



PGS
HERITAGE

**PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED
IMPROVEMENTS OF THE R33 NATIONAL ROAD SECTION 12: FROM N1 (KM 77.0) TO
SECTION 13 MODIMOLLE (KM 0.6), LIMPOPO PROVINCE.**

Issue Date: 28 July 2022
Revision No.: v0.1
Client: Environmental Edge (Pty) Ltd
PGS Project No:



Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favorable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, Regulations, and all other applicable legislation.
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application.
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not
- All the particulars furnished by me in this form are true and correct.
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realize that a false declaration is an offense in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations.

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ACKNOWLEDGEMENT OF RECEIPT

| Report Title | Palaeontological Desktop Assessment for the proposed Improvements of the R33 National Road Section 12: from N1 (Km 77.0) to Section 13 Modimolle (Km 0.6), Limpopo Province. | | |
|--------------|--|---|---|
| Control | Name | Signature | Designation |
| Author | Elize Butler |  | Palaeontologist |
| Reviewed | | | Archaeologist/Heritage Specialist/Project Manager – PGS Heritage |

This Palaeontological Impact Assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1 - NEMA Table

| Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017 | Relevant section in report | Comment where not applicable. |
|--|--|--|
| 1.(1) (a) (i) Details of the specialist who prepared the report | Page ii and Section 2 of Report – Contact details and company and Appendix A | - |
| (ii) The expertise of that person to compile a specialist report including a curriculum vitae | Section 2 – refer to Appendix A | - |
| (b) A declaration that the person is independent in a form as may be specified by the competent authority | Page ii of the report | - |
| (c) An indication of the scope of, and the purpose for which, the report was prepared | Section 4 – Objective | - |
| (cA) An indication of the quality and age of base data used for the specialist report | Section 5 – Geological and Palaeontological history | - |
| (cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change; | Section 9 | - |
| (d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment | | Desktop Assessment |
| (e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used | Section 7 Approach and Methodology | - |
| (f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or | Section 1 and 10 | |

| Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017 | Relevant section in report | Comment where not applicable. |
|---|---|---|
| activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives; | | |
| (g) An identification of any areas to be avoided, including buffers | Section 5 | No buffers or areas of sensitivity identified |
| (h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers; | Section 5 – Geological and Palaeontological history | |
| (i) A description of any assumptions made and any uncertainties or gaps in knowledge; | Section 7.1 – Assumptions and Limitation | - |
| (j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment | Section 1 and 10 | |
| (k) Any mitigation measures for inclusion in the EMPr | Section 1 and 10 | |
| (l) Any conditions for inclusion in the environmental authorisation | Section 1 and 10 | |
| (m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation | Section 1 and 10 | |
| (n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and | Section 1 and 10 | |
| (n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and | | |
| (n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and | Section 1 and 10 | - |

| Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017 | Relevant section in report | Comment where not applicable. |
|---|--|----------------------------------|
| mitigation measures that should be included in the EMP, and where applicable, the closure plan | | |
| (o) A description of any consultation process that was undertaken during the course of carrying out the study | N/A | |
| (p) A summary and copies if any comments that were received during any consultation process | N/A | |
| (q) Any other information requested by the competent authority. | N/A | |
| (2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply. | Section 3 compliance with SAHRA guidelines | |

EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the Palaeontological Desktop Assessment (PDA) to assess the proposed Improvements of the R33 National Road Section 12: from N1 (Km 77.0) to Section 13 Modimolle (Km 0.6) in Limpopo Province. In accordance with the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PDA is necessary to confirm if fossil material could potentially be present in the planned development area and to evaluate the potential impact of the proposed development on the Palaeontological Heritage of the area.

The proposed development is underlain by diabase as well as the Alma and Swaershoek Formations (Nylstroom Subgroup, Waterberg Group). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of diabase is Zero while that of the Nylstroom Subgroup (Waterberg Group) is Moderate (Almond and Pether 2008, SAHRIS website).

A Low Significance has been allocated to the development. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological resources of the area. The construction and operation of the project may be authorised, as the whole extent of the development footprint is not considered sensitive in terms of palaeontological heritage. If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Environmental Control Officer (ECO) in charge of these developments must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carry out by a palaeontologist.

It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

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Appendix A:

Curriculum Vitae Elize Butler

TERMINOLOGY AND ABBREVIATIONS

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic, or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influences its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place.
- carrying out any works on or over or under a place.
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place.
- constructing or putting up for display signs or boards.
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Fossil

Mineralized bones of animals, shellfish, plants, and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures, and equipment of cultural significance.
- places to which oral traditions are attached or which are associated with living heritage.
- historical settlements and townscapes.
- landscapes and natural features of cultural significance.
- geological sites of scientific or cultural importance.
- archaeological and palaeontological sites.
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Table 2: Abbreviations

| Abbreviations | Description |
|---------------|--|
| AIA | Archaeological Impact Assessment |
| ASAP | Association of South African Professional Archaeologists |
| CRM | Cultural Resource Management |
| ECO | Environmental Control Officer |
| EAP | Environmental Assessment Practitioner |
| EIA | Environmental Impact Assessment |
| ESA | Early Stone Age |
| GPS | Global Positioning System |
| HIA | Heritage Impact Assessment |
| I&AP | Interested & Affected Party |
| LSA | Late Stone Age |
| LIA | Late Iron Age |
| MSA | Middle Stone Age |
| MIA | Middle Iron Age |
| NEMA | National Environmental Management Act |
| NHRA | National Heritage Resources Act |
| PDA | Palaeontological Desktop Assessment |
| PIA | Palaeontological Impact Assessment |
| PHRA | Provincial Heritage Resources Authority |
| PSSA | Palaeontological Society of South Africa |
| SADC | Southern African Development Community |
| SAHRA | South African Heritage Resources Agency |
| SAHRIS | South African Heritage Resources Information System |

1 INTRODUCTION

The South African National Road Agency Soc Ltd plans to upgrade the R33 National Road within the Waterberg District Municipality and Modimole-Mookgopong Local Municipality (Limpopo Province) (Figure 1-2).

A traffic analysis conducted in 2019 indicated that the R33 experienced high traffic volumes and consequently needs to be upgraded to accommodate the increased traffic. The proposed road upgrade starts at Section 12 (km 77,0) and ends at Section 13 (km 0,6) about 600m after the intersection of R33 and R101.

1.1 PROJECT INFORMATION

The total length of the project is 12.3 km's. The project is divided into two distinct sections namely :

- Section 12 Km 77.0 to Km 86.0 (10.0km): This section has rural characteristics.
- Section 12 Km 86.0 to Section 13 Km 0.6 (2.3km): This section has urban characteristics¹.

The basic scope of work is as follows:

- Road widening to meet the minimum requirements of a Class 2 road that has an AADT of greater than 3000 veh/day, as recommended by SANRAL,
- Capacity upgrades in line with the traffic report
- Correction of horizontal geometry at some sections,
- Correction of vertical geometry at some sections,
- Upgrade/reinstatement of existing stormwater infrastructure,
- Intersection upgrades,
- Verge clearance to improve sight distance along the project route.
- Pavement strengthening by in-situ recycling and base import followed by double seal surfacing along the rural section,
- Box cutting and bitumen treated base (BTB) construction followed by asphalt surfacing along the urban section,
- Upgrade of river bridge and major culvert,
- Widening of a rail bridge
- Reinstatement and provision of road signage/markings, and
- Construction of a hawker facility at the beginning of the urban section.
- Upgrading of pedestrian walkways along the R33, with emphasis on the urban section
- Proper pedestrian accommodation at every signalised intersection (i.e. pedestrian signals with adequate time to cross the road and visible road marking indicating a pedestrian crossing)
- Special emphasis should be placed on Joe Slovo Drive and the R101 Thabo Mbeki Drive intersections due to the very high pedestrian activity at these intersections
- Upgrading of pedestrian facilities adjacent to the railway bridge (Km 86.75) ¹.

1.2 TECHNICAL DESCRIPTION

Major aspects of the project include:

- Strengthening of the existing pavement, general widening of the existing road cross section for capacity improvements and 3.0m surface shoulders,
- Substantial vertical and horizontal geometric improvements, widening of railway bridge and some major and minor culverts,
- Construction of 2 new river bridges
- Widening of existing agricultural underpass
- Possible 6.5 wide temporary deviation to accommodate two-way traffic during construction
- Stockpile areas and vegetation clearance outside road reserve in excess of one hectare¹.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-five years. She has experience in locating, collecting, and curating fossils. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

¹ Information provided by Environmental Edge (Pty) Ltd

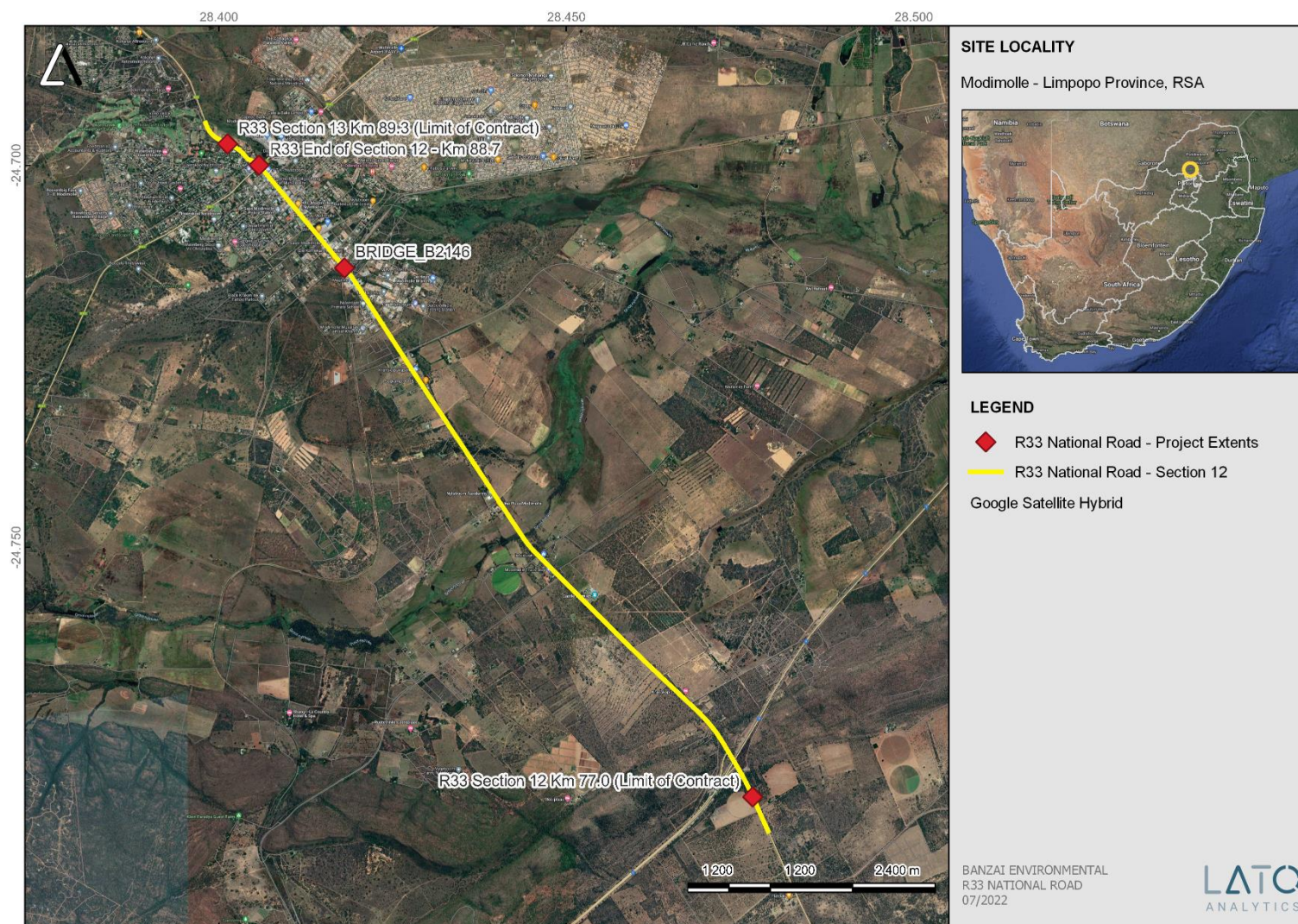


Figure 1: Google Earth Image (2022) depicting the proposed R33 National Road upgrade within the Modimolle-Mookgopong Local Municipality, Limpopo Province.

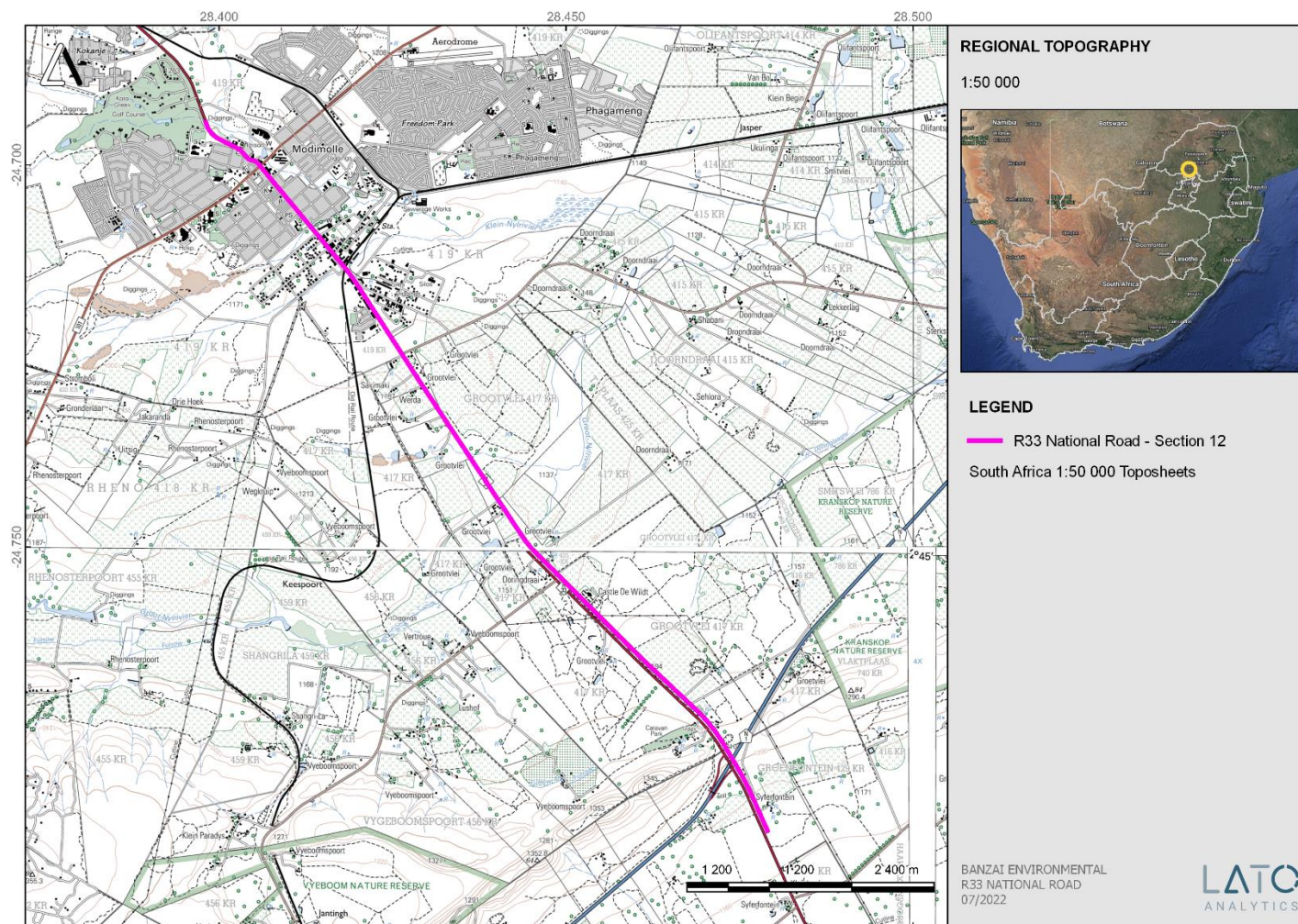


Figure 2: Extract of the 150 000 topographical maps indicating the location of the R33 National Road upgrade within the Modimole-Mookgopong Local Municipality, Limpopo Province.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include **“all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens”**.

The identification, evaluation and assessment of any cultural heritage site, artefact or finds in the South African context is required and governed by the following legislation:

- National Environmental Management Act (NEMA) Act 107 of 1998
- National Heritage Resources Act (NHRA) Act 25 of 1999
- Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified.

The next section in each Act is directly applicable to the identification, assessment, and evaluation of cultural heritage resources.

GNR 982 (Government Gazette 38282, 14 December 2014) promulgated under the National Environmental Management Act (NEMA) Act 107 of 1998

- Basic Assessment Report (BAR) – Regulations 19 and 23
- Environmental Impacts Assessment (EIA) – Regulation 23
- Environmental Scoping Report (ESR) – Regulation 21
- Environmental Management Programme (EMPr) – Regulations 19 and 23

National Heritage Resources Act (NHRA) Act 25 of 1999

- Protection of Heritage Resources – Sections 34 to 36
- Heritage Resources Management – Section 38

MPRDA Regulations of 2014

Environmental reports to be compiled for application of mining right – Regulation 48

- Contents of scoping report – Regulation 49
- Contents of environmental impact assessment report – Regulation 50
- Environmental management programme – Regulation 51
- Environmental management plan – Regulation 52

The NEMA (No 107 of 1998) states that an integrated EMP should (23:2 (b)) “...*identify, predict*

and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage”.

In agreement with legislative requirements, EIA rating standards as well as SAHRA policies the following comprehensive and legally compatible PIA report have been compiled.

Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length.
- the construction of a bridge or similar structure exceeding 50 m in length.
- any development or other activity which will change the character of a site—
- (Exceeding 5 000 m² in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m² in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

The aim of a Palaeontological Impact Assessment (PIA) is to decrease the effect of the development on potential fossils at the development site.

According to the “SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports” the purpose of the PIA is: 1) to identify the palaeontological importance of the rock formations in the footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) to clarify the **impact** on fossil heritage; and 4) to suggest how the developer might protect and lessen possible damage to fossil heritage.

The palaeontological status of each rock section is calculated as well as the possible impact of the development on fossil heritage by a) the palaeontological importance of the rocks, b) the type of development and c) the quantity of bedrock removed.

When the development footprint has a moderate to high palaeontological sensitivity a field-based assessment is necessary. The desktop and the field survey of the exposed rock determine the impact significance of the planned development and recommendations for further studies or mitigation are made. Destructive impacts on palaeontological heritage usually only occur during the construction phase while the excavations will change the current topography and destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

Mitigation usually precede construction or may occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. Preceding excavation of any fossils a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact as possible because our knowledge of local palaeontological heritage may be increased

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kml's) in the proposed development.
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect, and cumulative:
 - a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.

- b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
- c. **Cumulative impacts** result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present, or reasonably foreseeable future activities.
 - Fair assessment of alternatives (infrastructure alternatives have been provided);
 - Recommend mitigation measures to minimise the impact of the proposed development; and
 - Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The geology of the R33 National Road upgrade within the Modimole-Mookgopong Local Municipality, Limpopo Province is depicted on the 1:250 000 2428 Nylstroom Geological Map (1978) (Council of Geoscience, Pretoria) (**Figure 3-5**, Table 3). The proposed development is underlain by diabase (d, green); Alma (Mag, stippled brown) and Swaershoek Formations (Ms, brown) of the Nylstroom Subgroup, Waterberg Group. Recent Shape files compiled by the Council of Geosciences (Pretoria) is depicted in **Figure 6**. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of diabase is Zero while that of the Nylstroom Subgroup (Waterberg Group) is Moderate (Almond and Pether 2008, SAHRIS website).

The diabase is igneous rocks and are thus considered to have no palaeontological significance. However, the existence of the diabase rocks would have had a thermal metamorphic effect on the adjoining Waterberg Group and would decrease the chance of fossils preservation in this Group.

The main Waterberg Basin is situated in the Limpopo Province (South Africa) and extends into eastern Botswana. Extensive research on the Waterberg Group has been conducted by Jansen (1982), Callaghan *et al.* (1991), Callaghan and Brandl (1991) and Callaghan (1993). It is estimated that the Waterberg Group is about 2700 to 7000 m or more thick. The Waterberg Group lies unconformably on the Transvaal Supergroup, the Archaeon Kaapvaal Craton as well as the Bushveld Complex, while the Blouberg Formation is overlain by the Mogalakwena Formation. The Waterberg Group has yet not been dated but dolerite intrusions in the upper Waterberg Group is dated at c. 1879 to 1872 Ma (Hanson *et al.*, 2004).

The Waterberg Group is subdivided in the Nylstroom (oldest), Matlabas and Kransberg (youngest) Subgroups (Figure 3). All three Subgroups exhibits upwards-fining. The Waterberg Group is characterized by its dark greyish red colour. The red colour suggests an oxidizing environment when adequate free oxygen was available to oxides ferruginous minerals, creating the formation of

“red beds”. These rocks are very hard and chemically resistant, producing remarkable cliffs with a high topography (McCarthy and Rubidge 2005).

The Alma Formation overlies the Swaershoek Formation (Nykstroom Subgroup) and consists of a sequence of medium- to coarse-grained arkoses, feldspathic arenites, lithic arkoses, as well as subarkoses and litharenites. Sediments of the Alma Formation were deposited as a group of alluvial fans, that forms a bajada along the scarp produced by an uplifted block, south of the Murchison strike-slip fault zone.

Informally the Swaershoek Formation is subdivided in the upper and lower parts. Deposition of the lower Swaershoek Formation is thought to have been penecontemporaneous with the Bushveld Complex granite intrusions. This Formation comprise of arenites and rudites, (Meinster, 1971) without Bushveld granite clasts. The upper part comprises mainly of fractured rudites and arenites with intercalated lutites. At the base is a thick lava unit with several lava flows higher in the system. Although disputed Callaghan (1993) maintained that the Swaershoek Formation was deposited as fan-deltas.

Table 3: Stratigraphic subdivision of the Waterberg Group in the main Waterberg Basin (based on SACS, 1980, Taken from Barker et al, 2006).

| | Subgroups | Formations | | |
|-----------------|-----------|----------------------------------|----------------------------------|-----------------------------|
| | | South/southwest and central area | North/northeast and central area | Nylstroom Basin |
| WATERBERG GROUP | Kransberg | Vaalwater (≤ 475 m) | Vaalwater (≤ 475 m) | |
| | | Cleremont (~ 125 m) | Cleremont (~ 125 m) | |
| | | Sandriversberg (1250 m) | Mogalakwena (≤ 1500 m) | |
| | Matlabas | Aasvoëlkop (≤ 600 m) | Makgabeng (≤ 1200 m) | |
| | | Skilpadkop (≤ 600 m) | Setlaole (≤ 450 m) | |
| | Nylstroom | Alma (≤ 3000 m) | | Alma (1200–1800 m) |
| | | Swaershoek (≤ 1000 m) | | Swaershoek (≤ 2500 m) |

The Waterberg Group may contain trace fossils. Microbial mats have been recorded from younger sediments in the Waterberg Group in the Main Waterberg Basin, but to date not in the Nylstroom Basin. The black shales south-west of Potchefstroom comprises of overlapping laminated basal mounds that may be stromatolitic and spheroidal, indicating possible planktonic fossil algae (Nixon et al., 1988). These structures ranges in size from 3.5 - 17 mm high and up to 10 mm in diameter and may be present in the development.

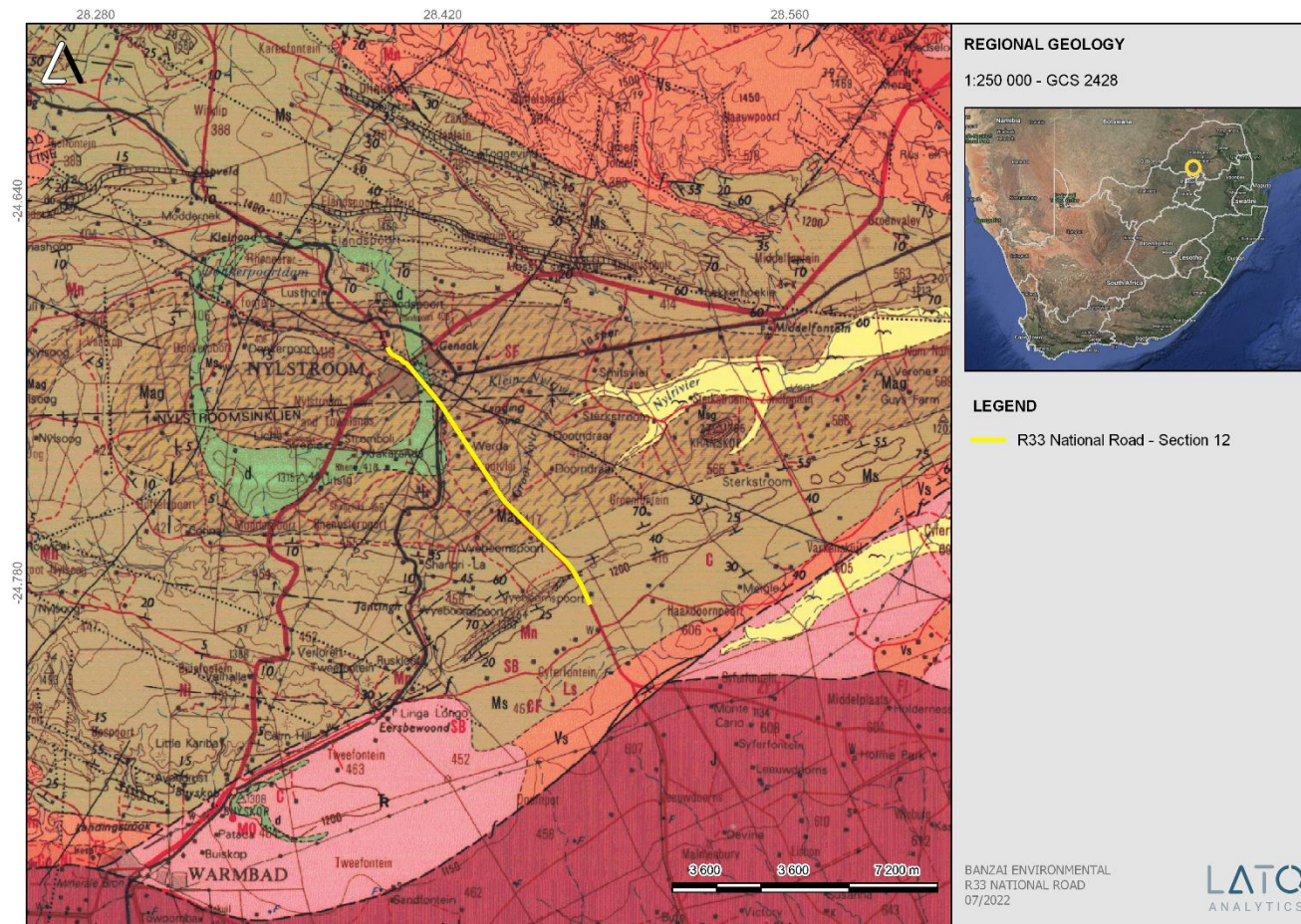


Figure 3: Extract of the 1:250 000 2428 Nylstroom Geological Map (1978) (Council of Geoscience, Pretoria) indicating the surface geology of the proposed development in yellow.

The study area is underlain by diabase (d, green); Alma Formation (Mag, stippled brown) and Swaershoek Formation (Ms, brown) of the Nylstroom Subgroup, Waterberg Group.

Palaeontological Desktop Assessment for the proposed R33 National Road upgrade in Limpopo

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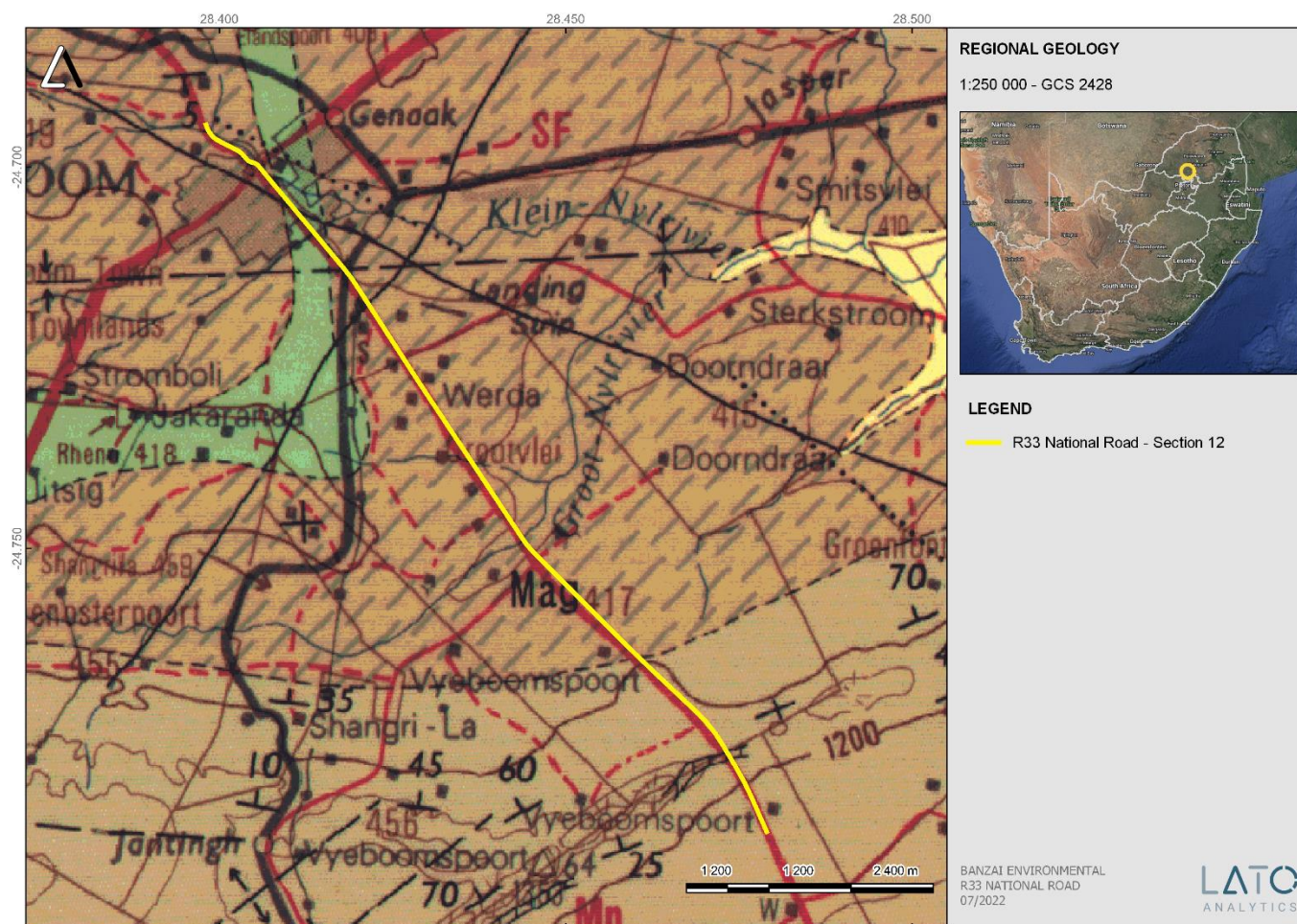


Figure 4: The proposed R33 National Road Upgrade is underlain by diabase (d, green); Alma Formation (Mag, stippled brown) and Swaershoek Formation (Ms, brown) of the Nylstroom Subgroup, Waterberg Group.

Table 4: Legend and short explanation of the 2428 Nylstroom Geological Map (1978) (Council of Geoscience, Pretoria).

MOGOLIAN MOGOLIUM

WATERBERG GROUP GROEP WATERBERG

| | |
|-----------------------------------|-----------------------------------|
| Subgroep Kransberg Subgroep | Vaalwater |
| | Cleremont |
| | Sandriviersberg (Mss) |
| | Mogalakwena (Mmc) |
| | Aasvoëlkop (Mas) |
| | Makgabeng (Mms) |
| | Schilpadkop |
| | Alma |
| | Swalershoek |
| | Subgroep Nylstroom Subgroep |

| |
|--|
| Fine-grained feldspathic and partly micaceous sandstone; arkose, siltstone and shale |
| Fynkorrelrige veldspatiese en gedeeltelik glimmerhoudende sandsteen; arkose, sliksteen en skalie |
| Coarse-grained white sandstone |
| Grofkorrelrige wit sandsteen |
| Coarse-grained yellow cross-bedded sandstone |
| Grofkorrelrige geel kruisgelaagde sandsteen |
| Sandstone, grit, conglomerate and boulder-conglomerate |
| Sandsteen, grintsteen, konglomeraat en rolblokkonglomeraat |
| Siltstone, mudstone; fine-grained feldspathic sandstone with conglomerate |
| Sliksteen, moddersteen; fynkorrelrige veldspatiese sandsteen met konglomeraat |
| Fine to medium-grained, sometimes feldspathic, sandstone |
| Fyn- tot middelkorrelrige, somtyds veldspatiese, sandsteen |
| Sandstone, grit, conglomerate and boulder-conglomerate with fine-grained sandstone at top |
| Sandsteen, grintsteen, konglomeraat en rolblokkonglomeraat met fynkorrelrige sandsteen aan top |
| Feldspathic and micaceous sandstone; graywacke, grit, mudstone, siltstone and conglomerate |
| Veldspatiese en glimmerhoudende sandsteen; grouwak, grintsteen, moddersteen, sliksteen en konglomeraat |
| Medium to coarse-grained sandstone; pebble-sandstone; tuffaceous graywacke; siltstone, shale and conglomerate |
| Middel- tot grofkorrelrige sandsteen; rolsteenhoudende sandsteen; tufagtige grouwak; sliksteen, skalie en konglomeraat |

| |
|-----|
| Mv |
| Mc |
| Mss |
| Mmc |
| Mas |
| Mms |
| Msg |
| Mag |
| Ms |

Diabase, dolerite, other basic to intermediate rocks of various ages
Diabaas, doleriet, ander basiese tot intermediêre gesteentes van verskeie ouderdomme

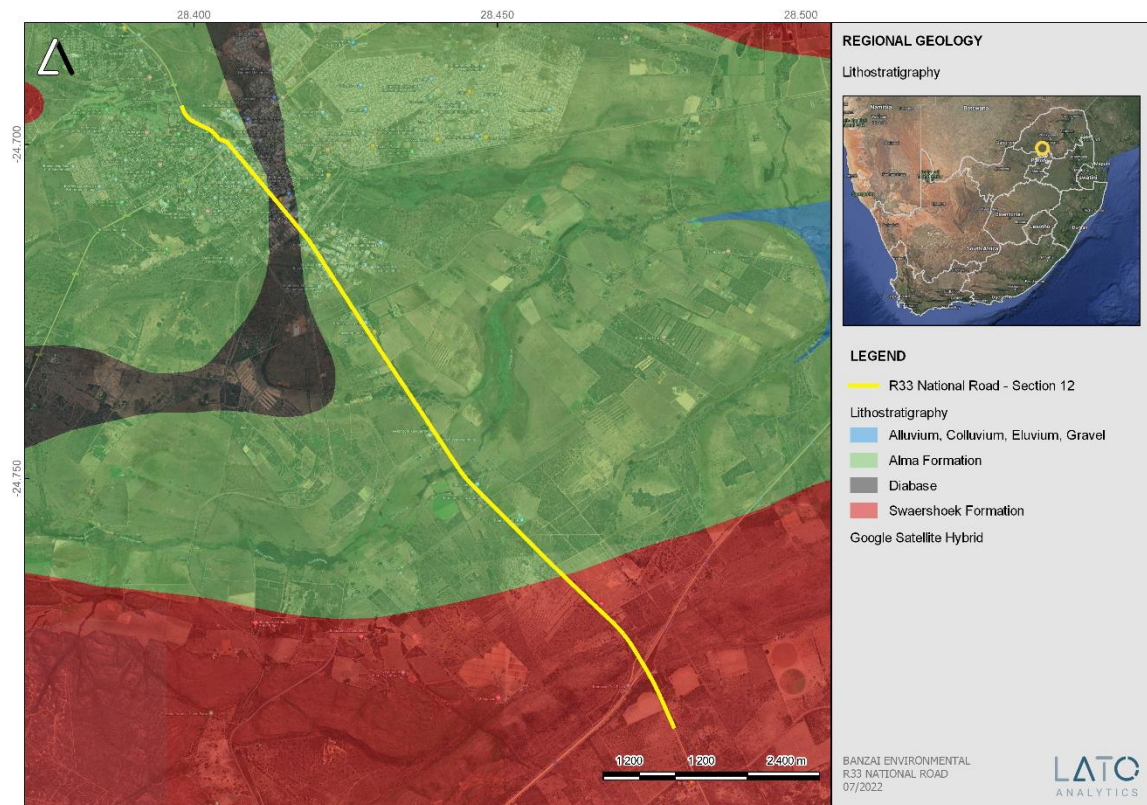


Figure 5: Geology indicated by Shape Files (Council for Geosciences, Pretoria.)

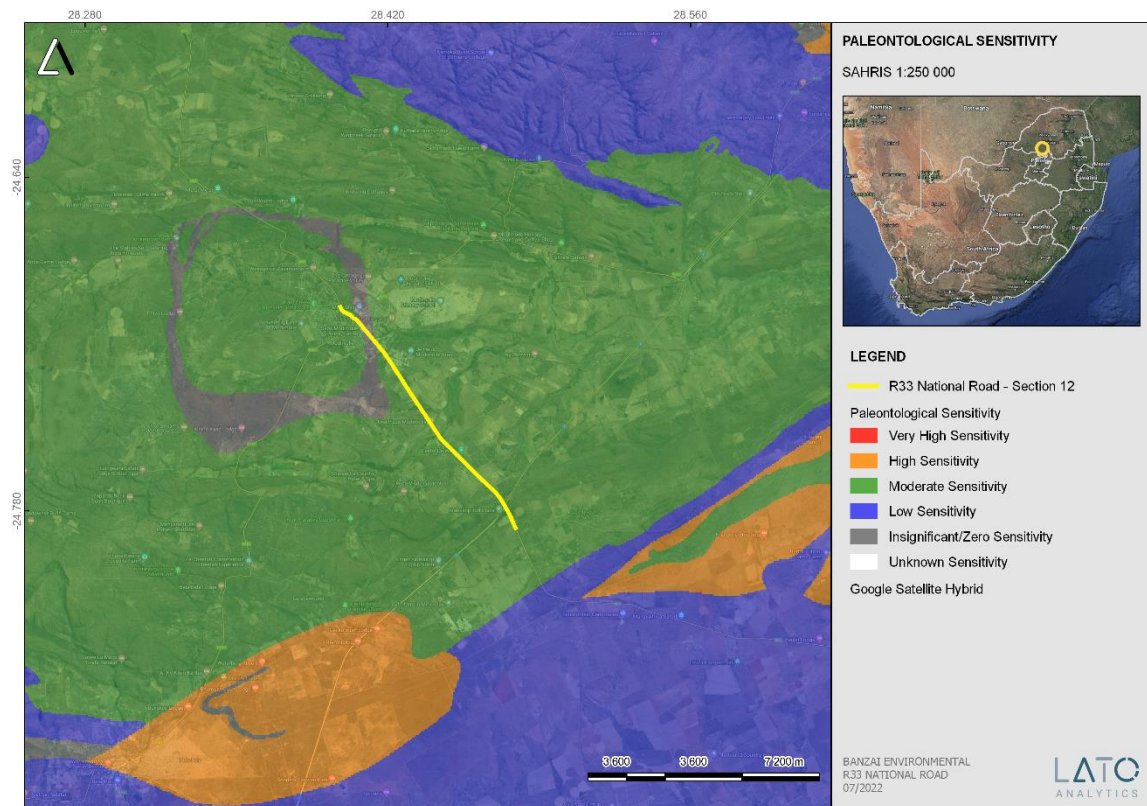


Figure 6: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in yellow.

| 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. |

According to the SAHRIS Palaeo Sensitivity map (Figure 64) the proposed development is underlain by sediments of Moderate (green) and Insignificant / Zero (grey) Palaeontological Sensitivity. The colours on the PalaeoMap indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

6 GEOGRAPHICAL LOCATION OF THE SITE

The locality of the R33 National Road upgrade is indicated in **Figure 1-2**.

The proposed road upgrade is starts at Section 12 (km 77,0) and ends at Section 13 (Km 0.6) in the town of Modimolle.

Table 5:GPS Coordinates

| R33 National Roads Upgrade | Latitude | Longitude |
|----------------------------|---------------|---------------|
| Northern point | 24°41'39.79"S | 28°23'53.16"E |
| Southern point | 24°47'13.81"S | 28°28'44.42"E |

7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a desktop study and includes Palaeontological impact assessment reports in the same area, aerial photos, and Google Earth images, topographical as well as geological maps.

7.1 Assumptions and Limitations

When conducting a PIA several factors can affect the accuracy of the assessment. The focal point of geological maps is the geology of the area, and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is used to provide information on the existence of fossils in an area which was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **assumed** that exposed fossil heritage is present within the footprint.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- Extract of the 2428 *Nylstroom* Geological Map (1978) (Council of Geoscience, Pretoria)
- A Google Earth map with polygons of the proposed development was obtained from PGS Consultants.
- PIAs in the area include Bamford, 2021, Fourie, H. and Rubidge ,B.S., 2015 (See references).

9 IMPACT ASSESSMENT METHODOLOGY

| IMPACT TABLE FORMAT | | | |
|---|--|---------------------------------|------------------------------|
| | Description | Before Mitigation | After Mitigation |
| <i>[Environmental Parameter]</i> e.g., Biodiversity | <i>Loss of Fossil Heritage</i> | | |
| Extent (Ex) | <i>A brief description indicating the chances of the impact occurring.</i> | 1 | 1 |
| Probability (Pr) | <i>A brief description of the ability of the environmental components recovery after a disturbance as a result of the activity.</i> | 2 | 2 |
| Reversibility (Re) | <i>A brief description of the environmental aspect likely to be affected by the activity e.g. Surface water.</i> | 4 | 4 |
| Irreplaceable loss of resources (L) | <i>A brief description of the degree in which irreplaceable resources are likely to be lost.</i> | 4 | 4 |
| Duration (D) | <i>A brief description of the amount of time the activity is likely to take to its completion.</i> | 4 | 4 |
| Cumulative effect (CE) | <i>A brief description of whether the impact will be exacerbated as a result of the activity.</i> | 2 | 2 |
| Intensity/magnitude (M) | <i>A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily.</i> | 2 | 1 |
| Significance Rating | <i>A brief description of the importance of an impact which in turn dictates the level of mitigation required.</i> | -34 (Negative Medium Impact) | -17 (Negative Low Impact) |
| Mitigation measures | <p>If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Environmental Control Officer (ECO) in charge of these developments must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carry out by a palaeontologist.</p> <p>It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.</p> | | |

10 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by diabase as well as the Alma and Swaershoek Formations (Nylstroom Subgroup, Waterberg Group). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of diabase is Zero while that of the Nylstroom Subgroup (Waterberg Group) is Moderate (Almond and Pether 2008, SAHRIS website).

It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological resources of the area. The project may be authorised, as the whole extent of the development footprint is not considered sensitive in terms of palaeontological heritage. If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Environmental Control Officer (ECO) in charge of these developments must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carry out by a palaeontologist.

It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

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