



PALAEONTOLOGICAL DESKTOP ASSESSMENT

40MW PHOTOVOLTAIC PLANT ACROSS
SITES 2B, 3B, 3C, 4B AND 5B ASSOCIATED
WITH THE TUBATSE FERROCHROME PLANT,
STEELPOORT, FETAKGOMO TUBATSE LOCAL
MUNICIPALITY, LIMPOPO

October 2023

COMPILED FOR: PGS HERITAGE



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.

PALAEONTOLOGICAL CONSULTANT:

Banzai Environmental (Pty) Ltd

CONTACT PERSON:

Elize Butler

[REDACTED]

[REDACTED]

[REDACTED]

SIGNATURE:



The heritage 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	The relevant section in the 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 B	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 2 – refer to Appendix B	-
(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 – Methods and Terms of Reference	-
(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 7	-



Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
(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 4 Approach and Methodology	-
(f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1, and 7	
(g) An identification of any areas to be avoided, including buffers	Section 1 & 8	
(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 4.1 – 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 9	
(k) Any mitigation measures for inclusion in the EMPr	Section 9	
(l) Any conditions for inclusion in the environmental authorisation	Section 9	



Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 9	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 9	
(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 mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 9	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process was handled as part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) process.



Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
(p) A summary and copies of any comments that were received during any consultation process	N/A	Not applicable. To date, no comments regarding heritage resources that require input from a specialist have been raised.
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(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 to conduct the Palaeontological Desktop Assessment (PDA) to assess the 40MW photovoltaic plant across sites 2B, 3B, 3C, 4B and 5B associated with the Tubatse Ferrochrome plant, Steelpoort, Fetakgomo Tubatse Local Municipality, Limpopo Province. Under the National Environmental Management Act, no 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, to evaluate the potential impact of the proposed development on the Palaeontological Heritage and to mitigate possible damage to fossil resources.

The proposed development is underlain by Quaternary alluvium and scree while the south and south eastern margins is underlain by the Magaliesberg Formation of the Pretoria Group (Transvaal Supergroup). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the superficial deposits is Low, while that of the potentially fossiliferous Magaliesberg Formation is High (Almond and Pether, 2009; Almond et al., 2013). In the Geotechnical report of the Limpopo Province, Groenewald et al (2014) indicates that the superficial deposits are of Low Palaeontological Sensitivity while that of the Magaliesberg Formation is High. Palaeontological Sensitivity generated by the DFFE National Environmental Web-Based Screening Tool indicates a small portion of High Palaeontological Sensitivity while the majority of the study area is underlain by sediments with a Medium Sensitivity. Updated geology (2014, Council for Geosciences) indicates that the study area is underlain by alluvium, colluvium, eluvium and gravel.

Based on desktop research it is concluded that fossil heritage of scientific and conservational interest in the PV footprint is relatively rare. **A Moderate Palaeontological Significance has been allocated for the construction phase of the PV development pre-mitigation and a very low significance post mitigation.** The construction phase will be the only development phase impacting Palaeontological Heritage and **no significant impacts are expected to impact the Operational and Decommissioning phases.** As the No-Go Alternative considers the option of 'do nothing' and maintaining the status quo, it will have a Neutral impact on the Palaeontological Heritage of the development. **The Cumulative impacts of the PV development near Steelpoort is considered to be medium pre-mitigation and Low post mitigation and falls within the acceptable limits for the project.** It is therefore considered that the proposed development will not lead to damaging impacts on the palaeontological resources of the area. **The construction of the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.** 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.



Recommendations:

- The ECO for this project must be informed that the Magaliesberg Formation has a **High Palaeontological Sensitivity**.
- If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources Agency (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 (recording and collection) can be carried out.
- Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.



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1 INTRODUCTION

PGS Heritage (Pty) Ltd (PGS) was commissioned by Royal HaskoningDHV (Pty) Ltd to conduct the Heritage Impact Assessment for the 40MW photovoltaic plant across sites 2B, 3B, 3C, 4B and 5B associated with the Tubatse FerroChrome (TFC) plant, Steelpoort, Fetakgomo Tubatse Local Municipality, Limpopo. Banzai Environmental (Pty) Ltd (Banzai) was in turn appointed to conduct the Palaeontological Desktop (PDA) assessment for the project.

1.1 Site Locality

The project site is located within the Fetakgomo Local Municipality of the Sekhukhune District Municipality in Limpopo Province. The locations are in and around Steelpoort¹ (Figure 1-2).

1.1.1 Site Description

The application area is located on the remainder of the farm Goudmyn 337KT and has a footprint size of roughly 59ha¹ (Figure 1-2).

1.2 Technical Description

Sites 2B, 3B, 3C, 4B and 5B will be assessed for the placement of PV infrastructure:

Table 2: Site Information

Site Number	Size (ha)	Farm Details
2B	47,49	Goudmyn 337 KT Ptn 00001 & Ptn 00010
3B	2,37	Goudmyn 337KT Ptn 0000
3C	1,71	Goudmyn 337 KT Ptn 00000
4B	5,52	Goudmyn 337 KT Ptn 00000
5B	2,14	Goudmyn 337 KT Ptn 00000 & Ptn 00006

The PV plant will consist of the following infrastructure presented below. Note that the below may be revised at a later stage when the concept design is available, and there will be sharing of infrastructure with the first phase i.e. previously authorised Sites 2, 3, 4 and 5.

- Solar PV panels that will be able to deliver the required 40MW output to the Samancor grid;
- Inverters that convert direct current (DC) generated by the PV modules into alternating current (AC) to be exported to the Samancor electrical grid;



- Transformer/ s that raises the system AC low voltage to medium voltage. The transformer converts the voltage of the electricity generated by the PV panels to the correct voltage for delivery to the TFC Plant;
- Transformer substation; and
- Instrumentation and Control consisting of hardware and software for remote plant monitoring and operation of the facility.

Associated infrastructure includes:

- Mounting structures for the solar panels in a fixed tilt of rotating tracking configuration;
- Cabling between the structures, to be laid underground where practical;
- New 33kV overhead powerlines between the various sites and the Tubatse East and - West substation buildings;
- Local substation and transformer yard at each PV site;
- Containerized switchgear substation at Tubatse East and -West MV substations for connecting to the Tubatse substation busbars;
- Water provision infrastructure (i.e. pipeline/ s, storage tank/ s, etc.) for PV panel cleaning;
- Battery Energy Storage System (BESS); and
- Internal access roads (typically 6m) roads will be constructed, but existing roads will be used as far as possible), fencing (approximately 3m in height), gates and access control¹.

¹ Information provided by PGS



2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This study has been conducted by Mrs Elize Butler. She has conducted approximately 500 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, 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 thirty 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.

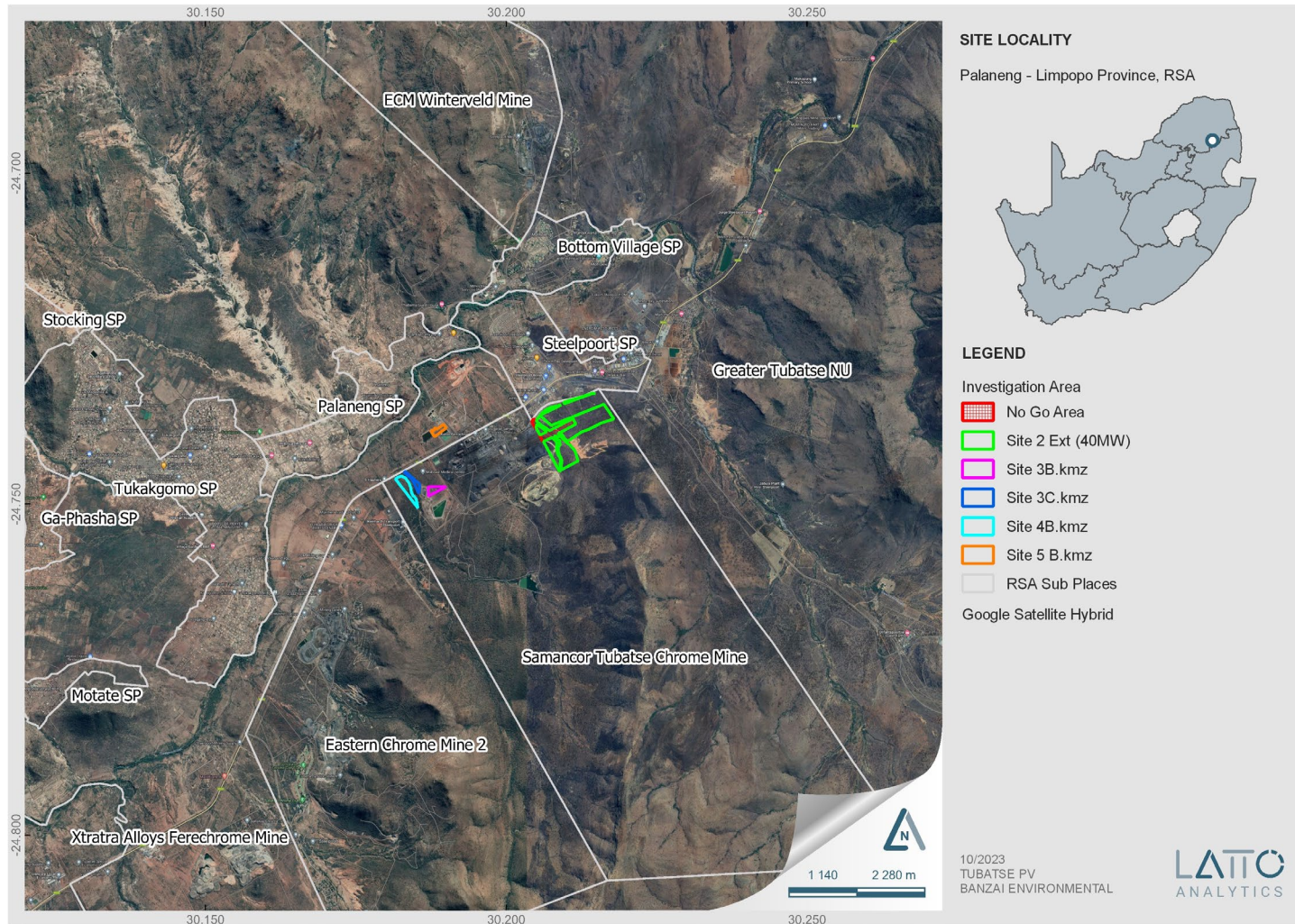


Figure 1: Regional locality of the proposed Tubatse PV Plant near Steelpoort in Limpopo Province.

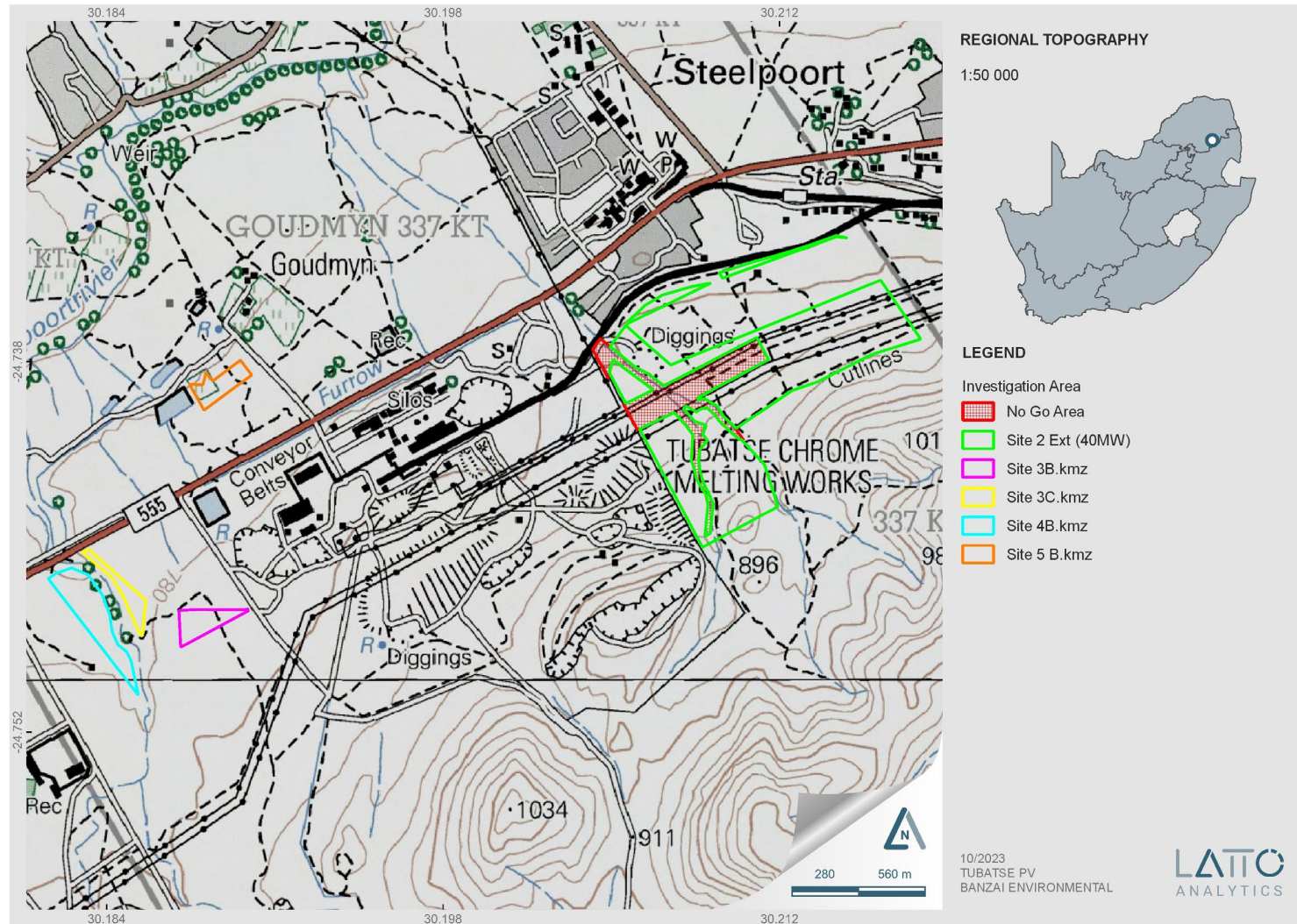


Figure 2: Locality Map of the proposed Tubatse PV Plant near Steelpoort in Limpopo Province.



3 LEGISLATION

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 METHODS AND TERMS OF REFERENCE

This study forms part of the Heritage Impact Assessment Report. 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.

All possible information is consulted to compile a scoping report, and this includes the following: Provisional DFFE Screening Tool, SAHRIS Palaeosensitivity map, all Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical and geological maps as well as scientific articles of specimens from the development area and Assemblage Zones.

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.

During a site investigation the palaeontologist does not only survey the development but also tries to determine the density and diversity of fossils in the development area. This is confirmed by examining representative exposures of fossiliferous rocks (sedimentary rocks contain fossil heritage whereas igneous and metamorphic rocks are mostly unfossiliferous). Rock exposures that are investigated usually contains a large portion of the stratigraphic unit, can be accessed easily and comprise of unweathered (fresh) exposed rock. These exposures may be natural (rocky outcrops in stream or river banks, cliffs, dongas) but could also be artificial (quarries, open building excavations and even railway and road cuttings). It is common practice for palaeontologist to log well-preserved fossils (GPS, and stratigraphic data) during field assessment studies.

Mitigation usually precedes 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 is possible as 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 of sensitive areas to be avoided (providing shapefiles/kmls) 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** are impacts that 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).

4.1 Assumptions and Limitations

The focal point of geological maps is the geology of the area and the sheet explanations of the Geological Maps were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have never been reviewed by palaeontologists and data is generally based on aerial photographs alone. 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 also used to provide information on the existence of fossils in an area which has not documented in the past. When using similar



Assemblage Zones and geological formations for Desktop studies it is generally **assumed** that exposed fossil heritage is present within the footprint. A field-assessment will thus improve the accuracy of the desktop assessment.

5 GEOLOGICAL AND PALAEOONTOLOGICAL HISTORY

The proposed Tubatse PV Plant near Steelpoort in Limpopo Province is depicted on the 1:250 000 Pilgrim's Rest 2430 Geological map (1986) (Council of Geoscience, Pretoria) (**Figure 3; Table 4**). The proposed development is underlain by Quaternary (Q, yellow) alluvium and scree while the south and south eastern margins is underlain by the Magaliesberg Formation (purple with red/black dots) of the Pretoria Group (Transvaal Supergroup). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the superficial deposits is Low (blue), while that of the potentially fossiliferous Magaliesberg Formation is High (orange) (**Figure 4, Table 5**; Almond and Pether, 2009; Almond et al., 2013). The Geotechnical report of the Limpopo Province, Groenewald et al (2014) described these sediments as "Alluvial deposits associated with recent water courses of main rivers and streams. These sediments are presently not well studied and records of fossil occurrences are mainly associated with archaeological reports aeolian sand, alluvium, colluvium, spring tufa (calcareous) and sinter (siliceous), lake deposits, peats, pedocretes or duricrusts (calcrete, ferricrete), soils and gravel (diamondiferous in places". Palaeontological Sensitivity generated by the DFFE National Environmental Web-Based Screening Tool indicates a small portion of High Palaeontological Sensitivity while the majority of the study area is underlain by sediments with a Medium Sensitivity (**Figure 5-6**). Updated geology (2014, Council for Geosciences) indicates that the study area is underlain by alluvium, colluvium, eluvium and gravel (n-qg) (**Figure 7**).

The Quaternary superficial deposits are the youngest geological deposits formed during the most recent period of geological time (approximately 2.6 million years ago to present). Most of the superficial deposits are unconsolidated sediments and consist of gravel, sand, silt, and clay.

The Quaternary deposits are important due to the palaeoclimatic changes that are reflected in the different geological formations (Hunter et al., 2006). During climate fluctuations in the Cenozoic Era most geomorphologic features were formed (Maud, 2012). Barnosky (2005) indicated that various warming and cooling events occurred in the Cenozoic but states that climatic changes during the Quaternary Period, specifically the last 1.8 Ma, were the most drastic relative to all climate variations in the past. These climate variations were both drier and wetter than the present and resulted in changes in river flow patterns, sedimentation processes and vegetation variation (Tooth et al., 2004).

Pedogenic limestone deposits is up to 10 meters thick and may displace or replace near-surface bedrocks. Netterberg (1978, 1980) revived the South African calcretes and found that the



calcretes comprise of glaebular calcrete (with separate nodules), hardpan calcrete that contain solid limestone and honeycomb calcrete (fusing with glaebules). These calcretes are locally conglomeratic with clasts of exotic pebbles and reworked calcretes.

These sediments could contain mammalian teeth, bones and horn cores, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from Quaternary deposits. Plant material such as foliage, wood, pollens, and peats are recovered as well as trace fossils like vertebrate tracks, termite and insect burrows, termitaria (termite heaps/mounds) as well as rhizoliths (root casts). Reworked Stone Age artifacts (Plio-Pleistocene) have been found in Quaternary alluvium. The Palaeontological Sensitivity of these superficial sediments are Low.

The Precambrian Transvaal Supergroup is approximately 2550-2050 Ma years old (Bekker et al. 2008; Catuneanu et al 1999,) (Late Archaean to Early Proterozoic) and is about 15 km thick. This Supergroup consists of sedimentary, volcanic and unmetamorphosed clastic rocks. The sandstone dominated Magaliesberg Formation overlies the mudrocks of the Silverton Formation, and in turn the Silverton Formation overlies the sandstone dominated Daspoort Formation. The Silverton Formation is a lithologically varied, mudrock-dominated sequence that was deposited on an offshore shelf along the borders of the Kaapvaal Craton (Eriksson et al. 2002, 2009). Volcanic ash-rich intervals are common as well as minor beds of carbonate and chert. Sandstones become more regular in the upper part of the sequence and was deposited under shallower conditions. In the eastern part of the Pretoria Basin, the Machadodorp Member lies in the middle of the Silverton Formation and is represented by a conspicuous interval of volcanic rocks (including agglomerates basaltic lavas as well as tuffs). The presence the volcanic pillow lavas and water-lain tuffs indicates that they were formed beneath the sea. The deep-water Silverton mudrocks were deposited in high sea levels and was followed by shallowing fluvial and deltaic sandstones in low sea levels of the overlying Magaliesberg Formation.

The Magaliesberg Formation is characterised by a regressive sandy shoreline defined by braid-delta and high energy tidal flats (Erikssen et al., 2006). The Magaliesberg Formation is known for microbial mat structures (desiccated mats sometimes resemble trace fossils) (Groenewald et al 2014).

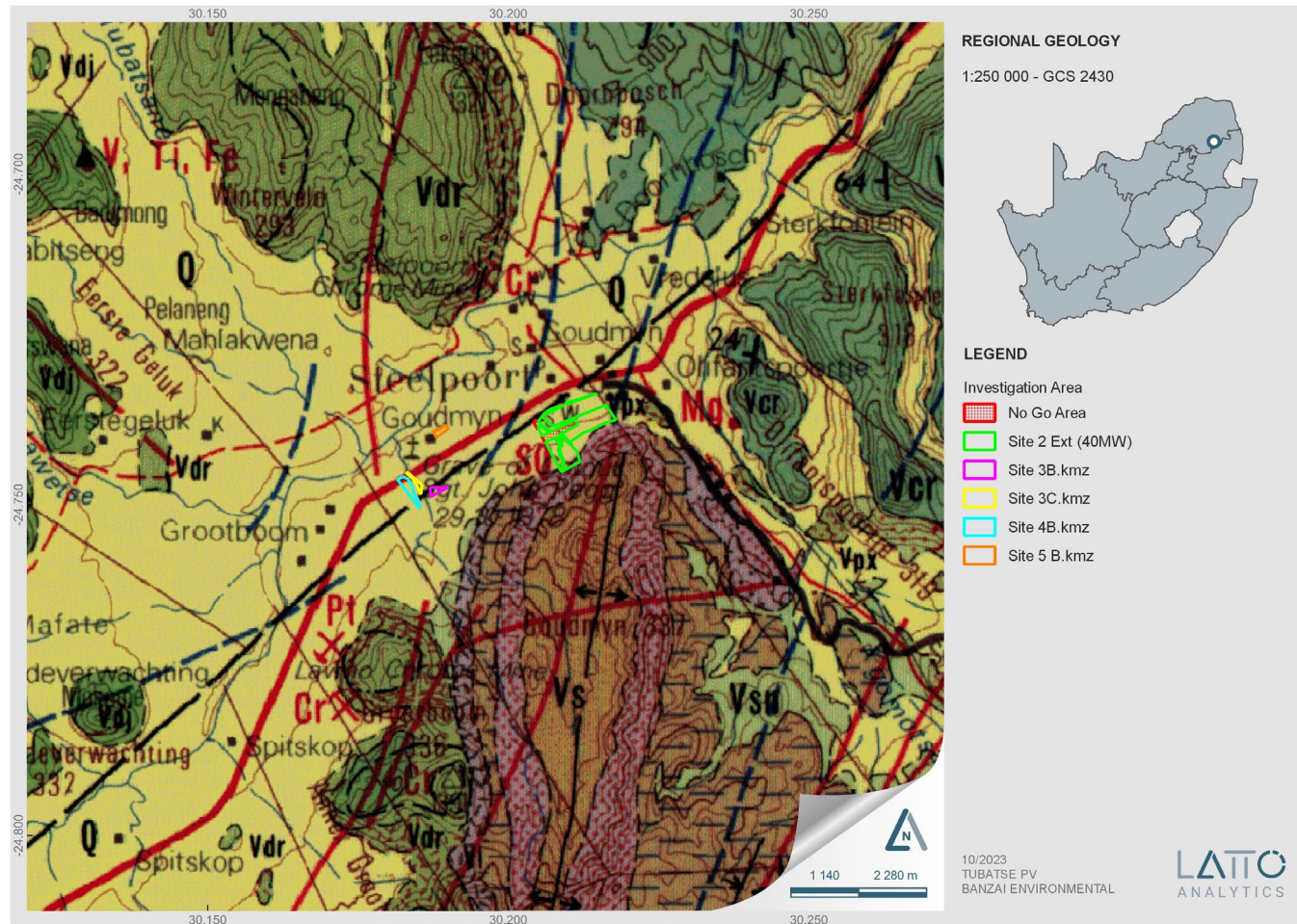
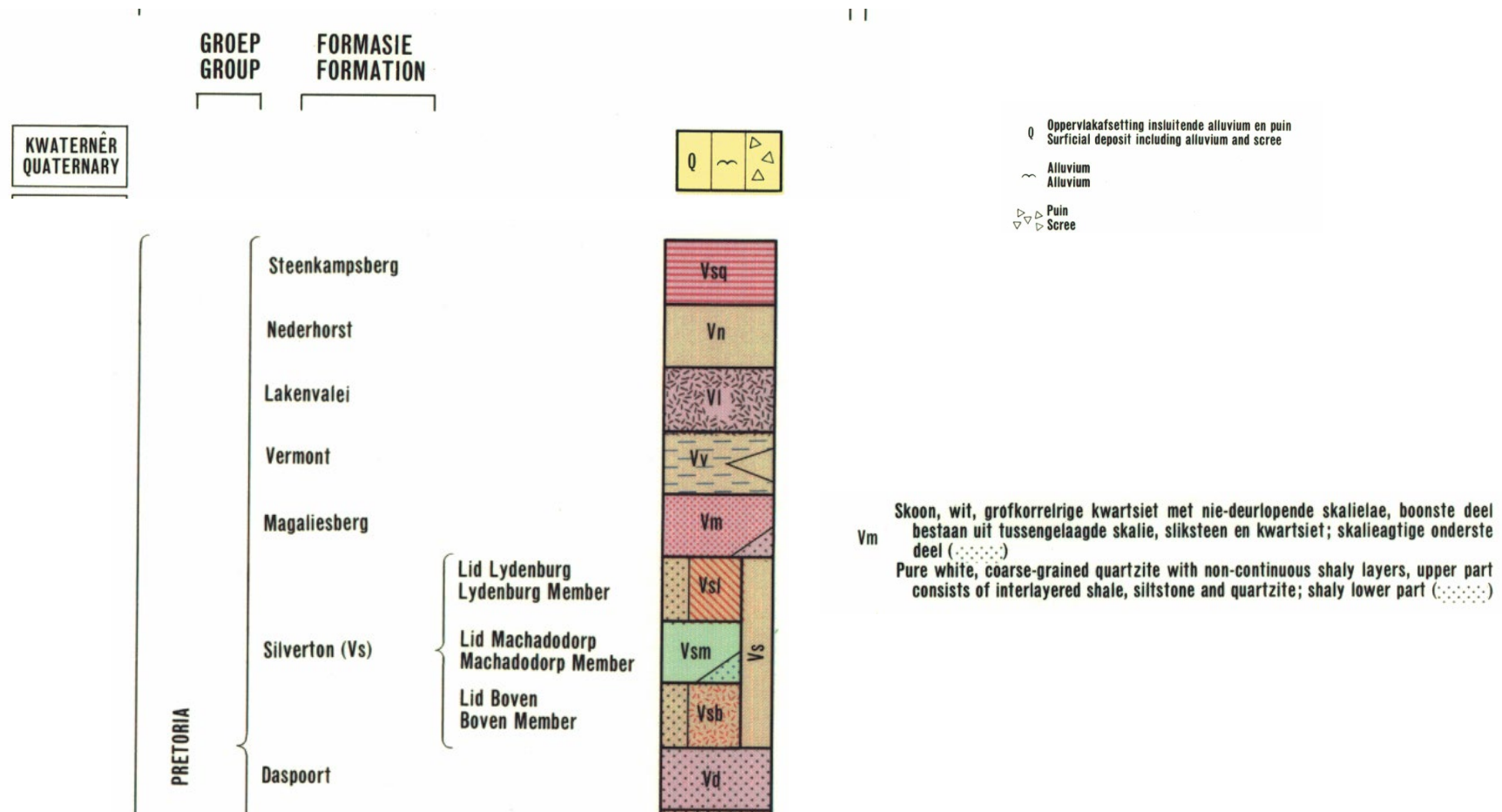


Figure 3. Extract of the 1:250 000 Pilgrim’s Rest Geological map 2430 (1986) (Council of Geoscience, Pretoria) indicates that the study area is underlain by Quaternary alluvium and scree as well as the Magaliesberg Formation (Pretoria Group, Transvaal Supergroup).



Table 3: Legend to the 1:250 000 Pilgrim's Rest 2430 Geological map (1986) (Council of Geoscience, Pretoria)



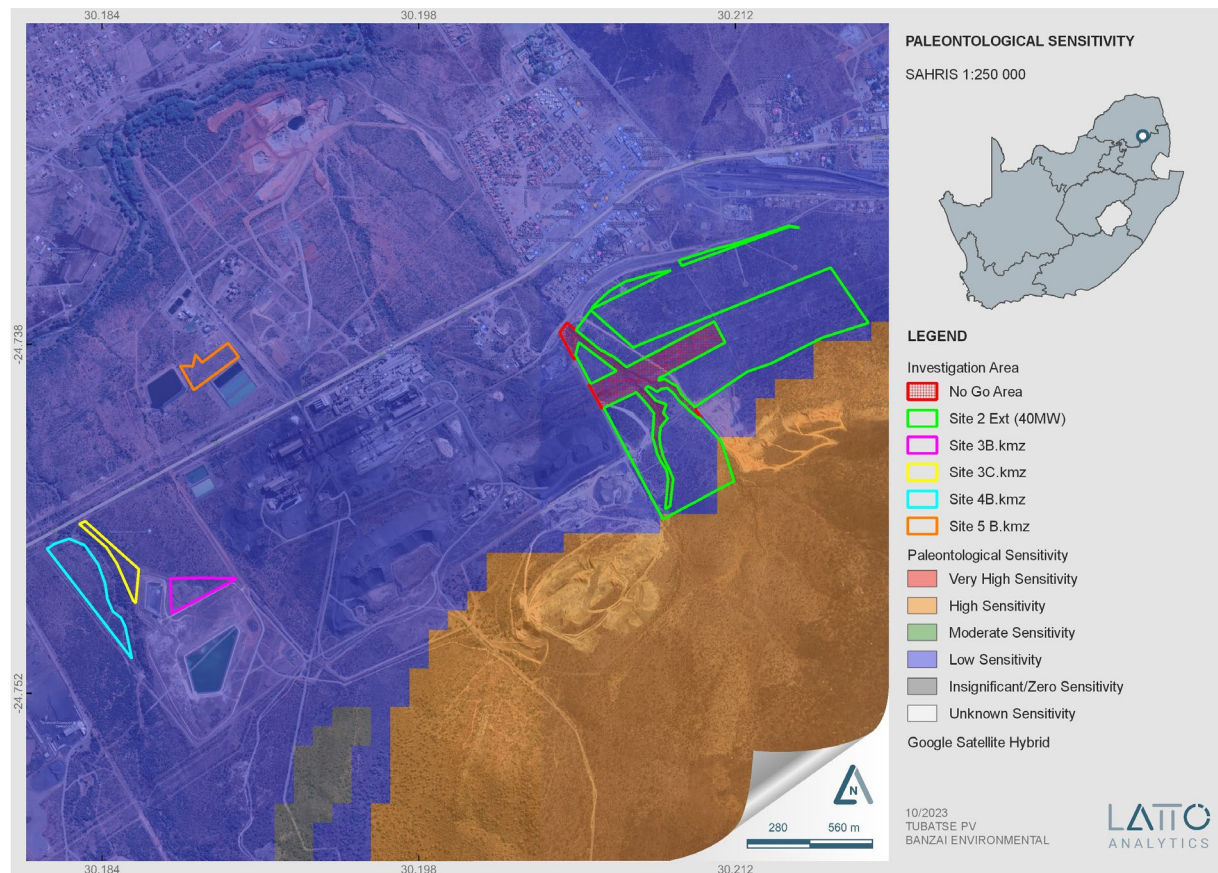


Figure 4: Extract of the SAHRIS PalaeoMap map (Council of Geosciences) indicates that the study area near Steelport in the Limpopo Province is underlain with sediments with a Low (blue) and High (orange) Palaeontological Sensitivity.



Table 4: Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website)

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.



Palaeontology Sensitivity Theme

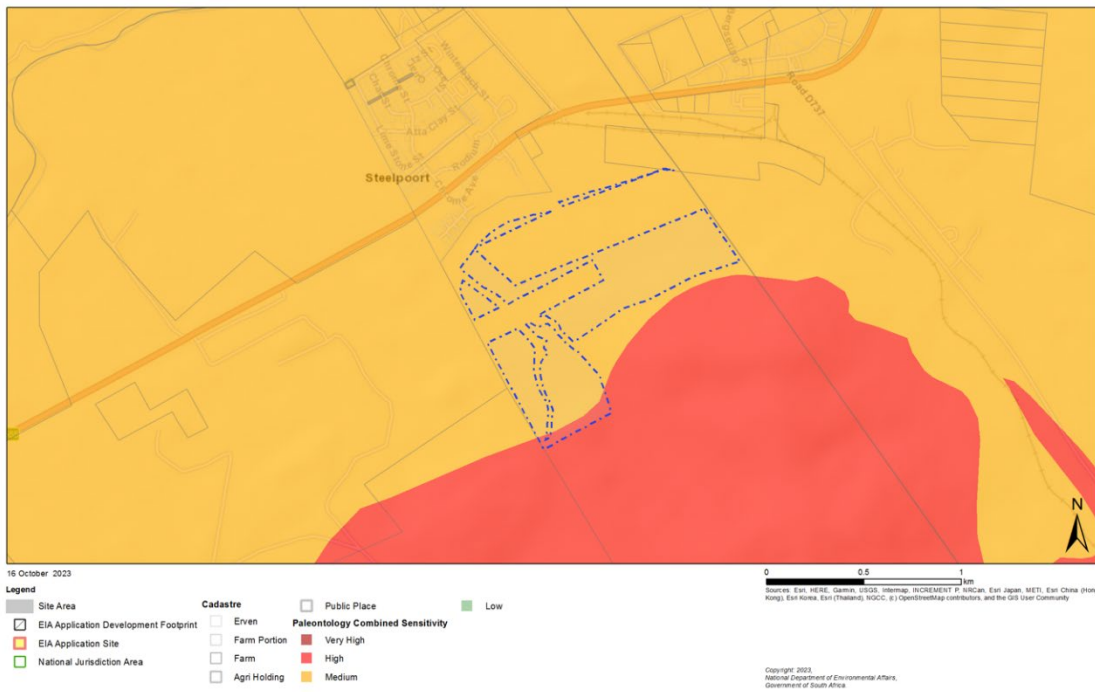


Figure 5: Palaeontological Sensitivity generated by the DFFE National Environmental Web-Based Screening Tool indicates a small portion of High Palaeontological Sensitivity while the majority of the study area is underlain by sediments with a Medium Sensitivity - Site 2B



Palaeontology Theme



Figure 6: Palaeontological Sensitivity generated by the DFFE National Environmental Web-Based Screening Tool indicates a Medium Palaeontological Sensitivity - Site 3B-5B

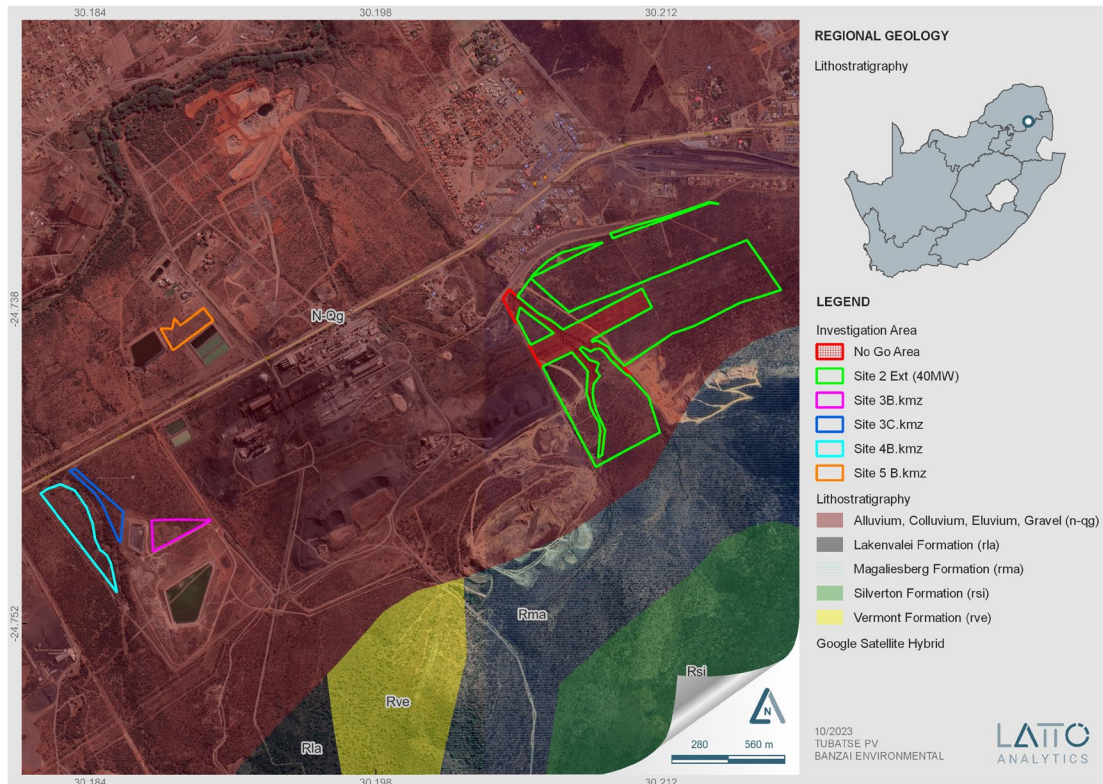


Figure 7: Updated Geology (2014, Council of Geosciences, Pretoria) indicates that the proposed study area is underlain by alluvium, colluvium, eluvium and Gravel (n-qg). These sediments are underlain by the Pretoria Group, Transvaal Supergroup.



6 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)
- A Google Earth map with polygons of the proposed development was obtained from PGS.
- 1:250 000 Pilgrim's Rest 2430 (1986) Geological map (1996) (Council of Geoscience, Pretoria)
- Updated (2014) geology produced by the Council of Geosciences, Pretoria.

7 ASSESSMENT METHODOLOGY

Site	Occurrence		Severity		Impact
Impact	Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude (severity) of impact	SP Rating
Loss of fossil Heritage	Low	Permanent	Site only	High	Moderate
Pre-mitigation	2	5	1	8	34
Loss of fossil Heritage	Low	Permanent	Site only	Minor	Low
Post-mitigation	2	5	1	2	16

$$SP \text{ (significance points)} = (\text{magnitude} + \text{duration} + \text{scale}) \times \text{probability}$$

8 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by Quaternary alluvium and scree while the south and south eastern margins is underlain by the Magaliesberg Formation of the Pretoria Group (Transvaal Supergroup). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the superficial deposits is Low, while that of the potentially fossiliferous Magaliesberg Formation is High (Almond and Pether, 2009; Almond et al., 2013). In the Geotechnical report of the Limpopo Province, Groenewald et al (2014) indicates that the superficial deposits is of Low Palaeontological Sensitivity while that of the Magaliesberg Formation is High. Palaeontological Sensitivity generated by the DFFE National Environmental Web-Based Screening Tool indicates a small portion of High Palaeontological Sensitivity while the majority of the study area is underlain by sediments with a Medium Sensitivity. Updated geology (2014, Council for Geosciences) indicates that the study area is underlain by alluvium, colluvium, eluvium and gravel.

Based on desktop research it is concluded that fossil heritage of scientific and conservational interest in the PV footprint is relatively rare. A **Moderate Palaeontological Significance has been allocated for the**



construction phase of the PV development pre-mitigation and a very low significance post mitigation. The construction phase will be the only development phase impacting Palaeontological Heritage and **no significant impacts are expected to impact the Operational and Decommissioning phases**. As the No-Go Alternative considers the option of 'do nothing' and maintaining the status quo, it will have a Neutral impact on the Palaeontological Heritage of the development. The **Cumulative impacts of the PV development near Steelpoort is considered to be medium pre- mitigation and Low post mitigation and falls within the acceptable limits for the project.** It is therefore considered that the proposed development will not lead to damaging impacts on the palaeontological resources of the area. **The construction of the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.** 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.

Recommendations:

- The ECO for this project must be informed that the Magaliesberg Formation has a **High Palaeontological Sensitivity**.
- If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources Agency (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 (recording and collection) can be carried out.
- Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.

9 CHANCE FINDS PROTOCOL

The following procedure will only be followed if fossils are uncovered during the excavation phase of the development.

9.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act No 25 of 1999) (NHRA)**. According to Section 3 of the Act, all Heritage resources



include “**all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**”.

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, 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.

A fossil is the naturally preserved remains (or traces thereof) of plants or animals embedded in rock. These organisms lived millions of years ago. Fossils are extremely rare and irreplaceable. By studying fossils, it is possible to determine the environmental conditions that existed in a specific geographical area millions of years ago.

This informational document is intended for workmen and foremen on construction sites. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

It is the responsibility of the Environmental Site Officer (ESO) or site manager of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the absence of the ESO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

9.2 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, 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). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.



- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.
- Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.
- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- If the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO. Fossil finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once the Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

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APPENDIX A

ENVIRONMENTAL IMPACT METHODOLOGY

RoyalHaskoningDHV: IMPACT ASSESSMENT METHODOLOGY

Impact Rating Methodology:

The potential environmental impacts associated with the project will be evaluated according to its nature, extent, duration, intensity, probability and significance of the impacts, whereby:

- Nature: A brief written statement of the environmental aspect being impacted upon by a particular action or activity;
- Extent: The area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales. This is often useful during the detailed



assessment phase of a project in terms of further defining the determined significance or intensity of an impact. For example, high at a local scale, but low at a regional scale;

- Duration: Indicates what the lifetime of the impact will be;
- Intensity: Describes whether an impact is destructive or benign;
- Probability: Describes the likelihood of an impact actually occurring; and
- Cumulative: In relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude (severity) of impact

To assess each of these factors for each impact, the following four ranking scales are used:

Criteria for the Ranking of Impacts

Probability	Duration
5 - Definite/ don't know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (8 - 15 years)
2 - Low probability	2 - Short-term (0 - 7 years) (impact ceases after the operational life of the activity)
1 - Improbable	1 - Immediate
0 - None	0 - None
Scale	Magnitude
5 - International	10 - Very high/ don't know
4 - National	8 - High
3 - Regional	6 - Moderate
2 - Local	4 - Low
1 - Site only	2 - Minor
0 - None	0 - None

Once these factors have been ranked for each impact, the significance of the two aspects, occurrence and severity, must be assessed using the following formula:



$$\text{SP (significance points)} = (\text{magnitude} + \text{duration} + \text{scale}) \times \text{probability}$$

The maximum value is 100 significance points (SP). The impact significance is then rated as follows:

Impact significance:

SP >75	Indicates high environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 75	Indicates moderate Environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that constitutes an improvement over pre-project conditions

Impacts must be assessed and rated before and after mitigation.



APPENDIX B

ELIZE BUTLER

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 30 years in Palaeontology

EDUCATION: B.Sc Botany and Zoology, 1988
University of the Orange Free State

B. Sc (Hons) Zoology, 1991
University of the Orange Free State

Management Course, 1991
University of the Orange Free State

M. Sc. Cum laude (Zoology), 2009
University of the Free State

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

Part time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part time laboratory assistant	Department of Virology University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998– currently

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