



PALAEONTOLOGICAL IMPACT ASSESSMENT

NOOITGEDACHT TAILINGS STORAGE
FACILITIES AND ASSOCIATED
PIPELINE INFRASTRUCTURE IN
WELKOM, FREE STATE PROVINCE

June 2024

COMPILED FOR:

Environmental Impact Management Services
(Proprietary) Limited



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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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 A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	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 – 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 8	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Executive Summary, 7 & 9	



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.
(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;	Executive Summary, 7 & 9	
(g) An identification of any areas to be avoided, including buffers	Executive Summary, & 9	
(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	Executive Summary, & 9	
(k) Any mitigation measures for inclusion in the EMPr	Section 10	
(l) Any conditions for inclusion in the environmental authorisation	Section 10	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Executive Summary, & 9	



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.
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Executive Summary, & 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	Executive Summary, & 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.
(p) A summary and copies of any comments that were received during any consultation process	N/A	Not applicable. To date, no comments regarding



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.
		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 Environmental Impact Management Services (Proprietary) Limited ("EIMS") to conduct the Palaeontological Impact Assessment (PIA) to assess the Nooitgedacht Tailings Storage Facilities (TSF) and associated pipeline infrastructure in Welkom, in the Free State. 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 PIA 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 study area is underlain by the aeolian sand, the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) as well as Permian Volksrust Formation (Ecca Group, Karoo Supergroup). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the aeolian sand is moderate, that of the Adelaide Subgroup is Very High, while that of the Volksrust Formation (Ecca Group, Karoo Supergroup) is High (Almond *et al*, 2013; SAHRIS website). The suggested location is classified as having Very High and Medium Palaeontology Theme Sensitivity in the DFFE Screening Report. Updated geology (Council of Geosciences, Pretoria) indicates that the development area is underlain by superficial alluvium, colluvium, eluvium and gravel, the Balfour Formation (Adelaide Subgroup, Beaufort Group, Karoo Supergroup) as well as Volksrust Formation (Ecca Group).

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 17 April 2023. No fossiliferous outcrop was detected in the proposed development area. The apparent rarity of fossil heritage in the proposed development footprint suggests that the impact of the development will be of a Low significance in palaeontological terms. 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.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO/site manager in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO/site manager 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 (recording and collection) can be carry out by a paleontologist.



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.

Impact Summary

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Planning Phase Nooitgedacht TSF	No Impact		No Impact		
Construction Stage Nooitgedacht TSF	Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study	Medium negative - 15	Negative Medium impact	6.5	Low positive
Operational Phase Nooitgedacht TSF	No Impact		No Impact		No Impact
Decommissioning Phase Nooitgedacht TSF	No Impact		No Impact		No Impact

It is therefore considered that the Nooitgedacht TSF and associated pipeline infrastructure will not lead to detrimental impacts on the palaeontological reserves of the area. Thus, the construction of the development may be authorised in its whole extent.



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1 INTRODUCTION

Harmony Gold Mining Company Limited (Harmony) own and operate a number of Gold Mines and Plants in the Welkom region in the Free State. Harmony currently deposit tailings onto the Free State South (FSS) 2 Tailings Storage Facility (TSF), St. Helena 4 TSF, St. Helena 123 TSF, Dam 23 TSF, Brand D TSF and Target 1&2 TSF. The current planned Life of Mine (LOM) of the Free State Operations exceed the available deposition capacity of these TSFs and Harmony is undertaking a feasibility assessment to construct the new Nooitgedacht TSF and associated pipeline infrastructure (**Figure 1-2**).

1.1 Project Description

A reserve reclamation study which looked at the reclamation and treatment of the 774Mt of tailings contained in reserve status in TSFs in the Free State through the sequentially reprocessing of tailings through Target Plant and Harmony One Plant, as Run of Mine Ore is depleted, will require deposition space in future.

The Nooitgedacht TSF was identified as deposition sites for residue from the reclamation of tailings (**Figure 1-2**).

Additional lines above ground surface will include

- Two 10km long slurry lines from Harmony One Plant to the St Helena Booster Pump Station;
- One 16km long slurry line from Brand A TSF to the St Helena Booster Pump Station; and
- One 17km slurry line from the St Helena Booster Pump Station to FSN 1 TSF.

The pipelines will be flanged steel pipelines of over 0,36m in diameter and installed above-ground on pre-cast concrete plinths and a 3.5m wide access road, adjacent to the pipelines, will be cleared/graded to provide access for construction, maintenance and inspections. The proposed pipelines traverse the following farm portions: Vlakplaats 125 Ptn 3, 4 and 5; Mijannie RE/66 Ptn 0; Toronto RE/115 Ptn 7 and 0; Rietpan 17 Ptn 0; Rietkuil 28 Ptn 0; Rheeders Dam 31 Ptn 0; Farm 41 Ptn 20; Ouders Gift 48 Ptn 0; Nooitgedacht 50 Ptn 0; Goedgedacht

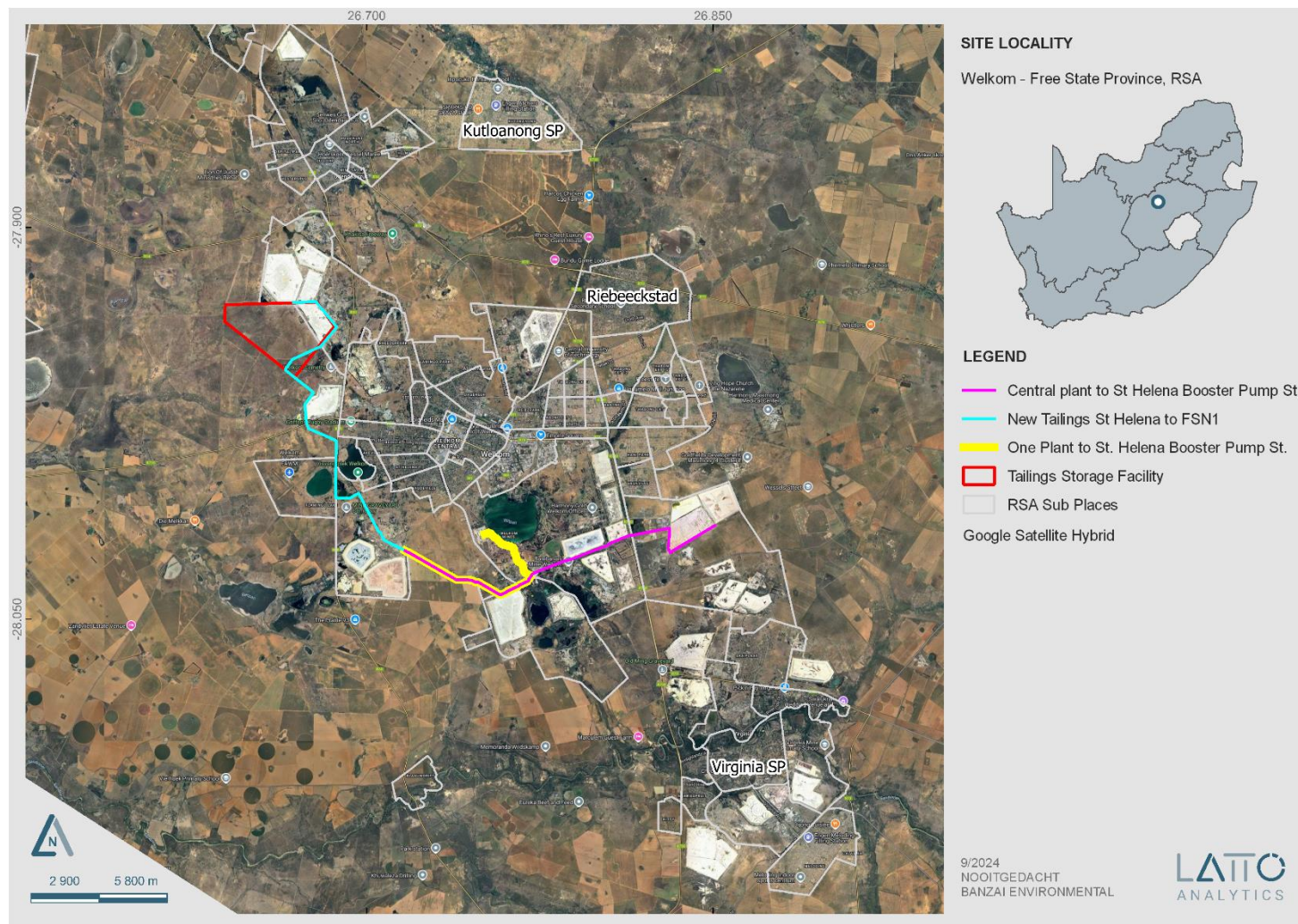


Figure 1: Regional Locality of the proposed Nooitgedacht TSF as well as associated pipeline infrastructure.

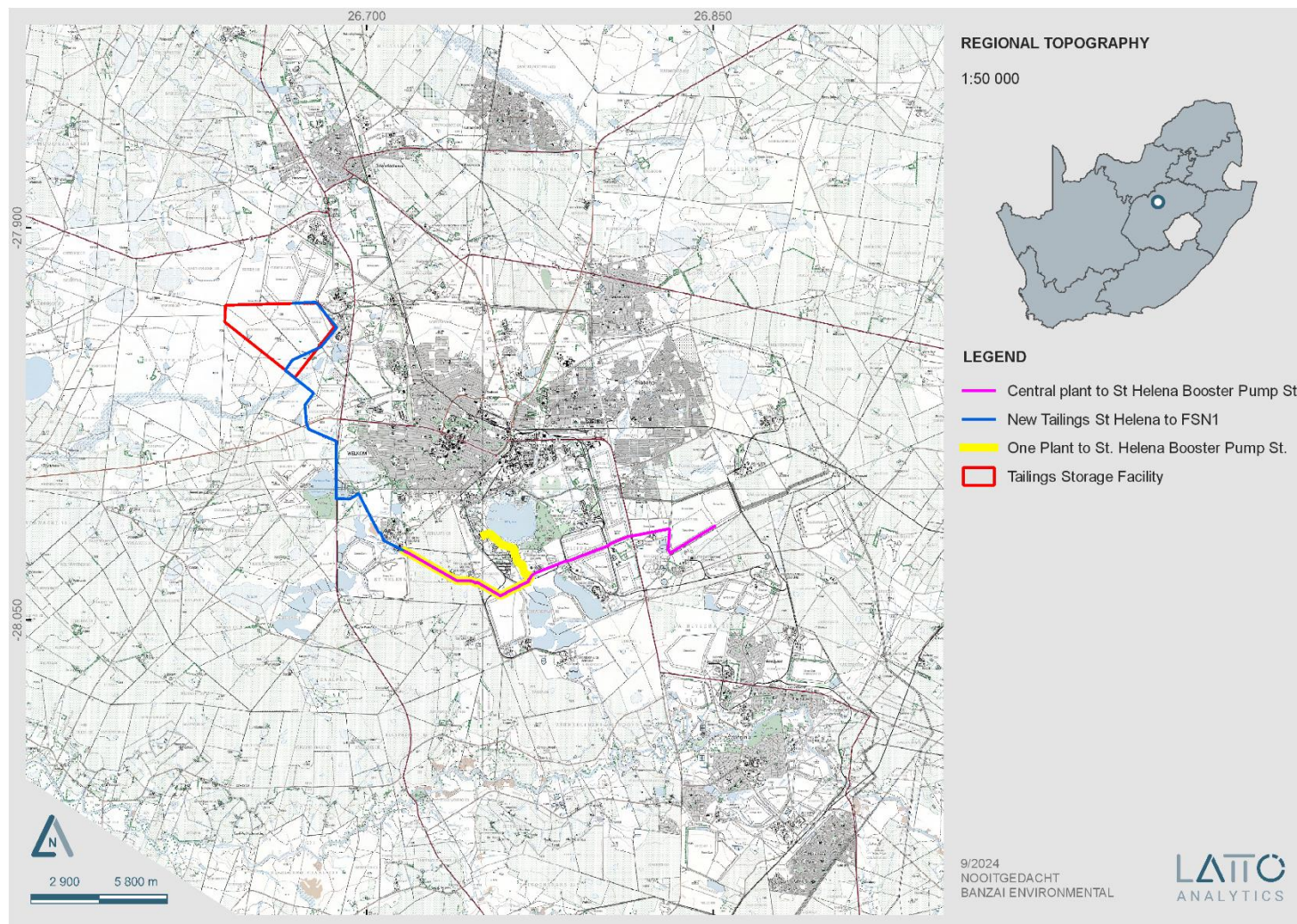


Figure 2: Regional topography of the proposed Nooitgedacht TSF and associated pipelines.



2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This 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-eight years. She has experience in locating, collecting, and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

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 METHODS AND TERMS OF REFERENCE

This Palaeontological Assessment is part of the HIA Report. The PIA's goals are to: 1) identify the palaeontological significance of the rock formations in the footprint; 2) evaluate the palaeontological magnitude of the formations; 3) clarify the impact on fossil heritage; and 4) make recommendations for how the developer might protect and minimize potential harm to fossil heritage, according to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports".

Calculations of the palaeontological state of each rock segment and the potential impact of development on fossil history take into account the palaeontological status of the rocks, the type of development, and the amount of bedrock removed.

The Provisional DFFE Screening Tool, the SAHRIS Palaeosensitivity map, all Palaeontological Impact Assessment reports for the same area, Google Earth images, topographical and geological maps, as well as academic articles about specimens from the development area and Assemblage Zones, are all used to create scoping reports.

When the development footprint has a moderate to high palaeontological sensitivity, a field-based assessment is necessary. A desktop or field assessment of the exposed rock is used to evaluate the significance of the proposed development's impact, and recommendations for more research or mitigation are made. Excavations for the project often only take place during the building phase, changing the terrain and destroying or permanently encasing fossils at or below the ground surface. Then, access to Fossil Heritage will no longer be available for academic study.

When doing a site investigation, a palaeontologist examines the local development as well as the quantity and variety of fossils found there. This can be demonstrated by looking at representative fossiliferous rock exposures (most igneous and metamorphic rocks are not fossiliferous, whereas sedimentary rocks contain fossil heritage). Examined rock exposures frequently contain a sizeable portion of the stratigraphic unit, which is primarily made up of recently exposed (unweathered) rock. These exposures may be man-made (such as quarries, open building excavations, even railway and road cuttings) or natural (such as cliffs, and dongas as well as rocky outcrops along stream or river banks). It is usual practice for palaeontologists to record well-preserved fossils (GPS, and stratigraphic data) during field assessment examinations.



Although mitigation is often done prior to construction, it may take place if potentially fossiliferous bedrock is revealed. Fossil collection and documentation are examples of mitigation. A permit from SAHRA must be obtained before beginning any fossil excavation, and the material must be stored at an authorized facility. When mitigation is properly used, it is possible to have a positive impact by raising awareness of the palaeontological past of the area.

By physically evaluating bedrock outcrops to determine their lithology and fossil richness and crisscrossing the development footprint, one can assess an area's fossil potential. Because the presence of fossils at the surface is so unexpected, an average sample size of the region is investigated. To be clear, however, the lack of fossils in a development footprint does not automatically suggest that there is no palaeontologically important material present on the site (on or below the ground surface).

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;
- Describe of the proposed project and provide information regarding the developer and consultant who commissioned the study;
- Describe location of the proposed development and provide geological and topographical maps
- Provide palaeontological and geological history of the affected area;
- Identify sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluate 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
- Detail the implications of specialist findings for the proposed development (such as permits, licenses etc).

4.1 Assumptions and Limitations

The geology of the area is the focal point of geological maps, and the sheet explanations of the Geological Maps were not intended to focus on palaeontological heritage. Many inaccessible areas of South Africa have never been examined by palaeontologists, and data is typically dependent solely on aerial pictures. Locality and geological information in museums and university databases is out of date, and data acquired in the past is not always adequately documented.

Comparable Assemblage Zones in other places are also used to provide information on the existence of fossils in areas that have not before been recorded. When similar Assemblage Zones and geological formations are used for Desktop studies, it is commonly assumed that exposed fossil exists within the footprint.

5 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The geology of the study area north-west of Welkom in the Free State is depicted on the 1: 250 000 Winburg 2826 (1987) and 2726 Kroonstad (2000) Geological Map (Council for Geosciences, Pretoria). The study area is underlain by the aeolian sand (Qs, yellow), the Adelaide Subgroup (Pa, Beaufort Group, Karoo Supergroup) as well as Permian Volksrust Formation (Pvo, peach) (Ecca Group, Karoo Supergroup) (**Figure 3, Table 2**). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the aeolian sand is moderate (green), that of the Adelaide Subgroup is Very High (red) while that of the Volksrust Formation (Ecca Group, Karoo Supergroup) is High (orange) (**Figure 4, Table 3**) (Almond *et al*, 2013; SAHRIS website). The suggested location is classified as having Very High (deep red) and Medium (yellow) Palaeontology Theme Sensitivity in the DFFE Screening Report (**Figure 5-6**). Updated geology (2014, Council of Geosciences, Pretoria) indicates that the development area is underlain by superficial alluvium, colluvium, eluvium and gravel, the Balfour Formation (pbf) of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) as well as the Volksrust Formation (Ecca Group) (**Figure 7**).

The Vignia/Welkom District is known for the presence of fluvial deposits along the present river courses that are terrestrial sediments and includes diatomite (diatom deposits), calcareous tufa, pedocretes, peats, spring deposits, soils and gravel and other Tertiary calcrete deposits, that is very important for understanding the Early and Late Pliocene period in this region (De Ruiter *et al*, 2010).

The late Cenozoic (Plio-Pleistocene) floodplain deposits (overbank sediments) found near the Sand-, Doring-, Vals- and Vet River systems including pan sites, contain confined but abundant mammal vertebrate fossil sites. In 1955, Meiring, described an *in situ* proboscidian fossil (mammoth), comprising



of a lower molar, large part of a tusk as well as a proximal portion of an ulna from the Sand River near Virginia. This specimen was found in pebbly channel-fill sediments about 40m above the current riverbed. Originally this specimen was described as *Archidiskodon scotti* (Meiring 1955) but was later assigned to the Pliocene species *Mammuthus subplanifrons* (Coppens et al. 1978). Later investigations uncovered a diverse fauna that include amphibians, birds, fish, reptiles, as well as several proboscideans, perissodactyls and artiodactyls from the same site (De Ruiter 2010).

Terrace gravels above the Vet River, southwest of Welkom have uncovered Pliocene fossils while surveys along the Doring, Vals, Sand and Vet Rivers produced moderately fossiliferous overbank sediments and erosional gullies that comprise of a variety of Quaternary-aged mammals (Brink et al. 1999; De Ruiter et al. 2011). Ancient pan sites, for example near Whites produced rich Quaternary-aged mammal fossil remains.

The geological map indicates that the study area is mantled by aeolian sand (Qs, yellow). Fossils are rare but includes a wide range of possible fossil remains. This includes tortoise remains, ostrich eggshells, non-marine mollusc shells, mammalian bones and teeth. Ostracods, diatoms and other microfossil groups and trace fossils (burrows, calcretised termitaria, rhizoliths), as well as freshwater stromatolites, peats, foliage, pollens and wood have been recovered.

The planned development is underlain by mudstones, sandstones, and shales, which were deposited under fluvial environments of the Adelaide Subgroup. The Adelaide Subgroup forms part of the Beaufort Group (**Figure 8**). The Beaufort Group is the third of the main subdivisions of the Karoo Supergroup. This group overlays the Ecca and consists essentially of sandstones and shales, deposited in the Karoo Basin from the Middle Permian to the early part of the Middle Triassic periods. The Beaufort Group was deposited on land through alluvial processes. This Group covers a total land surface area of approximately 200 000 km² in South Africa and is the first fully continental sequence in the Karoo Supergroup. The Beaufort Group is divided into the Adelaide and the overlying Tarkastad Subgroup. The Adelaide subgroup rocks are deposited under a humid climate that allowed for the establishment of wet floodplains with high water tables and are interpreted to be fluvio-lacustrine sediments (Johnson *et al* 2006).

In the south eastern portion of the Karoo Basin the Adelaide Subgroup consists of the Koonap, Middleton and Balfour Formations. West of 24° the Adelaide Subgroup is represented by the Abrahamskraal and Teekloof Formations and in the north the Group is represented by the Normandien Formation. The Adelaide Subgroup is approximately 5 000 m thick in the southeast, but this decreases to about 800m in the centre of the basin which thins out to about 100 to 200m in the north. The Balfour Formation is approximately 200 m thick, while the Abrahamskraal Formation is about 2 500 m thick and the Teekloof Formation 1 000 m. The Normandien Formation is only about 320 m thick.

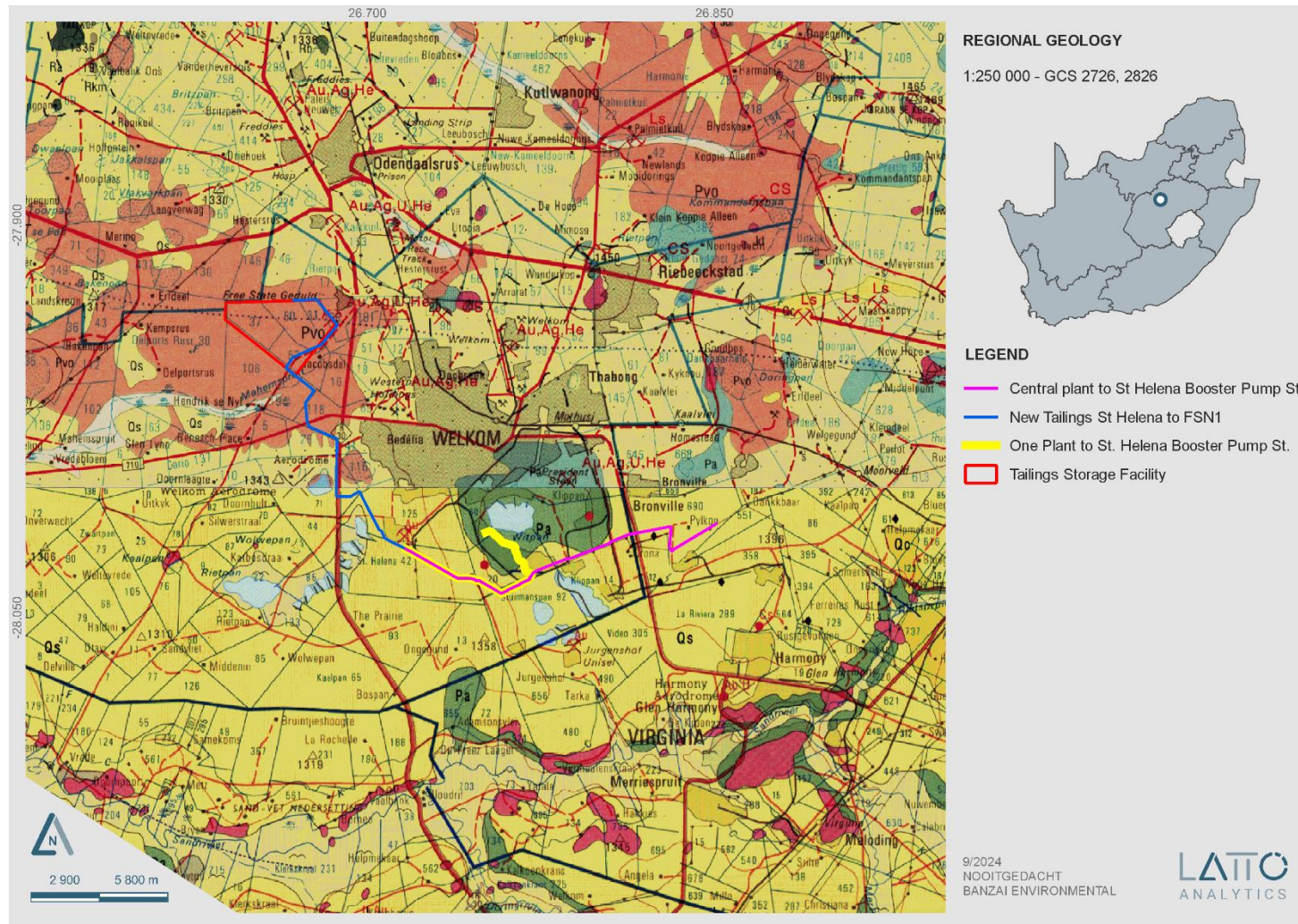
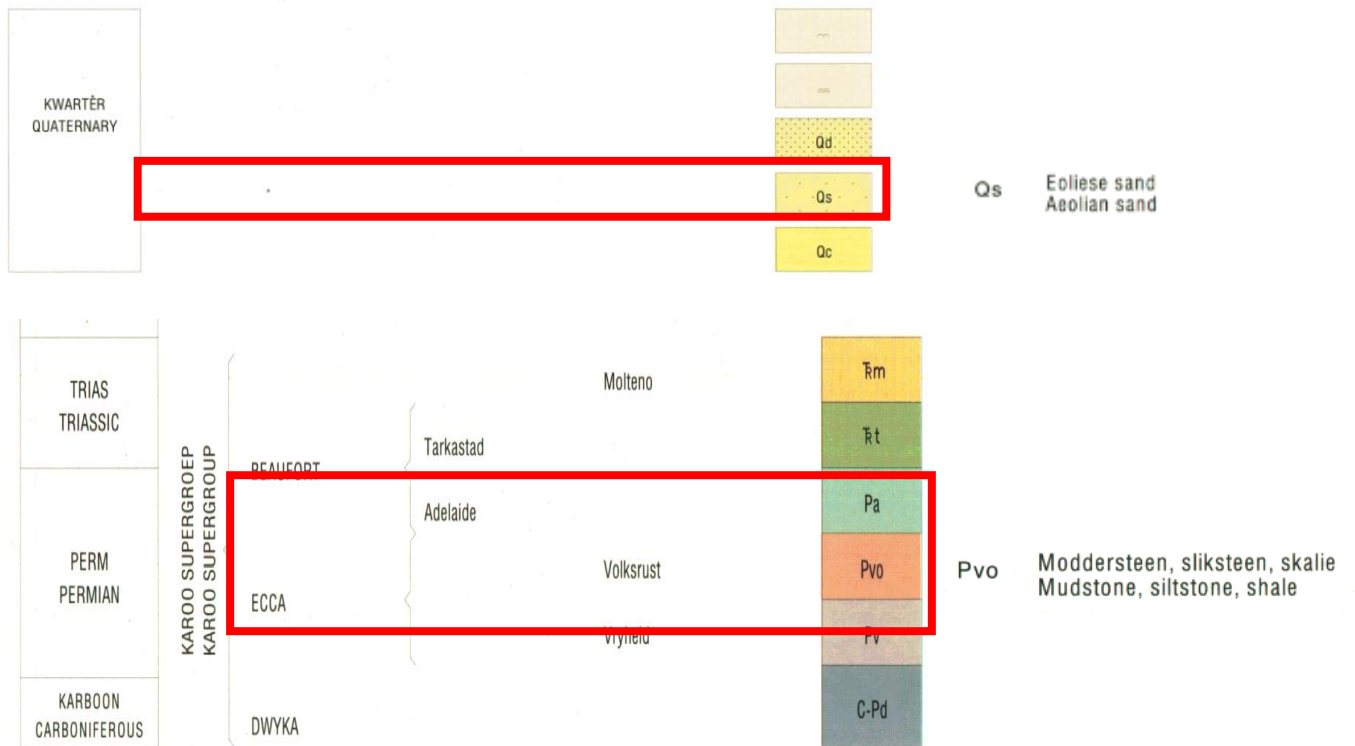


Figure 3: Extract of the 1:250 000 Winburg 2826 (1987) and Kroonstad 2726 (2000) Geological Map (Council for Geosciences, Pretoria) indicating that the study area is underlain by Quaternary sands (Qs, yellow), the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) as well as the Volksrust Formation of the Eccu Group.



Table 2: Legend to the 2726 Kroonstad (2000) Geological Map (Council for Geoscience, Pretoria).

Relevant sediments are indicated in a red block



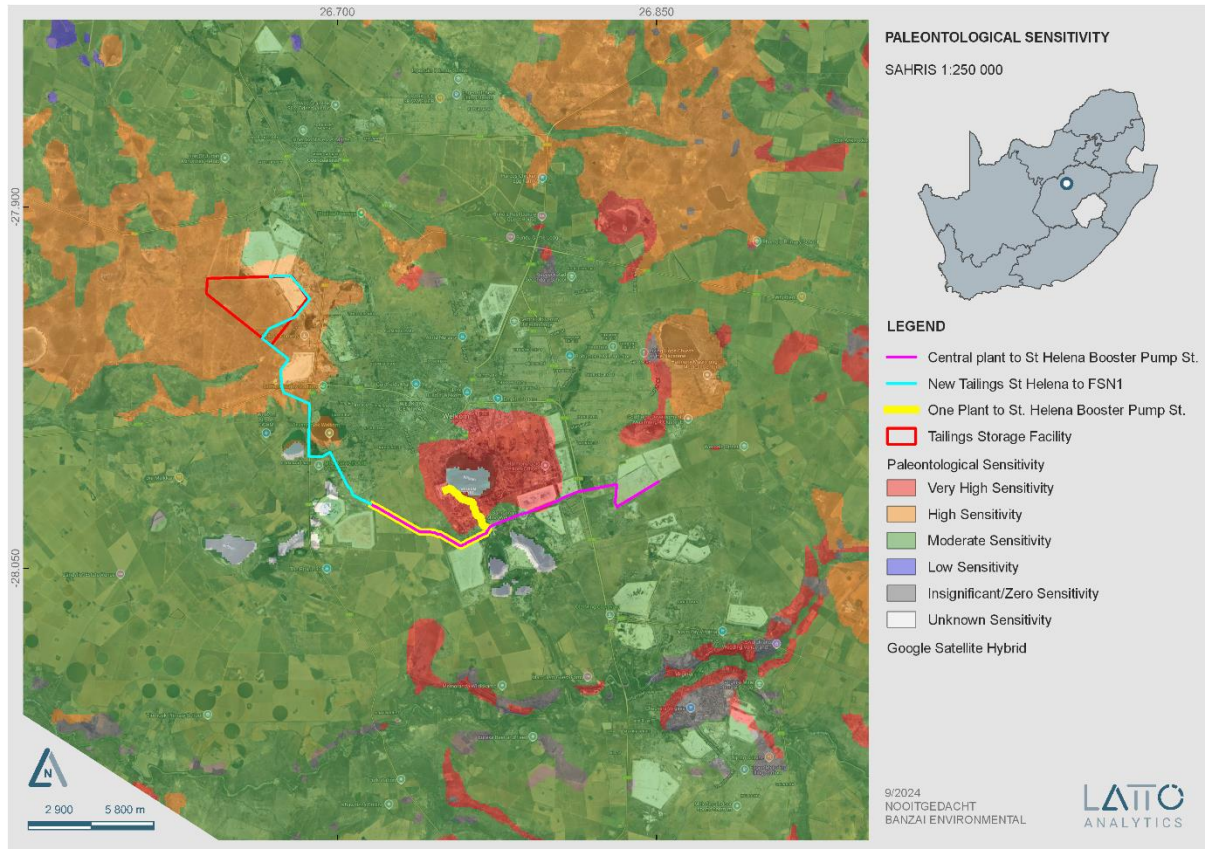


Figure 4: Extract of the SAHRIS PalaeoMap map (Council of Geosciences) indicating the Very High (red), High (orange) and Moderate (green) Palaeontological Sensitivity of the proposed study area.

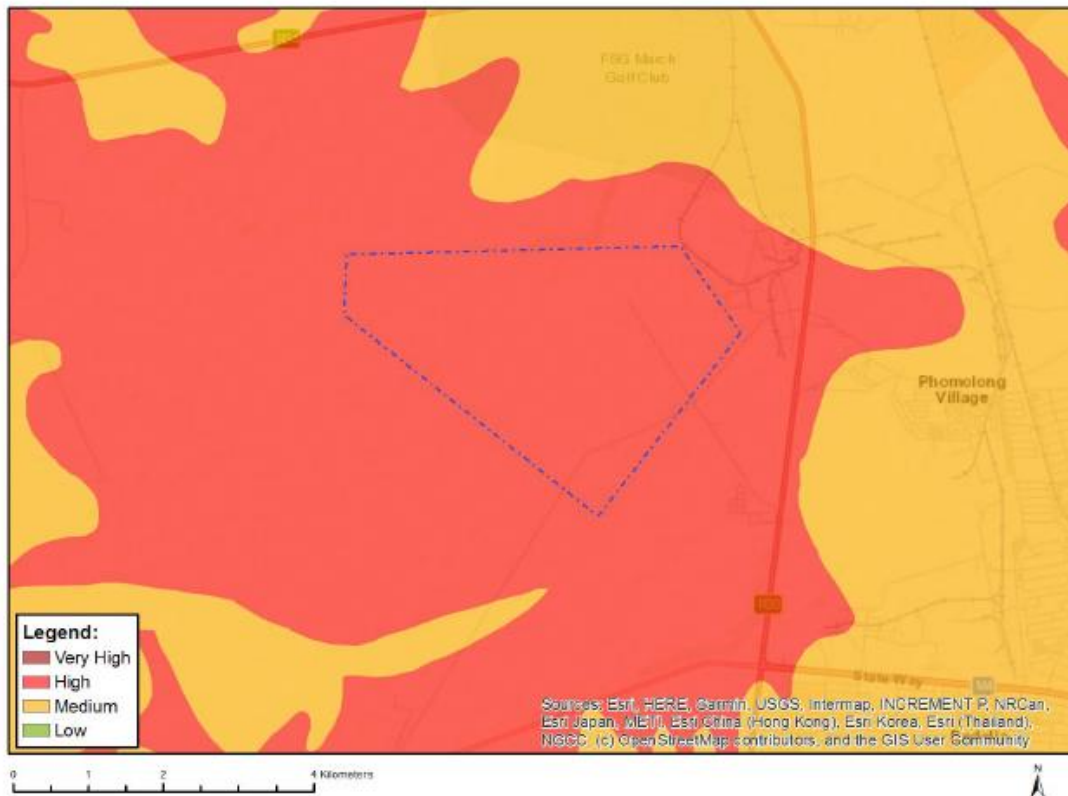


Table 3: Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website)

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.

According to the SAHRIS Palaeosensitivity map (Figure 4) the proposed development is underlain by sediments with a Very High (red), High (orange) and Moderate (green) Palaeontological Sensitivity.

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



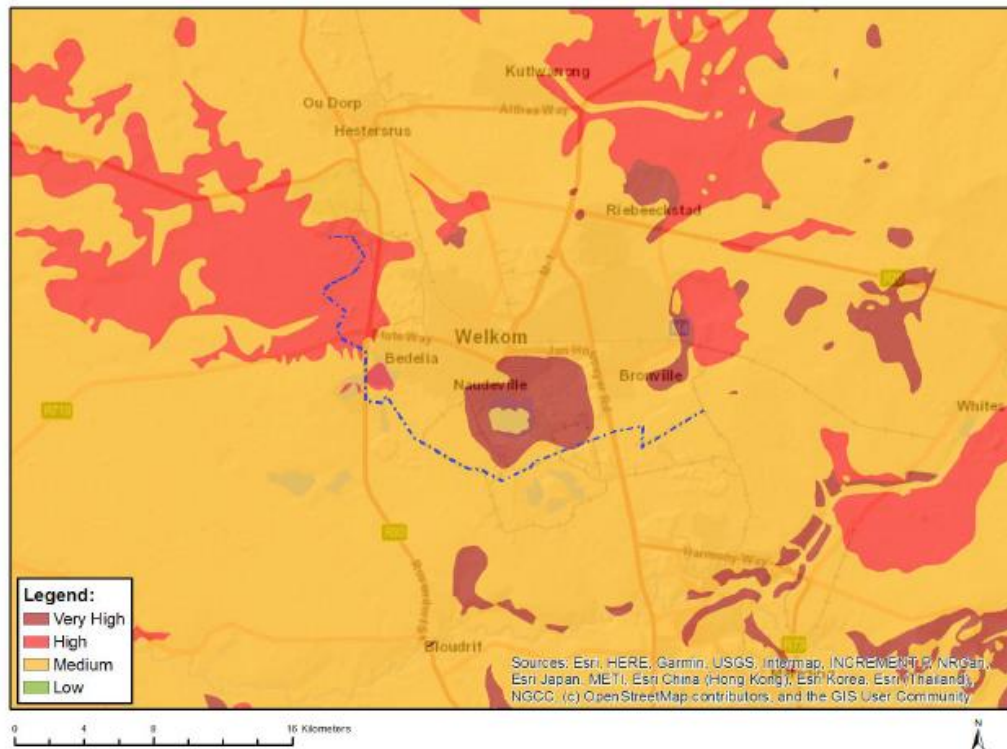
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Features with a High paleontological sensitivity
Medium	Features with a Medium paleontological sensitivity

Figure 5: Palaeontological Sensitivity of the Harmony Nooitgedacht Tailings Storage Facility study area by the National Environmental Web-based Screening Tool indicates a High Palaeontological Sensitivity.

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
High	Features with a High paleontological sensitivity
Medium	Features with a Medium paleontological sensitivity
Very High	Features with a Very High paleontological sensitivity

Figure 6: Palaeontological Sensitivity of the Harmony Nooitgedacht Pipeline study area by the National Environmental Web-based Screening Tool indicates a Very High Palaeontological (deep red) Sensitivity while areas with a High (red) and Medium (yellow) Sensitivity is also crossed.

The SAHRIS PalaeoMap (Figure 4) indicates a Very High (red), High (orange) and Moderate (green) Palaeontological Sensitivity which is in agreement with the DFFE Screening Tool (Figure 5-6). During a site investigation conducted on 2 April 2024 NO fossiliferous outcrops were detected. The DFFE and SAHRIS Palaeontological Sensitivity is thus contested with actual findings in the field

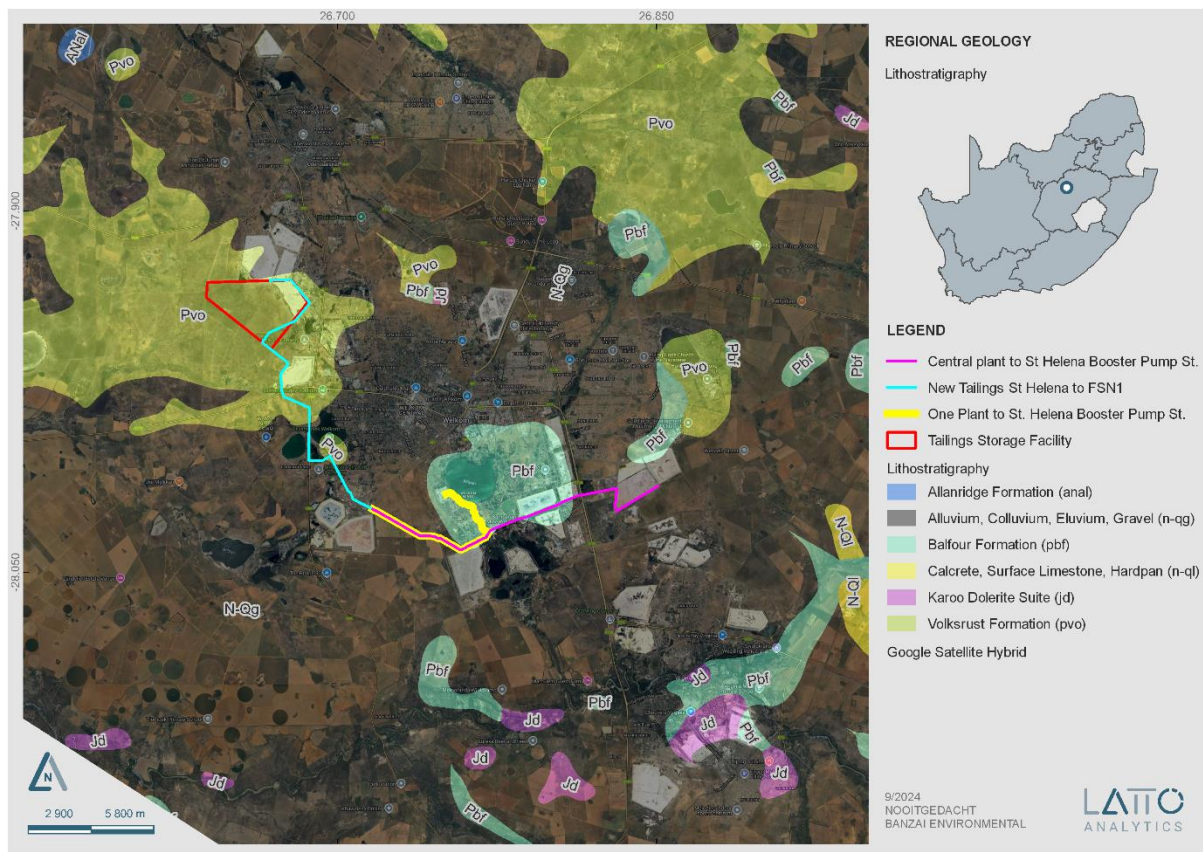


Figure 7: Updated Geology (2014, Council of Geosciences, Pretoria) indicates that the proposed study area is underlain by superficial alluvium, colluvium, eluvium and gravel (n-qg), the Balfour Formation (Pbf, Adelaide Subgroup) as well as Volksrust Formation (Pvo).,

The Adelaide Subgroup contains alternating greyish-red, bluish-grey, or greenish grey mudrocks in the southern and central parts of the Karoo Basin with very fine to medium grained, grey lithofeldspathic sandstones. The Balfour formation in the development footprint comprise of greenish- to bluish-grey and greyish-red mudstone, siltstone, subordinate sandstone. In the northern Normandien formation the basin consists of course to very coarse sandstones and granulostones. Coarsening–upward cycles are present in the lower part of the Normandien Formation while the mudrocks and sandstone units usually form fining-upward cycles. These cycles are positioned on erosion surfaces which is overlain by thin intraformational mud-pellet conglomerate and vary in thickness from a few meters to tens of meters. Singular sandstone units could vary from 6 meters to 60 meters in the south thinning northwards, but thick sandstone units are also present in the northern Normandien Formation (Groenewald1989, 1990).

The thicker sandstones of the Adelaide are usually multi-storey and usually have cut-and fill features. The sandstones are characterized internally by horizontal lamination together with parting lineation and less frequent trough crossbedding as well as current ripple lamination. The bases of the sandstone units are



massive beds, while ripple lamination is usually confined to thin sandstones towards the top of the thicker units. The mudrocks of the Adelaide Subgroup usually has massive and blocky weathering apart from in the Normandien and Daggaboersnek Member (Groenewald 1989, 1990). Sometimes desiccation cracks and impressions of raindrops are present. In the mudstones of the Beaufort Group calcareous nodules and concretions occur throughout.

The flood plains of the Beaufort Group (Karoo Supergroup) are internationally renowned for the early diversification of land vertebrates and provide the worlds' most complete transition from early "reptiles" to mammals. The Beaufort Group is subdivided into a series of biostratigraphic units based on its faunal content (Kitching 1977, 1978; Keyser *et al*, 1977, Rubidge 1995, Smith *et al*, 2020; Viglietti 2020). The proposed development is underlain by the Balfour Formation which is divided in the *Daptocephalus* (DAZ) which in turn is divided in the upper (younger) *Lystrosaurus maccaigi* - *Moschorhinus* and lower (older) *Dicynodon-Theriognathus* Subzones (Figure 5) (Viglietti, 2020).

The *Daptocephalus* Assemblage Zone (AZ) expands into the lower Palingkloof of the Upper Balfour Formation. This Zone is characterized by the occurrence of the two therapsids namely *Dicynodon* and *Theriognathus*. The *Daptocephalus* Assemblage Zone of the Beaufort Group shows the greatest vertebrate diversity and includes numerous well-preserved genera and species of dicynodonts, biarmosuchians, gorgonopsian, therocephalian and cynodont therapsid Synapsida. Captorhinid Reptilia are also present while eosuchian Reptilia, Amphibia and Pisces are rarer in occurrence. Trace fossils of vertebrates and invertebrates as well as *Glossopteris* flora plants have also been described.

The lower Palingkloof Member is of special importance as it precedes the Permo-Triassic Extinction Event which destroyed the vertebrate fauna and extinguished the diverse glossopterid plants. The lower *Lystrosaurus declivis* AZ forms part of the Katberg Formation (**Figure 9-10**). Vertebrate fossils are mostly found in the mudrock units between channel sandstones in the *Lystrosaurus declivis* Assemblage Zone. Specimens are well preserved and articulated skull and skeleton specimens have been abundantly found. Several bonebeds have been recorded. A common contributor to the floodplain bonebeds is juvenile *Lystrosaurus declivis* that most probably died due to severe drought conditions (Smith and Botha, 2005, Viglietti *et al.*, 2013, Smith and Botha-Brink, 2014). Numerous positively identified skeletons have been identified in burrows in this Assemblage Zone (Bordy *et al.*, 2011; Botha-Brink, 2017, Damiani *et al.*, 2003, Kitching, 1977; Modesto and Botha-Brink, 2010; Smith and Botha-Brink, 2014). Synchrotron scanning made it possible for Fernandez, *et al.*, 2013 to describe a burrow cast from the Early Triassic of the Karoo (**Figure 11**). This scan depicts a unique mixed-species association of an injured temnospondyl amphibian (*Broomistega*) sheltering in a burrow inhabited by an aestivating *Thrinaxodon*.

The Eccra Group (Karoo Supergroup) is a sedimentary rock sequence comprising of dark greenish-grey siltstone or shale and fine-grained sandstone. These shale and fine-grained sandstones of the Eccra are deeply weathered and rarely exposed. Weathered outcrops are usually scarce but if present the weathering expose thinly bedded, highly weathered shale with well-defined bedding planes. Botha and



Botha (2002) came to the conclusion that these sediments are deep-water deposits accumulating in an off-shore marine environment. This Group is Early to Late Permian in age (~289–253 Ma).

Trace fossils and abundant plant fossils are known from the deep-water deposits of this Group. The plant fossils are especially abundant in the sandstone rich units in the northern parts of the Basin. The first occurrence of the bivalve *Megadesmus* is reported from the upper Volksrust Shale Formation in the north-eastern Karoo Basin. This genus is well-known in deposits in India, Siberia, Australia, and South America. This is the first reported occurrence of this bivalve genus in Africa. This fossil has both valves articulated, indicating minimal transport after death. This large fossil was enclosed in interbedded shale-siltstone indicating a deltaic deposition at the Beaufort -Ecca Boundary (Cairncross *et al*, 2005).



Age	Gp		West of 24° E	East of 24° E	Free State / KwaZulu-Natal	Vertebrate Assemblage Zones	Vertebrate Subzones		
JURASSIC	STORMBERG			Drakensberg Gp	Drakensberg Gp	Massospondylus			
		Clarens Fm		Clarens Fm					
		upper Elliot Fm		upper Elliot Fm					
TRIASSIC	Tarkastad Subgp			lower Elliot Fm	lower Elliot Fm	Scalenodontoides			
				Molteno Fm	Molteno Fm				
			Burgersdorp Fm	Driekoppen Fm	Cynognathus	Cricodon-Ufudocyclops Trirachodon-Kannemeyeria Langbergia-Gargainia			
			Katberg Fm	Verkykerskop Fm	Lystrosaurus declivis				
			Palingkloof M.	Normandem Fm					
			Elandsberg M.		Harrismith M.	Daptocephalus	Lystrosaurus maccaigi-Moschorhinus		
	Ripplemead M.	Schoondraai M.							
	Daggaboersnek M.	Rooinekke M.	Dicynodon-Theriongnathus						
	Oudeberg M.	Frankfort M.	Cistecephalus						
PERMIAN	BEAUFORT	Adelaide Subgp	Teekloof Fm	Steenkampsvlakte M.	Middleton Fm	Volksrust Fm	Endothiodon	Tropidostoma-Gorgonops Lycosuchus-Eumotosaurus	
				Oukloof M.				Tapinocephalus	Diictodon-Styracocephalus Eosimops-Glanosuchus
				Hoedemaker M.				Eodicynodon	
				Poortjie M.					
				Abrahamskraal Fm	Koonap Fm				
				Waterford Fm	Waterford Fm				
ECCA			Tierberg/Fort Brown	Fort Brown					

Figure 8: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa.

Solid lines indicate known ranges, dotted lines indicate suspected but not confirmed ranges, single dot represents the stratigraphic position of the taxa that have only been recovered from a single bed.

Wavy lines indicate unconformities. (PLYCSR=Pelycosauria and MAMMFMES + Mammaliaformes. Gp=group, Subgp=Subgroup, Fm=Formation, M=Member)

The proposed cemetery development is indication by the blue arrow

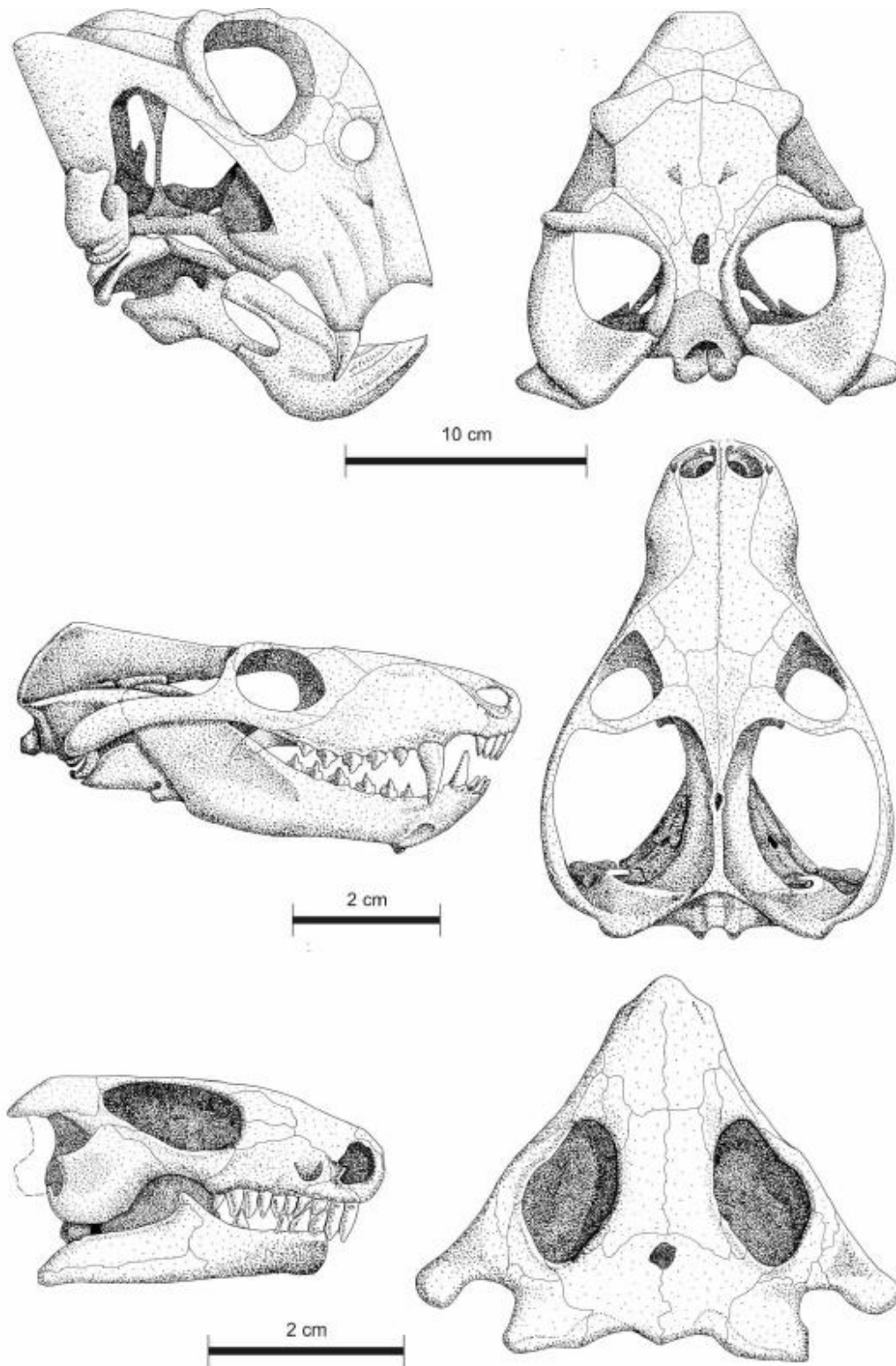


Figure 9: Lateral and dorsal views of the index taxa defining the *Lystrosaurus declivis* Assemblage Zone. (top) *Lystrosaurus declivis*, (centre) *Thrinaxodon liorhinus*, (bottom) *Procolophon trigoniceps*.

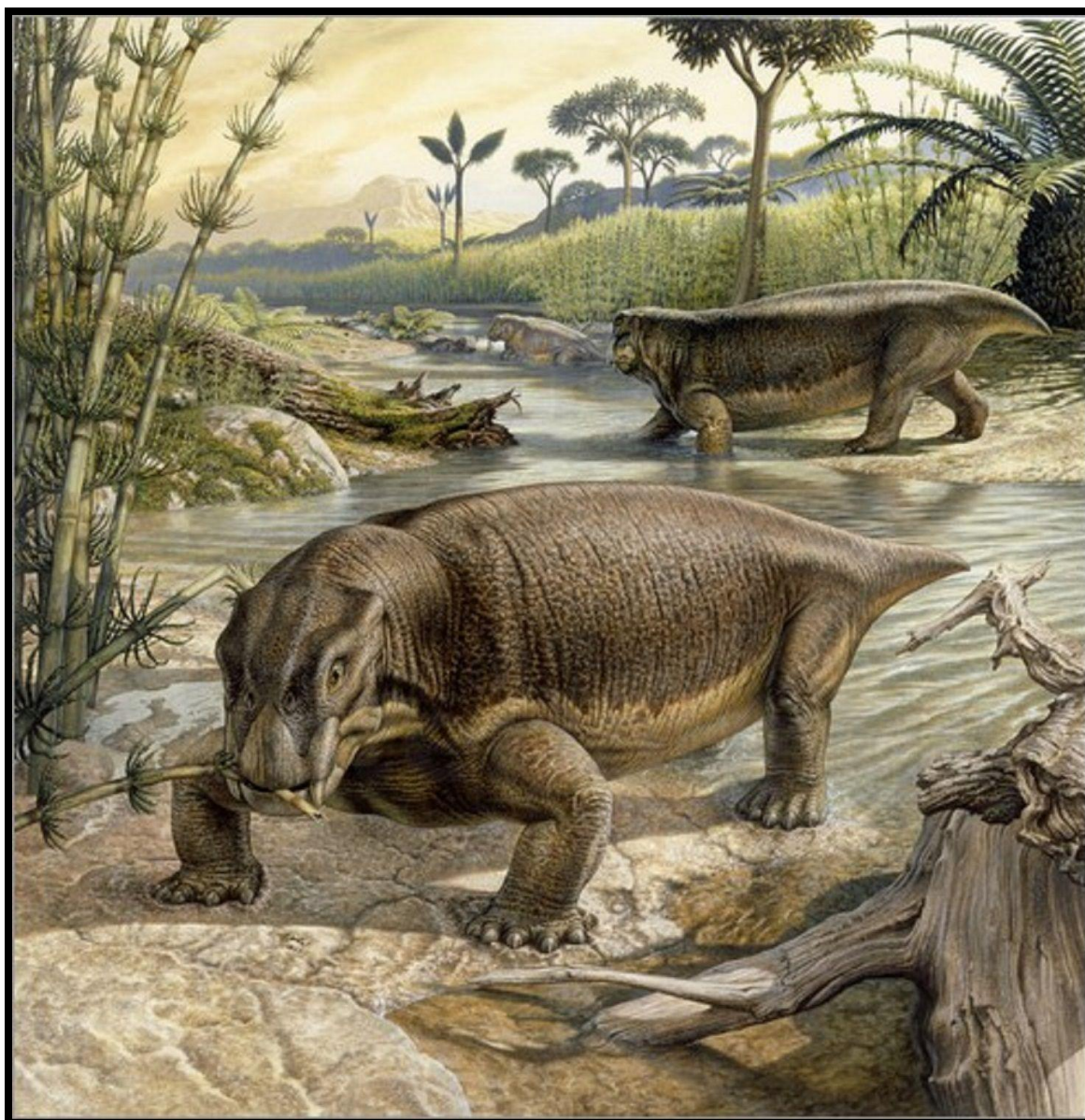


Figure 10: Reconstruction of Lystrosaurus.

<https://i.pinimg.com/564x/ac/7b/13/ac7b132d1d9882e6d9f9af804820a21e.jpg>

Lystrosaurus sp

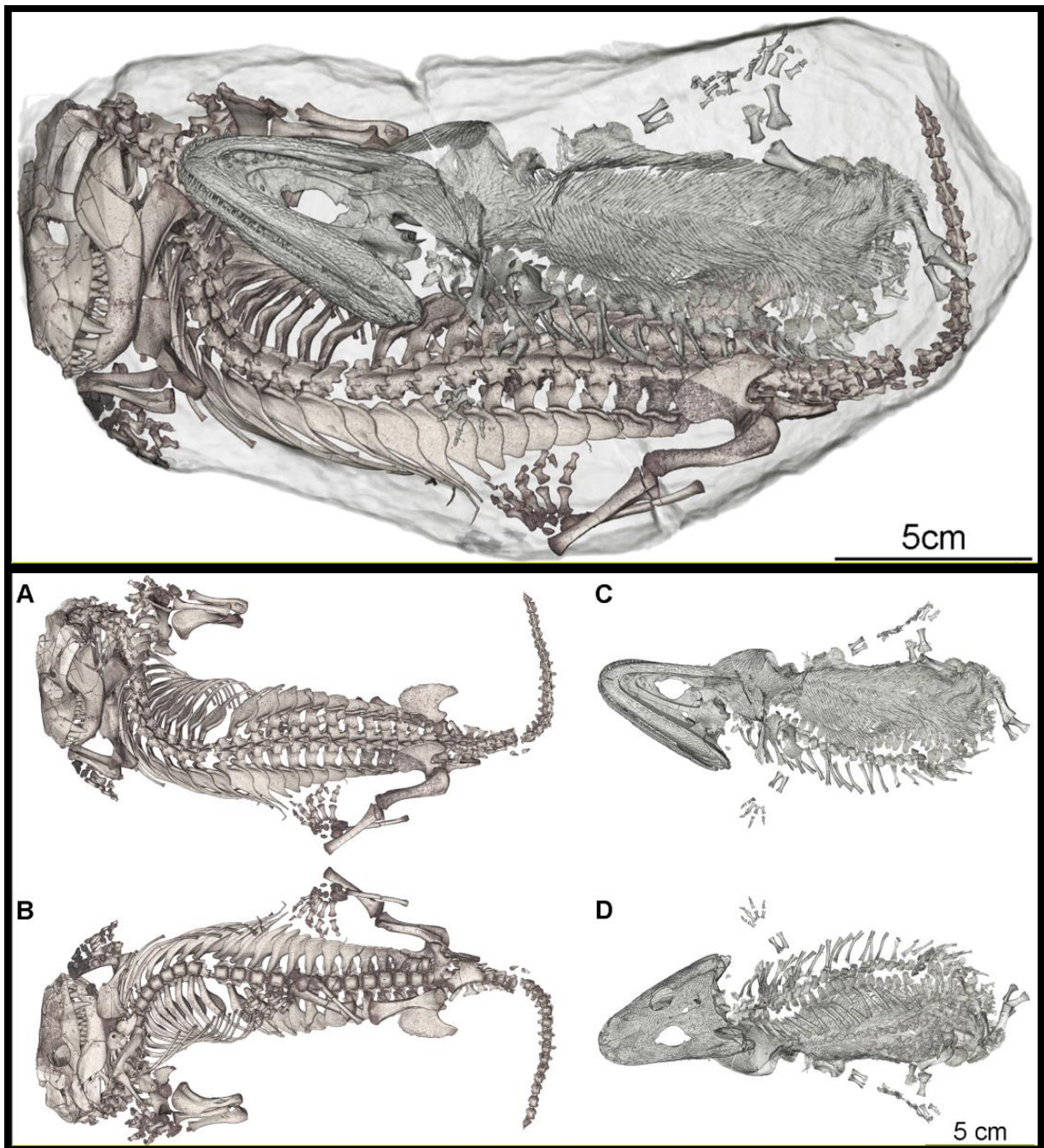


Figure 11: Synchrotron scan of a burrow cast from the Early Triassic indicates an injured temnospondyl amphibian (*Broomistega*) that sheltered in a burrow occupied by an aestivating therapsid (*Thrinaxodon*)
Image taken from Fernandez, et al., 2013.



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)
- Google Earth® satellite imagery.
- A Google Earth map with polygons of the proposed development was obtained from EIMS.
- 1:250 000 Kroonstad 2726 (2000) Geological Map (Council for Geosciences, Pretoria)
- 1:250 000 Winburg 2826 (1987) Geological Map (Council for Geosciences, Pretoria)
- Updated Geology (2014, Council for Geosciences, Pretoria)
- Palaeosensitivity map on SAHRIS (South African Heritage Resources Information System) website
- Department of Forestry, Fisheries and the Environment (DFFE) Screening tool report
- Published geological and palaeontological literature as well as PIAs in the area that includes
 - a. Almond, J.E. 2022. Proposed Khauta Solar PV Cluster and Associated Grid Connections near Welkom, Matjhabeng Local Municipality, Free State Province.
 - b. Bamford, M. 2023. Palaeontological Impact Assessment for the proposed Virginia Solar Park, SE of Virginia, Free State Province - Corona Solar Park.
 - c. Butler. E., 2022. Palaeontological Impact Assessment for the proposed Merapi PV plant phase 4 (46MW) on a site near Welkom, Mantsopa Local Municipality of Thabo Mofutsanyana District Municipality, Free State Province.
 - d. Butler. E., 2022. Palaeontological Impact Assessment for the proposed Doornrivier Solar 1, southwest of Matjhabeng (formerly Virginia) in the Free State
 - e. Butler. E., 2022. Palaeontological Impact Assessment (PIA) to assess Nyala Solar near Virginia in the Free State Province
 - f. Butler. E., 2022. Palaeontological Impact Assessment (PIA) to assess the Nyarhi Solar Power Plant (SPP) near Viljoenskroon in the Free State.
 - g. Butler. E., 2022. Palaeontological Impact Assessment (PIA) to assess Oryx Solar Power Plant near Virginia, in the Free State Province.
 - h. Butler. E., 2022. Palaeontological Impact Assessment (PIA) to assess Phofu Solar Power Plant (SPP) near Viljoenskroon, Free State Province.
 - i. Butler. E., 2022. Palaeontological Impact Assessment (PIA) to assess the Proposed Mokolobane Photovoltaic Solar Energy Facility near Welkom, Free State Province.
 - j. Butler. E., 2022. Palaeontological Impact Assessment (PIA) to assess proposed Lengana Solar Power Plant (SPP) near Welkom, in the Free State Province.

7 SITE VISIT

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 17 April 2023. Additional photographs of the study area were provided by Mr John von Mayer from EIMS. The study area has a very low topography and is mantled by superficial sediments as well as a thick cover of grass, obscuring any outcrops, if present. No fossiliferous outcrops were identified during the site visit.



Figure 12: General view overlooking the Nooitgedacht study area.



Figure 13: View overlooking the Valley TSF study area.

8 IMPACT ASSESSMENT METHODOLOGY

An assessment of the impact significance of the proposed Nooitgedacht TSF and associated pipeline infrastructure in the Free State indicates that development is underlain by the Auaternary sand (Qs), the Balfour Formation (Adelaide Subgroup, Beaufort Group) as well as the Volksrust Formation.

Nature of the Impact

The excavations and site clearance of the Nooitgedacht TSF will involve considerable excavations into the superficial sediments and also into the underlying bedrock. Existing topography will be modified while fossils may be destroyed on sealed-in, at the surface or below ground surface. The geology of the development indicates that fossils may be present in the development footprint.

Geographical extent of the impact

Impacts on fossil heritage will only occur during the construction phase of the development when new excavations into fresh potentially fossiliferous bedrock takes place. The extent of the area of potential impact is thus limited to the project site.

Sensitive areas

The Nooitgedacht TSF is completely underlain by the Volksrust formation of the Permian Eccca Group. However, during the site visit, no fossiliferous outcrops were found in the study area.

Duration of the Impact



The expected duration of the impact is potentially permanent too long term. In the absence of mitigation procedures (and if fossils are present in the development area) the harm or destruction of palaeontological heritage will be permanent.

Potential Significance of the Impact

The destruction/damage of fossil heritage in the development, underlain by the Volksrust Formation, will be permanent and irreversible. Any fossil heritage in the development area is considered to be of scientific and culturally significant and thus any negative impact on the fossil heritage will be highly significant.

Severity/ Beneficial scale

The development of the proposed Nooitgedacht TSF is beneficial, not only a local level, but regional as well. A secondary advantage of the construction of the project would be that the excavations may uncover fossils hidden beneath the surface and would have remained unknown to science.

Intensity of impact occurring

Probable significant impacts on palaeontological heritage during the construction phase are high

Probability

According to the Geology of the proposed development, fossil heritage can be found in the proposed development. The probability of significant impacts on palaeontological heritage during the construction phase are thus high.

Mitigation

If fossil heritage is present in the development footprint any negative or detrimental impact on these fossils can be mitigated by describing and collecting of the well-preserved fossils (by a professional palaeontologist). Mitigation should take place after vegetation clearance and before the ground is levelled for construction. A SAHRA permit will be required for fossil collection and the fossil heritage must be housed in an accredited institution (university or museum). If fossil heritage cannot be excavated a buffer could be placed around the fossil heritage thus protecting the fossils and fossil locality.

Mitigation would involve the collection and describing of fossils within the development footprint by a professional palaeontologist. This would take place after initial vegetation clearance but *before* the ground is levelled for construction.

Degree of irreversible Loss

Impacts on fossil heritage are generally irreversible. Scientifically all well-documented records and palaeontological studies of any fossils exposed during construction would represent a positive impact. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the



implementation of adequate mitigation procedures. If mitigation is undertaken the benefit scale for the project will be beneficial.

Irreplaceable loss

Fossil heritage may be present in the Volksrust Formation underlying the development. Significant loss of fossil heritage may be limited by taking a precautionary approach.

9 FINDINGS AND RECOMMENDATIONS

The study area is underlain by the aeolian sand, the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) as well as Permian Volksrust Formation (Ecca Group, Karoo Supergroup). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the aeolian sand is moderate, that of the Adelaide Subgroup is Very High, while that of the Volksrust Formation (Ecca Group, Karoo Supergroup) is High (Almond *et al*, 2013; SAHRIS website). The suggested location is classified as having Very High and Medium Palaeontology Theme Sensitivity in the DFFE Screening Report. Updated geology (Council of Geosciences, Pretoria) indicates that the development area is underlain by superficial alluvium, colluvium, eluvium and gravel, the Balfour Formation (Adelaide Subgroup, Beaufort Group, Karoo Supergroup) as well as Volksrust Formation (Ecca Group).

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 17 April 2023. No fossiliferous outcrop was detected in the proposed development area. The apparent rarity of fossil heritage in the proposed development footprint suggests that the impact of the development will be of a Low significance in palaeontological terms. 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.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO/site manager in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO/site manager 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 (recording and collection) can be carry out by a paleontologist.

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.

10 CHANCE FINDS PROTOCOL

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

10.1 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.

10.2 Background

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.

10.3 Introduction

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.

10.4 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. Fossils 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.

11 BIBLIOGRAPHY

Almond, J.E. & Pether, J. 2009. Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.

Almond, J., Pether, J, and Groenewald, G. 2013. South African National Fossil Sensitivity Map. SAHRA and Council for Geosciences. Schweitzer *et al.* (1995) pp p288.

Backwell, L.R., T. S. McCarthy, L. Wadley, Z. Henderson, C. M. Steininger, B. De Klerk, M. Barré, M. Lamothe, B. M. Chase, S. Woodbourne, G.J. Susino, M.K. Bamford, C. Sievers, J.S. Brink, L. Rossouw, L. Pollarolo, G. Trower, L. Scott, F. D'errico. 2014. Multiproxy record of late Quaternary climate change and Middle Stone Age human occupation at Wonderkrater, South Africa. *Quaternary Science Reviews*. 99: 42–59.

Barnosky, A.D. 2005. Effects of Quaternary Climatic Change on Speciation in Mammals. *Journal of Mammalian Evolution*. 12:247-264



- Brink, J.S. 1987. The archaeozoology of Florisbad, Orange Free State. *Memoirs of the National Museum* 24: 1 – 151.
- Brink, J.S. 2012. The post-1.0 Ma evolution of large mammal endemism in southern Africa in relation to East Africa and subsequent biogeographic isolation of the Cape coastal region. *Quaternary International* vol. 279–280: 69.
- Brink, J.S. 2016. Faunal evidence for mid- and late Quaternary environmental change in southern Africa. In: Knight, J. and Grab, S.W. (eds) *Quaternary environmental change in southern Africa: physical and human dimensions*. Cambridge University Press, pp. 286-307
- Brink, J.S., Berger, L.R., Churchill, S.E. 1999. Mammalian Fossils from Erosional Gullies (Dongas) In The Doring River Drainage, Central Free State Province, South Africa, pp. 79-90. In: Becker, C., Manhart, H., Peters, J., Schibler, J. (eds), *Historia Animalium ex Ossibus. Beiträge zur Paläoanatomie, Archäologie, Ägyptologie, Ethnologie und Geschichte der Tiermedizin: Festschrift für Angela Von Den Driesch zum 65. Geburtstag*. Rahden/Westf.: Verlag Marie Leidorf GmbH.
- Coppens, Y. et al. 1978. Proboscidea. In: V. Maglio and H.B.S. Cooke (eds). *Evolution of African Mammals*. Cambridge. Harvard University Press
- Cowan, R., 1995. *History of Life*. 2nd Edition. Blackwell Scientific Publications, Boston. 462pp.
- De Ruiter, Darryl J.; Brophy, Juliet K.; Lewis, Patrick J.; Kennedy, Alicia M.; Stidham, Thomas A.; Carlson, Keely B.; Hancox, P. John. 2010. *Preliminary investigation of the Matjhabeng, a Pliocene fossil locality in the Free State of South Africa*. <http://hdl.handle.net/10539/13821>
- De Wit, M.C.J., Marshall, T.R. & Partridge, T.C. 2000. Fluvial deposits and drainage evolution. In: Partridge, T.C. & Maud, R.R. (Eds.) *The Cenozoic of southern Africa*, pp.55-72. Oxford University Press, Oxford.
- Dingle, R.V., Siesser, W.G. & Newton, A.R. 1983. *Mesozoic and Tertiary geology of southern Africa*. viii + 375 pp. Balkema, Rotterdam.
- Du Toit, A.L., 1918. The zones of the Karroo System and their distribution. *Proceedings of the Geological Society of South Africa*, 21, 17-37.
- Du Toit, A. 1954. *The geology of South Africa*. xii + 611pp, 41 pls. Oliver & Boyd, Edinburgh.
- Groenewald G.H., Groenewald D.P. and Groenewald S.M., 2014. *Palaeontological Heritage of the Free State, Gauteng, Limpopo, Mpumalanga and North West Provinces*. Internal Palaeotechnical Reports, SAHRA.
- Groenewald, G., And Groenewald, D., 2014. SAHRA Palaeotechnical Report: Palaeontological Heritage of the Free State. Pp1-20.
- Hunter, D.R., Johnson, M.R., Anhaeusser, C. R. and Thomas, R.J. 2006. Introduction. (In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J. (Eds), *The Geology of South Africa*. Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria, 585-604.)
- Kent, L. E., 1980. Part 1: Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia and the Republics of Bophuthatswana, Transkei, and Venda. SACS, Council for Geosciences.
- Keyser, A.W. and Smith, R.H.M., 1979. Vertebrate biozonation of the Beaufort Group with special reference to the Western Karoo Basin. *Annals Geological Survey South Africa*, 12, 1-36.



- Klein, R.G. 1984. The large mammals of southern Africa: Late Pliocene to Recent. In: Klein, R.G. (Ed.) Southern African prehistory and paleoenvironments, pp 107-146. Balkema, Rotterdam.
- Lewis, Patrick J.; Brink, James S.; Kennedy, Alicia M.; Campbell, Timothy L. (2011). "Examination of the Florisbad microvertebrates". *South African Journal of Science*. **107**(7/8).
- MACRAE, C. 1999. Life etched in stone. Fossils of South Africa. 305 pp. The Geological Society of South Africa, Johannesburg.
- Macrae, C. 1999. Life etched in stone. Fossils of South Africa. 305 pp. The Geological
- Marchetti, L., Klein, H., Buchwitz, M., Ronchi, A., Smith, R.M.H., De Klerk, E., Sciscio, L. and Meiring, A.J.D. 1955. Fossil Proboscidean teeth and ulna from Virginia, OFS. *Navorsinge van die Nasionale Museum*, Bloemfontein 1, 187–201.
- Maud, R. 2012. Macroscale Geomorphic Evolution. (In Holmes, P. and Meadows, M. Southern Africa Geomorphology, New trends and new directions. Bloemfontein: Sun Press. p. 7- 21)
- McCarthy, T. & Rubidge, B. 2005. The story of Earth and life: a southern African perspective on a 4.6-billion-year journey. 334pp. Struik, Cape Town
- Partridge, T.C. & Scott, L. 2000. Lakes and pans. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.145 - 161. Oxford University Press, Oxford.
- Partridge, T.C., Botha, G.A. & Haddon, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.
- Partridge, T.C., Botha, G.A. & Haddon, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.
- S.A.C.S. (South African Committee for Stratigraphy), 1980. Stratigraphy of South Africa. Part 1. Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia, and the Republics of Bophuthatswana, Transkei, and Venda. Handbook of the Geological Survey of South Africa, 8, 690pp
- SAHRA 2012. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.
- Scott, L. & Rossouw, L. 2005 Reassessment of botanical evidence for palaeoenvironments at Florisbad, South Africa. *South African Archaeological Bulletin* 60: 96-102.
- Scott, L. & J.S. Brink. 1992. Quaternary palynology, palaeontology and palaeoenvironments in central South Africa. *South African Geographer* 19: 22-34.
- Scott, L. and Klein, R.G. 1981. A hyena-accumulated bone assemblage from Late Holocene deposits at Deelpan, Orange Free State. *Annals of the South African Museum* 86(6): 217 – 227.
- SG 2.2 SAHRA APMHOB Guidelines, 2012. Minimum standards for palaeontological components of Heritage Impact Assessment Reports, Pp 1-15.
- Shango, 2016. Development of exploration strategies for gas plays in the Virginia, Kroonstad and Heilbron areas, Report No SS0530/15, prepared by Shango Solutions, dated 20 January 2016.
- Tankard, A.J., Jackson, M.P.A., ERIKSSON, K.A., HOBDAV, D.K., HUNTER, D.R. & Minter, W.E.L. 1982. Crustal evolution of southern Africa – 3.8 billion years of earth history, xv + 523pp. Springer Verlag, New York.



- Thomas, M.J. 1981. The geology of the Kalahari in the Northern Cape Province (Areas 2620)
- Tooth, S. Brandt, D., Hancox P.J. And McCarthy, T. S. 2004. Geological controls on alluvial river behaviour: a comparative study of three rivers in the South African Highveld. *Journal of African Earth Sciences*, 38(2004): 79-97, 15 Aug.
- Van Zyl, W., S. Badenhorst & J.S. Brink. 2016. Pleistocene Bovidae from X Cave on Bolt's Farm in the Cradle of Humankind in South Africa. *Annals of the Ditsong National Museum of Natural History* 6: 39–73.
- Visser, D.J.L. (ed) 1984. Geological Map of South Africa 1:100 000. South African Committee for Stratigraphy, Council for Geoscience, Pretoria.
- Visser, D.J.L. (ed) 1989. *Toeligting: Geologiese kaart (1:100 000). Die Geologie van die Republieke van Suid Afrika, Transkei, Bophuthatswana, Venda, Ciskei en die Koningkryke van Lesotho en Swaziland*. South African Committee for Stratigraphy. Council for Geoscience, Pretoria, Pp 494.



Appendix A

CURRICULUM VITAE

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 1998–2022



TECHNICAL REPORTS

- Butler, E. 2014. Palaeontological Impact Assessment of the proposed development of private dwellings on portion 5 of farm 304 Matjesfontein Keurboomstrand, Knysna District, Western Cape Province. Bloemfontein.
- Butler, E. 2014. Palaeontological Impact Assessment for the proposed upgrade of existing water supply infrastructure at Noupoot, Northern Cape Province. 2014. Bloemfontein.
- Butler, E. 2015. Palaeontological impact assessment of the proposed consolidation, re-division, and development of 250 serviced erven in Nieu-Bethesda, Camdeboo local municipality, Eastern Cape. Bloemfontein.
- Butler, E. 2015. Palaeontological impact assessment of the proposed mixed land developments at Rooikraal 454, Vrede, Free State. Bloemfontein.
- Butler, E. 2015. Palaeontological exemption report of the proposed truck stop development at Palmiet 585, Vrede, Free State. Bloemfontein.
- Butler, E. 2015. Palaeontological impact assessment of the proposed Orange Grove 3500 residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape. Bloemfontein.
- Butler, E. 2015. Palaeontological Impact Assessment of the proposed Gonubie residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape Province. Bloemfontein.
- Butler, E. 2015. Palaeontological Impact Assessment of the proposed Ficksburg raw water pipeline. Bloemfontein.
- Butler, E. 2015. Palaeontological Heritage Impact Assessment report on the establishment of the 65 mw Majuba Solar Photovoltaic facility and associated infrastructure on portion 1, 2 and 6 of the farm Witkoppies 81 HS, Mpumalanga Province. Bloemfontein.
- Butler, E. 2015. Palaeontological Impact Assessment of the proposed township establishment on the remainder of portion 6 and 7 of the farm Sunnyside 2620, Bloemfontein, Mangaung metropolitan municipality, Free State, Bloemfontein.
- Butler, E. 2015. Palaeontological Impact Assessment of the proposed Woodhouse 1 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
- Butler, E. 2015. Palaeontological Impact Assessment of the proposed Woodhouse 2 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
- Butler, E. 2015. Palaeontological Impact Assessment of the proposed Orkney solar energy farm and associated infrastructure on the remaining extent of Portions 7 and 21 of the farm Wolvehuis 114, near Orkney, North West Province. Bloemfontein.
- Butler, E. 2015. Palaeontological Impact Assessment of the proposed Spectra foods broiler houses and abattoir on the farm Maiden Manor 170 and Ashby Manor 171, Lukhanji Municipality, Queenstown, Eastern Cape Province. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoot concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoot, Northern Cape. Prepared for Savannah Environmental. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed Woodhouse 1 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed Woodhouse 2 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
- Butler, E. 2016. Proposed 132kV overhead power line and switchyard station for the authorised Solis Power 1 CSP project near Upington, Northern Cape. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed Senqu Pedestrian Bridges in Ward 5 of Senqu Local Municipality, Eastern Cape Province. Bloemfontein.
- Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Modderfontein Filling Station on Erf 28 Portion 30, Founders Hill, City of Johannesburg, Gauteng Province. Bloemfontein.



- Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Modikwa Filling Station on a Portion of Portion 2 of Mooihoek 255 Kt, Greater Tubatse Local Municipality, Limpopo Province. Bloemfontein.
- Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Heidedal filling station on Erf 16603, Heidedal Extension 24, Mangaung Local Municipality, Bloemfontein, Free State Province. Bloemfontein.
- Butler, E. 2016. Recommended Exemption from further Palaeontological studies: Proposed Construction of the Gunstfontein Switching Station, 132kv Overhead Power Line (Single or Double Circuit) and ancillary infrastructure for the Gunstfontein Wind Farm Near Sutherland, Northern Cape Province. Savannah South Africa. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.
- Butler, E. 2016. Chris Hani District Municipality Cluster 9 water backlog project phases 3a and 3b: Palaeontology inspection at Tsomo WTW. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoot concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoot, Northern Cape. Savannah South Africa. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed upgrading of the main road MR450 (R335) from Motherwell to Addo within the Nelson Mandela Bay Municipality and Sunday's River valley Local Municipality, Eastern Cape Province. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment construction of the proposed Metals Industrial Cluster and associated infrastructure near Kuruman, Northern Cape Province. Savannah South Africa. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment for the proposed construction of up to a 132kv power line and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces. PGS Heritage. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed development of two burrow pits (DR02625 and DR02614) in the Enoch Mgijima Municipality, Chris Hani District, Eastern Cape.
- Butler, E. 2016. Ezibeleni waste Buy-Back Centre (near Queenstown), Enoch Mgijima Local Municipality, Eastern Cape. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment for the proposed construction of two 5 Mw Solar Photovoltaic Power Plants on Farm Wildebeestkuil 59 and Farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment for the proposed development of four Leeuwerberg Wind farms and basic assessments for the associated grid connection near Loeriesfontein, Northern Cape Province. Bloemfontein.
- Butler, E. 2016. Palaeontological impact assessment for the proposed Aggeneys south prospecting right project, Northern Cape Province. Bloemfontein.
- Butler, E. 2016. Palaeontological impact assessment of the proposed Motuoane Ladysmith Exploration right application, KwaZulu Natal. Bloemfontein.
- Butler, E. 2016. Palaeontological impact assessment for the proposed construction of two 5 MW solar photovoltaic power plants on farm Wildebeestkuil 59 and farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.
- Butler, E. 2016: Palaeontological desktop assessment of the establishment of the proposed residential and mixed-use development on the remainder of portion 7 and portion 898 of the farm Knopjeslaagte 385 Ir, located near Centurion within the Tshwane Metropolitan Municipality of Gauteng Province. Bloemfontein.
- Butler, E. 2017. Palaeontological impact assessment for the proposed development of a new cemetery, near Kathu, Gamagara local municipality and John Taolo Gaetsewe district municipality, Northern Cape. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of The Proposed Development of The New Open Cast Mining Operations on The Remaining Portions Of 6, 7, 8 And 10 Of the Farm Kwaggafontein 8 In the Carolina Magisterial District, Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Development of a Wastewater Treatment Works at Lanseria, Gauteng Province. Bloemfontein.



- Butler, E. 2017. Palaeontological Scoping Report for the Proposed Construction of a Warehouse and Associated Infrastructure at Perseverance in Port Elizabeth, Eastern Cape Province.
- Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Establishment of a Diesel Farm and a Haul Road for the Tshipi Borwa mine Near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Changes to Operations at the UMK Mine near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment for the Development of the Proposed Ventersburg Project-An Underground Mining Operation near Ventersburg and Henneman, Free State Province. Bloemfontein.
- Butler, E. 2017. Palaeontological desktop assessment of the proposed development of a 3000 MW combined cycle gas turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment for the Development of the Proposed Revalidation of the lapsed General Plans for Elliotdale, Mbhashe Local Municipality. Bloemfontein.
- Butler, E. 2017. Palaeontological assessment of the proposed development of a 3000 MW Combined Cycle Gas Turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed development of the new open cast mining operations on the remaining portions of 6, 7, 8 and 10 of the farm Kwaggafontein 8 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed mining of the farm Zandvoort 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the proposed Lanseria outfall sewer pipeline in Johannesburg, Gauteng Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of open pit mining at Pit 36W (New Pit) and 62E (Dishaba) Amandelbult Mine Complex, Thabazimbi, Limpopo Province. Bloemfontein.
- Butler, E. 2017. Palaeontological impact assessment of the proposed development of the sport precinct and associated infrastructure at Merrifield Preparatory school and college, Amathole Municipality, East London. PGS Heritage. Bloemfontein.
- Butler, E. 2017. Palaeontological impact assessment of the proposed construction of the Leahae training and fire station, Lenasia, Gauteng Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the new open cast mining operations of the Impunzi mine in the Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the construction of the proposed Viljoenskroon Munic 132 KV line, Vierfontein substation and related projects. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed rehabilitation of 5 ownerless asbestos mines. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the Lephalale coal and power project, Lephalale, Limpopo Province, Republic of South Africa. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of a 132KV powerline from the Tweespruit distribution substation (in the Mantsopa local municipality) to the Driedorp rural substation (within the Naledi local municipality), Free State province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the new coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of a Photovoltaic Solar Power station near Collett substation, Middelburg, Eastern Cape. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment for the proposed township establishment of 2000 residential sites with supporting amenities on a portion of farm 826 in Botshabelo West, Mangaung Metro, Free State Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the proposed prospecting right project without bulk sampling, in the Koa Valley, Northern Cape Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the proposed Aroams prospecting right project, without bulk sampling, near Aggeneys, Northern Cape Province. Bloemfontein.



- Butler, E. 2017. Palaeontological Impact Assessment of the proposed Belvior aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.
- Butler, E. 2017. PIA site visit and report of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of Tina Falls Hydropower and associated power lines near Cumbu, Mthlontlo Local Municipality, Eastern Cape. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of the Mangaung Gariep Water Augmentation Project. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed Belvoir aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of the Melkspruit-Rouxville 132KV Power line. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of a railway siding on a Portion of portion 41 of the farm Rustfontein 109 is, Govan Mbeki local municipality, Gert Sibande district municipality, Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed consolidation of the proposed Ilima Colliery in the Albert Luthuli local municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed extension of the Kareerand Tailings Storage Facility, associated borrow pits as well as a storm water drainage channel in the Vaal River near Stilfontein, North West Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of a filling station and associated facilities on the Erf 6279, district municipality of John Taolo Gaetsewe District, Ga-Segonyana Local Municipality Northern Cape. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed of the Lephalale Coal and Power Project, Lephalale, Limpopo Province, Republic of South Africa. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Overvaal Trust PV Facility, Buffelspoort, North West Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed development of the H₂ Energy Power Station and associated infrastructure on Portions 21; 22 And 23 of the farm Hartebeestspruit in the Thembisile Hani Local Municipality, Nkangala District near Kwamhlanga, Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the Sandriver Canal and Klippan Pump station in Welkom, Free State Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the 132kv and 11kv power line into a dual circuit above ground power line feeding into the Urania substation in Welkom, Free State Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed diamonds alluvial & diamonds general prospecting right application near Christiana on the remaining extent of portion 1 of the farm Kaffraria 314, registration division HQ, North West Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Hartebeesfontein, near Panbult, Mpumalanga. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Rustplaas near Piet Retief, Mpumalanga. Bloemfontein.
- Butler, E. 2018. Palaeontological Impact Assessment for the Proposed Landfill Site in Luckhoff, Letsemeng Local Municipality, Xhariep District, Free State. Bloemfontein.
- Butler, E. 2018. Palaeontological Impact Assessment of the proposed development of the new Mutsho coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Impact Assessment of the authorisation and amendment processes for Manangu mine near Delmas, Victor Khanye local municipality, Mpumalanga. Bloemfontein.



- Butler, E. 2018. Palaeontological Desktop Assessment for the proposed Mashishing township establishment in Mashishing (Lydenburg), Mpumalanga Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Desktop Assessment for the Proposed Mlonzi Estate Development near Lusikisiki, Ngquza Hill Local Municipality, Eastern Cape. Bloemfontein.
- Butler, E. 2018. Palaeontological Phase 1 Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.
- Butler, E. 2018. Palaeontological Desktop Assessment for the proposed electricity expansion project and Sekgame Switching Station at the Sishen Mine, Northern Cape Province. Bloemfontein.
- Butler, E. 2018. Palaeontological field assessment of the proposed construction of the Zonnebloem Switching Station (132/22kV) and two loop-in loop-out power lines (132kV) in the Mpumalanga Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Field Assessment for the proposed re-alignment and de-commissioning of the Firham-Platrand 88kv Powerline, near Standerton, Lekwa Local Municipality, Mpumalanga province. Bloemfontein.
- Butler, E. 2018. Palaeontological Desktop Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.
- Butler, E. 2018. Palaeontological field Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.
- Butler, E. 2018. Palaeontological desktop assessment of the proposed Mookodi – Mahikeng 400kV line, North West Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Desktop Assessment for the proposed Thornhill Housing Project, Ndlambe Municipality, Port Alfred, Eastern Cape Province. Bloemfontein.
- Butler, E. 2018. Palaeontological desktop assessment of the proposed housing development on portion 237 of farm Hartebeestpoort 328. Bloemfontein.
- Butler, E. 2018. Palaeontological desktop assessment of the proposed New Age Chicken layer facility located on holding 75 Endicott near Springs in Gauteng. Bloemfontein.
- Butler, E. 2018 Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.
- Butler, E. 2018. Palaeontological field assessment of the proposed development of the Wildealskloof mixed use development near Bloemfontein, Free State Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Field Assessment of the proposed Megamor Extension, East London. Bloemfontein
- Butler, E. 2018. Palaeontological Impact Assessment of the proposed diamonds Alluvial & Diamonds General Prospecting Right Application near Christiana on the Remaining Extent of Portion 1 of the Farm Kaffraria 314, Registration Division HQ, North West Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Impact Assessment of the proposed construction of a new 11kV (1.3km) Power Line to supply electricity to a cell tower on farm 215 near Delpportshoop in the Northern Cape. Bloemfontein.
- Butler, E. 2018. Palaeontological Field Assessment of the proposed construction of a new 22 kV single wood pole structure power line to the proposed MTN tower, near Britstown, Northern Cape Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Exemption Letter for the proposed reclamation and reprocessing of the City Deep Dumps in Johannesburg, Gauteng Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Exemption letter for the proposed reclamation and reprocessing of the City Deep Dumps and Rooikraal Tailings Facility in Johannesburg, Gauteng Province. Bloemfontein.
- Butler, E. 2018. Proposed Kalabasfontein Mine Extension project, near Bethal, Govan Mbeki District Municipality, Mpumalanga. Bloemfontein.
- Butler, E. 2018. Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.
- Butler, E. 2018. Palaeontological Desktop Assessment of the proposed Mookodi – Mahikeng 400kV Line, North West Province. Bloemfontein.
- Butler, E. 2018. Environmental Impact Assessment (EIA) for the Proposed 325mw Rondekop Wind Energy Facility between Matjiesfontein and Sutherland in the Northern Cape Province.
- Butler, E. 2018. Palaeontological Impact Assessment of the proposed construction of the Tooverberg Wind Energy Facility, and associated grid connection near Touws River in the Western Cape Province. Bloemfontein.



- Butler, E. 2018. Palaeontological impact assessment of the proposed Kalabasfontein Mining Right Application, near Bethal, Mpumalanga.
- Butler, E., 2019. Palaeontological Desktop Assessment of the proposed Westrand Strengthening Project Phase II.
- Butler, E., 2019. Palaeontological Field Assessment for the proposed Sirius 3 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province
- Butler, E., 2019. Palaeontological Field Assessment for the proposed Sirius 4 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province
- Butler, E., 2019. Palaeontological Field Assessment for Heuningspruit PV 1 Solar Energy Facility near Koppies, Ngwathe Local Municipality, Free State Province.
- Butler, E., 2019. Palaeontological Field Assessment for the Moeding Solar Grid Connection, North West Province.
- Butler, E., 2019. Recommended Exemption from further Palaeontological studies for the Proposed Agricultural Development on Farms 1763, 2372 And 2363, Kakamas South Settlement, Kai! Garib Municipality, Mgcawu District Municipality, Northern Cape Province.
- Butler, E., 2019. Recommended Exemption from further Palaeontological studies: of Proposed Agricultural Development, Plot 1178, Kakamas South Settlement, Kai! Garib Municipality
- Butler, E., 2019. Palaeontological Desktop Assessment for the Proposed Waste Rock Dump Project at Tshipi Borwa Mine, near Hotazel, Northern Cape Province:
- Butler, E., 2019. Palaeontological Exemption Letter for the proposed DMS Upgrade Project at the Sishen Mine, Gamagara Local Municipality, Northern Cape Province
- Butler, E., 2019. Palaeontological Desktop Assessment of the proposed Integrated Environmental Authorisation process for the proposed Der Brochen Amendment project, near Groblershoop, Limpopo
- Butler, E., 2019. Palaeontological Desktop Assessment of the proposed updated Environmental Management Programme (EMPr) for the Assmang (Pty) Ltd Black Rock Mining Operations, Hotazel, Northern Cape
- Butler, E., 2019. Palaeontological Desktop Assessment of the proposed Kriel Power Station Lime Plant Upgrade, Mpumalanga Province
- Butler, E., 2019. Palaeontological Impact Assessment for the proposed Kangala Extension Project Near Delmas, Mpumalanga Province.
- Butler, E., 2019. Palaeontological Desktop Assessment for the proposed construction of an iron/steel smelter at the Botshabelo Industrial area within the Mangaung Metropolitan Municipality, Free State Province.
- Butler, E., 2019. Recommended Exemption from further Palaeontological studies for the proposed agricultural development on farms 1763, 2372 and 2363, Kakamas South settlement, Kai! Garib Municipality, Mgcawu District Municipality, Northern Cape Province.
- Butler, E., 2019. Recommended Exemption from further Palaeontological Studies for Proposed formalisation of Gamakor and Noodkamp low-cost Housing Development, Keimoes, Gordonia Rd, Kai !Garib Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.
- Butler, E., 2019. Recommended Exemption from further Palaeontological Studies for proposed formalisation of Blaauwskop Low-Cost Housing Development, Kenhardt Road, Kai !Garib Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.
- Butler, E., 2019. Palaeontological Desktop Assessment of the proposed mining permit application for the removal of diamonds alluvial and diamonds kimberlite near Windsorton on a certain portion of Farm Zoelen's Laagte 158, Registration Division: Barkly Wes, Northern Cape Province.
- Butler, E., 2019. Palaeontological Desktop Assessment of the proposed Vedanta Housing Development, Pella Mission 39, Khâi-Ma Local Municipality, Namakwa District Municipality, Northern Cape.
- Butler, E., 2019. Palaeontological Desktop Assessment for The Proposed 920 KWP Groenheuwel Solar Plant Near Augrabies, Northern Cape Province
- Butler, E., 2019. Palaeontological Desktop Assessment for the establishment of a Super Fines Storage Facility at Amandelbult Mine, Near Thabazimbi, Limpopo Province
- Butler, E., 2019. Palaeontological Impact Assessment for the proposed Sace Lifex Project, Near Emalahleni, Mpumalanga Province
- Butler, E., 2019. Palaeontological Desktop Assessment for the proposed Rehau Fort Jackson Warehouse Extension, East London



- Butler, E., 2019. Palaeontological Desktop Assessment for the proposed Environmental Authorisation Amendment for moving 3 Km of the Merensky-Kameny 132KV Powerline
- Butler, E., 2019. Palaeontological Impact Assessment for the proposed Umsobomvu Solar PV Energy Facilities, Northern and Eastern Cape
- Butler, E., 2019. Palaeontological Desktop Assessment for six proposed Black Mountain Mining Prospecting Right Applications, without Bulk Sampling, in the Northern Cape.
- Butler, E., 2019. Palaeontological field Assessment of the Filling Station (Rietvlei Extension 6) on the Remaining Portion of Portion 1 of the Farm Witkoppies 393JR east of the Rietvleidam Nature Reserve, City of Tshwane, Gauteng
- Butler, E., 2019. Palaeontological Desktop Assessment of The Proposed Upgrade of The Vaal Gamagara Regional Water Supply Scheme: Phase 2 And Groundwater Abstraction
- Butler, E., 2019. Palaeontological Desktop Assessment of The Expansion of The Jan Kempdorp Cemetery on Portion 43 Of Farm Guldenskat 36-Hn, Northern Cape Province
- Butler, E., 2019. Palaeontological Desktop Assessment of the Proposed Residential Development on Portion 42 Of Farm Geldunskat No 36 In Jan Kempdorp, Phokwane Local Municipality, Northern Cape Province
- Butler, E., 2019. Palaeontological Impact Assessment of the proposed new Township Development, Lethabo Park, on Remainder of Farm Roodepan No 70, Erf 17725 And Erf 15089, Roodepan Kimberley, Sol Plaatjies Local Municipality, Frances Baard District Municipality, Northern Cape
- Butler, E., 2019. Palaeontological Protocol for Finds for the proposed 16m WH Battery Storage System in Steinkopf, Northern Cape Province
- Butler, E., 2019. Palaeontological Exemption Letter of the proposed 4.5WH Battery Storage System near Midway-Pofadder, Northern Cape Province
- Butler, E., 2019. Palaeontological Exemption Letter of the proposed 2.5ml Process Water Reservoir at Gloria Mine, Black Rock, Hotazel, Northern Cape
- Butler, E., 2019. Palaeontological Desktop Assessment for the Establishment of a Super Fines Storage Facility at Gloria Mine, Black Rock Mine Operations, Hotazel, Northern Cape:
- Butler, E., 2019. Palaeontological Desktop Assessment for the Proposed New Railway Bridge, and Rail Line Between Hotazel and the Gloria Mine, Northern Cape Province
- Butler, E., 2019. Palaeontological Exemption Letter of The Proposed Mixed Use Commercial Development on Portion 17 of Farm Boegoeberg Settlement Number 48, !Kheis Local Municipality in The Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2019. Palaeontological Desktop Assessment of the Proposed Diamond Mining Permit Application Near Kimberley, Sol Plaatjies Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2019. Palaeontological Desktop Assessment of the Proposed Diamonds (Alluvial, General & In Kimberlite) Prospecting Right Application near Postmasburg, Registration Division; Hay, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2019. Palaeontological Desktop Assessment of the proposed diamonds (alluvial, general & in kimberlite) prospecting right application near Kimberley, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2019. Palaeontological Phase 1 Impact Assessment of the proposed upgrade of the Vaal Gamagara regional water supply scheme: Phase 2 and groundwater abstraction. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2019. Palaeontological Desktop Assessment of the proposed seepage interception drains at Duvha Power Station, Emalahleni Municipality, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2019. Palaeontological Desktop Assessment letter for the Proposed PV Solar Facility at the Heineken Sedibeng Brewery, near Vereeniging, Gauteng. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2019. Palaeontological Phase 1 Assessment for the Proposed PV Solar Facility at the Heineken Sedibeng Brewery, near Vereeniging, Gauteng. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2019. Palaeontological field Assessment for the Proposed Upgrade of the Kolomela Mining Operations, Tsantsabane Local Municipality, Siyanda District Municipality, Northern Cape Province, Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2019. Palaeontological Desktop Assessment of the proposed feldspar prospecting rights and mining application on portion 4 and 5 of the farm Rozynen 104, Kakamas South, Kai! Garib



Municipality, Zf Mgcawu District Municipality, Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2019. Palaeontological Phase 1 Field Assessment of the proposed Summerpride Residential Development and Associated Infrastructure on Erf 107, Buffalo City Municipality, East London. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2019. Palaeontological Desktop Impact Assessment for the proposed re-commission of the Old Balgay Colliery near Dundee, KwaZulu Natal.

Butler, E., 2019. Palaeontological Phase 1 Impact Assessment for the Proposed Re-Commission of the Old Balgay Colliery near Dundee, KwaZulu Natal. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2019. Palaeontological Desktop Assessment for the Proposed Environmental Authorisation and Amendment Processes for Elandsfontein Colliery. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2019. Palaeontological Impact Assessment and Protocol for Finds of a Proposed New Quarry on Portion 9 (of 6) of the farm Mimosa Glen 885, Bloemfontein, Free State Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2019. Palaeontological Impact Assessment and Protocol for Finds of a proposed development on Portion 9 and 10 of the Farm Mimosa Glen 885, Bloemfontein, Free State Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2019. Palaeontological Exemption Letter for the proposed residential development on the Remainder of Portion 1 of the Farm Strathearn 2154 in the Magisterial District of Bloemfontein, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2019. Palaeontological Field Assessment for the Proposed Nigel Gas Transmission Pipeline Project in the Nigel Area of the Ekurhuleni Metropolitan Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2019. Palaeontological Desktop Assessment for five Proposed Black Mountain Mining Prospecting Right Applications, Without Bulk Sampling, in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E. 2019. Palaeontological Desktop Assessment for the Proposed Environmental Authorisation and an Integrated Water Use Licence Application for the Reclamation of the Marievale Tailings Storage Facilities, Ekurhuleni Metropolitan Municipality - Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2019. Palaeontological Impact Assessment for the Proposed Sace Lifex Project, near Emalahleni, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2019. Palaeontological Desktop Assessment for the proposed Golfview Colliery near Ermelo, Msukaligwa Local Municipality, Mpumalanga Province

Butler, E., 2019. Palaeontological Desktop Assessment for the Proposed Kangra Maquasa Block C Mining development near Piet Retief, in the Mkhondo Local Municipality within the Gert Sibande District Municipality. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2019. Palaeontological Desktop Assessment for the Proposed Amendment of the Kusipongo Underground and Opencast Coal Mine in Support of an Environmental Authorization and Waste Management License Application. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2019. Palaeontological Exemption Letter of the Proposed Mamatwan Mine Section 24g Rectification Application, near Hotazel, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Field Assessment for the Proposed Environmental Authorisation and Amendment Processes for Elandsfontein Colliery. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment for the Proposed Extension of the South African Nuclear Energy Corporation (Necsa) Pipe Storage Facility, Madibeng Local Municipality, North West Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Field Assessment for the Proposed Piggery on Portion 46 of the Farm Brakkefontien 416, Within the Nelson Mandela Bay Municipality, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological field Assessment for the proposed Rietfontein Housing Project as part of the Rapid Land Release Programme, Gauteng Province Department of Human Settlements, City of Johannesburg Metropolitan Municipality. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment for the Proposed Choje Wind Farm between Grahamstown and Somerset East, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment of the Proposed Prospecting Right Application for the Prospecting of Diamonds (Alluvial, General & In Kimberlite), Combined with A Waste License



Application, Registration Division: Gordonia and Kenhardt, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Impact Assessment for the Proposed Clayville Truck Yard, Ablution Blocks and Wash Bay to be Situated on Portion 55 And 56 Of Erf 1015, Clayville X11, Ekurhuleni Metropolitan Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment for the Proposed Hartebeesthoek Residential Development. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment for the Proposed Mooiplaats Educational Facility, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Impact Assessment for the Proposed Monument Park Student Housing Establishment. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Field Assessment for the Proposed Standerton X10 Residential and Mixed-Use Developments, Lekwa Local Municipality Standerton, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Field Assessment for the Rezoning and Subdivision of Portion 6 Of Farm 743, East London. Banzai Environmental (Pty) Ltd, Bloemfontein. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Field Assessment for the Proposed Matla Power Station Reverse Osmosis Plant, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment of the Proposed Prospecting Right Application Without Bulk Sampling for the Prospecting of Diamonds Alluvial near Bloemhof on Portion 3 (Portion 1) of the Farm Boschpan 339, the Remaining Extent of Portion 8 (Portion 1), Portion 9 (Portion 1) and Portion 10 (Portion 1) and Portion 17 (Portion 1) of the Farm Panfontein 270, Registration Division: Ho, North West Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment of the Proposed Prospecting Right Application Combined with a Waste Licence Application for the Prospecting of Diamonds Alluvial, Diamonds General and Diamonds near Wolmaransstad on the Remaining Extent, Portion 7 and Portion 8 Of Farm Rooibult 152, Registration Division: HO, North West Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment of the Proposed Prospecting Right Application With Bulk Sampling combined with a Waste Licence Application for the Prospecting of Diamonds Alluvial (Da), Diamonds General (D), Diamonds (Dia) and Diamonds In Kimberlite (Dk) near Prieska On Portion 7, a certain Portion of the Remaining Extent of Portion 9 (Wouter), Portion 11 (De Hoek), Portion 14 (Stofdraai) (Portion of Portion 4), the Remaining Extent of Portion 16 (Portion Of Portion 9) (Wouter) and the Remaining Extent of Portion 18 (Portion of Portion 10) of the Farm Lanyon Vale 376, Registration Division: Hay, Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment of the Proposed Prospecting Right Area and Mining Permit Area near Ritchie on the Remaining Extent of Portion 3 (Anna's Hoop) of the Farm Zandheuveld 144, Registration Division: Kimberley, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment of the Proposed Okapi Diamonds (Pty) Ltd Mining Right of Diamonds Alluvial (Da) & Diamonds General (D) Combined with a Waste Licence Application on the Remaining Extent of Portion 9 (Wouter) of the Farm Lanyon Vale 376; Registration Division: Hay; Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Field Assessment of the Proposed Prospecting Right Application for the Prospecting of Diamonds (Alluvial & General) between Douglas and Prieska on Portion 12, Remaining Extent of Portion 29 (Portion of Portion 13) and Portion 31 (Portion of Portion 29) on the Farm Reads Drift 74, Registration Division; Herbert, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment for the Proposed Mining Permit Application Combined with a Waste License Application for the Mining of Diamonds (Alluvial) Near Schweitzer-Reneke on a certain Portion of Portion 12 (Ptn of Ptn 7) of the Farm Doornhoek 165, Registration Division: HO, North West Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment for Black Mountain Koa South Prospecting Right Application, Without Bulk Sampling, in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Impact Assessment of the Proposed AA Bakery Expansion, Sedibeng District Municipality, Gauteng. Banzai Environmental (Pty) Ltd, Bloemfontein.



- Butler, E., 2020. Palaeontological Desktop Assessment for the Proposed Boegoeberg Township Expansion, !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2020. Palaeontological Desktop Assessment for the Proposed Gariep Township Expansion, !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2020. Palaeontological Desktop Assessment for the Proposed Groblershoop Township Expansion, !Kheis Local Municipality, Zf Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2020. Palaeontological Desktop Assessment for the Proposed Grootdrink Township Expansion, !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2020. Palaeontological Exemption Letter for the Proposed Opwag Township Expansion, !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2020. Palaeontological Exemption Letter for the Proposed Topline Township Expansion, !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2020. Palaeontological Desktop Assessment for the Proposed Wegdraai Township Expansion, !Kheis Local Municipality, Zf Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2020. Palaeontological field Assessment for the Proposed Establishment of an Emulsion Plant on Erf 1559, Hardustria, Harrismith, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, 2020. Part 2 Environmental Authorisation (EA) Amendment Process for the Kudusberg Wind Energy Facility (WEF) near Sutherland, Western and Northern Cape Provinces- Palaeontological Impact Assessment. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2020. Palaeontological Desktop Assessment Proposed for the Construction and Operation of the Battery Energy Storage System (BESS) and Associated Infrastructure and inclusion of Additional Listed Activities for the Authorised Droogfontein 3 Solar Photovoltaic (PV) Energy Facility Located near Kimberley in the Sol Plaatje Local Municipality, Francis Baard District Municipality, in the Northern Cape Province of South Africa. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2020. Palaeontological Impact Assessment for the Proposed Development of a Cluster of Renewable Energy Facilities between Somerset East and Grahamstown in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for the Proposed Amaoti Secondary School, Pinetown, eThekweni Metropolitan Municipality KwaZulu Natal. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the Proposed an Inland Diesel Depot, Transportation Pipeline and Associated Infrastructure on Portion 5 of the Farm Franshoek No. 1861, Swinburne, Free State Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the proposed erosion control gabion installation at Alpine Heath Resort on the farm Akkerman No 5679 in the Bergville district Kwazulu-Natal. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the proposed Doornkloof Residential development on portion 712 of the farm Doornkloof 391 Jr, City of Tshwane Metropolitan Municipality in Gauteng, South Africa. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for the Proposed Expansion of the Square Kilometre Array (SKA) Meerkat Project, on the Farms Mey's Dam RE/68, Brak Puts RE /66, Swartfontein RE /496 & Swartfontein 2/496, in the Kareeberg Local Municipality, Pixley Ka Seme District Municipality, and the Farms Los Berg 1/73 & Groot Paardekloof RE /74, in the Karoo Hoogland Local Municipality, Namakwa District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for De Beers Consolidated Mines: Proposed Drilling on Portion 6 of Scholtzfontein 165 and Farm Arnotsdale 175, Herbert District in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for De Beers Consolidated Mines: Proposed Drilling on the Remaining Extent of Biessie Laagte 96, and Portion 2 and 6 of Aasvogel Pan 141, Near Hopetown in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.



- Butler, E., 2021. Palaeontological Desktop Assessment for De Beers Consolidated Mines: Proposed Drilling in the North West Province: on Portions 7 (RE) (of Portion 3), 11, 12 (of Portion 3), 34 (of Portion 30), 35 (of Portion 7) of the Farm Holfontein 147 IO and Portions 1, 2 and the RE) of the Farm Kareeboschbult 76 Ip and Portions 1, 2, 4, 5, 6, (of Portion 3), 7 (of Portion 3), 13, 14, and the Re of the farm Oppaslaagte 100IP and portions 25 (of Portion 24) and 30 of the farm Slyphsteen 102 IP. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for the Proposed Expansion of the Cavalier Abattoir on farm Oog Van Boekenhoutskloof of Tweefontein 288 JR, near Cullinan, City of Tshwane Metropolitan Municipality, Gauteng. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the Proposed Doornkloof Residential Development on Portion 712 of the Farm Doornkloof 391 JR, City of Tshwane Metropolitan Municipality in Gauteng, South Africa. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for the proposed High Density Social Housing Development on part of the Remainder of Portion 171 and part of Portion 306 of the farm Derdepoort 326 JR, City of Tshwane. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for the proposed Red Rock Mountain Farm activities on Portions 2, 3 and 11 of the Farm Buffelskloof 22, near Calitzdorp in the Western Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for the proposed Mixed-use Development on a Part of Remainder of Portion 171 and Portion 306 of the farm Derdepoort 326 JR, City of Tshwane. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the Proposed Realignment of the D 2809 Provincial Road as well as the Mining Right Application for the Glisa and Paardeplaats Sections of the NBC Colliery (NBC) near Belfast (eMakhazeni), eMakhazeni Local Municipality, Nkangala District Municipality, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for the proposed construction of Whittlesea Cemetery within Enoch Mgijima Local Municipality area, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the establishment of a mixed-use development on Portion 0 the of Erf 700, Despatch, Nelson Mandela Bay Municipality, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for the proposed East Orchards Poultry Farm, Delmas/Botleng Transitional Local Council, Mpumalanga. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the proposed East Orchards Poultry Farm, Delmas/Botleng Transitional Local Council, Mpumalanga. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment to assess the proposed Gariep Road upgrade near Groblershoop, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the Ngwedi Solar Plant which forms part of the authorised Paleso Solar Powerplant near Viljoenskroon in the Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the Noko Solar Power Plant and power line which forms part of the authorised Paleso Solar Powerplant near Orkney in the North West. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the Proposed Power Line as part of the Paleso Solar Power Plant near Viljoenskroon in the Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the Thakadu Solar Plant which forms part of the authorised Paleso Solar Powerplant near Viljoenskroon in the Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2020. Palaeontological Desktop Assessment for the proposed Farming Expansions on Portions 50 of the Farm Rooipoort 555 JR, Portion 34 of the Farm Rooipoort 555 JR, Portions 20 and 49 of the Farm Rooipoort 555 JR and Portion 0(RE) of the Farm Oudou Boerdery 626 JR, Tshwane Metropolitan Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2020. Palaeontological Desktop Assessment for the proposed Saselamani CBD on the Remainder of Tshikundu's Location 262 MT, and the Remainder of Portion 1 of Tshikundu's Location



262 MT, Collins Chabane Local Municipality, Limpopo Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Impact Assessment for the proposed expansions of the existing Molare Piggery infrastructure and related activities on Portion 0(Re) of the farm Arendsfontein 464 JS, Portion 0(Re) of the farm Wanhoop 443 JS, Portion 0(Re) of the farm Eikeboom 476 JS and Portions 2 & 7 of the farm Klipbank 467 JS within the jurisdiction of the Steve Tshwete Local Municipality, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Desktop Assessment for the proposed Nchwaning Rail Balloon Turn Outs at Black Rock Mine Operations (BRMO) near Hotazel in the John Taolo Gaetsewe District Municipality in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Desktop Assessment for the proposed Black Rock Mining Operations (BRMO) new rail loop and stacker reclaimer Project at Gloria Mine near Hotazel in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2020. Palaeontological Desktop Assessment for the proposed Nchwaning Rail Balloon Turn Outs at Black Rock Mine Operations (BRMO) near Hotazel in the John Taolo Gaetsewe District Municipality in the Northern Cape.

Butler, E., 2021. Palaeontological Impact Assessment for the proposed utilization of one Borrow Pit for the planned Clarkebury DR08034 Road Upgrade, Engcobo Local Municipality, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Desktop Assessment for the proposed Kappies Kareeboom Prospecting Project on Portion 1 and the Remainder of the farm Kappies Kareeboom 540, the Remainder of Farm 544, Portion 5 of farm 534 and Portion 1 of the farm Putsfontein 616, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Desktop Assessment for the proposed Kameel Fontein Prospecting Project on the Remainder of the farm Kameel Fontein 490, a portion of the farm Strydfontein 614 and the farm Soetfontein 606, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Desktop Assessment for the proposed Lewis Prospecting Project on Portions of the Farms Lewis 535, Spence 537, Wright 538, Symthe 566, Bredenkamp 567, Brooks 568, Beaumont 569 and Murray 570, John Taolo Gaetsewe District Municipality in the Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Desktop Assessment for the Construction of the Ganspan Pering 132kV Powerline, Phokwane Local Municipality, Frances Baard District Municipality in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Desktop Assessment for the Longlands Prospecting Project on a Portion of the farm Longlands 350, Frances Baard District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Impact Assessment for the proposed development of 177 new units in the northern section of Mpongo Park in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Desktop Assessment for the proposed Qhumanco Irrigation Project, Chris Hani District Municipality Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Desktop Assessment for the proposed Raphuti Settlement Project on Portions of the Farm Weikrans 539KQ in the Waterberg District Municipality of the Limpopo Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Impact Assessment for the Senqu Rural Project, Joe Gqabi District Municipality, Senqu Local Municipality, in the Eastern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Impact Assessment for the proposed new Township development on portion of the farm Klipfontein 716 and farm Ceres 626 in Bloemfontein, Mangaung Metropolitan Municipality, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Desktop Assessment for the ECDOT Borrow Pits and WULA near Sterkspruit, Joe Gqabi District Municipality in the Eastern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

Butler, E., 2021. Palaeontological Desktop Assessment for the proposed SANRAL Stone Crescent Embankment Stabilisation Works along the N2 on the farm Zyfer Fonteyn 253 (Portion 0, 11 and 12RE) and Palmiet Rivier 305 (Portion 34, 36) near Grahamstown in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.



- Butler, E., 2021. Palaeontological Impact Assessment for the Klein Rooipoort Trust Citrus Development, in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the proposed Victoria West water augmentation project in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for the proposed Campbell Sewer, Internal Reticulation, Outfall Sewer Line and Oxidation Ponds, located on ERF 1, Siyancuma Local Municipality in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for the proposed Development and Upgrades within the Great Fish River Nature Reserve, Eastern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for proposed Parsons Power Park a portion of Erf 1. within the Nelson Mandela Bay Municipality in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for the proposed expansion of the farming operations on part of portions 7 and 8 of farm Boerboonkraal 353 in the Greater Tubatse Local Municipality of Sekhukhune District, Limpopo Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment to assess the proposed low-level pedestrian bridge, in Heilbron, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment to assess the proposed township developments in Hertzogville, Malebogo, in Heilbron, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment for the proposed construction of Malangazana Bridge on Farm No.64 Nkwenkwana, Engcobo Local Municipality, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment to assess the proposed Construction of Middelburg Integrated Transport Control Centre on Portion 14 of Farm 81 Division of Middelburg, Chris Hani District Municipality in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment for the Witteberge Sand Mine on the remainder of farm Elandskrag Plaas 269 located in the Magisterial District of Laingsburg and Central Karoo District Municipality in the Western Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Impact Assessment (PIA) to assess the proposed Agrizone 2, Dube Trade Port in KwaZulu Natal Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2021. Palaeontological Desktop Assessment assessing the proposed Prospecting Right application without bulk sampling for the prospecting of Chrome ore and platinum group metals on the Remaining Extent of the farm Doornspruit 106, Registration Division: HO; North West Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Palaeontological Desktop Assessment for the proposed Ennerdale Extension 2 Township Establishment on the Undeveloped Part of Portion 134 of the Farm Roodepoort 3021Q, City of Johannesburg Metropolitan Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Palaeontological Desktop Assessment for the Construction of the ESKOM Mesong 400kV Loop-In Loop-Out Project, Ekurhuleni Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Palaeontological Desktop Assessment for the Proposed Vinci Prospecting Right Application on the Remainder of the Farm Vinci 580, ZF Mgcawu District Municipality, in the Northern Cape Province, Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Palaeontological Desktop Assessment for the proposed Farm 431 Mining Right Application (MRA), near Postmasburg, ZF Mgcawu District Municipality, in the Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Palaeontological Impact Assessment for the Leeuw Braakfontein Colliery Expansion Project (LBC) in the Amajuba District Municipality, KwaZulu-Natal. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Palaeontological Desktop Assessment for the proposed reclamation of the 5L23 TSF in Ekurhuleni, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Palaeontological Desktop Assessment for the Proposed Mogalakwena Mine Infrastructure Expansion (near Mokopane in the Mogalakwena Local Municipality, Limpopo Province). Banzai Environmental (Pty) Ltd, Bloemfontein.



- Butler, E., 2022. Palaeontological Desktop Assessment for the proposed 10km Cuprum to Kronos Double Circuit 132kV Line and Associated Infrastructure in Copperton in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Palaeontological Impact Assessment for the proposed Hoekplaas WEF near Victoria West in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Palaeontological Desktop Assessment (PDA) assessing the proposed Prospecting Right Application without bulk sampling for the Prospecting of Diamonds Alluvial (DA), Diamonds General (D), Diamonds in Kimberlite (DK) & Diamonds (DIA) on the Remaining Extent of the Farm Goede Hoop 547, Remaining Extent of the Farm 548, Remaining Extent of Portion 2 and Portion 3 of the Farm Skeyfontein 536, Registration Division: Hay, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Palaeontological Impact Assessment for the proposed extension of Duine Weg Road between Pellsrus and Marina Martinique as well as a Water Use Authorisation (WUA) for the project. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Proposed Mimosa Residential Development and Associated Infrastructure on Fairview Erven, in Gqeberha (Port Elizabeth), Nelson Mandela Bay Metropolitan Municipality, Eastern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Palaeontological Impact Assessment for the Witteberge Sand Mine on the remainder of farm Elandskrag Plaas 269 located in the Magisterial District of Laingsburg and Central Karoo District Municipality in the Western Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E., 2022. Palaeontological Desktop Assessment to assess the Palaeontology for the Somkhele Anthracite Mine's Prospecting Right Application, on the Remainder of the Farm Reserve no 3 No 15822 within the uMkhanyakude District Municipality and the Mtubatuba Local Municipality, KwaZulu Natal. Banzai Environmental (Pty) Ltd, Bloemfontein.
- Butler, E. 2022. Palaeontological Desktop Assessment to assess the proposed Altina 120 MW Solar Photovoltaic (PV) Project near Orkney in the Free State
- Butler, E. 2022. Palaeontological Desktop Assessment to assess the proposed SERE Solar Photovoltaic Plant Phase 1A and associated infrastructure in the Western Cape Province.
- Butler, E. 2022. Palaeontological Impact Assessment for the proposed development of a 10 MW Solar Photovoltaic (PV) Plant and associated grid connection infrastructure on Portion 9 of the Farm Little Chelsea 10, Eastern Cape Province.
- Butler, E. 2022. Palaeontological Desktop Assessment to assess the proposed Dominion 1 Solar Park, located on the Remaining Extent of Portion 18 of Farm 425, near Klerksdorp within the North-West Province.
- Butler, E., 2022. Palaeontological Desktop Assessment to assess the proposed Dominion 2 Solar Park, located on the Remaining Extent of Portion 8 of Farm 425, near Klerksdorp within the North-West Province.
- Butler, E., 2022. Palaeontological Desktop Assessment to assess the proposed Dominion 3 Solar Park, located on the Remaining Extent of Portion 11 of Farm 425, and Remaining Extent of Portion 31 of Farm 425 near Klerksdorp within the North-West Province
- Butler, E., 2022. Palaeontological Impact Assessment to assess the Delta Solar Power Plant on the remaining extent of the farm Kareefontein No. 340, Dr Ruth Segomotsi Mompati District Municipality, Lekwa-Teemane Local Municipality near Bloemhof in the North West Province
- Butler, E., 2022. Palaeontological Impact Assessment to assess the Sonneblom Solar Power Plant (SPP) on Portion 1 of the farm Blydschap No. 504 within the Mangaung Metropolitan Municipality, southeast of Bloemfontein in the Free State.
- Butler, E., 2022. Palaeontological Impact Assessment for the proposed Naos Solar PV One Project near Viljoenskroon in the Free State.
- Butler, E., 2022. Palaeontological Impact Assessment for the proposed Naos Solar PV Two Project near Viljoenskroon in the Free State.
- Butler, E., 2022. Palaeontological Impact Assessment for the proposed Naos Solar PV Two Project near Viljoenskroon in the Free State
- Butler, E., 2022. Palaeontological Impact Assessment for the Ngwedi Solar Power near Viljoenskroon in the Free State.
- Butler, E., 2022. Palaeontological Impact Assessment for the Noko Solar Power Plant and power line near Orkney in the North West.
- Butler, E., 2022. Palaeontological Impact Assessment for the Proposed Power Line as part of the Paleso Solar Power Plant near Viljoenskroon in the Free State



Butler. E., 2022. Palaeontological Impact Assessment for the Thakadu Solar Plant which near Viljoenskroon in the Free State

Butler. E., 2022. Palaeontological Impact Assessment of the Kentani, Braklaagte, Klipfontein, Klipfontein 2, Leliehoek and Sonoblomo PV Facilities located near Dealsville in the Free State Province

Butler. E., 2022. Palaeontological Impact Assessment for the proposed Harvard 1 Solar Photovoltaic (PV) facility on Portion 5 of Farm Spes Bona no 2355, Mangaung Metropolitan Municipality in the Free State.

Butler. E., 2022. Palaeontological Impact Assessment for proposed Harvard 2 Solar Photovoltaic (PV) facility on Portion 8 of Farm Spes Bona No 2355, Mangaung Metropolitan Municipality in the Free State.

Butler. E., 2022. Palaeontological Impact Assessment for the proposed Doornrivier Solar 1, southwest of Matjhabeng (formerly Virginia) in the Free State

Butler. E., 2022. Palaeontological Desktop Assessment for the proposed Leeuwbosch PV solar photovoltaic (PV) plant and associated infrastructure on Portion 37 of the Farm Leeuwbosch No. 44 near Leeudoringstad within the Maquassi Hills Local Municipality in the Dr Kenneth Kaunda District Municipality in the North West Province.



PALAEONTOLOGICAL IMPACT ASSESSMENT

FREE STATE RECLAMATION
NOOITGEDACHT RETURN WATER
AND LOW-PRESSURE WATER SUPPLY
SYSTEM IN WELKOM, FREE STATE
PROVINCE

July 2025

COMPILED FOR: PGS Heritage Consultants



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.



FSR Nooitgedacht Return Water and Low-Pressure water supply system

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

Tel: +27 844478759

Email: info@banzai-group.com

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: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).

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 1	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 2 – refer to Appendix 1	-
(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	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Executive Summary, Section 8	



Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
(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;	Executive Summary, Section	
(g) An identification of any areas to be avoided, including buffers	Executive Summary, Section	
(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	Executive Summary, Section 8	
(k) Any mitigation measures for inclusion in the EMP	Section 9	
(l) Any conditions for inclusion in the environmental authorisation	Section 9	
(m) Any monitoring requirements for inclusion in the EMP or environmental authorisation	Executive Summary, Section 8	



Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Executive Summary, Section 8	
(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	Executive Summary, Section 8	-
(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.
(p) A summary and copies of any comments that were received during any consultation process	N/A	Not applicable. To date, no comments regarding



Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
		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	



LOSSARY OF TERMS

Fossil

A fossil is the preserved remnants or vestiges of a long-dead organism, generally from millions of years ago. Fossils can be mineralized skeletons, shells, or other hard pieces of ancient animals and plants, as well as impressions, moulds, and casts left in sedimentary rock when the organism's remains decomposed and left an impression. Fossils provide valuable insights into the evolution and biodiversity of ancient species, allowing scientists to study and understand their evolution and biodiversity.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act No 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

Palaeontology, also referred to as "palaeontology" in American English, is the scientific study of ancient life and the history of life on Earth as recorded in the fossil record. Palaeontologists are scientists who study and analyse the remnants of plants, animals, and other species from the distant past, as well as traces of their activity such as footprints and burrows. Palaeontologists attempt to understand the evolution, diversity, and interactions of life forms throughout Earth's history by researching fossils and the geological environment in which they are found, which can provide vital insights into the planet's geological and biological past.



LIST OF ABBREVIATIONS

BA	Basic Assessment
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
CA	National Competent Authority
ECO	Environmental Control Officer
EMPr	Environmental Management Programme
ESO	Environmental Site Officer
HIA	Heritage Impact Assessment
Ma	Millions of years ago
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
NW	North-West
PIA	Palaeontological Impact Assessment
PSSA	Palaeontological Society of South Africa
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
S&EIA	Scoping & Environmental Impact Assessment
ToR	Terms of Reference



EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS HERITAGE Consultants to conduct the Palaeontological Desktop Assessment (PDA) to assess the **Free State Reclamation (FSR) Nooitgedacht Return Water and Low-Pressure water supply system** near Welkom, in the Free State. 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, to evaluate the potential impact of the proposed development on the Palaeontological Heritage and to mitigate possible damage to fossil resources.

The study area is underlain by the aeolian sand while the surrounding area is underlain by the Adelaide Subgroup (Beaufort Group) as well as Permian Volksrust Formation (Ecca Group) both of the Karoo Supergroup. The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the aeolian sand is Moderate (Almond *et al*, 2013; SAHRIS website), which is supported by the DFFE (Department of Forestry, Fisheries and the Environment) Screening Report.

Due to the Sensitivities of the study area, no site investigation was conducted for the Project but desktop research has indicated that the Palaeontological Sensitivity of the area is Low. The apparent rarity of fossil heritage in the proposed development footprint suggests that the impact of the development will be of a Low significance in palaeontological terms. 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.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO/site manager in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO/site manager 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 (recording and collection) can be carry out by a paleontologist.

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.

These recommendations should be incorporated into the Environmental Management Plan for the FSR Nooitgedacht Return Water and Low-pressure water supply system.



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APPENDIX 1: CV



1 INTRODUCTION

The Free State Reclamation (FSR) Project aims to increase the reclamation of tailings in Harmony's Free State operations from 800ktpm to 2000ktpm. Residue from the FSR reclamation operation is planned to be deposited at the new 800Ha Nooitgedacht Tailings Facility (TSF) (**Figure 1**).

During the environmental authorisation and water licensing process, the Department of Water and Sanitation indicated that in the return water from the Nooitgedacht TSF was pumped back to 13 Dam it would have to be lined. The 13 Dam is the water source for the current reclamation and the return point for process and decant water from the TSFs.

The lining of 13 Dam was not considered a viable option.

1.1 Project Location

The Nooitgedacht TSF site is approximately 10km NW of the Welkom and 13 Dam and the proposed LP Dams are located approximately 9km SSE from the center of Welkom.

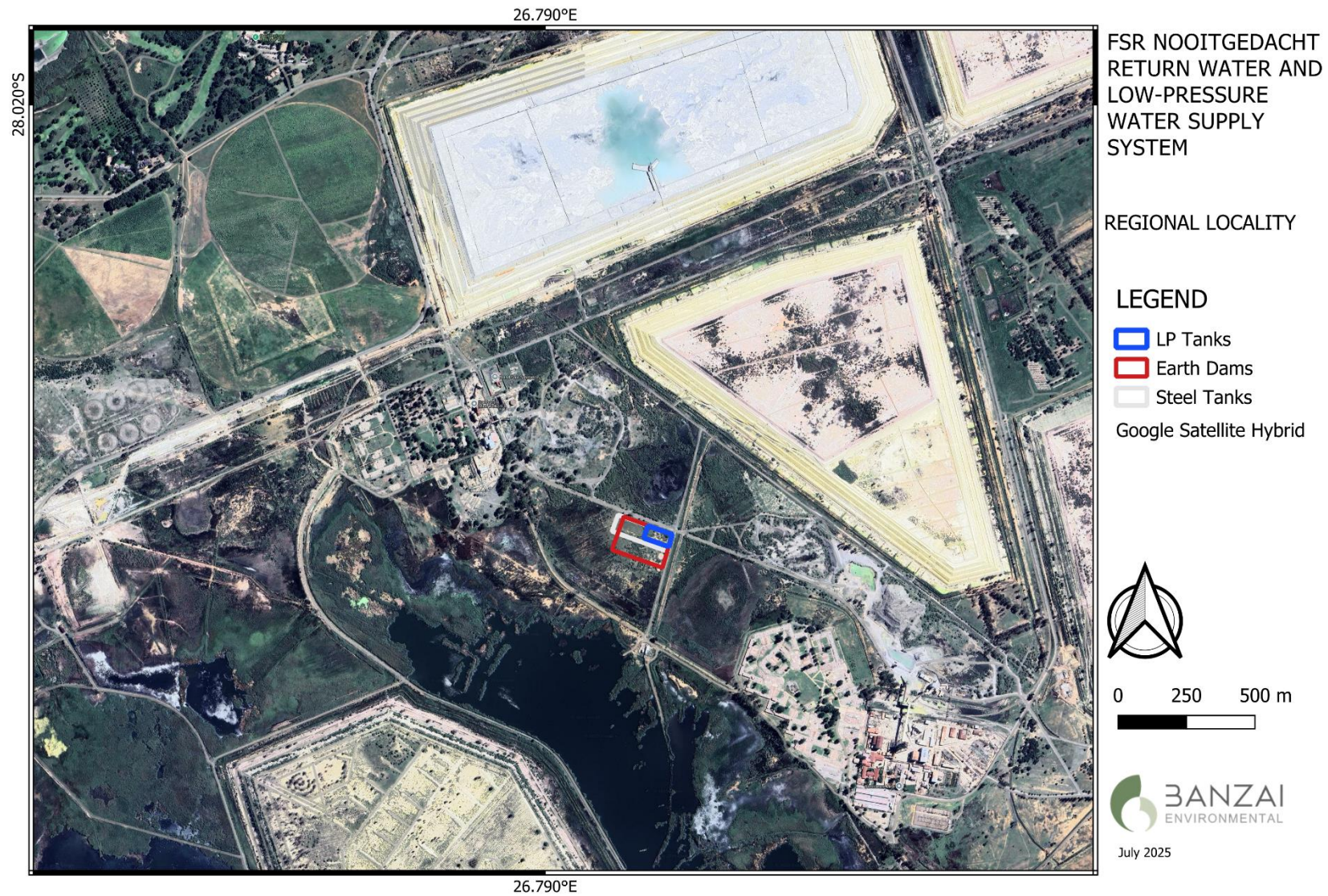


Figure 1: Regional Locality.



1.2 Low Pressure Water Supply

A trade off study was conducted considering three options for the 40 megalitre Low Pressure (LP) water storage system and considered:

- Two HDPE lined earth dams – footprint 190m X 125m
- Two concrete tanks – footprint 95m X 45m
- Twelve Steel tanks. – footprint 210m X 65M



Figure 2: Lined Earth Dam area.



Figure 3: Steel tank area



Figure 4: Concrete tank area



Figure 5: Proposed LP water system.

All of the water for the FSR Project will be pumped to the LP water system. The water source for the reclamation operation will include:

- Return water from the Nooitgedacht TSF
- Treated effluent from Waste Water Treatment works
- Ground water from boreholes
- Overflow water from the Metallurgical Plants

The option with the smallest footprint, at ground level, that provides a simple suction manifold layout and positive suction head for the pumps at all times is the installation of the two 40m diameter concrete tanks.

The concrete tanks designed according to the guidelines from the Department of Water and Sanitation and the SANS standards will: -

- be constructed above natural ground level.
- be to atmosphere
- be placed on a 95m x 45m concrete slab foundation, with a 2m concrete apron surrounding the water tanks.
- Be 40m diameter and 18m high and open at the top with internal and external access ladders for maintenance purposes.
- have the suction outlet pipe 1.5m above the base of the tank.
- have the outlets joined with a T-piece to the pump suction manifold.



- have an internal finish of cementitious flexible waterproofing slurry.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Please refer to Appendix A (Specialist CV).

This study has been conducted by Mrs. Elize Butler of Banzai Environmental (Pty) Ltd. She has conducted approximately 700 palaeontological impact assessments (PIA) 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, including exploration field trips in search of new localities in the Karoo Basin. She has been a member

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 METHODS AND TERMS OF REFERENCE

This Palaeontological Assessment is part of the HIA Report. The PIA's goals are to: 1) identify the palaeontological significance of the rock formations in the footprint; 2) evaluate the palaeontological magnitude of the formations; 3) clarify the impact on fossil heritage; and 4) make recommendations for how the developer might protect and minimize potential harm to fossil heritage, according to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports".

Calculations of the palaeontological state of each rock segment and the potential impact of development on fossil history take into account the palaeontological status of the rocks, the type of development, and the amount of bedrock removed.

The Provisional DFFE Screening Tool, the SAHRIS Palaeosensitivity map, all Palaeontological Impact Assessment reports for the same area, Google Earth images, topographical and geological maps, as well as academic articles about specimens from the development area and Assemblage Zones, are all used to create scoping reports.

When the development footprint has a moderate to high palaeontological sensitivity, a field-based assessment is necessary. A desktop or field assessment of the exposed rock is used to evaluate the significance of the proposed development's impact, and recommendations for more research or mitigation are made. Excavations for the project often only take place during the building phase, changing the terrain and destroying or permanently encasing fossils at or below the ground surface. Then, access to Fossil Heritage will no longer be available for academic study.

When doing a site investigation, a palaeontologist examines the local development as well as the quantity and variety of fossils found there. This can be demonstrated by looking at representative fossiliferous rock exposures (most igneous and metamorphic rocks are not fossiliferous, whereas sedimentary rocks contain fossil heritage). Examined rock exposures frequently contain a sizeable portion of the stratigraphic unit, which is primarily made up of recently exposed (unweathered) rock. These exposures may be man-made (such as quarries, open building excavations, even railway and road cuttings) or



natural (such as cliffs, and dongas as well as rocky outcrops along stream or river banks). It is usual practice for palaeontologists to record well-preserved fossils (GPS, and stratigraphic data) during field assessment examinations.

Although mitigation is often done prior to construction, it may take place if potentially fossiliferous bedrock is revealed. Fossil collection and documentation are examples of mitigation. A permit from SAHRA must be obtained before beginning any fossil excavation, and the material must be stored at an authorized facility. When mitigation is properly used, it is possible to have a positive impact by raising awareness of the palaeontological past of the area.

By physically evaluating bedrock outcrops to determine their lithology and fossil richness and crisscrossing the development footprint, one can assess an area's fossil potential. Because the presence of fossils at the surface is so unexpected, an average sample size of the region is investigated. To be clear, however, the lack of fossils in a development footprint does not automatically suggest that there is no palaeontologically important material present on the site (on or below the ground surface).

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;
- Describe of the proposed project and provide information regarding the developer and consultant who commissioned the study;
- Describe location of the proposed development and provide geological and topographical maps
- Provide palaeontological and geological history of the affected area;
- Identify sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluate 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
- Detail the implications of specialist findings for the proposed development (such as permits, licenses etc).
-

4.1 Assumptions and Limitations

The geology of the area is the focal point of geological maps, and the sheet explanations of the Geological Maps were not intended to focus on palaeontological heritage. Many inaccessible areas of South Africa have never been examined by palaeontologists, and data is typically dependent solely on aerial pictures. Locality and geological information in museums and university databases is out of date, and data acquired in the past is not always adequately documented.

Comparable Assemblage Zones in other places are also used to provide information on the existence of fossils in areas that have not before been recorded. When similar Assemblage Zones and geological formations are used for Desktop studies, it is commonly assumed that exposed fossil exists within the footprint.

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The FSR study area, situated near Welkom in the Free State, is mapped on the 1: 250 000 Winburg 2826 (1987) Geological Sheet (Council for Geoscience, Pretoria). Bedrock in this area here is completely mantled by unconsolidated, yellow-buff aeolian sand (Qs) (**Figure 6**), while adjacent outcrops expose mudstones and sandstones of the Adelaide Subgroup (Pa, Beaufort Group) and shales of the Volksrust Formation (Pvo, Eccia Group), both belonging to the Permian Karoo Supergroup. According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS), this aeolian sand has a Moderate Palaeontological Sensitivity (green) (Almond *et al.*, 2013), whereas the National Department of Forestry, Fisheries and the Environment (DFFE) screening tool classifies the study area as **Medium** Sensitivity for the palaeontology theme (yellow; **Figure 8**).

Although the aeolian cover itself is typically poor in fossil material, the broader Virginia–Welkom district is internationally renowned for late Cenozoic fluvial and lacustrine deposits that fringe the present Sand,



Doring, Vals, and Vet River systems. These terrestrial sediments include diatomite, calcareous tufa, pedocretes, spring deposits, peats, gravels and other calcrete-rich horizons that record environmental change from the Early to Late Pliocene (De Ruiter *et al.*, 2010). Floodplain (overbank) facies, pan-margin muds and inset terrace gravels have yielded a diverse vertebrate assemblage comprising amphibians, reptiles, birds, and mammals, together with abundant plant macro- and microfossils. Classic discoveries include the *in situ* proboscidian skeleton recovered by Meiring (1955) from a Sand River channel fill ~40 m above the modern riverbed. Originally identified as *Archidiskodon scotti*, the specimen is now assigned to the early mammoth *Mammuthus subplanifrons* (Coppens *et al.*, 1978) and is accompanied by a rich fauna of large and small mammals, fishes, and avian remains (De Ruiter, 2010).

Within the mapped aeolian sand mantle (Qs) of the present study area, fossils are scarce but can include tortoise shell fragments, ostrich eggshell, non-marine molluscs, scattered mammalian bone and teeth, plant wood, pollen, diatoms, ostracods, rhizoliths, and calcretised termitaria. Nevertheless, the overall palaeontological sensitivity is assessed as low to moderate because these wind-blown sediments are often reworked, poorly consolidated, and lack stable stratification. By contrast, any underlying or nearby Plio-Pleistocene fluvial terraces, pan-margin clays, or spring tufas are of high palaeontological importance: they host well-preserved vertebrate and invertebrate faunas (Brink *et al.*, 1999; De Ruiter *et al.*, 2011). **However, it is important to notice that the project will be constructed above ground level and no deep excavations will take place.** The standard Chance-Find procedures will suffice within wind-blown sands, while any subsurface excavation intersecting buried fluvial or pan deposits should be monitored by a qualified palaeontologist, and fossil material collected under permit for curation in an accredited repository. The latter will however not be necessary.

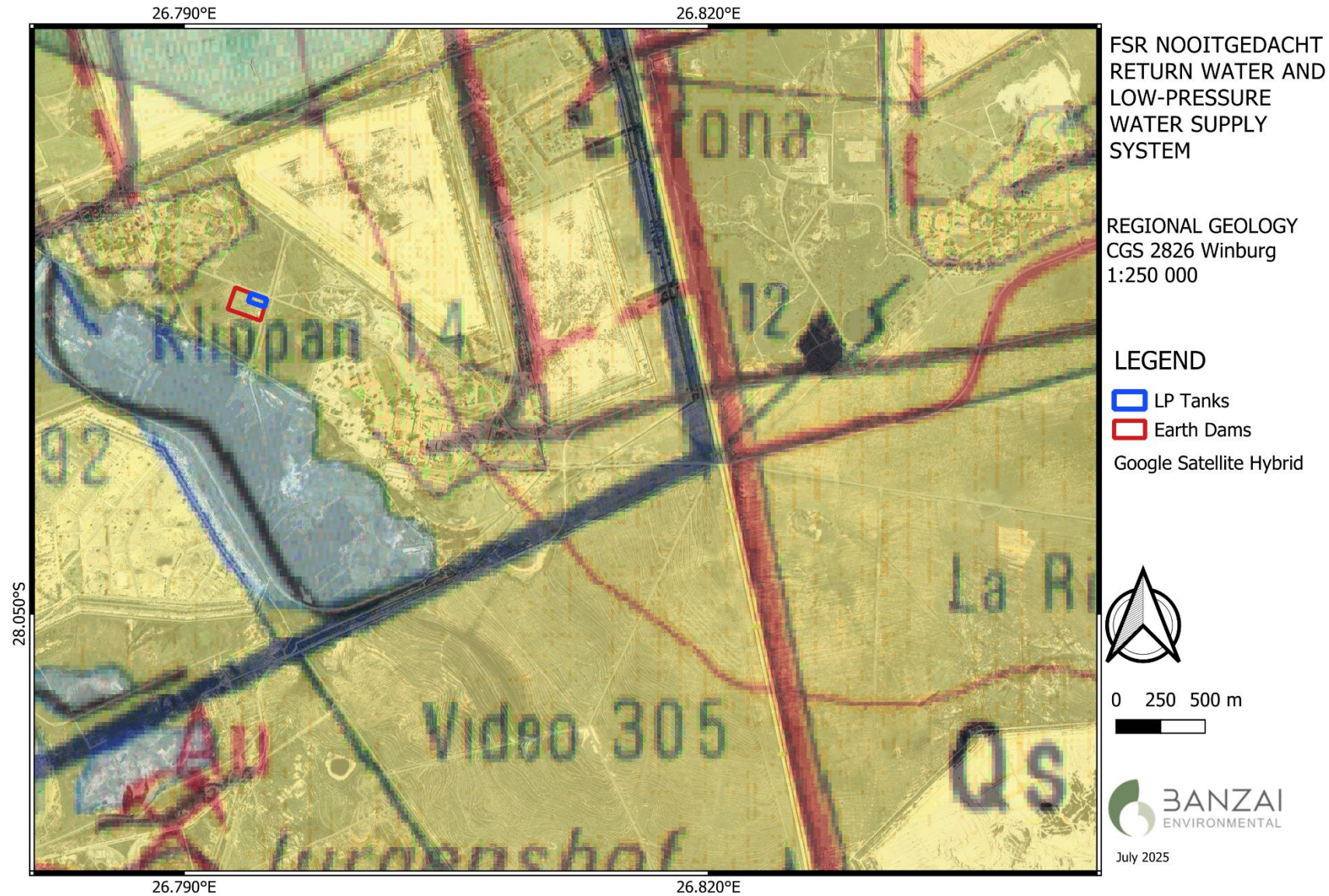


Figure 6: Extract of the 1:250 000 Winburg 2826 (1987) Geological Map (Council for Geosciences, Pretoria) indicating that the study area is underlain



FSR Nooitgedacht Return Water and Low-Pressure water supply system



Figure 7: Extract of the SAHRIS PalaeoMap (Council of Geosciences) indicating the Moderate (green) Palaeontological Sensitivity of the proposed study area.



Table 2: 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.

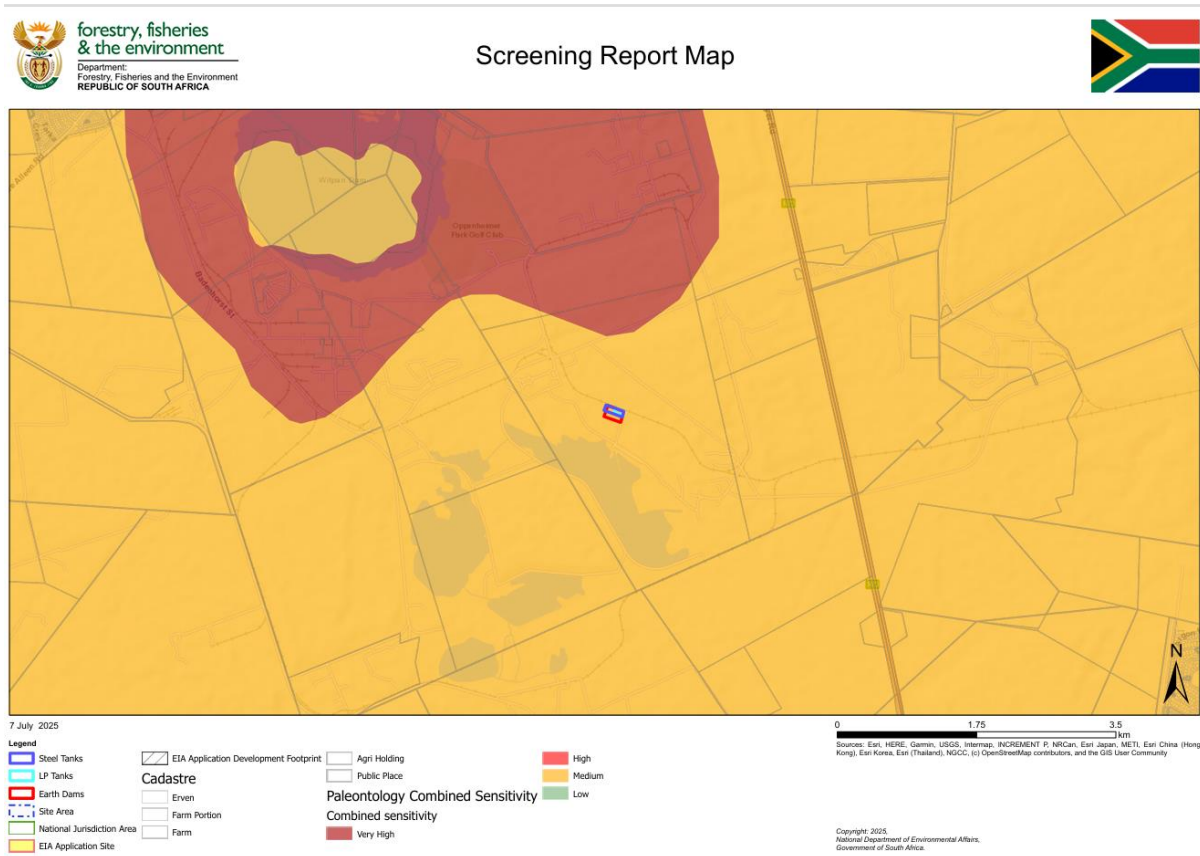


Figure 8: Palaeontological Sensitivity of the study area by the National Environmental Web-based Screening Tool indicates a Medium (orange) Palaeontological Sensitivity.

The SAHRIS PalaeoMap (Figure 7) indicates a Moderate (green) Palaeontological Sensitivity which is in agreement with the DFFE Screening Tool (Figure 8). Due to the Sensitivities of the study area no site investigation was conducted for the current study but desktop research has indicated that it is Low. The DFFE and SAHRIS Palaeontological Sensitivity is thus in agreement with desktop research of the area.

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)
- Google Earth® satellite imagery.
- A Google Earth map with polygons of the proposed development was obtained from EIMS.
- 1:250 000 Kroonstad 2726 (2000) Geological Map (Council for Geosciences, Pretoria)



- 1:250 000 Winburg 2826 (1987) Geological Map (Council for Geosciences, Pretoria)
- Updated Geology (2014, Council for Geosciences, Pretoria)
- Palaeosensitivity map on SAHRIS (South African Heritage Resources Information System) website
- Department of Forestry, Fisheries and the Environment (DFFE) Screening tool report
- Published geological and palaeontological literature as well as PIAs in the area that includes
 - Almond, J.E. 2022. Proposed Khauta Solar PV Cluster and Associated Grid Connections near Welkom, Matjhabeng Local Municipality, Free State Province.
 - Bamford, M. 2023. Palaeontological Impact Assessment for the proposed Virginia Solar Park, SE of Virginia, Free State Province - Corona Solar Park.
 - Butler, E., 2022. Palaeontological Impact Assessment for the proposed Merapi PV plant phase 4 (46MW) on a site near Welkom, Mantsopa Local Municipality of Thabo Mofutsanyana District Municipality, Free State Province.
 - Butler, E., 2022. Palaeontological Impact Assessment for the proposed Doornrivier Solar 1, southwest of Matjhabeng (formerly Virginia) in the Free State
 - Butler, E., 2022. Palaeontological Impact Assessment (PIA) to assess Nyala Solar near Virginia in the Free State Province
 - Butler, E., 2022. Palaeontological Impact Assessment (PIA) to assess the Nyarhi Solar Power Plant (SPP) near Viljoenskroon in the Free State.
 - Butler, E., 2022. Palaeontological Impact Assessment (PIA) to assess Oryx Solar Power Plant near Virginia, in the Free State Province.
 - Butler, E., 2022. Palaeontological Impact Assessment (PIA) to assess Phofu Solar Power Plant (SPP) near Viljoenskroon, Free State Province.
 - Butler, E., 2022. Palaeontological Impact Assessment (PIA) to assess the Proposed Mokolobane Photovoltaic Solar Energy Facility near Welkom, Free State Province.
 - Butler, E., 2022. Palaeontological Impact Assessment (PIA) to assess proposed Lengana Solar Power Plant (SPP) near Welkom, in the Free State Province.

7 IMPACT ASSESSMENT METHODOLOGY

The EIMS Impact Assessment Methodology was utilized for this project (Appendix 1)



Table 3: Summary of Impact Tables

Identifier	Discipline	Impact	Alternative	Phase	Event
Palaeontology	Loss of fossil Heritage	No	Construction	Normal Operation	
					Pre-Nature
					Pre-Extent
					Pre-Duration
					Pre-Magnitude
					Pre-Reversibility
					Consequence
					Pre-Probability
					Pre-Mitigation Significance
					Pre-Mitigation Significance
					Post-Nature
					Post-Extent
					Post-Duration
					Post-Magnitude
					Post-Reversibility
					Consequence2
					Post-Probability
					Post-mitigation Significance
					Post-Mitigation Significance
					Confidence
					Cumulative Impact
					Irreplaceable loss
					Priority Factor
					Final score
					Post-Mitigation Significance

8 FINDINGS AND RECOMMENDATIONS

The study area is underlain by the aeolian sand while the surrounding area is underlain by the Adelaide Subgroup (Beaufort Group) as well as Permian Volksrust Formation (Ecca Group) both of the Karoo Supergroup. The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the aeolian sand is Moderate (Almond *et al*, 2013; SAHRIS website), which is supported by the DFFE (Department of Forestry, Fisheries and the Environment) Screening Report.

Due to the Sensitivities of the study area, no site investigation was conducted for the Project but desktop research has indicated that the Palaeontological Sensitivity of the area is Low. The apparent rarity of fossil heritage in the proposed development footprint suggests that the impact of the development will be of a Low significance in palaeontological terms. 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.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO/site manager in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO/site manager 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 (recording and collection) can be carry out by a paleontologist.

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.

These recommendations should be incorporated into the Environmental Management Plan for the FSR Nooitgedacht Return Water and Low-pressure water supply system.

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.

9.2 Background

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.



9.3 Introduction

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.

9.4 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. Fossils 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.



10 BIBLIOGRAPHY

- Almond, J.E., Pether, J. & Roberts, D.L. 2013. *Palaeo-sensitivity Map of South Africa*. Council for Geoscience Report No. 2013-0140.
- Brink, J.S., Lee-Thorp, J.A. & De Ruiter, D.J. 1999. First Quaternary mammal assemblage from the Free State. *South African Journal of Science* 95: 11–16.
- Coppens, Y., et al. 1978. *Proboscidean Evolution and Palaeo-environment*. CNRS, Paris.
- Council for Geoscience. 1987. *1 : 250 000 Geological Map, Sheet 2826 (Winburg)*. Pretoria.
- De Ruiter, D.J. 2010. Vertebrate palaeontology of the Pliocene Sand River site, Free State. *Annals of the Ditsong National Museum of Natural History* 1: 13–33.
- De Ruiter, D.J., Brink, J.S. & Rossouw, L. 2011. Palaeo-environments of the Free State Plio-Pleistocene deposits. In: *Cenozoic Environments of Southern Africa* (eds. M. Dirks & S. Cohen), pp. 125–145. Springer.
- Meiring, A.J.D. 1955. A mammoth from the Free State, South Africa. *Transactions of the Royal Society of South Africa* 34: 123–138.
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APPENDIX 1

CURRICULUM VITAE

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	30 years in Palaeontology
EDUCATION:	University of the Orange Free State B.Sc Botany and Zoology, 1988 University of the Orange Free State B. Sc (Hons) Zoology, 1991 University of the Free State M. Sc. <i>Cum laude</i> (Zoology), 2009

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

EMPLOYMENT HISTORY

Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–2022
Banzai Environmental	2016 to present

Elize Butler has conducted approximately **850** Paleontological Impact Assessments for developments in the Free State, KwaZulu-Natal, Eastern, Northern and Western 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. She has experience in locating, collecting, and curating fossils. She has been a member of the Paleontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

MEMBERSHIP

Paleontological Society of South Africa (PSSA) 2006-currently.

A full CV is available on request.