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.

Compiled for:

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Prepared by

Banzai Environmental

28 June 2020

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

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

Disclosure of Vested Interest

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

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

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SIGNATURE:

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

Table 1 *- NEMA Table*

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to **Appendix A**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 9	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Desktop Study	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1 and 10	
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified
(h) A map superimposing the activity including the associated structures and infrastructure on the	Section 5 – Geological and	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
environmental sensitivities of the site including areas to be avoided, including buffers;	Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 10	
(k) Any mitigation measures for inclusion in the EMPr	N/A	
(l) Any conditions for inclusion in the environmental authorisation		None required
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	N/A	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 10	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 10	-
(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 will be conducted as part of the EIA and EMPr process.
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	Not applicable.

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where 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 Milnex CC to conduct the Palaeontological Desktop Assessment (PDA) assessing the proposed Bondeo 140 CC 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. The National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), states that a Palaeontological Impact Assessment (PIA) is necessary to discover if fossil material is present within the planned development. This PDA is thus necessary to evaluate the effect of the construction on the palaeontological resources.

The development is underlain by the Miocene to Recent Cenozoic Kalahari Group which are in turn underlain by sediments of the Dwyka Group. The Palaeontological Sensitivity of the Kalahari Group is low and that of the Dwyka Group is low (Almond and Pether 2008, SAHRIS website). It is therefore considered that the proposed mining development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the mine may be authorised 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 ECO/site manager in charge of these developments must be informed immediately. These discoveries ought to be secured (preferably *in situ*) and the ECO/site manager ought to alert SAHRA so that appropriate mitigation (documentation and collection) can be undertaken by a professional palaeontologist.

The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

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Appendix A: CV

1 INTRODUCTION

The project entails the proposed Bondeo 140 CC 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 (Figure1-3).

1.1 BACKGROND

(Information provided by Milnex CC)

Alluvial diamonds have been recovered from properties along the middle Orange River, between Douglas and Prieska since the early 1880's. Initially much of this activity was focussed on the Rooikoppie gravels – deflation gravels derived from the colluvial and eluvial reworking of pre-existing alluvial deposits. Later it was recognised that the underlying palaeochannel gravels, often buried beneath a hard calcrete carapace, represented an economically viable, high volume target. During the period February and May 2006 a local drill contractor under instruction from HCVWD and supervised by Robert Cooke, a consulting geologist based in Kimberley drilled a total of 191 boreholes (2,097m) on Okapi, and 278 boreholes (3,265m) on Farhom. The data collected from the boreholes were used in the construction of a geological model for the area from which contour plans illustrating gravel thickness, overburden thickness and bedrock elevation were produced. Exploration Potential of some 4,481,331m^3 of Rooikoppie and 43,258,590m^3 of Primary gravels were estimated to exists on the Wouterspan property (de Decker, 2006). During March 2005 and February 2006, a total of 513,892m^3 Primary gravel and 24,013m^3 Rooikoppie gravel was bulk sampled by HCVWD. Results from this exercise indicated that sample average grades were around 0.55ct/100m^3.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty-six 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 for 16 years. She has been conducting PIAs since 2014.

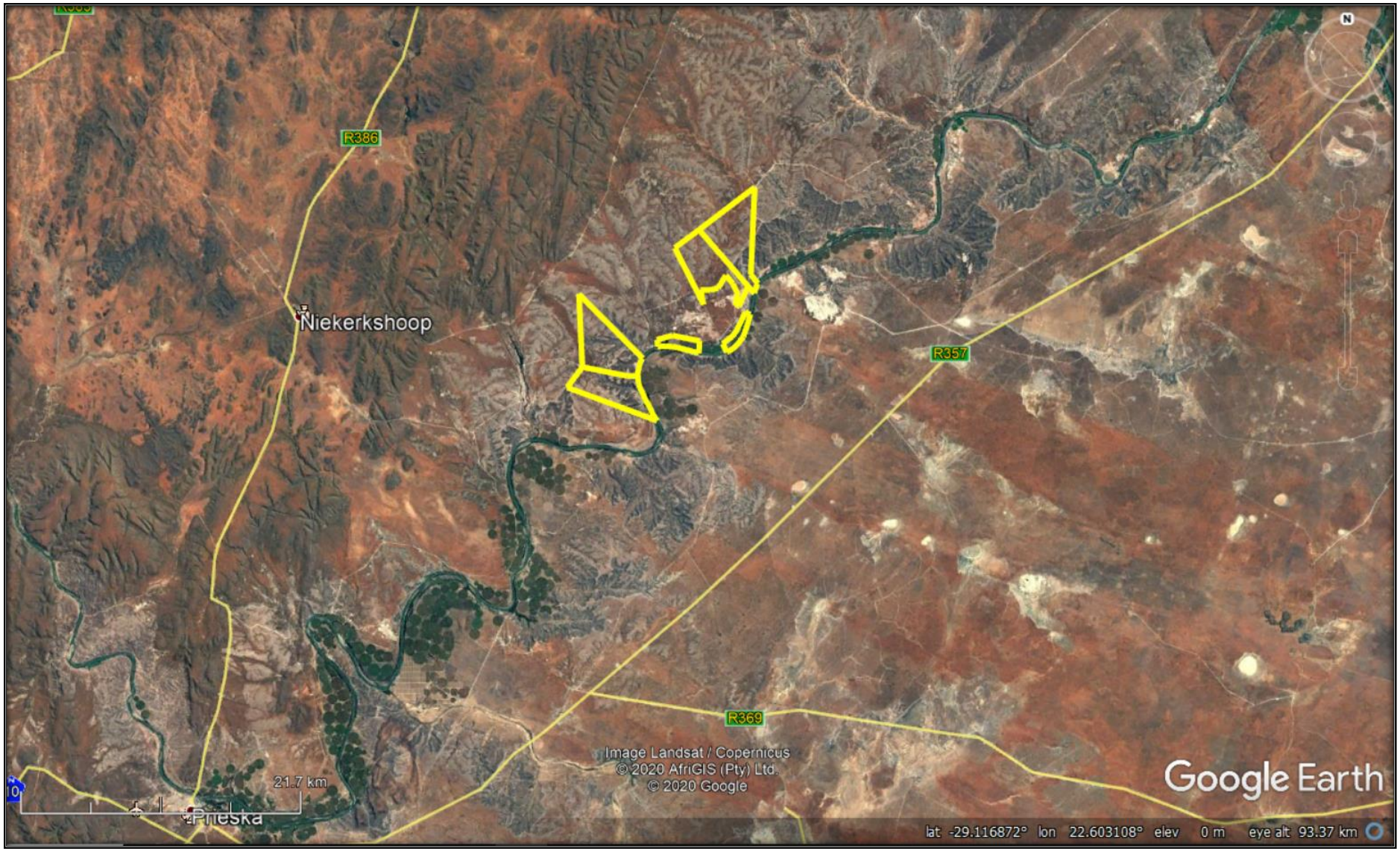


Figure 1: Google Earth (2020) indicating the general locality of the proposed development, near Prieska, Northern Cape Province.

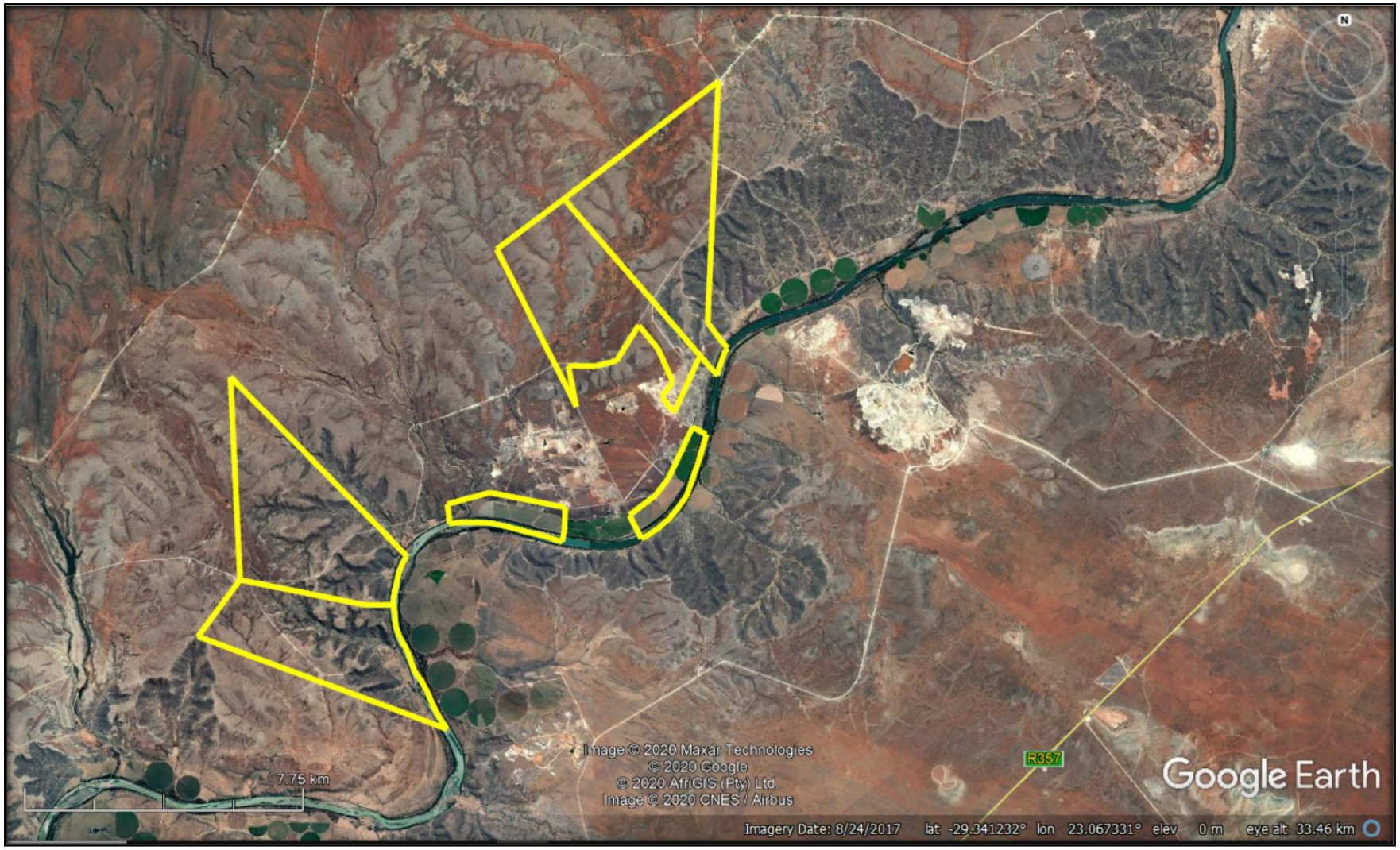
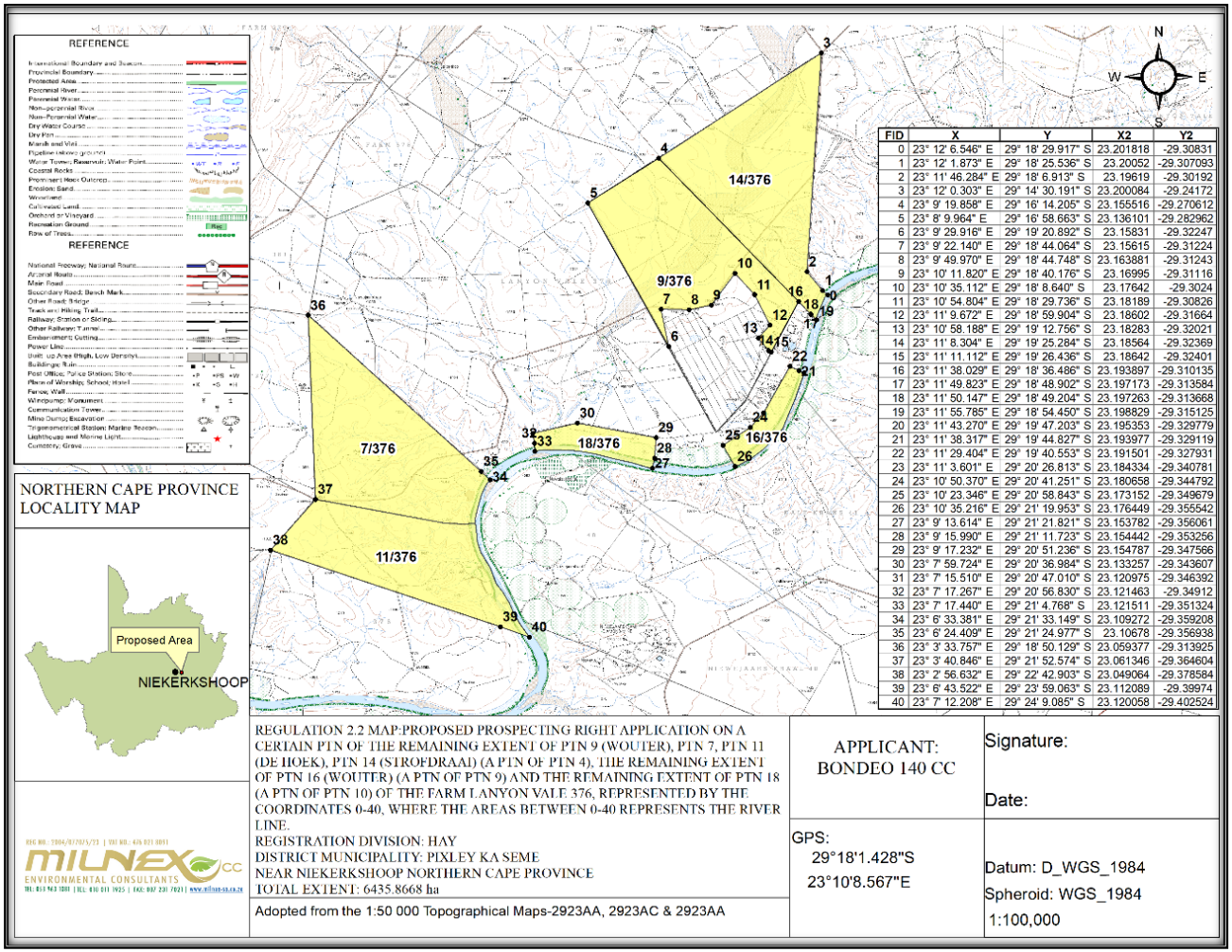


Figure 2: Close up Google Earth Image (2020) indicating the locality of the proposed Bondeo 140 CC development, near Prieska, Northern Cape Province.



FID	X	Y	X2	Y2
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1	23° 12' 1.873" E	29° 18' 25.536" S	23.20052	-29.307093
2	23° 11' 46.284" E	29° 18' 6.913" S	23.19619	-29.30192
3	23° 12' 0.303" E	29° 14' 30.191" S	23.200084	-29.24172
4	23° 9' 19.858" E	29° 16' 14.205" S	23.155516	-29.270612
5	23° 8' 9.964" E	29° 16' 58.663" S	23.136101	-29.282962
6	23° 9' 29.916" E	29° 19' 20.892" S	23.15831	-29.32247
7	23° 9' 22.140" E	29° 18' 44.064" S	23.15615	-29.31224
8	23° 9' 49.970" E	29° 18' 44.748" S	23.163881	-29.31243
9	23° 10' 11.820" E	29° 18' 40.176" S	23.16995	-29.31116
10	23° 10' 35.112" E	29° 18' 8.640" S	23.17642	-29.3024
11	23° 10' 54.804" E	29° 18' 29.736" S	23.18189	-29.30826
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14	23° 11' 8.304" E	29° 19' 25.284" S	23.18564	-29.32369
15	23° 11' 11.112" E	29° 19' 26.436" S	23.18642	-29.32401
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18	23° 11' 50.147" E	29° 18' 49.204" S	23.197263	-29.313668
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25	23° 10' 23.346" E	29° 20' 58.843" S	23.173152	-29.349679
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35	23° 6' 24.409" E	29° 21' 24.977" S	23.10678	-29.356938
36	23° 3' 33.757" E	29° 18' 50.129" S	23.059377	-29.313925
37	23° 3' 40.846" E	29° 21' 52.574" S	23.061346	-29.364604
38	23° 2' 56.632" E	29° 22' 42.903" S	23.049064	-29.378584
39	23° 6' 43.522" E	29° 23' 59.063" S	23.112089	-29.39974
40	23° 7' 12.208" E	29° 24' 9.085" S	23.120058	-29.402524

Figure 3: Locality of the proposed Prospecting Right Application 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.

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**".

Palaeontological heritage is unique and non-renewable and is protected by the NHRA. Palaeontological resources 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)**, a 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 300m in length;
- the construction of a bridge or similar structure exceeding 50m in length;
- any development or other activity which will change the character of a site—
    a. (exceeding 5 000 m^2 in extent; or
    b. involving three or more existing erven or subdivisions thereof; or
    c. involving three or more erven or divisions thereof which have been consolidated within the past five years; or
    d. the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
    e. the re-zoning of a site exceeding 10 000m^2 in extent;
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

The objective of a Palaeontological Impact Assessment (PIA) is to determine the impact of the development on potential palaeontological material at the site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the aims of the PIA are: 1) to **identify** the palaeontological status of the exposed as well as rock formations just below the surface

in the development footprint 2) to estimate the **palaeontological importance** of the formations 3) to determine the **impact** on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;
- Submit a comprehensive overview of all appropriate legislation, guidelines;
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study;
- Description and location of the proposed development and provide geological and topographical maps;
- Provide Palaeontological and geological history of the affected area;
- Identification sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
    a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
    b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
    c. Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided);
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed Okapi Mining Right and Waste License Application is depicted on the 1:250 000 2922 Prieska Geological Map (Council of Geoscience) (Figure 4). The development is located 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. The development is underlain by the Miocene to Recent Cenozoic Kalahari Group which are underlain by sediments of the Dwyka Group.

The Orange-Vaal River system is recognised as the primary secondary resource for alluvial diamond deposits along the west coast of Namaqualand and in the Northern Cape. Between Douglas and Prieska the present-day Orange River exhibits a meandering channel morphology, which are best developed in regions underlain by the Dwyka Group. Gresse (2003) states that intensive exploration has revealed remnants of a similar older meandering system, which are covered by calcrete and sand along the middle-Orange River.

Both sides of the Orange River valley between Douglas and Prieska are flanked by a steep calcrete-capped escarpment approximately 60-100 m above the present river level. The valley width varies between 8 and 10 km, while the depth is about 80 m below the calcrete cap. Remnants of older valley floors are preserved as topographic benches which are capped by younger, less indurated calcrete deposits. On the northern bank, where the large Cretaceous calcrete cap of the Ghaap Plateau is exposed, an older calcrete cap is present about 150 m above the riverbed. This escarpment is about 10 km from the Orange River and shows the distance of scarp retreat due to river incision since the Cretaceous. The distance fluctuates according to bedrock hardness—the scarp regressed faster on the soft Dwyka sediments between Ghaap se Berg and Asbesberge, thus exposing a large extended Dwyka Group ‘basin’ which extends northwards towards Postmasburg and Finsch. Calcrete scarp retreat and calcrete erosion indicates repeated land cycle evolution and frequent lowering of base level and river incision due to local tectonic activity along the course of the Orange River or sea level fluctuations (Gresse, 2003).

The Rooikoppie gravels covers the calcrete caps as well as the fluvial terrane deposits. Multi-cyclic deflation and gravitational deposits are represented by Rooikoppie gravels and sourced from surface scree deposits and/or elevated fluvial deposits. Diamondiferous Rooikoppie gravels frequently overlie, and underly barren fluvial deposits. Diamonds are found where the Rooikoppie gravels recycled older diamondiferous fluvial deposits.

Orange River kimberlites are the primary sources of diamonds imprisoned in the palaeogravels. Intermediate secondary sources include colluvial, alluvial and fluvial deposits in the catchment

regions of the Orange and Vaal rivers. Diamonds were deposited along the river courses in favourable trap sites in point-bar complexes or in bedrock-traps within-channel bars, mainly in scour pools, areas of divergent flow and meanders.

Cenozoic Kalahari Group

The Cenozoic Kalahari Group is the most widespread body of terrestrial sediments in southern Africa. The Cenozoic sands and calcretes of the Kalahari Group range in thickness from a few metres to more than 180m (Partridge et al., 2006). The youngest formation of the Kalahari group is the Gordonia Formation which is generally termed Kalahari sand and comprises of red aeolian sands that covers most of the Kalahari Group sediments. The pan sediments of the area originated from the Gordonia Formation and contains white to brown fine-grained silts, sands and clays. Some of the pans consist of clayey material mixed with evaporates that shows seasonal effects of shallow saline groundwaters. Quaternary alluvium, aolian sands, surface limestone, silcrete, and terrace gravels are also included in the Kalahari Group (Kent 1980).

Partridge *et al*., (2006) describes numerous types of superficial deposits of Late Caenozoic (Miocene to Pliocene to Recent) age throughout the Karoo Basin. Sands and gravel in the development footprint has a possible fluvial origin. The fossil assemblages of the Kalahari are generally very low in diversity and occur over a wide range. These fossils represent terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods and trace fossils. The palaeontology of the Quaternary superficial deposits has been relatively neglected in the past. Late Cenozoic calcrete may comprise of bones, horn corns as well as mammalian teeth. Tortoise remains have also been uncovered as well as trace fossils which includes termite and insect's burrows and mammalian trackways. Amphibian and crocodile remains have been uncovered where the depositional settings in the past were wetter.

Almond & Pether 2008 allocated a low significance to the Kalahari Group because fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. In the past palaeontologists did not focus on Cenozoic superficial deposits although they sometimes comprise of significant fossil biotas. However, Groenewald and Groenewald (2014) allocated a high palaeontological sensitivity to the Cenozoic aged terrestrial organisms which are important indicators of palaeoenvironmental conditions.

Dwyka Group

The Dwyka Group is Late Carboniferous to Early Permian in age (300-290 Million years ago (Ma) (Figure 2) and overlies glaciated Precambrian bedrock faces along the northern margin of the basin. In the south the Dwyka overlies the Cape Supergroup unconforrmably/paraconformably and in the east it unconformably overlies the Natal Group and Msikaba Formation. Underlying rocks,

especially in the north, form in places well-developed striated glacial pavements. Visser (1986) identified several types of lithofacies which he perceived to be deposited in a marine basin.

The Dwyka Group is divided into northern and southern facies (Visser, 1981) due to the distinctive lithological variations over the basin. The Mbizane Formation consists mainly of the northern inlet facies which is characterised by thickness changes, extremely varying lithology and low massive diamictite (~20 %) and high mudrock (~40%) content. The Elandsvlei Formation is the southern platform and are depicted by a high massive diamictite (~70%) and low mudrock (~8%) content, gradual southernly increase in thickness (100 m to 800 m). Debris eroded, from the highlands was deposited by a ground ice sheet but in the west fluctuations in the ice front caused bedded diamictons and subaqueous and subglacial outwash sediments (Visser *et al* 1987).

The Permian Ecca Group outcrops widely in the Karoo Basin and spans the Late Carboniferous Dwyka Group and Late Permian-Middle Triassic Beaufort Group. The Ecca Group consists essentially of a clastic sequence of mudstone, sandstone, siltstone, minor conglomerates and coal in places (SACS, 1980) (Catuneau *et al* 2005).This Group is the thickest in the southern part of the Karoo basin where it reaches 3000 m and thins out elsewhere in the basin.

The Dwyka sediments are of low palaeontological sensitivity. The Permo-Carboniferous Dwyka Group is known for its track ways also known as Ichnofacies that was formed by fish and arthropods. Fossilized faeces or coprolites have also been recovered. Body fossils consists of gastropods, invertebrates and marine fish, as well as fossil plants. A rich diversity of conifers, cordaitaleans, glossopterids, ginkgoaleans, pollens and spores have been described from this Group while ferns, horsetails and lycopods, are also found.

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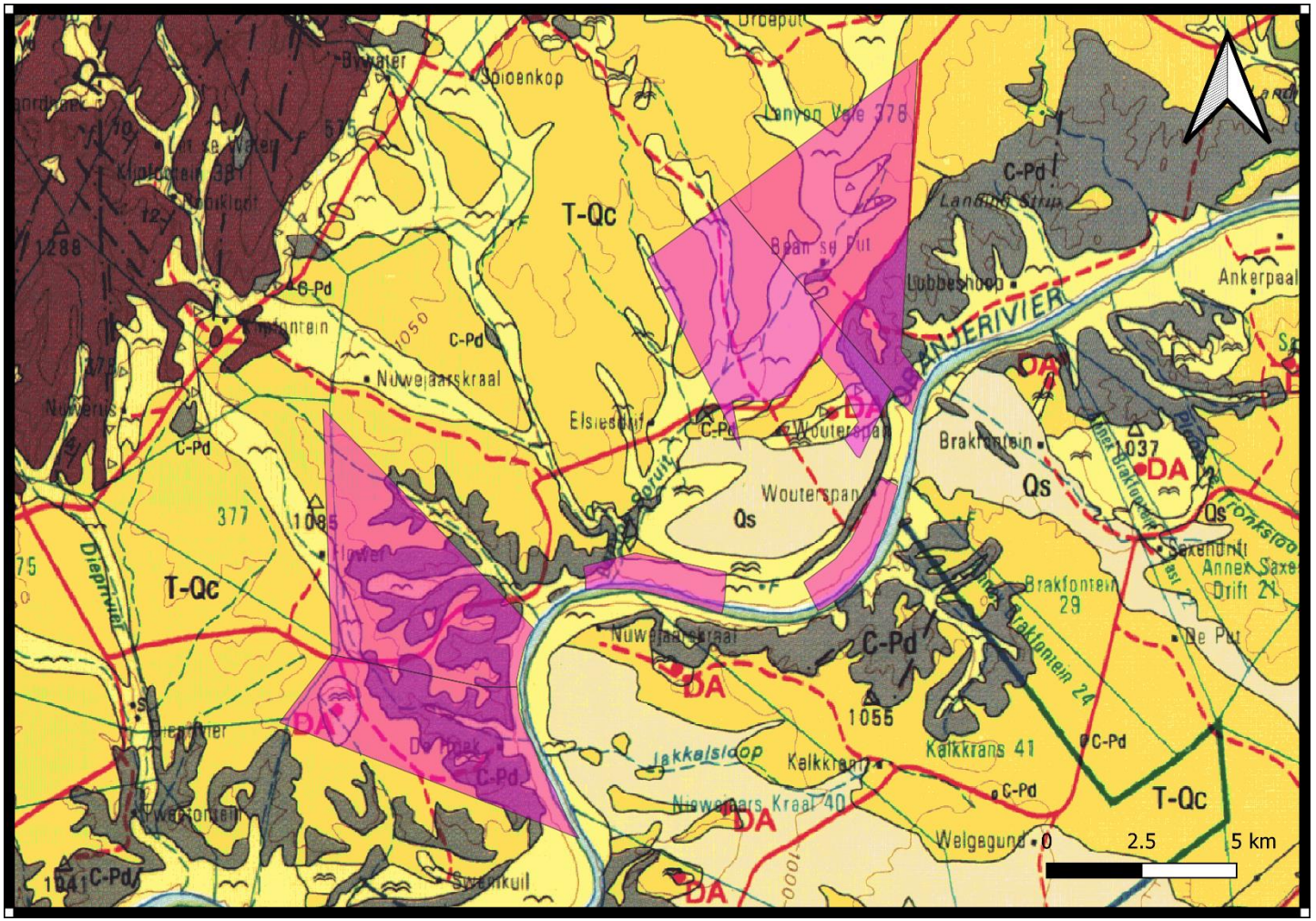
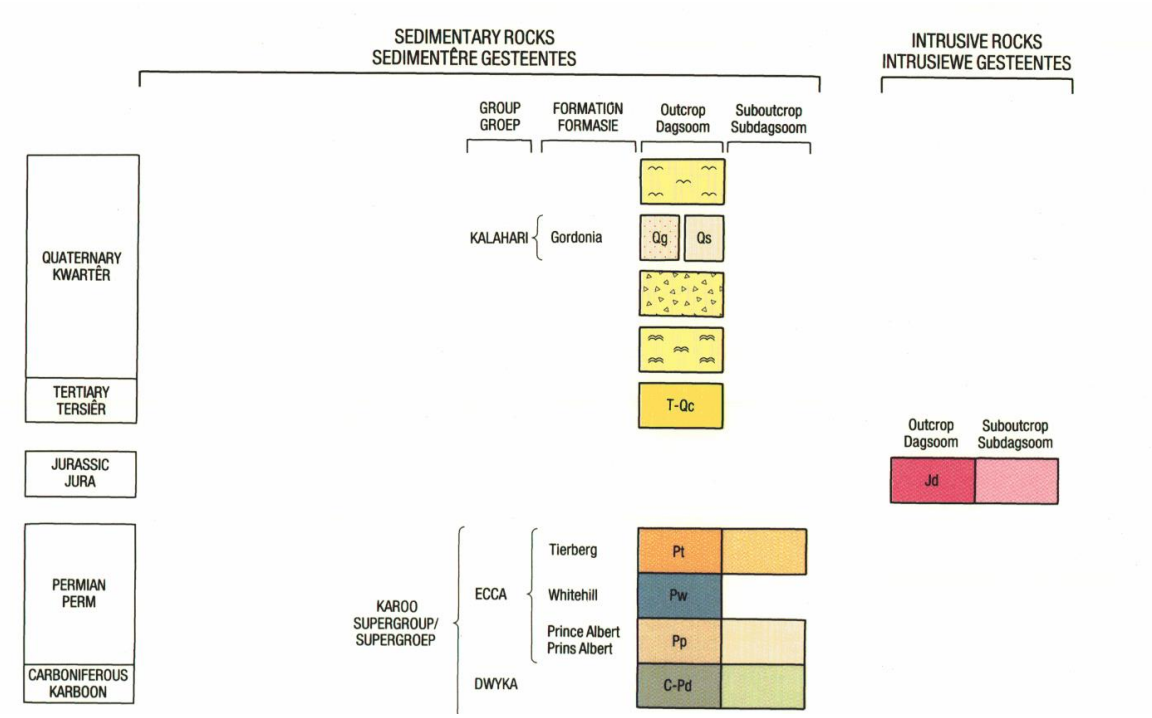


Figure 4: Extract of the 1:250 000 2922 Prieska Geological map (Council of Geoscience) of the proposed development (development footprint indicated in pink). Surface geology indicates that the development footprint is underlain by the Kalahari and Dwyka Groups. Map drawn by QGIS 2.18.



Legend to Map and short explanation.

Qs – Kalahari Group. Gordonia Formation-Quaternary Red to flesh-coloured wind-blown sand (beige).

C-Pd – Dwyka Group

T-Qc-Calcrete

Jd- Jurassic dolerite

Mining activity –(DA) Diamonds

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development is located along the Northern Bank of the middle Orange River between Douglas and Prieska in the Northern Cape, South Africa. The proposed development is approximately 100 km southwest of Douglas and 200 km from Kimberley. The proposed development will be approximately 2180.2646 hectares in extent. The proposed development will be 6435.8668 ha in extent.

7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This include all trace fossils and fossils. All available information is consulted to

compile a desktop study and includes: Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

7.1 Assumptions and Limitations

The focal point of geological maps is the geology of the area and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have never been reviewed by palaeontologists and data is generally based on aerial photographs alone. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is sourced to provide information on the existence of fossils in an area which was not documented in the past. When using similar Assemblage Zones and geological formations for Desktop studies it is generally **assumed** that exposed fossil heritage is present within the footprint. **A field-assessment will thus improve the accuracy of the desktop assessment.**

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984);
- 1: 250 000 2922 Prieska Geological map (Council of Geoscience);
- A Google Earth map with polygons of the proposed development was obtained from Milnex CC.;
- 1:50 000 Topographical Maps 2923 AA, 2923 AC

9 IMPACT ASSESSMENT METHODOLOGY

9.1 Impact Rating System

Impact assessment must take account of the nature, scale and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the following project phases:

• Construction

• Operation

• Decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should

also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact the following criteria is used:

Table 2:*The rating system*

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).

Table 1 Continues

DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).

2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

Table 1 Continues

REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.

3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects

Table 1 Continues

SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: (**Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.** The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.

29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive

9.2 Summary of Impacts

The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent. Impacts on palaeontological heritage during the construction phase could potentially occur but are regarded as having a low probability. The significance of the impact occurring will be low.

10 FINDINGS AND RECOMMENDATIONS

The development is underlain by the Miocene to Recent Cenozoic Kalahari Group which are underlain by sediments of the Dwyka Group. The Palaeontological Sensitivity of the Kalahari Group is low and that of the Dwyka Group is low (Almond and Pether 2008, SAHRIS website). It is therefore considered that the proposed mining development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the mine may be authorised 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 ECO/site manager in charge of these developments must be informed immediately. These discoveries ought to be secured (preferably *in situ*) and the ECO/site manager ought to alert SAHRA so that appropriate mitigation (documented and collection) can be undertaken by a professional palaeontologist.

The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

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.

Appendix A – Elize Butler CV

CURRICULUM VITAE

ELIZE BUTLER

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 26 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

Registered as a PhD fellow at the Zoology Department of the UFS
2013 to current

Dissertation title: A new gorgonopsian from the uppermost D*aptocephalus Assemblage Zone*, in the Karoo Basin of South Africa

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

Part-time Laboratory assistant — Department of Zoology & Entomology University of the Free State Zoology 1989-1992

Part-time laboratory assistant — Department of Virology University of the Free State Zoology 1992

Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

TECHNICAL REPORTS

TECHNICAL REPORTS

1. **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.
2. **Butler, E. 2014.** Palaeontological Impact Assessment for the proposed upgrade of existing water supply infrastructure at Noupoort, Northern Cape Province. 2014. Bloemfontein.
3. **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.
4. **Butler, E. 2015.** Palaeontological impact assessment of the proposed mixed land developments at Rooikraal 454, Vrede, Free State. Bloemfontein.
5. **Butler, E. 2015.** Palaeontological exemption report of the proposed truck stop development at Palmiet 585, Vrede, Free State. Bloemfontein.
6. **Butler, E. 2015.** Palaeontological impact assessment of the proposed Orange Grove 3500 residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape. Bloemfontein.
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8. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Ficksburg raw water pipeline. Bloemfontein.
9. **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.
10. **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.
11. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Woodhouse 1 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse729, near Vryburg, North West Province. Bloemfontein.

12. **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.
13. **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.
14. **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.
15. **Butler, E. 2016.** Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoort 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 Noupoort, Northern Cape. Prepared for Savannah Environmental. Bloemfontein.
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26. **Butler, E. 2016.** Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoort 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 Noupoort, Northern Cape. Savannaha South Africa. Bloemfontein.
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57. **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.
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80. **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 HO, North West Province. Bloemfontein.

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99. **Butler, E. 2018.** Palaeontological field assessment of the proposed development of the Wildealskloof mixed use development near Bloemfontein, Free State Province. Bloemfontein.
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132. **E. Butler. 2019.** Palaeontological Desktop Assessment for the establishment of a Super Fines Storage Facility at Amandelbult Mine, Near Thabazimbi, Limpopo Province
133. **E. Butler. 2019.** Palaeontological Impact Assessment for the proposed Sace Lifex Project, Near Emalahleni, Mpumalanga Province
134. **E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed Rehau Fort Jackson Warehouse Extension, East London
135. **E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed Environmental Authorisation Amendment for moving 3 Km Of the Merensky-Kameni 132KV Powerline
136. **E. Butler. 2019.** Palaeontological Impact Assessment for the proposed Umsobomvu Solar PV Energy Facilities, Northern and Eastern Cape
137. **E. Butler. 2019.** Palaeontological Desktop Assessment for six proposed Black Mountain Mining Prospecting Right Applications, without Bulk Sampling, in the Northern Cape.
138. **E. Butler. 2019.** Palaeontological field Assessment of the Filling Station (Rietvlei Extension 6) on the Remaininng Portion of Portion 1 of the Farm Witkoppies 393JR east of the Rietvleidam Nature Reserve, City of Tshwane, Gauteng
139. **E. Butler. 2019.** Palaeontological Desktop Assessment Of The Proposed Upgrade Of The Vaal Gamagara Regional Water Supply Scheme: Phase 2 And Groundwater Abstraction
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PRESENTATION

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Attended the Society of Vertebrate Palaeontology 73th Conference in Los Angeles, America. October 2012.

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Butler, E., and J. Botha-Brink. Cranial skeleton of *Galesaurus planiceps*, implications for biology and lifestyle. University of the Free State Seminar Day, Bloemfontein. South Africa. November 2007.

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INTERNATIONAL VISITS

Natural History Museum, London	July 2008
Paleontological Institute, Russian Academy of Science, Moscow	November 2014