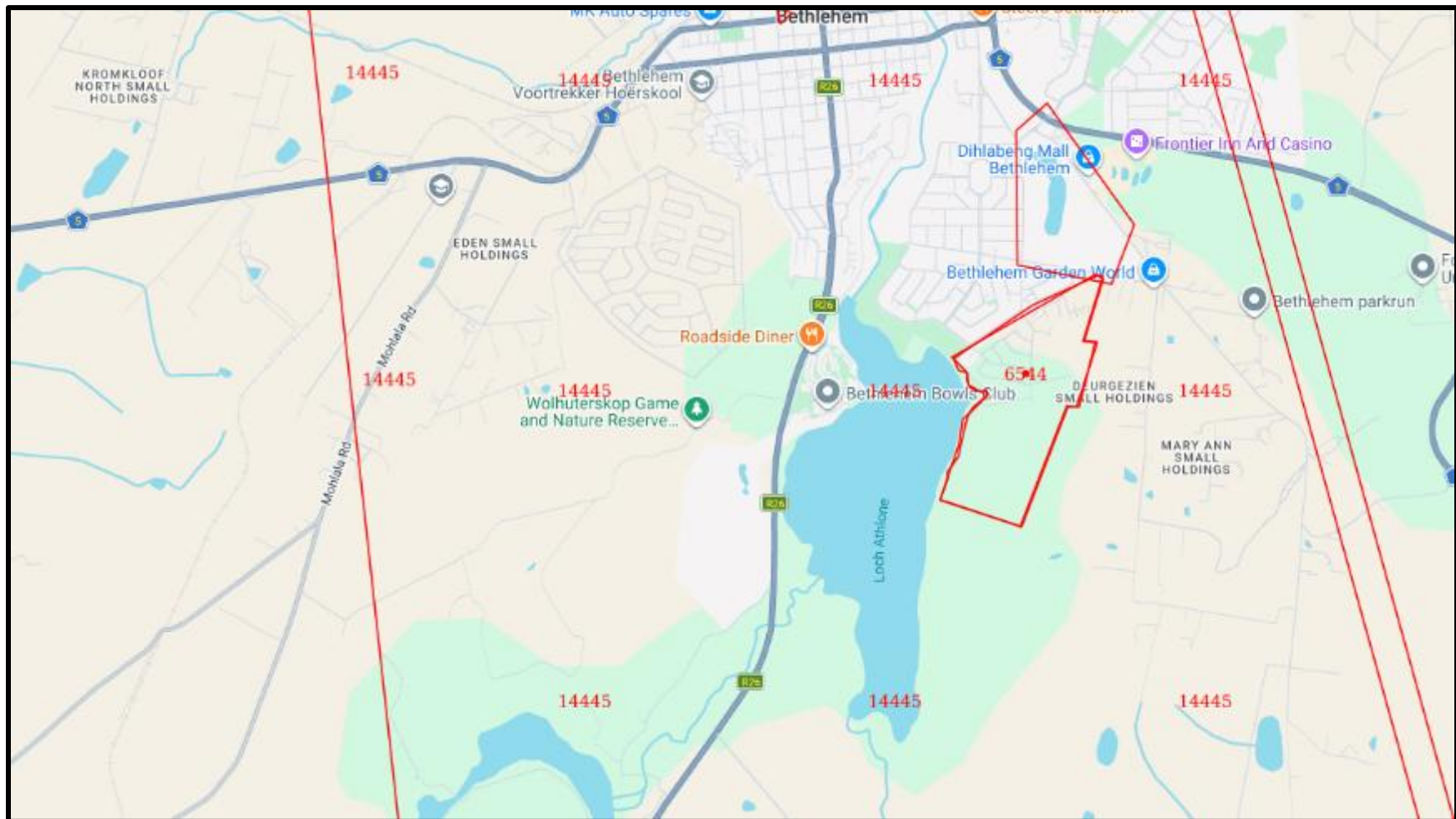
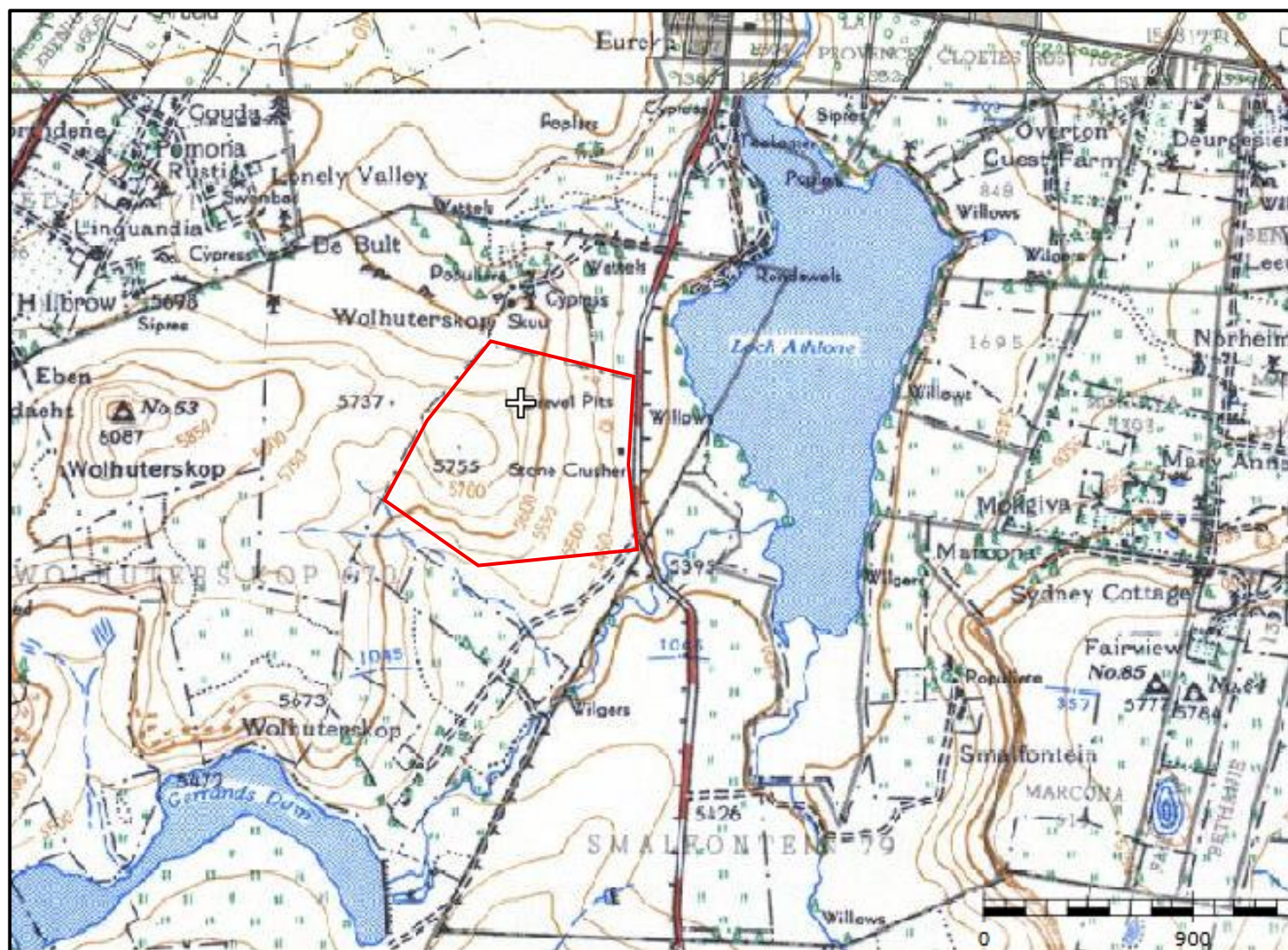


FIG. 8: 1947 AERIAL PHOTOGRAPH OF SOME OF THE STUDY AREA²

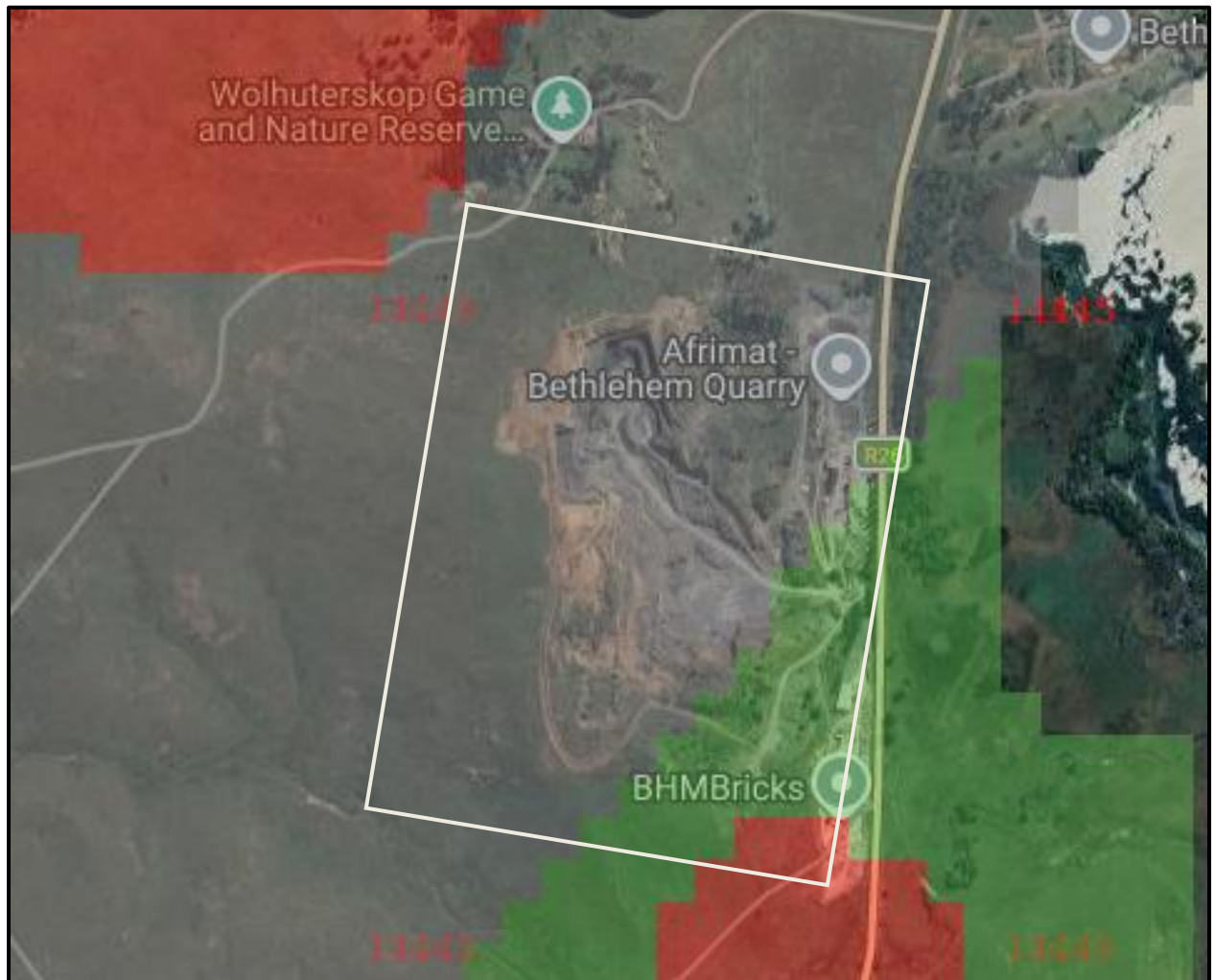


² 212_2_354

FIG. 9: LOCATION OF THE STUDY AREA IN 1979³

³ 2828DA Monontsha 1979

IG. 10: PALAEOLOGICAL 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 on 1 April 2026. Ground visibility was very good in most places. The southern section of the study area was very disturbed with dense vegetation. It falls outside of the proposed quarrying area even if it is within the current boundary. The location of recorded sites is given in Fig. 11 and Table 2.

TABLE 2: LOCATION OF RECORDED FEATURES

Name	Latitude	Longitude	Description	Significance
LSA Core	28.263835233	28.296324231	Single artefact	Low
LSA Flake	28.263550952	28.296045417	Single artefact	Low
Sangar 1	28.263482045	28.296491979	Defensive stone walling	Medium
Stone Cairn	28.263469709	28.296431399	Pile of stones behind Sangar 1	Medium
Grave 1	28.264592498	28.296166647	smaller than Grave 2	High
Grave 2	28.264592324	28.296181793	0.8m x 1.4m	High
Sangar 2	28.265028209	28.296445957	Defensive stone walling	Medium
Kraal 1	28.268695858	28.298241168	8m x 10m	Low

SANGAR 1

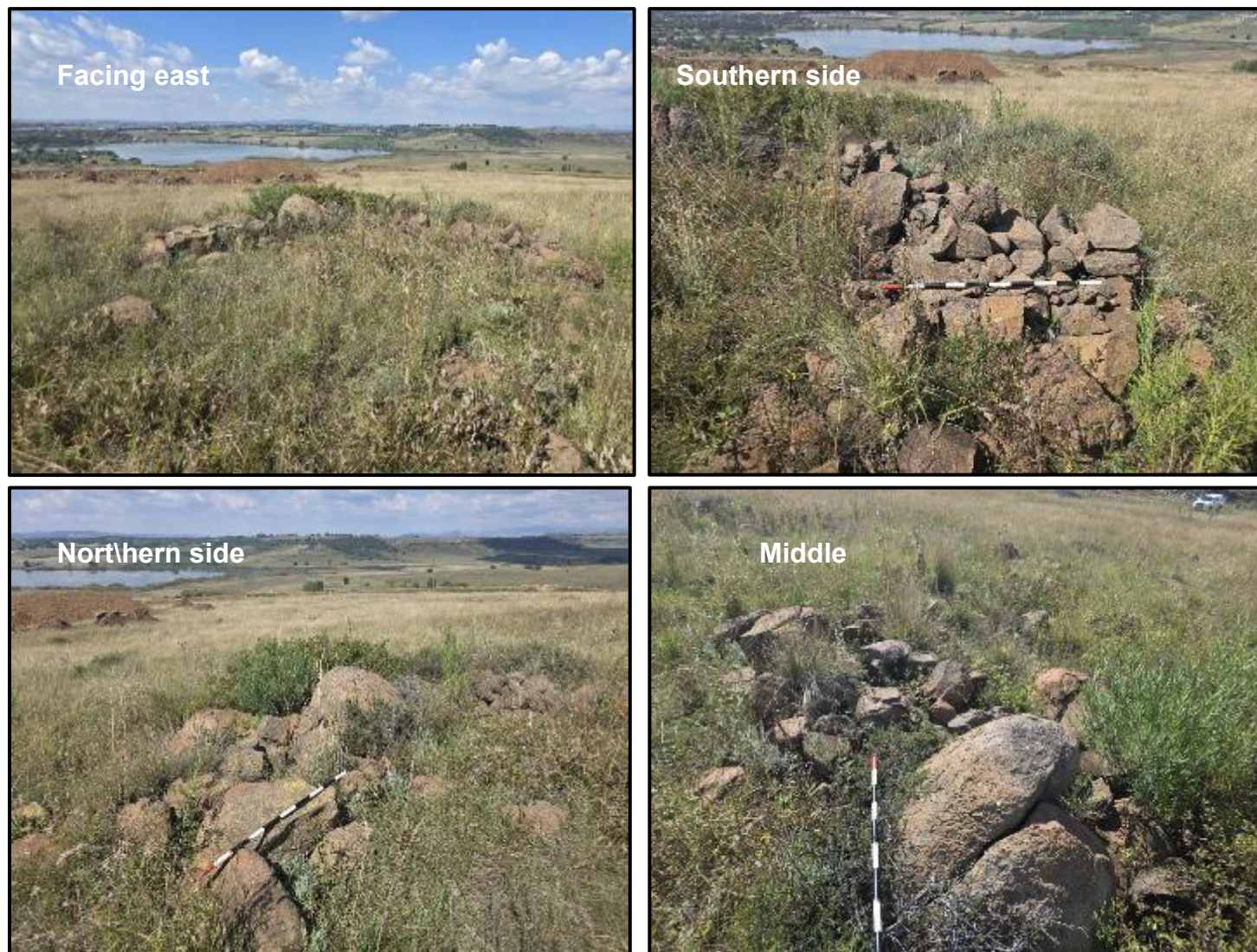
Sangar 1 is located at the edge of the hill facing northeast towards the valley below. The sangar is 4m in diameter and made from local rocks (fig. 12). Some of the walling has collapsed in the centre. The walling is between 0.5m and 1m in height. The Sangar is probably a Boer defensive fortification and/or observation point for incoming British soldiers.

The *Voetgangers* mentioned by De Wet would have been placed here.

FIG. 11: LOCATION OF RECORDED FEATURES



FIG. 12: SANGAR 1



Significance: The Sangar is of medium significance as it is related to a known Battlefield. The sangar is well preserved and probably one of the few surviving sangars from the battlefield.

Mitigation: The feature should preferably be unaffected by the quarry. If the area must be quarried, then the sangar should be rebuilt in an appropriate location. The area surrounding the sangar should have a metal detector survey.

SAHRA Rating: 3B

STONE CAIRN

The stone cairn occurs ~3.6m west of the western section of sangar 1 (fig. 13). The cairn is ~1m in diameter and 0.5m in height. It consists of dolerite rocks stacked to form a pile. It is not a grave and appears to be a platform.

Significance: The cairn is of low significance but is probably related to the sangar.

Mitigation: The feature should preferably be unaffected by the quarry. If the area must be quarried, then the cairn should be rebuilt near the fence, or on the other side of the fence. The area surrounding the cairn should have a metal detector survey.

SAHRA Rating: 3B

SANGAR 2

Sangar 1 is located at the southern edge of the hill facing southeast towards the valley below. The sangar is 5m in diameter and made from local rocks (fig. 14). Some of the walling has collapsed in the centre. The walling is between 0.5m and 1m in height. Sangar 2 is located ~163m south of Sangar 1.

FIG. 13: STONE CAIRN



The Sangar is probably a Boer defensive fortification and/or observation point for incoming British soldiers.

The *Voetgangers* mentioned by De Wet would have been placed here.

Significance: The Sangar is of medium significance as it is well preserved and probably one of the few surviving sangars from the battlefield.

Mitigation: The feature should preferably be unaffected by the quarry. If the area must be quarried, then the sangar should be rebuilt in an appropriate location. The area surrounding the sangar should have a metal detector survey.

SAHRA Rating: 3B

FIG. 14: SANGAR 2



Grave 1 and Grave 2

Graves 1 and 2 are located between the two sangars and near the western fence. These features fulfil the description of a grave: well defined oval mound of stones ~1m x 1.5m- 2m in size. It is the fact that the features are well defined/outlined that makes them a human made feature.

Grave 1 ~1m x 0.7m in size and on the edge of the fence track (fig. 15 top). It is ~10cm – 20cm in height. It is in a north-south orientation.

Grave 2 is ~2m east of Grave 1. It is ~1.5m x 0.8m in size (fig. 14 bottom). It is in a north-south orientation.

If these are graves, then they are probably of juveniles.

These features should be treated as graves until proven otherwise.

Significance: The graves are of high significance.

Mitigation: The graves need to be demarcated as they occur next to the current fence track. Grave 1 was nearly damaged by the track, and the track should be realigned around the two graves. I suggest the track does a small detour around the graves with a 5m buffer around them. The close proximity of the graves to the fence suggests that they will not be affected by the quarry.

SAHRA Rating: 3A

FIG. 15: GRAVES 1 AND 2



KRAAL 1

Kraal 1 is located in the southern part of the study area on a small ridge. The kraal is 8m x 10m in size and the southern side has no wall (fig. 16). The kraal is probably related to the farm and one of the original kraals.

The kraal is unlikely to be part of the Anglo-Boer war features as the entrance is facing downhill and in line with advancing forces, i.e. the Boers could not hide behind the walls.

Significance: The kraal is of low significance.

Mitigation: The kraal is unlikely to be affected. If it is affected then it should be accurately mapped and photographed.

SAHRA Rating: 3C

ISOLATED ARTEFACTS

A single Late Stone Age flake and core were noted on the top of the hill (fig. 17). These would be part of an open scatter and have low significance.

FIG. 16: KRAAL 1



FIG. 17: LSA ARTEFACTS



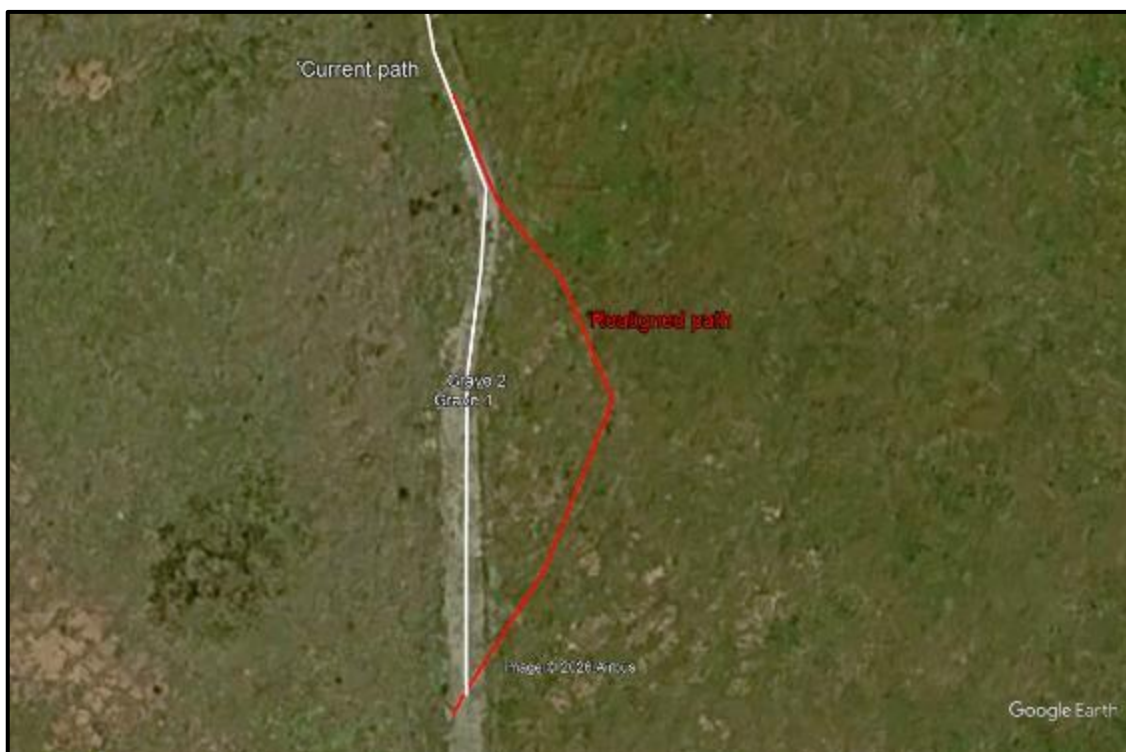
MANAGEMENT PLANS

Graves

Graves normally require a 20m buffer around them. This would be difficult in this case as the perimeter fencing is ~4m from Grave 1, and the perimeter path occurs between the grave and the fence. The path has just missed Grave 1 by a few centimetres. I suggest the following:

1. the no-go buffer is reduced to 10m
2. The fence path is realigned and goes around the graves (fig. 18)
3. The graves must be clearly demarcated with a 5m buffer between the edge of the grave and the demarcation. The demarcation must be visible and stop vehicle traffic.
4. Further studies regarding the graves will be required if the Mining Right extends closer towards the graves, i.e. near the 10m buffer. This can be tested by ground penetrating radar or partial excavation.

FIG. 18: PATH REALIGNMENT AROUND THE GRAVES



Stone walling

There are two types of stone walling: the cattle kraal and the two sangars (and stone cairn). The cattle kraal is of low significance and could be destroyed if needed. It does appear to be out of the quarry boundary and thus it is unlikely to be affected.

The sangars should be preserved at all costs. They form part of the Battle of Wolhuters Kop that is associated with the Battle for Bethlehem during the 2nd Anglo-Boer War. The battlefield is part of a cultural landscape and living heritage and it is described by General De Wet in his diary. The sangars form part of the outer defense or observation positions as the English marched towards Bethlehem. These two features could be used, in conjunction with the rest of Wolhuters Kop Nature Reserve as part of heritage battlefield route. The rest of the nature reserve would need to be surveyed for similar features and developed.

The sangars and stone cairn need to be clearly demarcated and placed within the mine plan. The demarcations need to be 5m from the walling and around each sangar.

If there are compelling reasons to quarry this area, and thus demolish the sangars, then I suggest the sangars are rebuilt just outside of the fence property with the same stones and architecture. This would require detailed land surveying for location and height, and then a specific technique to relocate the stones and rebuild in the same place. It is a 3D puzzle and would require professional to undertake this work.

Conversation with Afrimat staff indicated that this area will not be quarried and that it is just above a ridge that is too close to the fence. Afrimat need to confirm this.

Palaeontology

The chances of fossiliferous material occurring within the study areas is very low. However a Chance Find Protocol needs to form part of the EmpR.

A Chance Find Protocol will need to form part of the EMPr. This is summarised in Appendix B.

It is in our reasoned opinion that the activity be authorised provided the appropriate mitigation is undertaken. The confidence level of these finding is high.

CONCLUSION

A HIA was undertaken to update the EMPr for the Afrimat (Pty) Ltd Bethlehem quarry. No HIA was previously undertaken. Several heritage features were noted during the survey. These include stone walling for a kraal and sangars, two possible graves and isolated artefacts.

The possible graves need to be treated as graves until proven otherwise. Testing can be via ground penetrating radar or partial excavation.

It would be preferable to not affect the sangars and stone cairn as they are part of the Battle of Wolhuters Kop during the 2nd Anglo-Boer War. They form part of the cultural landscape. If there are compelling reasons to quarry the area by the sangars, then they sangars should be rebuilt in approximate locations on the opposite side of the fence in the Wolhuters Kop Nature Reserve. The area around the sangars should also be surveyed with a metal detector for potential 2nd Anglo-Boer War artefacts. This will need to be undertaken by a qualified archaeologist and permits from SAHRA will be required.

The stone walled kraal is of low significance. If it will be destroyed, then it needs to be accurately surveyed and photographed. SAHRA does not require a permit for features, or sites, of low significance.

Most of the proposed areas to be mined are underlain by Karoo dolerite and no significant fossils were preserved in the surface exposures of the geological formations on site. Even in cases where deep excavation (>1,5m) are planned for development purposes (geotechnical reports), the author expects that the “chance find” of well-preserved, highly significant fossils (vertebrates, plants and trace fossils) is still **very low**.

A Chance Find Protocol will be initiated and needs to form part of the EMPr.

It is in our reasoned opinion that the activity be authorised provided the appropriate mitigation is undertaken. The confidence level of these finding is high.

REFERENCES

MAPS

2828DA Monontsha 1979, 2000

2763 (SG map)

212_2_354

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 South African Archaeology Association – CRM Section in 1998 that then became the Association of Southern African Professional Archaeologists. Gavin is rated as a Principal Investigator with expertise status in Rock Art, Stone Age and Iron Age studies. In addition to this, he was worked on both West and East Coast shell middens, Anglo-Boer War sites, and Historical Period sites.

DECLARATION OF INDEPENDENCE

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

A handwritten signature in black ink, appearing to read 'G. Anderson', with a stylized flourish above the name.

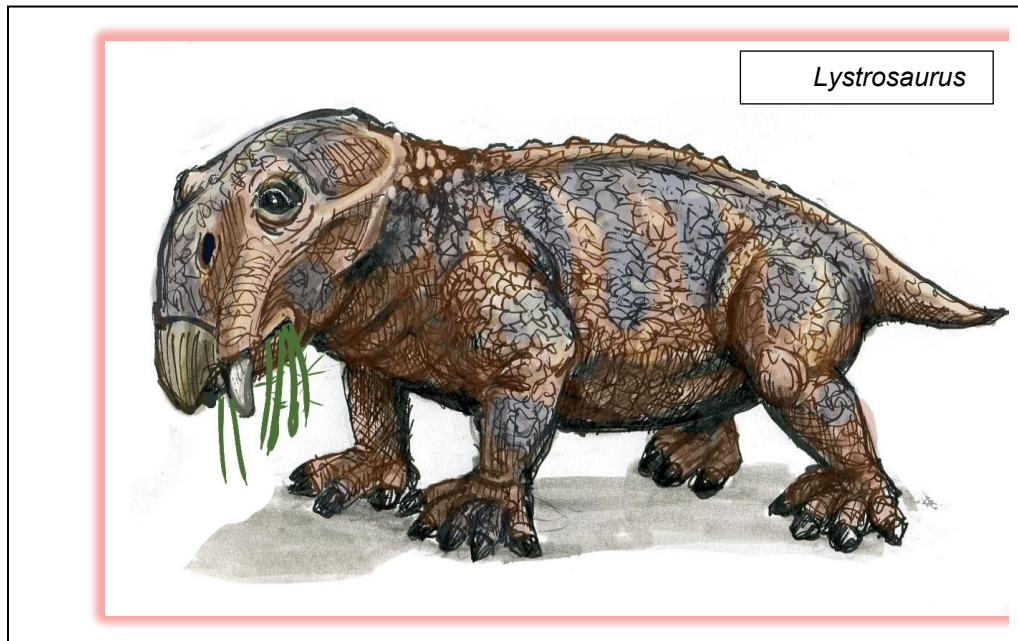
Gavin Anderson
Archaeologist/Heritage Impact Assessor

APPENDIX A
PIA DESKTOP

**Palaeontological Impact Assessment (Pia) For The
Upgrading Of The Afrimat Bethlehem Quarry, Dihlabeng
Local Municipality, Thabo Mofutsanyane District
Municipality, Free State Province.**

FOR

**UMLANDO: Archaeological Surveys & Heritage
Management**



DATE: 23 April 2026

Scientific Specialist

Dr Gideon Groenewald, Hon Research Fellow ESI Wits University

Cell: 078 713 6377

EXECUTIVE SUMMARY

Dr Gideon Groenewald was requested by Gavin Anderson: UMLANDO: Archaeological Surveys & Heritage Management, to undertake a Phase 1 Palaeontological Assessment Survey for the planning of the upgrading of the EMPr at the Afrimat Quarry near Bethlehem, Dihlabeng Local Municipality, Thabo Mofutsanyane District Municipality, Free State Province.

This study refers to the specific areas earmarked for the development of mining activities.

This study forms an integral part of the Palaeontological Impact Assessment for the activities related to the upgrading of the mining rights and the area of focus for this specific study is the peri-urban as well as rural farmland areas to the southwest of Bethlehem.

This Phase 1 Survey is done to prepare a “Chance Find Protocol” (CFP) document to assist with possible future field visits and to complete a Phase 2 PIA (if required) since parts of the development site is underlain by geological formations with an inferred very high sensitivity for Palaeontological Heritage

The geology underlying the project area for the upgrading of the Afrimat Bethlehem Quarry south of Bethlehem in the Dihlabeng Local Municipality, Thabo Mofutsanyane District Municipality comprises Mesozoic to Cenozoic aged sedimentary rocks of the Karoo Supergroup, as well as Quaternary alluvial deposits.

The study site is underlain by deeply weathered Karoo dolerite with minor outcrops of sandstone and shale of the Molteno, Formation of the Karoo Supergroup.

Recommendations

- The EAP and developer must be informed that the Afrimat Bethlehem Quarry is underlain by rocks with a very low to very high sensitivity for palaeontological heritage. Following the site visits on Friday 17th April 2026, it is the professional opinion of Dr Gideon Groenewald, accredited palaeontologist, that the chance-find of significant fossils in study area is very low.

- The project will require a formal “Chance Find Protocol” that will have to be upgraded during the construction phases of the project. (The Chance Find Protocol document is attached to this report).
- **Without mitigation** the project will have a **very high negative impact** on palaeontological heritage. **With mitigation** (see CFP attached) the project will have a **very high positive** impact on Global palaeontological heritage, mainly because excavations of more than 1,5m deep will expose new bedrock that would never have been exposed for thousands of years.
- Recommendations for palaeontological monitoring and mitigation (CFP Document attached) will have to be incorporated into the EMP for approval by HFS/SAHRA.
- It is recommended that, with the mitigations proposed, there are no reasons why this project cannot be implemented.

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INTRODUCTION

Dr Gideon Groenewald was requested by Gavin Anderson: UMLANDO: Archaeological Surveys & Heritage Management, to undertake a Phase 1 Palaeontological Assessment Survey for the planning of the upgrading of the EMPR at the Afrimat Quarry near Bethlehem, Dihlabeng Local Municipality, Thabo Mofutsanyane District Municipality, Free State Province.

This study refers to the specific areas earmarked for the development of mining activities.

This study forms an integral part of the Palaeontological Impact Assessment for the activities related to the upgrading of the mining rights and the area of focus for this specific study is the peri-urban as well as rural farmland areas to the southwest of Bethlehem.

This Phase 1 Survey is done to prepare a “Chance Find Protocol” (CFP) document to assist with possible future field visits and to complete a Phase 2 PIA (if required) since parts of the development site is underlain by geological formations with an inferred very high sensitivity for Palaeontological Heritage. (Almond and Pether, 2008; Groenewald, 2014, 2012; Groenewald et al., 2014).

The aims of this independent assessment of the Palaeontological Heritage is to:

- a. *Review findings of previous Paleontological studies in the same area*
- b. *Record new palaeontological finds during the Phase 1 Impact Assessment*

Modus operandi

- *Review documentation of existing PIA studies of the area*
- *Review reality of the palaeontology of the site*
- *Phase 1 PIA site investigation and PIA Report with recommendations – GIS mapping of palaeontological sensitivity - **first deliverable***
- *Inclusion of a “Chance Find Protocol” (CFP) document to assist the EAP and the ECO with operational management issues regarding possible impact on palaeontological heritage – **secondary deliverable***

Summary of Project Parameters as per ToR's

Client name: **UMLANDO: Archaeological Surveys & Heritage Management**

Site name: **Afrimat Quarry site, Thabo Mofutsanyane District Municipality**

Property description: **Afrimat Quarry Site, Dihlabeng Local Municipality, Thabo Mofutsanyane District Municipality**

Project title: **Proposed upgrading of the mining permit for the Afrimat Quarry, Dihlabeng Local Municipality, Thabo Mofutsanyane District Municipality, Free State Province**

Legal Requirements

This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999 (revised 2017). 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 Phase 1 site 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 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.

Prior to a field investigation, a preliminary assessment (desktop study) of the topography and geology of the study area was made using appropriate 1:250 000 geological information (2828 Harrismith) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc.) were 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 project 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

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., 2009; Almond and Pether, 2009, 2008; 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) recommended.
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 larger alluvium deposits. At least one site visit by a competent palaeontologist is compulsory. Collection of a representative sample of potential fossiliferous material is recommended.
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 intrusion 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 one site visit by a suitably qualified palaeontologist is recommended.

Rocks with very high palaeontological sensitivity are present within the development footprint and palaeontological mitigation measures must be incorporated into the Environmental Management Plan (EMP) for this project. The 1:250 000 scale vector maps obtained from the Council for Geoscience indicates some of the formations underlying the area applicable to this report as being relatively simple sandstone and mudstone deposits and dolerite of the Karoo Supergroup (Bordy and Groenewald, 2026; Groenewald, 1996; Johnson et al., 2009; MacRae, 1999; McCarthy and Rubidge, 2005).

The study area is characterised by an undulating landscape of highly modified Anthropogenic development (agricultural areas, urban development)

interconnected by areas of lesser human development associated with the grassland underlain by the Karoo Supergroup. Most of the younger geology is associated with Cenozoic aged palaeo-land surfaces and river terraces.

Field work during this survey as well as literature surveys indicated that the rock units that will be exposed most of the time is the potentially fossiliferous Tarkastad Subgroup of the Karoo Supergroup as well as un-fossiliferous dolerite (Johnson et al., 2009; MacRae, 1999; McCarthy and Rubidge, 2005; Smith et al., 2020; Viglietti et al., 2020)

Scope and Limitations of the Phase 1 Investigation

The scope of a Phase 1 Investigation includes:

- an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units;
- a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports;
- data on the project provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged); where feasible, location and examination of any fossil collections from the study area (e.g. museums); and
- an on-site investigation to assess the identified palaeontological sensitive areas within the development footprint/ study area, including a formal palaeontological collection if fossils are of collectable quality. The investigation focuses on the bedrock exposure where excavations would most probably require palaeontological monitoring.

The results of the field investigation are used to predict the potential of buried fossil heritage within the development footprint. In some investigations, (as in this study), this involves the examination of similar accessible bedrock exposures, such as road cuttings and quarries, along roads that run parallel to or across the development footprint.

Summary of the proposed development

The development entails the formal upgrading of the EMPr and mining license for the Afrimat Quarry south of Bethlehem.

Locality and Project Site Description

The study area for this report is limited to the site of the Afrimat Quarry, for supply of dolerite aggregate for industrial use in the Dihlabeng Local Municipality, Thabo Mofutsanyane District Municipality, Free State Province (Figure 1). The rural hinterland is selectively developed for peri-urban and town development, agricultural activities (grazing and arable land).



Figure 1 Locality and layout of Afrimat: Bethlehem quarry site

The landscape is defined by the typically open rolling hills and grazing areas in the adjacent Wolhuterskop Nature Reserve, underlain by Tarkastad Subgroup sandstone and mudstone, with mainly dolerite in the study area. Local hills are typically formed by outcrops of Karoo aged dolerite. Rivers are mostly perennial and only flows strongly during high rainfall events in the summer rainfall season.

The project can be defined as a typical large point development with associated borrow pit infrastructure. Moving of equipment and transport of all materials will be along existing and/or newly developed roads.

This Phase 1 Palaeontological impact survey aims to provide the decision making authorities (HFS/SAHRA) with a general summary of the geology and palaeontology of the development site, with indications of how the specific development phases will have to be assessed in more detail, once the actual layouts are established.

It is important that the EAP as well as the developer understand the *modus operandi* of Palaeontological Impact assessments in relatively large projects. The professional palaeontologist will indicate a very high sensitivity for palaeontological heritage in rock units where there is a very high likelihood of finding significant fossil remains (in this case fossils of invertebrates, vertebrates, plant fossils and trace fossils of Triassic age) in an exposed rock outcrop area of 100m² or basically 20m x 5m. During fieldwork, this scenario was duplicated and the existing road reserve was scanned for outcrops of fossiliferous rocks. Where significant evidence for fossils are recorded in outcrop areas of 100m², the rock unit is mapped as “very highly sensitive” because it is **very highly likely** that an excavation for the clearing of vegetation to develop any infrastructure, will expose significant fossils. If this is proven, the palaeontologist must train the ECO and dedicated members of the technical team of the contractor, to recognise “**significant**” **fossils**. (Significant fossils are the remains of vertebrates, invertebrates, plants and trace-fossils, that are uniquely well preserved and the judgement is subjective, with a very strong element of personal observation by the ECO). The ECO and Resident Engineer will then communicate an urgent call to the **appointed palaeontologist** to come onto site to collect/remove/sample the fossils. In the

case of well-defined fossils observed, the appointed palaeontologist must apply for a destruction permit on behalf of the developer.

It will be impractical and too expensive to employ a full-time professional palaeontologist to “wait and see” on the construction site. The aim of a well-planned “Chance Find Protocol” (which must be part of the EMP of this project) will be to recover fossils without causing “standing time”. If this process is well-planned, no un-planned standing time needs to be generated as a result of palaeontological heritage discoveries.

GEOLOGY

The project area is underlain by rocks of the Mesozoic aged Karoo Supergroup that includes the Triassic aged, fossil rich Tarkastad Subgroup, Jurassic aged dolerite and younger covers of Quaternary alluvium (Figure 2).

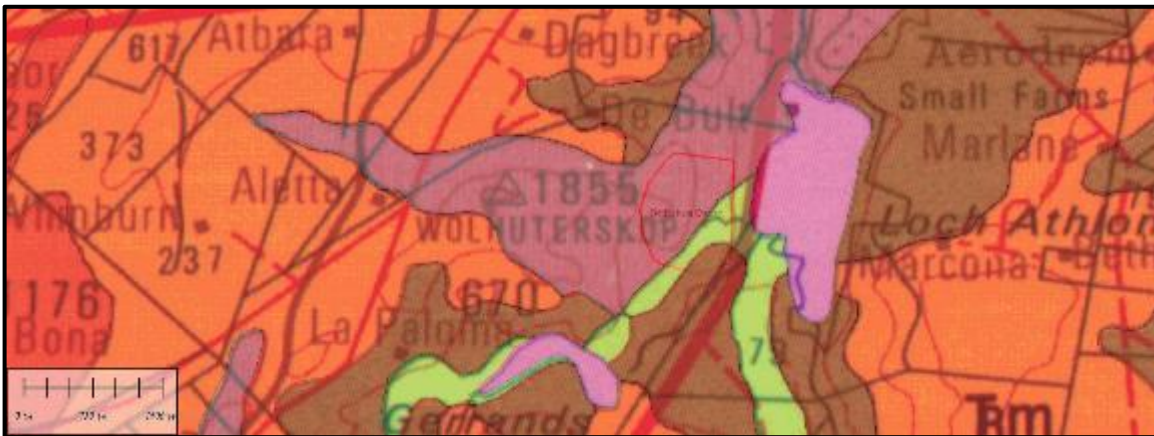


Figure 2 The study areas are underlain by rocks of the Tarkastad Subgroup, Molteno Formation of Stormberg Group and dolerite of the Karoo Supergroup. River valleys are underlain by alluvium



Figure 3 Geological legend for Figure 2

Karoo Supergroup

Field work during this survey as well as literature surveys indicated that the rock units that will be exposed most of the time is the potentially fossils rich rocks of the Karoo Supergroup, with potential exposure of the fossiliferous Tarkastad Subgroup and Molteno Formation, a well-known rock sequence of the Stormberg Group that contains highly significant palaeontological heritage (Groenewald et al., 2014; Groenewald, 1996; Johnson et al., 2009; MacRae, 1999; McCarthy and Rubidge, 2005; Rubidge (ed), 1995; Smith et al., 2020).

The Tarkastad Subgroup

The Tarkastad Subgroup can contain significant fossils of vertebrata in the Cynognathus Assemblage Zone. The lower Katberg Formation is not exposed in the study area.

The Stormberg Group

Stormberg Group mudstones and sandstones form the foothills of the Drakensberg Escarpment. The red, green and purple coloured mudstones which characterize this group were deposited in a steadily drying swampland (Johnson et al., 2009; MacRae, 1999; McCarthy and Rubidge, 2005).

Geology of the Stormberg Group in the Study Area

The Molteno Formation (Trm)

The Molteno Formation is characterised by a sequence of very coarse-grained sandstone and in the study area this sandstone is interbedded with layers of intrusive dolerite which forms the main target material for mining.

The Molteno Formation forms a prominent marker in the Upper Karoo Supergroup (Bordy and Groenewald, 2026).

Karoo Dolerite

Jurassic aged Karoo Dolerite represents the intrusion of very large volumes of basaltic lava during a Jurassic aged Large Igneous Province (LIPS) event (Groenewald, 2024).

Alluvium

The valley floors are mostly filled with Quaternary aged alluvium.

PALAEONTOLOGY

Karoo Supergroup

The Karoo Supergroup is renowned for the globally significant palaeontological heritage of fossils as well as trace fossils that are preserved in the sedimentary rock sequence (Bordy and Groenewald, 2026; Catuneanu et al., 2005; Chapelle et al., 2025; Groenewald et al., 2023; Groenewald D.P., Day O.D., Cameron R. P-C. and Rubidge B.S., 2022; Johnson et al., 2009; MacRae, 1999; Marchetti et al., 2019; Mason and Christie, 1986; McCarthy and Rubidge, 2005; Ronchi et al., 2023; Viglietti et al., 2017).

The study area is specifically underlain by the very productive Tarkastad Subgroup as well as the Stormberg Group that is represented by the Molteno Formation.

Tarkastad Subgroup

The Triassic aged Tarkastad Subgroup underlies the lower lying areas in the Afrimat: Bethlehem quarry site and is dominated by red mudstone and fossils of the *Cynognathus* Assemblage Zone.

Stromberg Group

These Triassic to Jurassic aged rocks record known extinction events and also some of the best known examples of dinosaur eggs with embryos (Chapelle et al., 2025).

The Stormberg Group is however only represented by the Molteno Formation which is dominated by remains of plant fossils. (Bordy and Groenewald, 2026; Chapelle et al., 2025; McPhee et al., 2018; Viglietti et al., 2020).

The Molteno Formation (Trm)

This sequence of sediments is rated as some of the most productive deposits of Mesozoic plant fossils of *Dicroidium* assemblages in the world. At their peak development during the Late Triassic these seed ferns inhabited a variety of ecological niches, including riverine forests, wetlands and open woodland. The open woodland was dominated by cycadeoids, ginkos and conifers. Rich assemblages of insects are also recorded from these sequences. A rich plethora of early gymnosperms are also recorded from outcrops in KwaZulu-Natal, notably Little Switzerland, Kannaskop, Umkomaas and Bird River. These deposits are seen by scientists as examples of one of the richest plant histories and the clearest window into the Late Triassic plant and insect communities in the World (Anderson and Anderson, 1984; Johnson et al., 2009; MacRae, 1999; McCarthy and Rubidge, 2005). Although no vertebrate remains have been described from the Molteno Formation several dinosaur tracks have been described from the formation.

Karoo Dolerite (Jd)

The Jurassic aged dolerite of the Karoo Supergroup will, as an igneous rock, not contain any fossils.

Recent Alluvium

Extensive alluvium deposits are associated with the river valleys and some of the footslopes are underlain by deposits of the Quaternary aged Masotcheni Formation. To date, no significant fossils have been recorded from these sediments. These deposits are allocated a moderate sensitivity for Palaeontological heritage.

PRELIMINARY ASSESSMENT RESULTS

The paleontological sensitivity was predicted after identifying potentially fossiliferous rock units; ascertaining the fossil heritage from the literature and evaluating the nature and scale of the development itself. The paleontological sensitivity varies from very highly sensitive for the Karoo Supergroup rocks to moderately and very low sensitive in areas underlain by the younger Quaternary aged sedimentary sequences and dolerite (Figure 4).



Figure 4 The study area is largely underlain by geology with a very low significance for palaeontological heritage. Only small areas seem to be moderately and very highly sensitive.

Figure 6 The planned extension area for mining at the Afrimat Bethlehem Quarry falls on dolerite with a very low sensitivity in terms of palaeontological heritage

FIELD INVESTIGATIONS

Dr Gideon Groenewald, experienced fieldworker (GGG Consultants) visited the site of the project on Friday, 17 April 2026. Our observations are that most of the proposed areas to be mined are underlain by Karoo dolerite and no significant fossils were preserved in the surface exposures of the geological formations on site.

Photographic recordings of geological information at specific localities (Figure 5) were recorded for record purposes (Table 2).

Even in cases where deep excavation (>1,5m) are planned for development purposes (geotechnical reports), the author expects that the “chance find” of well-preserved, highly significant fossils (vertebrates, plants and trace fossils) is still **very low** (Figure 7).



Figure 5 Photographic Records of observations as reported in Table 2

Table 2 Photographic recordings in the study area for the R415 route upgrade (see Figure 8)

Photo	(GPS station) Coordinates	Comments	Photographic Record
AFRF1	28.2588 68° S 28.3034 19° E	Typical view from the north. The mining activity will be restricted to the dolerite outcrops in the higher lying hills in the background.	
AFRF2	28.2633 62° S 28.3029 04° E	The site and basic infrastructure at Afrimat Bethlehem Quarry. The site is underlain by dolerite and highly disturbed. No fossils were observed	
AFRF2	28.2633 62° S 28.3029 04° E	The site and basic infrastructure at Afrimat Bethlehem Quarry. The site is underlain by dolerite and highly disturbed. No fossils were observed	
AFRF3	28.2650 82° S 28.3027 96° E	Deep excavations into dolerite and weathered dolerite on site. Sandstone blocks are from inclusions in the dolerite sills and no fossils were observed	
AFRF4	28.2655 16° S 28.3023 68° E	Disturbed environments and all underlain by dolerite. No fossils were expected and no fossils observed	
AFRF5	28.2664 46° S 28.3013 97° E	Sub-outcrops of dolerite. The site is disturbed and no fossils were expected. No fossils observed	

AFRF6	28.2673 85° S 28.3008 50° E	Extension of the working area and clearing of vegetation towards the south and north confirmed dolerite outcrops where initial desktop surveys predicted sedimentary rocks with high potential for fossils. Confirmation that no fossils are present	
AFRF6	28.2673 85° S 28.3008 50° E	Extension of the working area and clearing of vegetation towards the south and north confirmed dolerite outcrops where initial desktop surveys predicted sedimentary rocks with high potential for fossils. Confirmation that no fossils are present	
AFRF7	28.2666 13° S 28.2991 88° E	Dolerite outcrops extend towards the west. The dolerite sill proves to be extensive and keeps a good thickness for mining purposes. No fossils expected, no fossils observed	
AFRF8	28.2580 75° S 28.2984 66° E	Outcrops of Molteno Formation sandstone as relicts in the dolerite sill. No fossils expected, no fossils observed	
AFRF9	28.2581 41° S 28.2993 60° E	Dolerite outcrops and grass covered slopes. No fossils were observed	

PALAEONTOLOGICAL IMPACT AND MITIGATION

The predicted palaeontological impact of the project is based on the initial mapping assessment and literature reviews. Following the field investigation (Table 2) the initial palaeontological sensitivity for all mining sections of the proposed upgrading of the Afrimat Bethlehem Quarry is very low. (Figure 8).

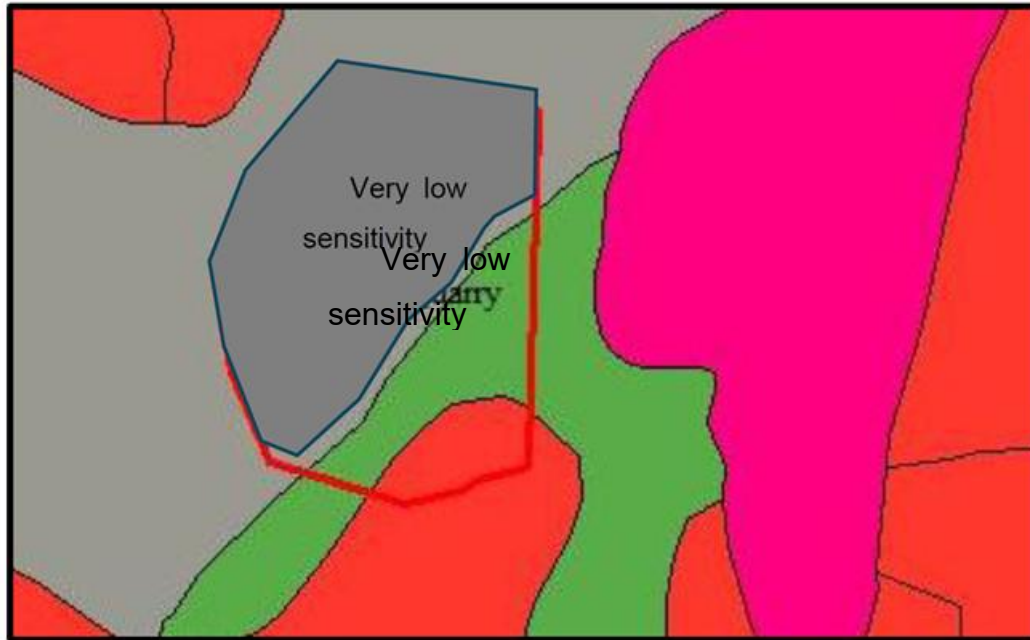


Figure 6 The planned extension area for mining at the Afrimat Bethlehem Quarry falls on dolerite with a very low sensitivity in terms of palaeontological heritage

The chance find of vertebrate and/or plant fossils in the Tarkastad Subgroup and the Molteno Formation is usually **very high**. In the case of this upgrading the entire area earmarked for mining is however underlain by dolerite, with a very low significance in terms of palaeontological heritage. The south-eastern part of the study site is not applicable to the development of the quarry and deep soil cover prevents exposure of significant fossils.

Mitigation for fossils will allow preservation of highly significant vertebrate, plant and trace fossils and it is therefore recommended that, where Palaeozoic to Cenozoic aged fossils are exposed, a palaeontologist be appointed who can take responsibility for the palaeontological treasures in this part of the Karoo Supergroup.

CONCLUSIONS

The geology underlying the project area for the upgrading of the Afrimat Bethlehem Quarry south of Bethlehem in the Dihlabeng Local Municipality, Thabo

Mofutsanyane District Municipality comprises Mesozoic to Cenozoic aged sedimentary rocks of the Karoo Supergroup, as well as Quaternary alluvial deposits.

The study site is underlain by deeply weathered Karoo dolerite with minor outcrops of sandstone and shale of the Molteno, Formation of the Karoo Supergroup.

Recommendations

- The EAP and developer must be informed that the Afrimat Bethlehem Quarry is underlain by rocks with a very low to very high sensitivity for palaeontological heritage. **Following the site visits on Friday 17th April 2026, it is the professional opinion of Dr Gideon Groenewald, accredited palaeontologist, that the chance-find of significant fossils in study area is very low.**
- The project will require a formal “Chance Find Protocol” that will have to be upgraded during the construction phases of the project. (The Chance Find Protocol document is attached to this report).
- **Without mitigation** the project will have a **very high negative impact** on palaeontological heritage. **With mitigation** (see CFP attached) the project will have a **very high positive** impact on Global palaeontological heritage, mainly because excavations of more than 1,5m deep will expose new bedrock that would never have been exposed for thousands of years.
- Recommendations for palaeontological monitoring and mitigation (CFP Document attached) will have to be incorporated into the EMP for approval by HFS/SAHRA.
- It is recommended that, with the mitigations proposed, there are no reasons why this project cannot be implemented.

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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

CHANCE FIND PROTOCOL FOR PALAEOLOGICAL HERITAGE

Heritage Authority Approval for the proposed upgrading of the EMPr for the Afrimat Bethlehem Quarry in the Dihlabeng Local Municipality, Thabo Mofutsanyane District Municipality, Free State Province

Mitigation for excavation Impact on Palaeontological Heritage Resources in the excavation areas on the site of the Afrimat Bethlehem Quarry

It is essential that the appointed palaeontologist, in consultation with the Project Environmental Manager and the contractors and ECO's of excavation works during the implementation phase of the project, develop a short-term strategy for the **recovery** of unexpected fossils before any excavation operation. As part of such a strategy, the discussions with the palaeontologist must include:

- Initially, and at least for the *duration of excavations*, visit the site on request of the ECO of the specific excavation site, to ensure recording of all potentially significant fossil strata. Due to the longevity of this contractual involvement it is not possible to have pre-determined timing on further visits and it is a conclusion from present observations, that more frequent visits by the Palaeontologist during excavations into the soils on site **will not be required** at this stage.
- Determine a short-term strategy and budget for the recording of significant fossils. Following an assessment of the sensitivity of the project area for Palaeontological Heritage, a limited budget must be proposed as an estimated amount needed to safeguard unexpected Palaeontological Heritage items during construction. The above mentioned strategy is simply an oral agreement on when the site is to be inspected and what the finds are that might be recorded. The site visit must include an introduction session with all the managers of the Project Team, including training of the ECO and site managers by the appointed palaeontologist, to basically train people to know what to look out for in terms of fossil heritage on site. This action will be required at the start of each individual exploration activity for the duration of exploration in the “greenfield sections” of the site.
- Following the Phase 1 Survey, follow-up site visits (Phase 2 PIA) are not recommended at this stage.
- In the **very un-likely** case of reporting of any unusual sedimentary structures and fossils along the access routes, the Palaeontologist must be

notified, and a site visit must be arranged at the earliest possible time with the Palaeontologist. In the case of the site ECO or the Site Manager becoming aware of suspicious looking material that might be a “Significant Find”, the excavation must be halted in that specific area and the Project Environmental Manager (PEM) must be informed who will inform the Project Engineer. The Palaeontologist must be given enough time to reach the site and the PEM will request a Site Instruction from the Engineer to allow for removal the material before excavation continues.

Mitigation Measures Normally Encountered

1. Mitigation of palaeontological material must begin as soon as possible and preferably when “trial excavation” takes place. The appointed specialists must acquaint themselves with the operation and determine feasible mitigation strategies.

2. A plan for systematic sampling, recording, preliminary sorting and storage of palaeontological and sedimentological samples will be developed during the early stages of the project, in collaboration with the National Museum in Bloemfontein, that is the closest Institutes to the site. It is essential that coordination between the Palaeontological specialist and the engineering teams ensure minimum standing time, and if possible, no standing time.

3. In the unlikely event of a significant fossil find, mitigation will involve an attempt to capture all rare fossils and systematic collection of all fossils discovered. This will take place in conjunction with descriptive, diagrammatic and photographic recording of exposures, also involving sediment samples and samples of both representative and unusual sedimentary or biogenic features. The fossils and contextual samples will be processed (sorted, sub-sampled, labelled, boxed) and documentation consolidated, to create an archive collection from the excavated sites for future researchers.

Functional responsibilities of the Developer

1. Ensuring, at their cost, that a representative archive of palaeontological samples and other records is assembled to characterise the palaeontological occurrences affected by the exploration operation.

2. Provide field aid, if necessary, in the supply of materials, labour and machinery to excavate, load and transport sampled material from the excavation areas to the sorting areas, removal of overburden if necessary, and the return of discarded material to the disposal areas. In the case of this project it is foreseen that invertebrate and trace fossils will be present. *(If fossils of Triassic age are exposed, it will be Very Highly significant and the Palaeontologist will obviously be in close communication with the site ECO and the PEM to act as required by HFS/SAHRA without causing undue standing time for the contractors).*

3. “Facilitate” systematic recording of the stratigraphic and palaeo-environmental features of exposures in the fossil-bearing excavations, by allowing time to describe and measure geological sections, and by providing aid in the surveying of positions where significant fossils are found. *(In the case of this specific development, the likelihood of such finds in the sediments is **highly unlikely**. The total estimated time that needs to be allowed for specialist involvement during construction is one working day for every month of construction).*

4. Provide safe storage for fossil material found routinely during excavation operations by construction personnel. In this context, isolated fossil finds in disturbed material qualify as “normal” fossil finds.

5. Provide covered, dry storage for samples and facilities that is defined as a work area for sorting, labelling and boxing/bagging of samples. (This storage facility is normally one secure shipping container measuring **2mX3m** that is placed at the main site office for the project.

6. Costs of basic curation and storage in the sample archive at the National Museum in Bloemfontein (labels, boxes, shelving and, if necessary, specifically-tasked temporary employees).

Documentary record of palaeontological occurrences

1. The contractors will, after consultation with the PEM and in collaboration with the Palaeontologist, make the excavation plan available to the appointed specialist, in which the following information are indicated on the plan in the site office at the excavation site. This must be done in conjunction with the appointed

specialist and form part of the on-going revision of this “Chance Find Protocol” (CFP), during the excavation stage of the project:

1.1. Initially, all known specific palaeontological information will be indicated on the plan. This will be updated throughout the excavation period.

1.2 Locations of samples and measured sections are to be pegged, and routinely accurately surveyed. Sample locations, measured sections, etc., must be recorded three-dimensionally if any significant fossils are recorded during the time of excavation. This information must be recorded during the first site visit and a clearance from the Palaeontologist (e-mail message will suffice) must be followed up with subsequent e-mail communications with the Site Specific ECO, Site Manager and the PEM.

Functional responsibilities of the appointed Palaeontologist

1. **If applicable** after completion of the Phase 2 site visit, apply for a permit to collect fossils during the lifetime of the Project and establishment of a representative collection of fossils and a contextual archive of appropriately documented and sampled palaeoenvironmental and sedimentological geodata in collaboration with the National Museum in Bloemfontein as well as the ESI at WITS University.

2. Undertake an initial evaluation of potentially affected areas and of available exposures in excavations. A short training session, inclusive of the PEM, Project Managers and the ECO's or their representatives, must preferably be presented during the second site visit to this project.

3. On the basis of the above, and evaluation during the early stages of excavation development, in collaboration with the PEM and the contractor management team, more detailed practical strategies to deal with the fossils encountered routinely during excavation, as well as the strategies for major finds must briefly be agreed on.

4. If fossils are recorded, informal on-site training in responses applicable to “normal” fossil finds must be provided for the PEM, ECO and environmental staff by the appointed specialist. **This step is will only be arranged following the**

discovery of significant fossils at the time of the Phase 2 site visits, if applicable.

5. Respond to significant finds and undertake appropriate mitigation.

6. Initially, for the first six months of construction, and if the PEM or the appropriate ECO indicates significant “strange looking rocks” that might be similar to the fossils indicated to the staff during the information sessions, visit at least once in twelve weeks to “touch base” with the monitoring progress. Document interim “normal” finds and undertake an inspection and documentation of new excavation faces. A strategy for further visits during the life of the excavation must be discussed.

7. Transport of material from the site to the Institute that is recommended by HFS/SAHRA, and/or the National Museum in Bloemfontein and /or the ESI, Wits University.

8. Reporting on the significance of discoveries, as far as can be preliminarily ascertained. This report is in the public domain and copies of the report must be deposited at HFS, the National Museum, ESI and the South African Heritage Resources Authority (SAHRA). It must fulfil the reporting standards and data requirements of these bodies.

9. Reasonable participation in publicity and public involvement associated with palaeontological discoveries.

Exposure of palaeontological material

1. In the event of excavations exposing new palaeontological material, not regarded as normative/routine as outlined in the initial investigation, such as a **major fossil find**, the following procedure must be adhered to:

1.1 The appointed specialist or alternates (HFS/SAHRA; National Museum, ESI at WITS University) must be notified by the responsible officer (e.g. the PEM, Chief Engineer, ECO or Contractor Manager), of major or unusual discoveries during excavation, found by the Contractor Staff.

1.2 Should a major *in situ* occurrence be exposed, excavation will immediately cease in that area so that the discovery is not disturbed or altered in any way until the appointed specialist or scientists from the recommended Institute, or its

designated representatives, have had reasonable opportunity to investigate the find. Such work will be at the expense of the Developer.

1.3 Significant fossil finds are known from this area and the appointed palaeontologist must clear continued excavation on the proviso that any suspicious material will be indicated by the ECO to the Palaeontologist via emailed photographic information.

CONCLUSION

The development site for the proposed Upgrading of the EMPr for the Afrimat Bethlehem Quarry in the Dihlabeng Local Municipality, Thabo Mofutsanyane District Municipality, Free State Province, has a very low rating for Palaeontological Heritage. Further mitigation for Palaeontological Heritage (Phase 2 field inspection and report) is **not recommended at this stage**. The ECO must however inform the Project Palaeontologist of any suspicious material.

It is recommended that:

- The PEM and ECO's must be informed of the fact that a very low rating for Palaeontological Sensitivity is allocated to the areas underlain by dolerite of the Karoo Supergroup. Areas underlain by the Tarkastad Subgroup are allocated a very high sensitivity but will be excluded from mining activities. A medium sensitivity is allocated to the areas underlain by alluvium, where mining will also not be done.
- This "Chance Find Protocol" must be included in the EMPr of the Project and a reasonable budget must be allocated to ensure compliance with the legal responsibility of the developer in terms of the proper conservation of and storage of Palaeontological Heritage.
- HFS/SAHRA must be informed of the content of this "Chance Find Protocol".
- Following the Phase 1 survey, it is the professional opinion of Dr Gideon Groenewald, accredited palaeontologist, that NO FURTHER MITIGATION for Palaeontological Heritage is recommended.

- It is the professional opinion of Dr Gideon Groenewald that, on the proviso that the proposed mitigation measures are adhered to, there is no reason why HFS/SAHRA cannot approve the continuation of this project.

APPENDIX B
CHANCE FIND PROTOCOL

CHANCE FIND PROTOCOL – HERITAGE RESOURCES

PURPOSE

Potential impacts on heritage resources can occur during construction as a result of unearthing during construction. This protocol outlines the procedures to be followed in the event that a heritage resource is uncovered.

Palaeontological finds

Monitoring Programme for Palaeontology is to commence once the excavations for all structures and infrastructure begin. The following procedure is only required if fossils are seen on the surface and when excavations commence.

1. When excavations begin the rocks must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (silicified wood, plants, insects, bone, shells) should be put aside in a suitably protected place. This way the construction activities will not be interrupted.
2. Where possible, photographs of similar fossils must be provided to the contractor to assist in recognizing the fossil plants and bones that might be encountered on site. This information must be built into the EMP's training and awareness plan and procedures.
3. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
4. If there is any possible fossil material found by the Contractor/environmental officer then a qualified palaeontologist should visit the site to inspect the selected material and check the excavations where feasible.
5. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further

study. Before the fossils are removed from the site, a South African Heritage Resources Agency (SAHRA) permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.

6. If no good fossil material is recovered, then any site inspections by the palaeontologist will not be necessary.

7. If no fossils are found and the excavations have finished, then no further monitoring is required.

Archaeological finds

If you believe that you may have encountered any archaeological materials, stop work in the area and follow the procedure below:

1. The heritage resource must be avoided and all activities in the immediate vicinity temporarily ceased.

2. A suitably qualified specialist must be informed and commissioned to consider the heritage resource, either via communicating with the Environmental Officer via telephone or email or based on a site visit.

3. Appropriate measures are to be provided by a qualified specialist towards immediate management of the heritage resource.

Should the specialist conclude that the find is a heritage resource protected in terms of the NRHA (1999) Sections 34, 36, 37 and NHRA (1999) Regulations (Regulation 38, 39, 40), the specialist must notify SAHRA on behalf of the Developer.

If required by SAHRA, the specialist must conduct a HIA in terms of NHRA Section 38 that must include rescue actions/excavations.

Graves

Should any unmarked human burials/remains be found during the course of construction:

1. Work in the immediate vicinity should cease and the find must immediately be reported to the archaeologist, or the South African Heritage Resources Agency (SAHRA).
2. Where human remains are part of a burial they would need to be exhumed under a permit from SAHRA (for pre-colonial burials as well as burials later than about AD 1500).
3. For newer graves, should the specialist conclude that the find is a heritage resource protected in terms of the NHRA (1999) Section 35 and NHRA (1999) Regulations (Regulation 38, 39, 40) SAHRA may require that an identification of interested parties, consultation and /or grave relocation take place.
4. Consultation must take place in terms of NHRA (1999) Regulations 39, 40, 42;
5. Grave relocation must take place in terms of NHRA (1999) Regulations 34.
6. These measure should be undertaken by a qualified archaeologist, and in accordance with relevant legislation, permitting, statutory permissions and subject to any local and regional provisions, laws and by-laws pertaining to human remains.

If required by current, relevant legislation, a full social consultation process should occur in conjunction with the mitigation of cemeteries and burials.

Under no circumstances may burials be disturbed or removed until such time as necessary statutory procedures required for grave relocation have been met.