BANZAI ENVIRONMENTAL

PALAEONTOLOGICAL IMPACT ASSESSMENT

HOOGLAND NORTHERN WIND FARM CLUSTER:

NORTHERN CAPE WATERCOURSE CROSSING UPGRADES

NORTHERN AND WESTERN CAPE PROVINCE

2022

CaseID: 18203

Compiled For

SLR Consulting (South Africa) (Pty) Ltd

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

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

- I realize that a false declaration is an offense in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

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

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

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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 – 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 1;10 and 11	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1;9 & 11	
(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 specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1;10 & 11	
(g) An identification of any areas to be avoided, including buffers	Section 1 & 11	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 11	
(k) Any mitigation measures for inclusion in the EMPr	Section 1 and 11	
(l) Any conditions for inclusion in the environmental authorisation	Section 1 and 11	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1 and 11	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 11	
(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 11	-
(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 Environmenta

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
		I 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 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 SLR South Africa Consulting (Pty) Ltd to conduct the Palaeontological Impact Assessment (PIA) to assess the offsite upgrading of existing watercourse crossings of the Hoogland Northern Wind Farm Cluster in the Northern and Western Cape Provinces. 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 crossings are underlain by alluvium, Abrahamskraal Formation and Poortjie Member (Teekloof Formation) of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. According to the PalaeoMap of the South African Heritage Resources Information System the Palaeontological Sensitivity of the Adelaide Subgroup is Very High, that of the Cenozoic Superficial deposits is Moderate and the Palaeontological Sensitivity of the Jurassic dolerite is Zero. Due to the Very High Sensitivity in the development area, a site visit was triggered.

In the last few decades extensive research and collecting have been conducted by palaeontologists in this part of the basin and the National Palaeontological databases indicate that the Loxton area is highly fossiliferous. A two day-site-specific field survey of the development footprint for the Northern Cape watercourse crossing upgrades was conducted on foot on 25 and 26 June 2022. A few fossiliferous sites were identified in the vicinity of the watercourse crossings. Many fossil taxa are known from only a single fossil and, thus, any fossil material is potentially highly significant. By implementing mitigation measures the significance of the impact will be reduced to low. A No-Go alternative for the road-crossings has been assessed as there is no alternatives to the existing road crossings. If mitigation measures are followed the upgrading of the watercourse crossings will not lead to detrimental impacts on the palaeontological reserves of the area and upgrade of the watercourse crossings may be authorised as part of the Northern Cluster Wind Farm development.

Recommendations:

- The Environmental Control Officer (ECO) for this project must be informed that sediments of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) have a Very High Palaeontological Sensitivity.
- Training of accountable supervisory personnel (ECO) by a qualified palaeontologist in the recognition of fossil heritage is very important and necessary.

- If Palaeontological Heritage is uncovered during surface clearing and excavations the Chance Finds Protocol attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources Agency (SAHRA) (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation (recording and collection) can be carried out.
- A well-preserved tetrapod skull and skeleton were observed near crossing DR02314-2&3 (-31.819436; 22.089300). Mitigation of this specimen is recommended.
- Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).
- These recommendations should be incorporated into the Environmental Management Programme for the proposed development.

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Appendix A:

1 INTRODUCTION

Red Cap Energy (Pty) Ltd and its affiliate (Red Cap Hoogland 1 (Pty) Ltd, Red Cap Hoogland 2 (Pty) Ltd, Red Cap Hoogland 3 (Pty) Ltd and Red Cap Hoogland 4 (Pty) Ltd), hereafter referred to as "Red Cap" proposes the development of four Wind Farm (WF) Facilities and associated grid connections (together known as the Hoogland Projects) between Loxton and Beaufort West in the Western Cape Province. Hoogland 1 and 2 Wind Farms (Northern Cluster) are located close to Loxton while Hoogland 3 and 4 Wind Farms (Southern Cluster) are closer to Beaufort West. Each Cluster will share a grid connection (Figure 1-3).

SLR Consulting (South Africa) (Pty Ltd) has been commissioned by Red Cap to conduct an Environmental Authorisation (EA) Application for the proposed Hoogland Northern Wind Farm Cluster between Loxton and Beaufort West, Western Cape Province (Hoogland 1: 14/12/16/3/3/2/2147 and Hoogland 2: 14/12/16/3/3/2/2146).

Each Wind Farm will include up to 60 turbines with a targeted generation capacity of a maximum of 420MW each. The footprint for the Northern Cluster falls within the Western Cape Province.

Dr John Almond of Natura Viva CC conducted the Palaeontological Impact Assessment for the Hoogland Northern Cluster.

Almond, J. E. 2022a. Proposed Hoogland Wind Farms and Grid Connection Project Northern Cluster: Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Associated Hoogland Northern Grid Connection, Western Cape Province: Palaeontological Heritage.

Dr Almond found that the proposed development is underlain by the lower Beaufort Group of Middle to Late Permian age. He identified tetrapod skulls and post-cranial skeletal remains, tetrapod burrow casts as well as a low diversity of trace fossils during a site visit. He determined that the fossil heritage in the development footprint was of limited scientific or conservation value and suggested that the final layouts of the development had to be crossed checked against the National Palaeontological Database as well as other relevant sources. The appointed palaeontologist should recommend mitigation measures such as possible walkdowns of previously unsurveyed areas. He also suggested the implementing of a Chance Finds Protocol for the Construction phase of the development.

Watercourse crossing upgrades on existing roads (shared by both Northern Cluster WEFs') in the Northern Cape Province are part of the development footprint however were not specifically assessed as part of the PIA. However, these watercourse crossing upgrades on existing roads are in the Northern Cape and are therefore under the jurisdiction of SAHRA.

SAHRA issued an Interim Comment on 26 May 2022 requesting a field-based PIA of the stream crossings in the Northern Cape as part of the EIA phase as fossils have been identified in streams in the Western Cape sector of the development.

In a letter of response (3 June 2022) Dr Almond stated that the appointed archaeologist who had been on site had concluded that the crossings were unlikely to have a good exposure of Beaufort Group bedrock or older alluvium and thus did not expect issues with regards to fossils in these Northern Cape crossings specifically. However, Dr Almond recommended that the PIA for the Northern Wind Farm Cluster be reinforced to specify paleontological walk downs of the stream crossings in the Northern Cape in the pre-construction phase.

In their Interim Comment of 10 June 2022, SAHRA was not satisfied with the motivation for not conducting a field-based PIA for the watercourse crossings during the EIA phase of the application. They concluded that it did not comply with the 2012 PIA Minimum Standards and thus this PIA was commissioned to assess the impacts to the environment before the decision-making stage.

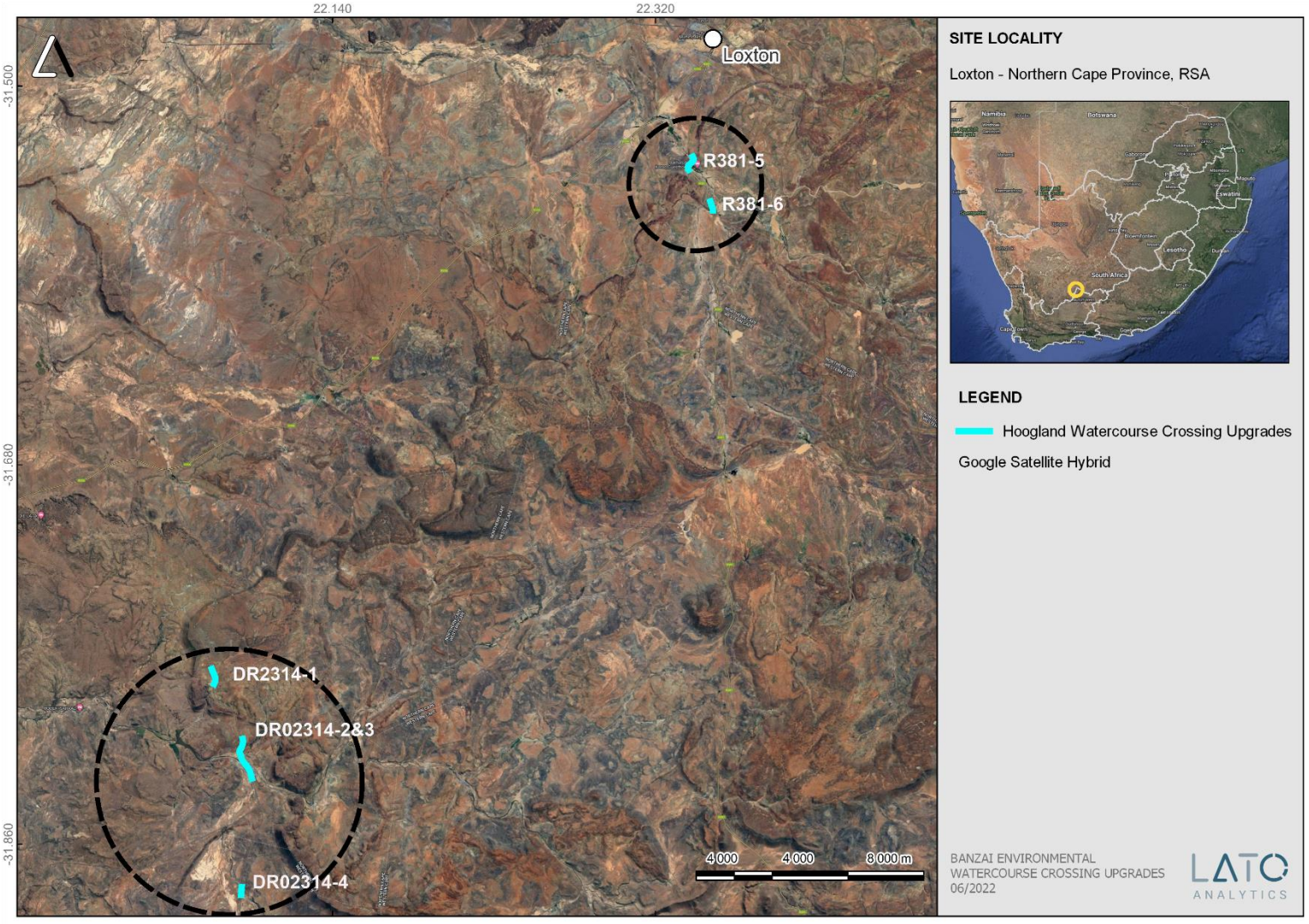


Figure 1: Regional locality of the watercourse crossings south of Loxton in the Northern Cape Province.

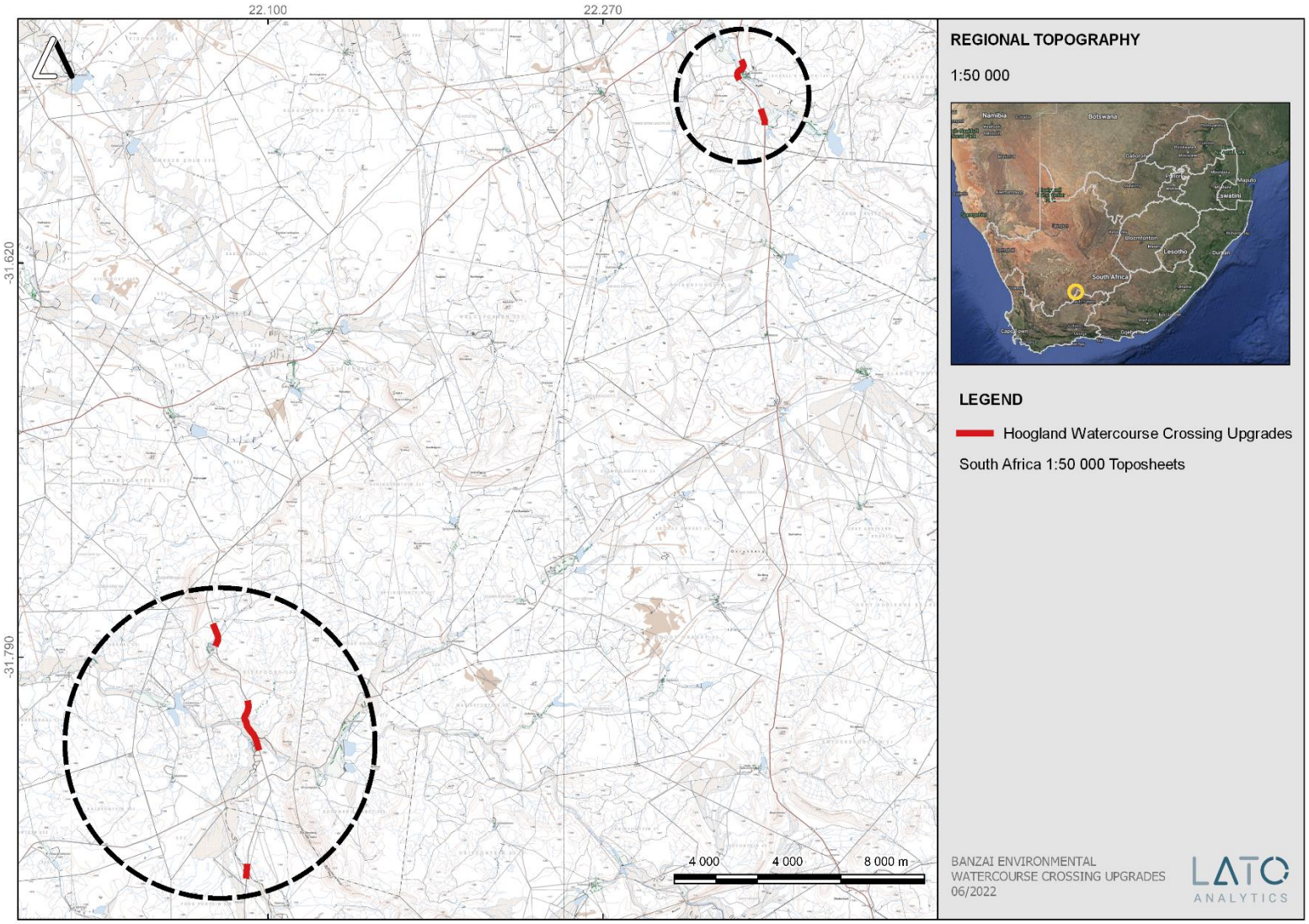


Figure 2: Locality Map of the watercourse crossings south of Loxton in the Northern Cape Province.

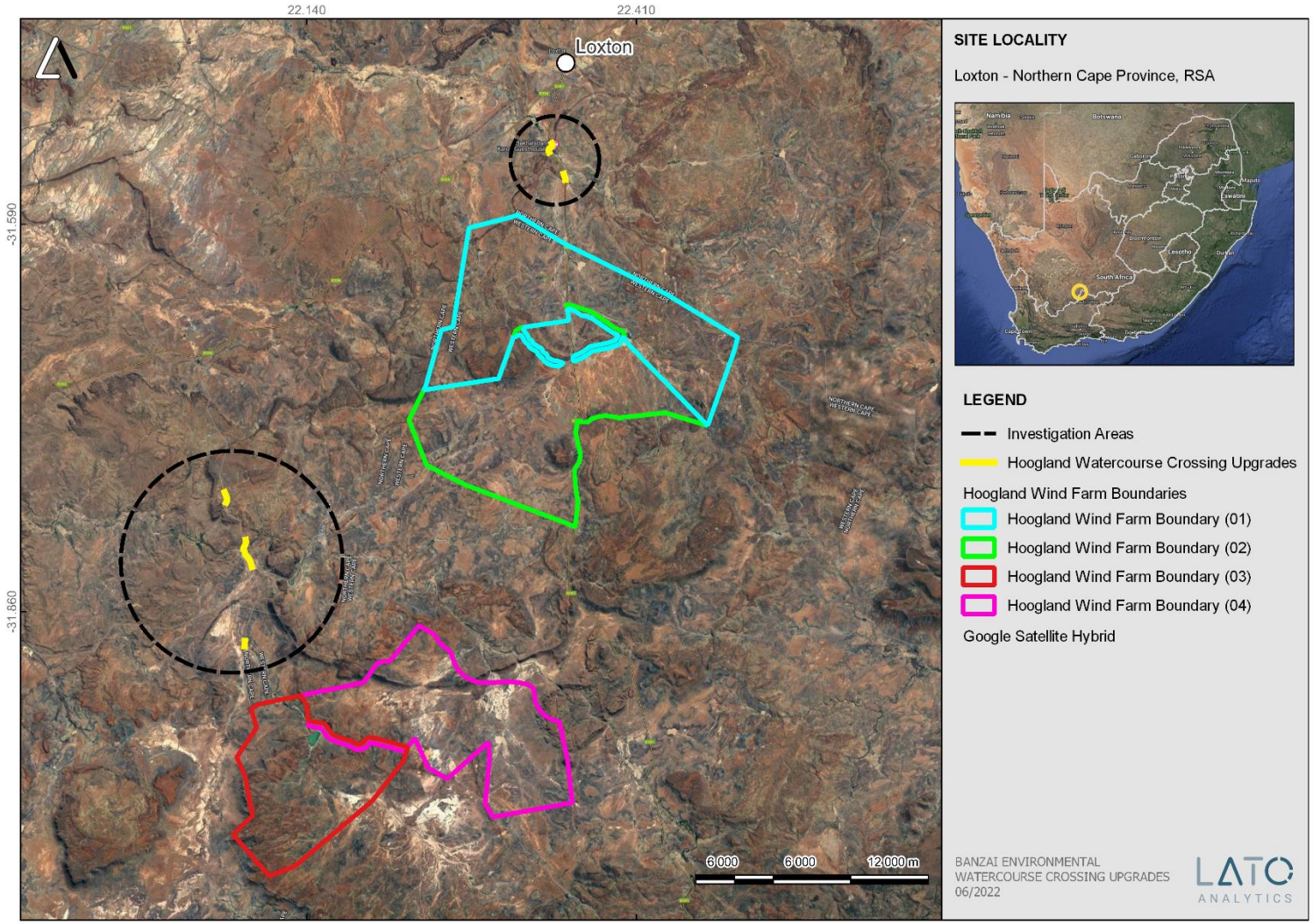


***Figure 3**: Hoogland watercourse crossing upgrades in the Northern Cape, in relation to the Hoogland WEF, are indicated in the black circle.*

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This study has been conducted by Mrs Elize Butler. She has conducted approximately 400 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.

The geology of this project was verified by Professor WA van der Westhuizen. He obtained his Ph.D. in geochemistry from the University of the Free State, South Africa, in 1984. He acted as departmental chairperson (Geology Department) from 1998 to 2013. He retired as full professor in 2015. Research in southern Africa includes the Ventersdorp Supergroup, volcanology, mineralogy, geology of eastern Namaqualand, vanadium deposits in the Otavi Mountainland. Consulting work was conducted in South Africa, Namibia, Zimbabwe, and Malawi. Prof van der Westhuizen was an author and co-author for more than 70 peer reviewed articles and more than 70 conference presentations at national and international level. Apart from being a registered professional scientist, up to his retirement he was a member of the following societies: Fellow of the Geological Society of SA, Archaeological Society of SA, International Association of Volcanology and Chemistry of the Earth's Interior, Spectroscopic Society of SA, International Liaison Group on Gold Mineralisation

3 LEGISLATION

National Heritage Resources Act (25 of 1999)

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

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

- National Environmental Management Act (NEMA) Act 107 of 1998
- National Heritage Resources Act (NHRA) Act 25 of 1999
- Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002

- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified.

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

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

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

National Heritage Resources Act (NHRA) Act 25 of 1999

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

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 has been compiled.

Palaeontological heritage is exceptional 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 will inform 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 m^2 in extent; or

- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m² in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

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

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

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

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

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

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation, and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kml's) in the proposed development.
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect, and cumulative:
    a. Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
    b. Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity.
    c. Cumulative impacts result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present, or reasonably foreseeable future activities.
- Fair assessment of alternatives (in this case the No-Go alternative has been assessed as there are no alternatives to the existing road crossings):
- 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 existing watercourse crossings proposed for upgrade as part of the Hoogland Northern WF Cluster are indicated on the 1:250 000 Victoria West 3122 (1989) Geological Map (Council for Geosciences, Pretoria) (Figure 4). The crossings are underlain by alluvium (yellow, single bird figure), Abrahamskraal Formation (Pa, light green) and Poortjie Member (Ptp, dotted green) (Teekloof Formation) of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup (Figure 4; Table 2). Le Roux & Keyser (1988) provided a sheet explanation of the area. This part of the basin

is extensively intruded by dolerite (Jd, red) dykes and sills and the surrounding Beaufort Group sediments have been baked thus compromising the fossil heritage of the area through thermal metamorphism. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Quaternary superficial deposits is Moderate while that of the Adelaide Subgroup is Very High (Almond *et al*, 2013; SAHRIS website). Due to the Very High Sensitivity of the Adelaide Subgroup as shown on *Figure 11*, a field assessment was triggered.

Note: Dr Almond conducted the PIAs for the Hoogland Northern Cluster and Southern Cluster (Almond 2022a and 2022b) as well as that of the adjacent Nuweveld Cluster (Almond, 2020a, 2020b, 2020c, and 2021). In these reports he gave excellent geological interpretations of the area and this PIA should be read in conjunction with the mentioned reports. This report provides more information and background on the potential fossil occurrences in the development area.

The Cenozoic superficial deposits are the youngest geological deposits formed during the most recent geological period (approximately 2.6 million years ago to present). Most of the superficial deposits are unconsolidated sediments and consist of clay, gravel, sand, silt, that form relatively thin, discontinuous patches of sediments. These sediments comprise of channel, floodplain, and stream deposits.

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

Cenozoic fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages may in some cases occur in extensive alluvial and colluvial deposits. In the past palaeontologists did not focus on Caenozoic superficial deposits although they sometimes comprise of significant fossil deposits. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn corns, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from Quaternary deposits. Plant material such as foliage, wood, pollens, and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts).

The Loxton area is extensively intruded by dolerite dikes and sills (Jd, red) of the Karoo Igneous Province. The area is also known for its dolerite koppies. These dolerite intrusions have baked

the surrounding potentially fossiliferous bedrock through thermal metamorphism thus influencing the quality of fossil preservation. The Karoo Igneous Province in southern Africa is a classic continental flood basalt province that was formed during the Early Jurassic Period. This province occurs over a comprehensive area in southern Africa and comprises a widespread system well developed igneous bodies (dykes, sills) that invaded the sediments of the Main Karoo Basin. Flood basalts do not typically form any visible volcanic structures, but with a series of outbursts form a suite of fissures of sub-horizontal lava flows that may vary in thickness. The Karoo is an old flood basalt province and is preserved today as erosional remnants of a more extensive lava cap that covered much of southern Africa in the geological past. This Suite is entirely unfossiliferous.

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; Keyser *et al*, 1977; Rubidge 1995; Smith *et al*, 2020; Viglietti 2020). As previously mentioned some watercourse crossings is underlain by the Abrahamskraal Formation as well as the Poortjie Member of the Teekloof Formation. The stratigraphically younger Poortjie Formation is biostratigraphically represented by the Endothiodon Assemblage Zone (AZ). This biozone is subdivided by the *Tropidostoma-Gorgonops and* the *Lycosuchus-Eunotosaurus* Subzones (Table 2), while the *Abrahamskraal* Formation is represented by the *Tapinocephalus* and upper Eodicynodon AZ.

Day and Smith (2020) proposed a subdivision of the Endothiodon AZ in the *lower Lycosuchus – Eunotosaurus* Subzone and the upper *Tropidostoma – Gorgonops* Subzone. The contact between these subzones is represented by the first appearance of *Tropidostoma dubium*. The first appearance of *Aulacephalodon bainii* terminates the Endothiodon AZ

The *Endothiodon* AZ is comparable with much of the Middleton Formation (east of 24°E) as well as the lower Teekloof Formation (west of 24°E). Day *et al* (2015) found that the *Endothiodon* Assemblage Zone West of 24°E is present in the upper two thirds of the Poortjie Member (Day *et al*., 2015) overlying the Hoedemaker Member except in the upper strata. Near Victoria West the lithostratigraphy may vary due to thinning of lithostratigraphic units (Day and Rubidge, 2019) (Day and Rubidge, 2019).

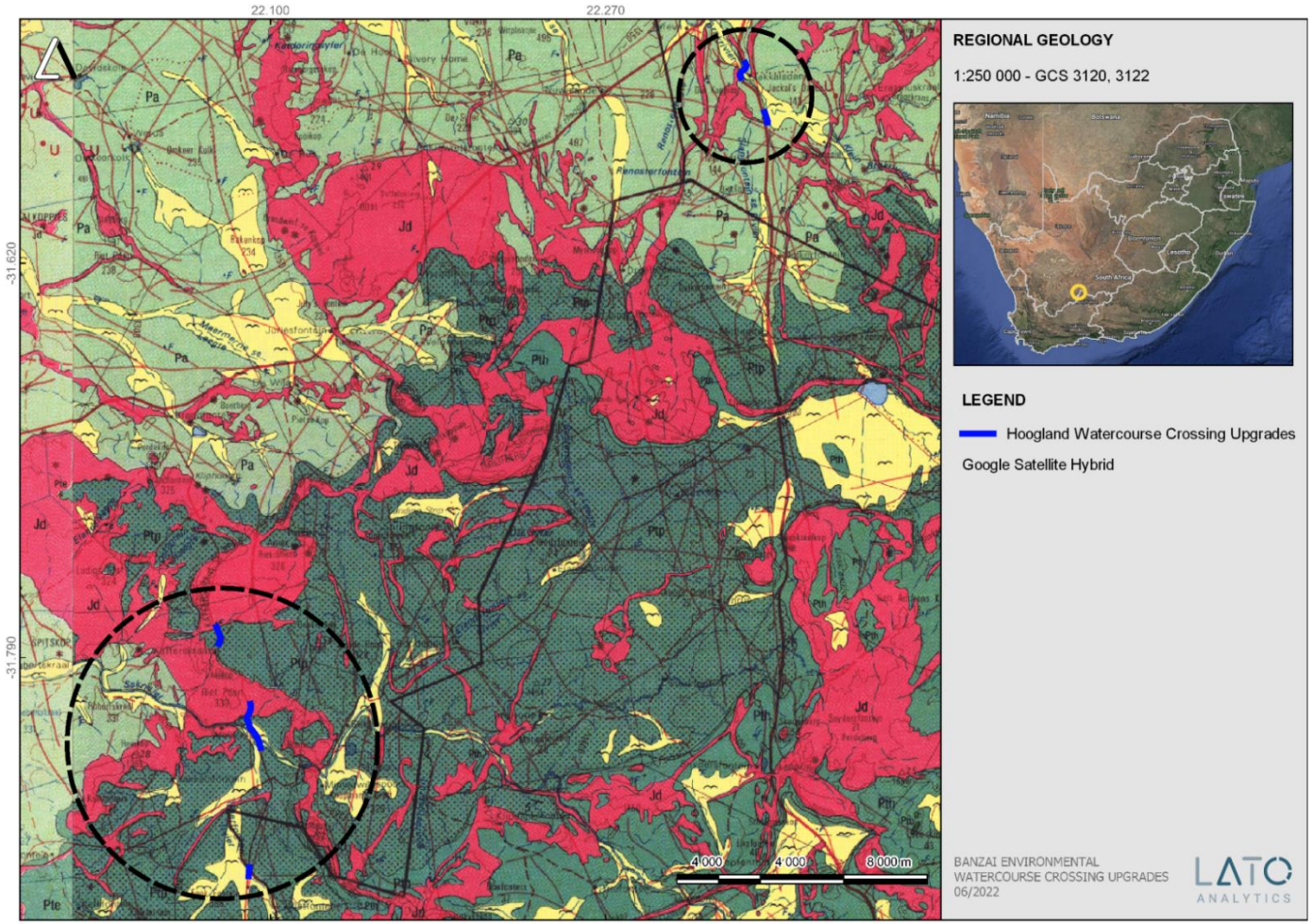
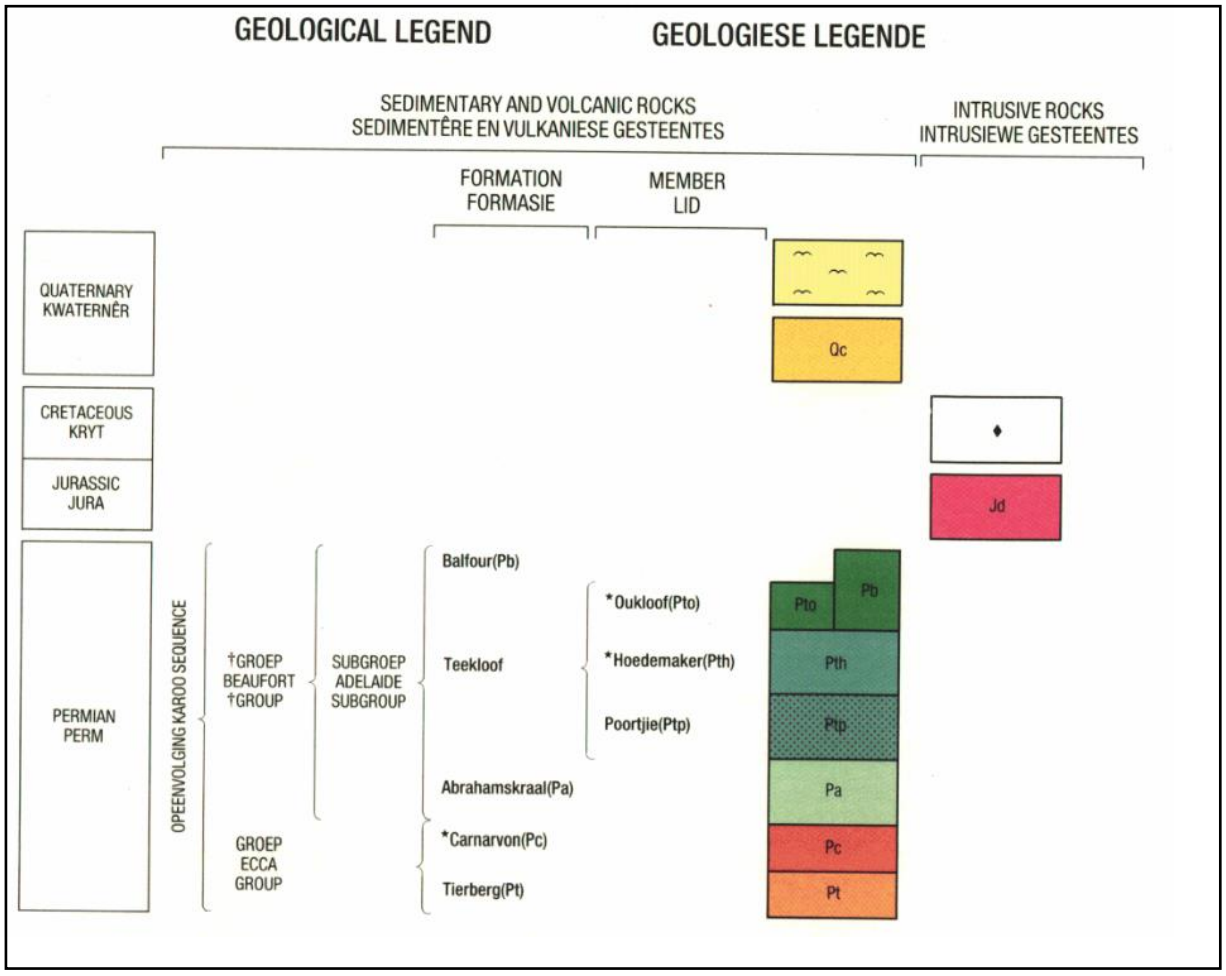


***Figure 4**. Extract of the 1:250 000 Victoria West 3122 (1989) Geological Map (Council for Geosciences, Pretoria) indicating the geology of the Hoogland watercourse crossings south of Loxton in the Northern Cape Province. The development is underlain by alluvium (yellow, single bird figure), Abrahamskraal Formation (Pa, light green) and Poortjie Member (Ptp, dotted green) (Teekloof Formation) of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup.*

Table 2: Legend of the 1:250 000 Victoria West 3122 (1989) Geological Map (Council for Geosciences, Pretoria)



LITHOLOGY
LITOLOGIE

~	Alluvium Alluvium	Pc	Sandstone, siltstone, grey shale Sandsteen, sliksteen, grys skalie
Qc	Calcrete Kalkreet	Pt	Grey shale, siltstone Grys skalie, sliksteen
♦	Kimberlite Kimberliet	Pth	Red and purple mudstone, subordinate sandstone Rooi en pers moddersteen, ondergeskikte sandsteen
Jd	Dolerite Doleriet	Pto	Purple mudstone, sandstone Pers moddersteen, sandsteen
Pa	Grey and green mudstone, subordinate sandstone Grys en groen moddersteen, ondergeskikte sandsteen	Ptp	Purple, green and grey mudstone, sandstone Pers, groen en grys moddersteen, sandsteen
Pb	Green and red mudstone, sandstone; sandstone-rich Oudeberg Member at base Groen en rooi moddersteen, sandsteen; sandsteenryke Lid Oudeberg aan basis		

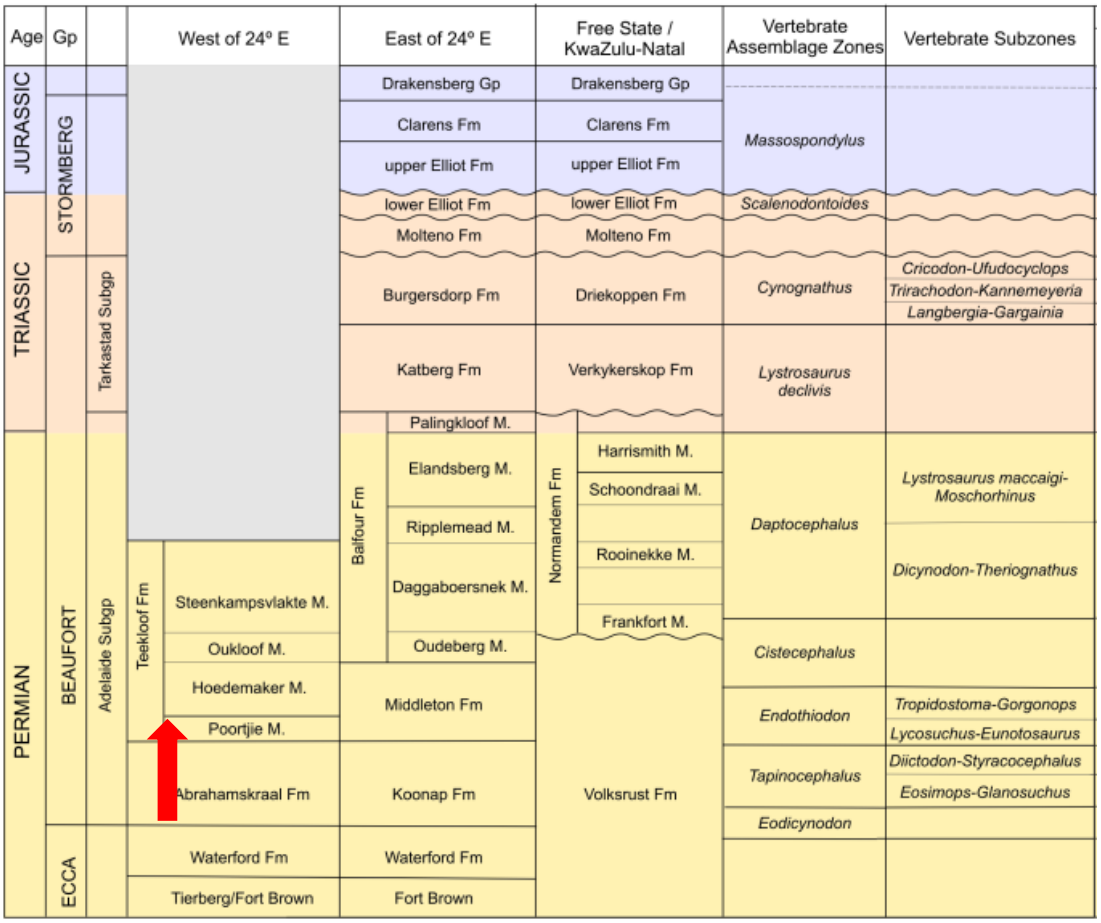


***Figure 5**: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa. Solid lines indicate known ranges. Wavy lines indicate unconformities. (PLYCSR=Pelycosauria and MAMMFMES+Mammaliaformes. Gp=group, Subgp-Supbroup, Fm=Formation, M=Member). The proposed watercourse crossing upgrades are indicated by the red arrow*

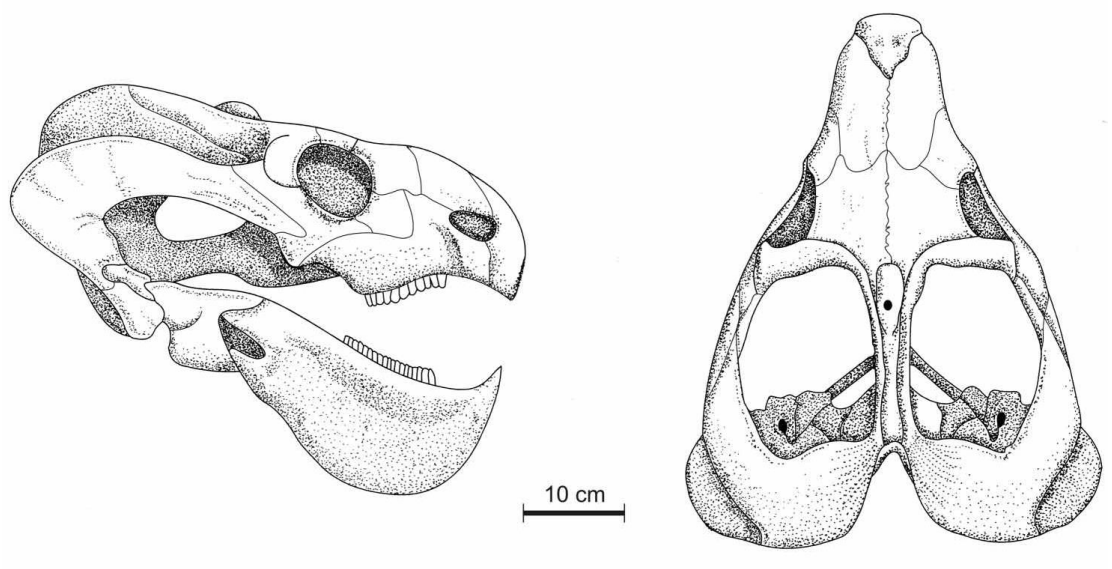


***Figure 6**: Endothiodon bathystoma, in lateral and dorsal views is the biozone defining fossil of the Endothiodon Assemblage Zone*

The dicynodont genera *Endothiodon*, *Emydops, Diictodon, Pristerodon* and the gorgonopsian *Gorgonops* characterizes the *Endothiodon* AZ. In South Africa, *Endothiodon* is most probably represented by the single species *Endothiodon bathystoma* (Figure 6) (Brink, 1986; Cox and Angielczyk, 2015; Maharaj, 2018) that becomes abundant after the Capitanian mass extinction. Endothiodon is very rarely recovered from other intervals.

Characterizing taxa of the *Lycosuchus – Eunotosaurus* Subzone is *Eunotosaurus africanus* and the lycosuchid theroceohalian *Lycosuchus vanderrieti* that co-occur with Endothiodon (Figure 7). This Subzone represents the first stage of ecological recovery after the Capitanian mass extinction. (Day *et al*., 2013; Kammerer *et al*., 2015) and records the stratigraphically lowest occurrence of large gorgonopsians and bauroid therocephalians. Basal therocephalians include the scylacosaurid *Glanosuchus macrops* while the small gorgonopsian *Eriphostoma microdon* is also present in this Subzone. This Subzone mostly corresponds with the arenaceous Poortjie Member with a sandstone mudrock ratio of 1:2. A sudden increase of sandstone bodies is present at the base of this member and the change from single-storied to multi-storied channel sandstone geometries. Mudrocks are represented by subordinate dark-reddish brown mudstone and greenish-grey siltstone. Roussouw and De Villiers (1952) describes calcareous nodular horizons that weathers to a brown colour as well as thin sheets of pink-weathering silicified siltstone.

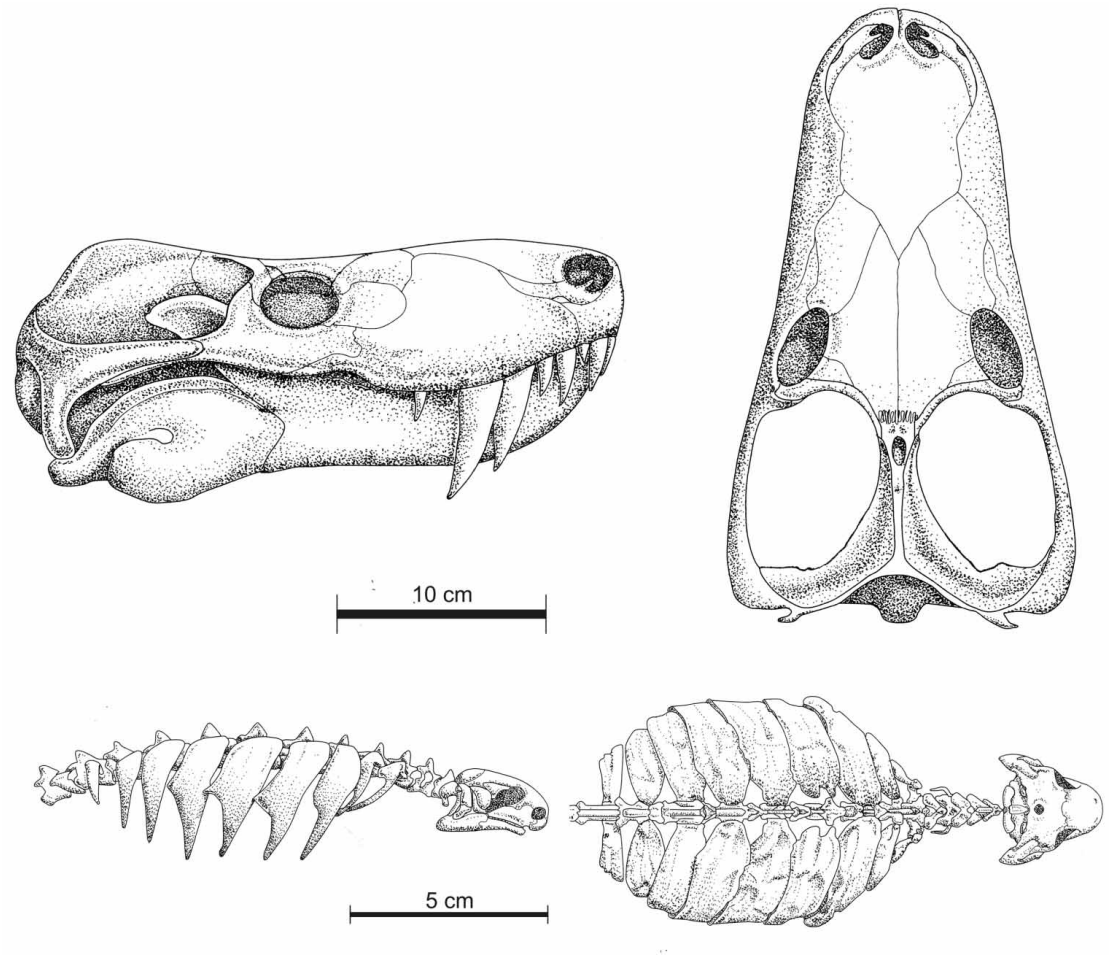


Figure 7: *Lateral and dorsal views of Lycosuchus vanderrieti (top), and Eunotosaurus africanus (bottom), the biozone defining taxa of the Lycosuchus – Eunotosaurus Subzone (Taken from Day and Smith, 2020)*

A renewed uplift in the Gondwanides (about 260 Mya) caused a variety of sand-dominated braided streams flowing northeasterly and crossing the southern Karoo alluvial plains in the direction of an intracontinental sea (Rubidge, 2005). The arenaceous Poortjie Member preserves these channels. Renewed tectonism is indicated by the presence of various laterally continuous thin sheets of silicified mudrocks (Rossouw and De Villiers, 1952). These sediments are rich in in volcanic ash (Ho Tun, 1979). The *Abrahamskraa*l and *Teekloof* Formations contains these tuffaceous horizons. Radiometric dates indicate that the base of the Poortjie Member is about 260 260 My while the upper boundary is about 259 and 258 Ma (Day *et al*., 2015, Lucas and Shen, 2018).

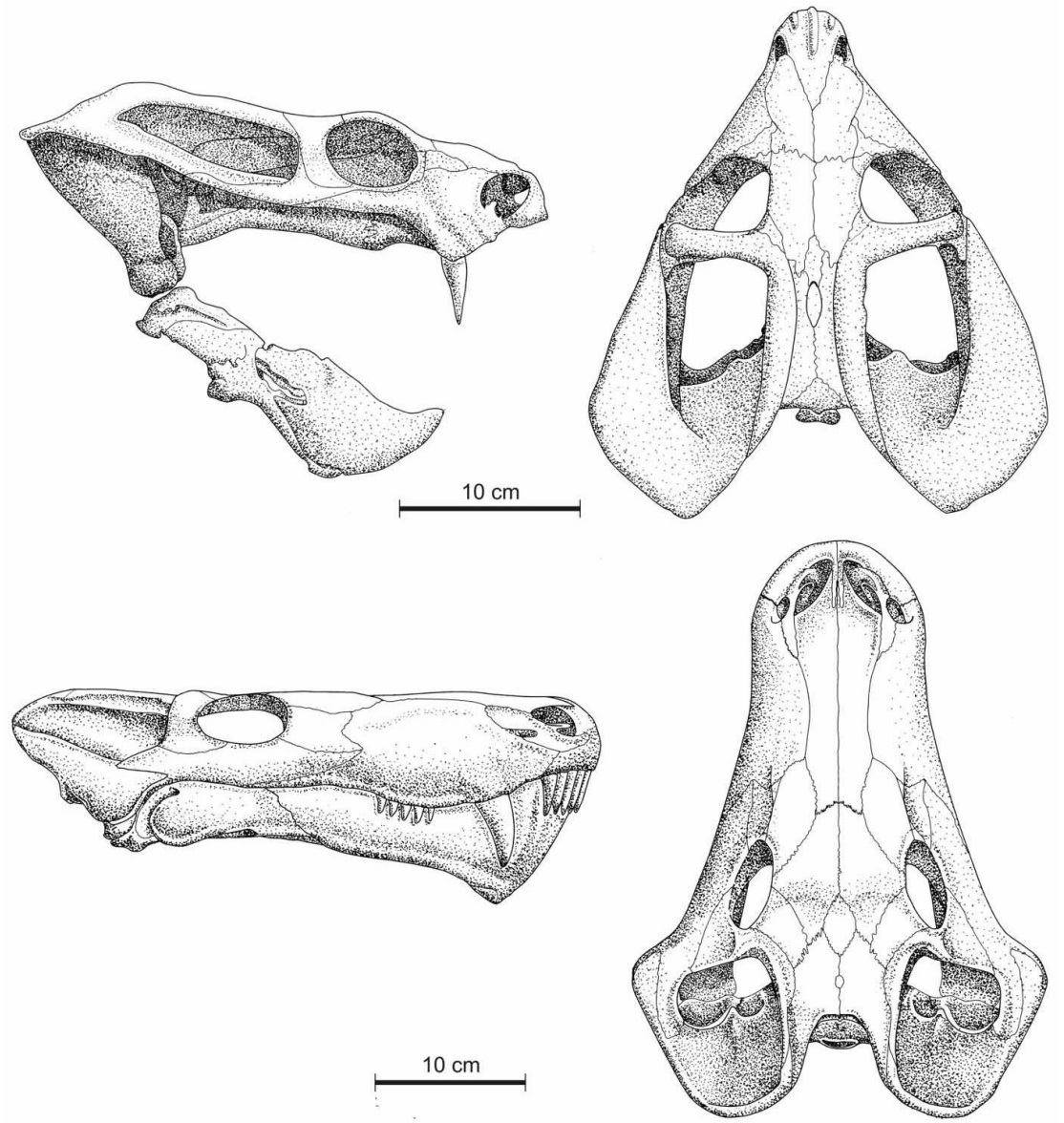


Figure 8: Lateral and dorsal views of the index taxa of the Tropidostoma – Gorgonops Subzone namely (top) Tropidostoma dubium, (bottom) Gorgonops torvus

The predominantly mudrock *Tropidostoma-Gorgonops* Subzone is a sequence of fluvio-lacustrine strata. Vertebrate fossils are mostly found in massively bedded thick greenish-grey siltstone with minor mudstone intercalations occurring between the main channel sandstones. These sediments are thick coarsening upwards sequences of between 5 to 10m thick and is understood to be prograding crevasse splay complexes. The latter was deposited by repeated overbank flood events originating from the channel banks and accumulating in lowland flood basins. Scattered oblate pedogenic carbonate nodules forming horizons is present in massive siltstones. This is interpreted to be calcic vertisols that were deposited under a seasonally dry humid-temperate climate (Smith, 1993) at the base of meanderbelt slopes.

The *Tropidostoma - Gorgonops* Subzone has a greater abundance of taxons than the *Lycosuchus - Eunotosaurus* Subzone. This Subzone is characterised by the presence of rare basal cynodonts. large gorgonopsians, basal baurioid therocephalians, cryptodont dicynodonts, and small pareiasaurs. Fossils in this Subzone is predominately found in overbank facies

Fossils of the *Tropidostoma-Gorgonops* Subzone are mainly found in the overbank facies — particularly in the fine-grained sandstone and massive siltstone sheets of the proximal floodplain facies (Smith, 1993). This subzone is known for its dense cluster of *Diictodon* skulls that are found in a patch of 20 to 50m. *Diictodon* (Smith, 1993) and *Youngina* (Smith and Evans, 1995) juvenile aggregations has been described in the literature.

Fossils are usually disarticulated unweathered, well-preserved specimens while fully articulated specimens are usually intercurled paired skeletons. Fossils bones are usually enclosed in smooth-surfaced calcareous pedogenic nodular material. Rare burrow casts accredited to the digging activity of dicynodonts is present in the in the lower part of the subzone but absent in the upper section. Coprolites comprising of bones has also been recovered. The *Tropidostoma - Gorgonops* Subzone reaches a thickness of between 130 and 150m along the Nuweveld escarpment and becomes thinner in the north (Day and Rubidge, 2019).

The watercourse crossing upgrades on the R381 are underlain by the Abrahamskraal Formation. As the second oldest tetrapod biozone in the Karoo, the *Tapinocephalus* AZ is basically restricted to the Abrahamskraal Formation. The lower margin of the AZ is variable due to diachrony. This AZ comprises of the upper third of the *Abrahamskraal* Formation in the southwestern boundary of the basin, has an undefined span between Middleton in the south and Beaufort West. East of Middleton and north of Sutherland in the Eastern, Western and Northern Cape Provinces the AZ comprises the whole of the *Abrahamskraal* AZ. In the southern Free State, it is present in the Lower Adelaide Subgroup (Groenewald *et al*., 2019).

The *Tapinocephalus* AZ is a rich tetrapod assemblage zone that consists of basal members of therapsid clades Biarmosuchia, Anomodontia, Dicynodontia, Therocephalia, and Gorgonopsia; basal members of the parareptilian clade Pareiasauria; and rare varanopids as well as derived members of the therapsid clade Dinocephalia. The *Tapinocephalus* AZ is characterised by the tapinocephalid dinocephalian species *Tapinocephalus atherstonei* and *Moschops capensis*, the dicynodont *Eosimops newtoni*, and *Robertia broomiana* and the pareiasaur *Bradysaurus baini*.

This AZ includes dinocephalians (*Moschops capensis*), basal pareiasaurs (*Bradysaurus*) that co-occur with pylaecephalid dicynodonts *Eosimops*. and *Robertia*. This AZ has a maximum thickness of about 1500 m it comprises of the upper two thirds of the *Abrahamskraal* Formation. The Assemblage Zone can be subdivided into two subzones based on the absence of the dicynodont Diictodon feliceps: in the lower Eosimops - Glanosuchus Subzone and the presence of Diictodon in the upper Diictodon Eosimops - Glanosuchus Subzone. The contact between these subzones is the first appearance of *Diictodon felips* at the base of the Moordenaars Member. The upper part of the biozone reflects the Capitanian mass extinction and the low diversity post extinction. The first appearance of *Endothiodon bathystoma* terminates the zone.

Fossilized bones are generally encrusted with calcareous material and sometimes smaller fossils are entirely concealed in micritic nodules. In the northern margin of the basin the calcitic crusts is grey to greenish in colour while in the southern margin of the basin the nodules are very hard and often grey with orange weathering due to low-grade metamorphism related to the proximity of the Cape Fold Belt.

The *Eosimops - Glanosuchus Subzone* is at its thickest 1 100 m. This subzone consists of siltstones, sandstones, and mudstones with erosively-based upward fining cycles (Paiva, 2015; Smith and Keyser, 1995, Wilson *et al*., 2014). A 60 to 85 siltstone: mudstone ration is present in this succession with a greenish-grey to bluish-grey and less common greyish-red to purple colour. (Cole *et al*., 2016).

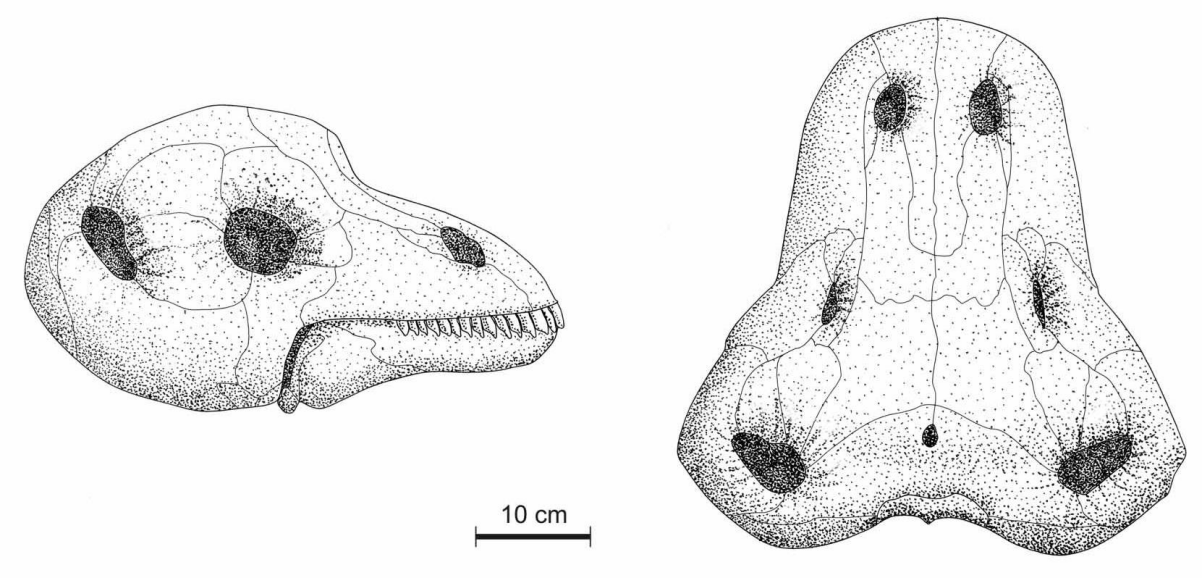


***Figure 9**: Tapinocephalus atherstonei, the index taxon of the Tapinocephalus Assemblage Zone, in lateral and dorsal view.*

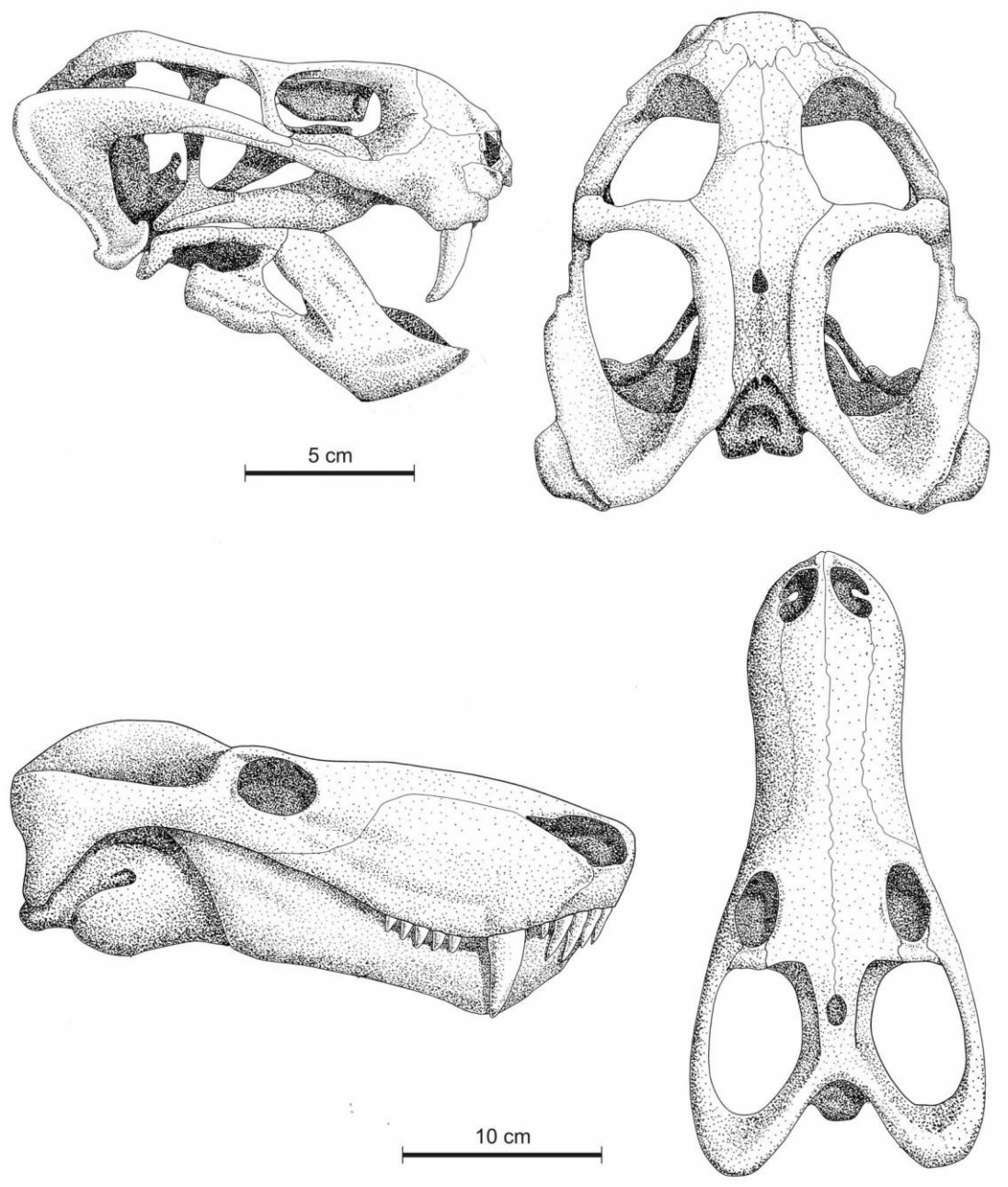


Figure 10: *Lateral and dorsal view of the index taxa of the Eosimops - Glanosuchus Subzone in (top) Eosimops newtoni; (bottom) Glanosuchus macrops*

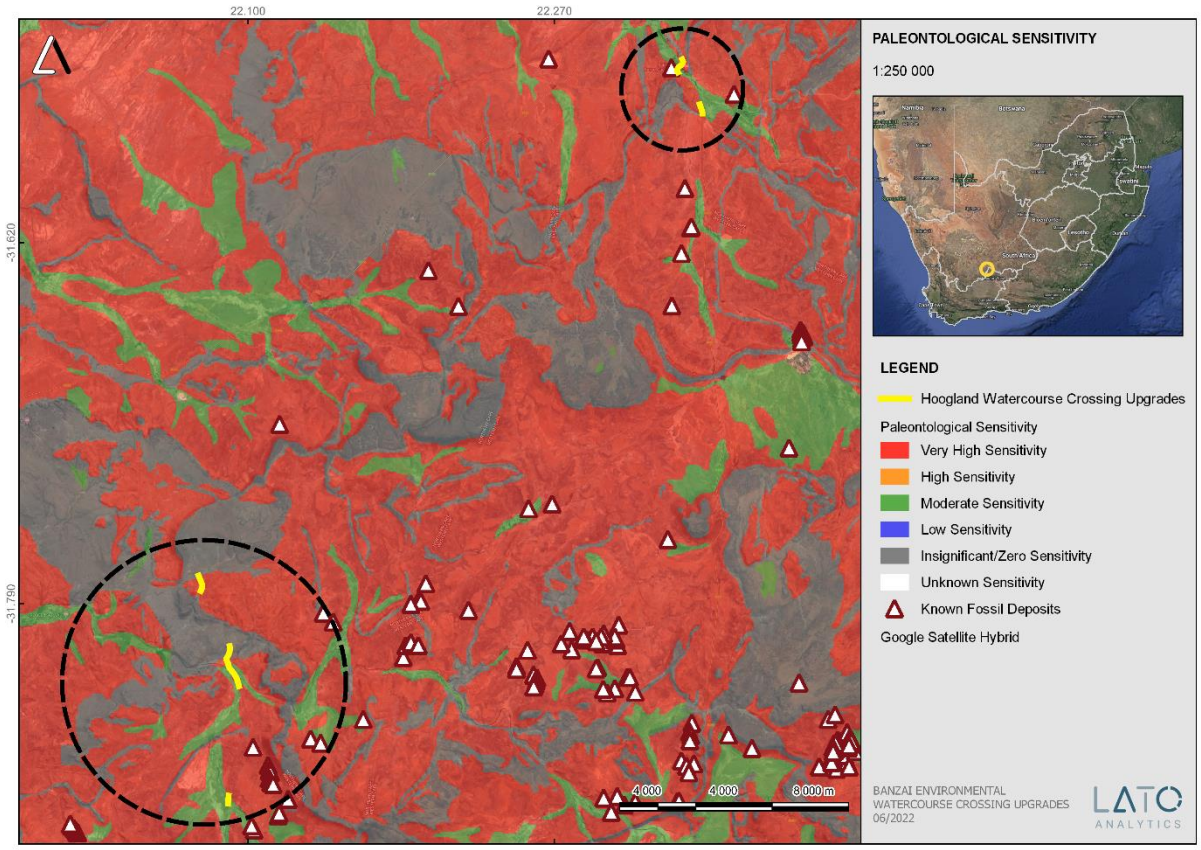


***Figure 11**: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the development in yellow. Fossils finds recorded on the National Palaeontological Database is indicated in white triangles.*

According to the SAHRIS Palaeosensitivity map (Figure 11) the development is underlain by sediments with a Very High (red), Moderate (green) and Zero (grey) Palaeontological Significance.

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.

Based on the above sensitivity categories, a field assessment and protocol for finds is triggered for the proposed watercourse crossing upgrades. The sensitivity categories also align with the DFFE Screening Tool findings which similarly triggers a PIA in terms of GN 320 of 20 March 2020 (NEMA).

6 GEOGRAPHICAL LOCATION OF THE SITE

The Hoogland Project is located between Loxton and Beaufort West in the Western Cape Province. The watercourse crossings upgrades assessed in this report are in the Northern Cape Province on the R361 (about 7km south of Loxton) and DR0214 (about 86 km north-west of Beaufort West) (Table 4).

Table 4: GPS coordinates

Watercourse crossings		Latitude	Longitude
DR2314-1	Beginning	31°46'36.83"S	22° 4'21.43"E
	End	31°47'2.44"S	22° 4'25.97"E
DR2314-2&3	Beginning	31°48'36.18"S	22° 5'23.47"E
	End	31°49'43.60"S	22° 5'41.83"E
DR2314-4	Beginning	31°52'49.28"S	22° 5'21.40"E
	End	31°53'2.45"S	22° 5'20.19"E
R381-5	Beginning	22°20'26.72"E	22°20'26.72"E
	End	31°32'23.22"S	22°20'18.14"E
R381-6	Beginning	31°33'17.51"S	22°21'1.80"E
	End	31°33'33.11"S	22°21'7.06"E

7 METHODS

The aim of a desktop study is to evaluate the possible risk to palaeontological heritage in the proposed development. This includes all trace fossils as well as all fossils in the proposed footprint. All possible information is consulted to compile a desktop study, and this includes the following: all 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 of the Geological Maps were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have never been reviewed by palaeontologists and data is generally based on aerial photographs alone. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Areas with similar Assemblage Zones in other areas is also used to provide information on the existence of fossils in an area which has not documented in the past. When using similar Assemblage Zones and geological formations for Desktop studies it is generally assumed that exposed fossil heritage is present within the footprint. A field-assessment will thus improve the accuracy of the desktop assessment and thus this study has been commissioned.

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)
- Palaeontological Sensitivity Map on SAHRIS
- A Google Earth kmz files of the proposed development was obtained from SLR Consulting as well as background information.
- Topographic maps (1:50 000) of the 3122 Victoria West area.
- 1:250 000 Victoria West 3122 (1998) Geological Map (Council for Geosciences, Pretoria)
  PIAs in the area included that of (Almond 2020a-c, 2021, 2022a-b)

9 SITE VISIT

A site-specific field survey of the development footprint was conducted on foot on 25-26 June 2022. The following photographs of the site was taken (Figure 7-35). Several fossiliferous sites were identified during the site visit.

9.1 DR2314-1

The Palaeontological Sensitivity of this section is High Very high as loose plant fossils were detected.

Figure 12: Extensive dolerite outcrops.

-31.813347; 22.089489

Figure 13: View of nearby dam with koppies capped by a dolerite sill in the background.

-31.783981; 22.073856

Figure 14: Imprint of fossilized plant in mudstone in the vicinity of the crossing.

-31.784631; 22.073836

9.2 DR02314-2&3

The Palaeontological Sensitivity of this section is High Very high as tetrapod fossils were detected in the Poortjie Member (Teekloof Formation) of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup.

Figure 15: Flat topography, low vegetation with dolerite outcrops in the background.

-31.820408; 22.089864

Figure 16: Extensive dolerite outcrops.

-31.815389; 22.088133

***Figure 17**: Small tetrapod skull and skeleton. Skull imbedded in rock with tusks visible.*

-31.819436; 22.089300

Figure 18: Drainage line on sedimentary rock.

-31.820350; 22.089678

***Figure 19**: Low water crossing over Sakrivier. Poorly sorted scattered dolerite, sandstone and hornfels are present as well as unconsolidated gravely Cenozoic superficial deposits.*

-31.823906; 22.092894

Figure 20: Well-developed mudcast breccias with channel sandstone.

-31.824067; 22.093050

9.3 DR02314-4

Figure 21: View over the Northern Cape indicates a flat topography without any visible outcrops.

-31.880828; 22.089244

Figure 22: *Sakrivier drainage line with scattered dolerite scree.*

-31.882400; 22.089078

9.4 R381-5

Ripple marks were detected on loose slabs in this section

Figure 23: View southwards towards the Brakrivier bridge. Low relief terrain with patches of mudstone and sandstone with downwasted surface gravels of dolerite, quartzite, and calcrete. Vegetation comprises of low grasses and bossieveld.

-31.534475; 22.341136

***Figure 24**: Low relief terrain with low grasses and bossieveld and koppies in the background.*

-31.534789; 22.341203

Figure 25: Sandy Caenozoic alluvium in stepped stream gulley exposure with mudstone and tabular sandstone with downwasted surface gravels of dolerite, quartzite, and calcrete. Grey-green and purple-brown mudrocks capped by channel sandstone.

-31.534744; 22.341036

Figure 26: Eastern side of the R381 with poorly sorted colluvium dominated by sandstone, quartzite, hornfels and dolerite. Isolated fragments of loose wave ripples are preserved.

-31.558522; 22.351803

Figure 27: Dense vegetation with open patches poorly sorted colluvium, sandstone, and small dolerite corestones

-31.535619; 22.341269

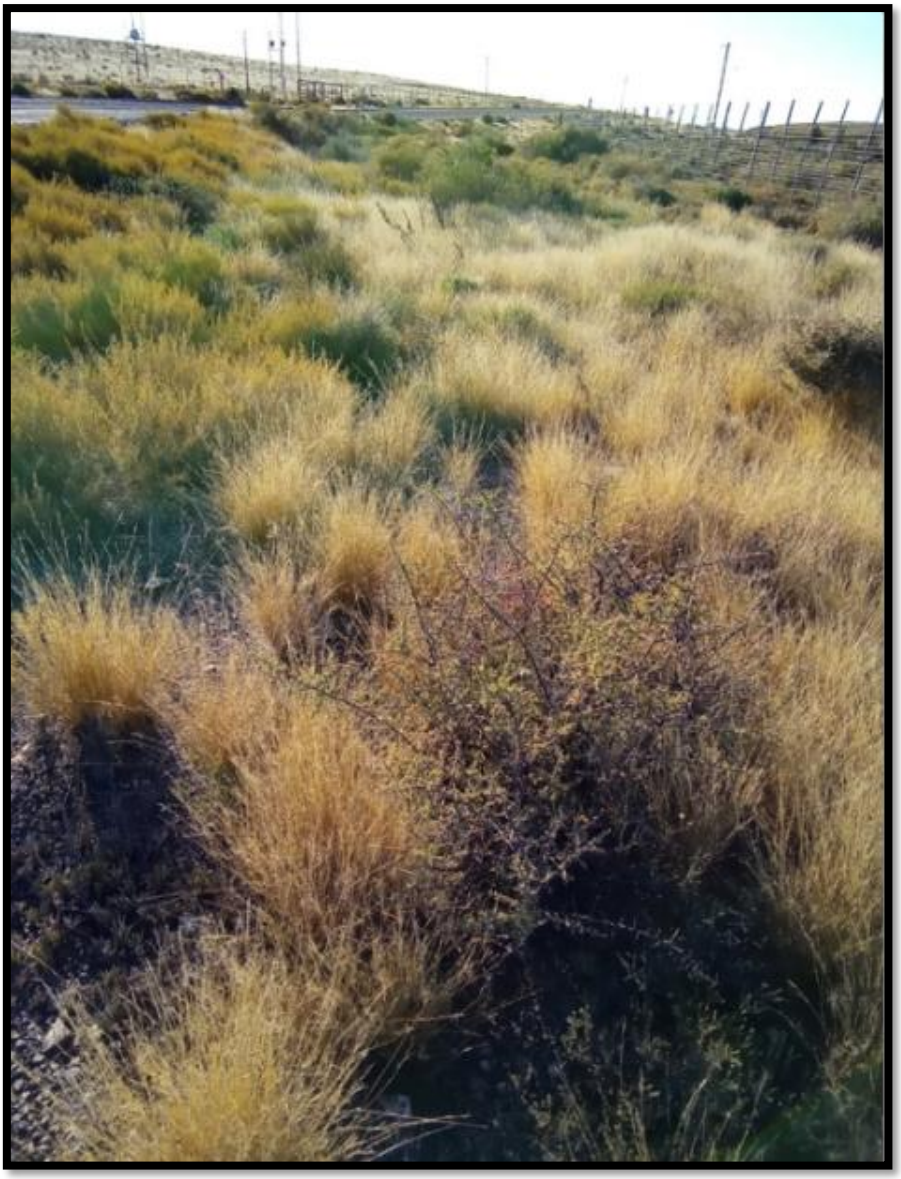


Figure 28: Dense grassy vegetation with bossieveld. Unvegetated patches is dominated by dense concentrations of sandstone, quartzite, hornfels and dolerite.

-31.537947; 22.338392

***Figure 29**: Concrete bridge built in 1952.*

-31.536264; 22.340339

9.5 R381-6

Fragmented fossils as well as trace fossils were detected in this section and thus the area has a High Palaeontological Sensitivity

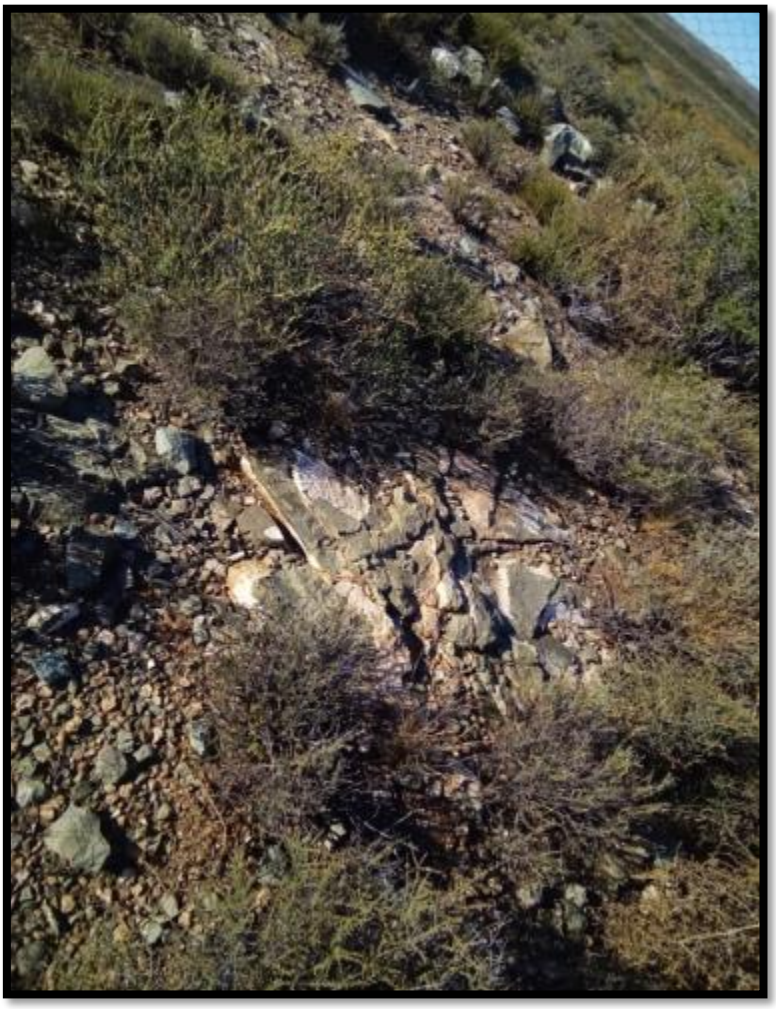


***Figure 30**: Calcretized sandstone and mudrock rubble.*

-31.555292; 22.350817

***Figure 31**: Horizontal trace fossils in tabular sandstone.*

-31.558522; 22.352003

***Figure 32**: Weathered fossilized vertebrate skeletal bones in green-grey mudstone.*

-31.819422; 22.089292

***Figure 33**. Slab of poorly preserved wave ripples with scattered fragments of grey mudrock*

-31.559175; 22.351869

***Figure 34**. Yellowish baked sandstones with quartzite, hornfels and dolerite.*

Figure 35: Slangfonteinspruit comprises of sand with isolated mudrock outcrops and thick vegetation.

-31.536578; 22.339903

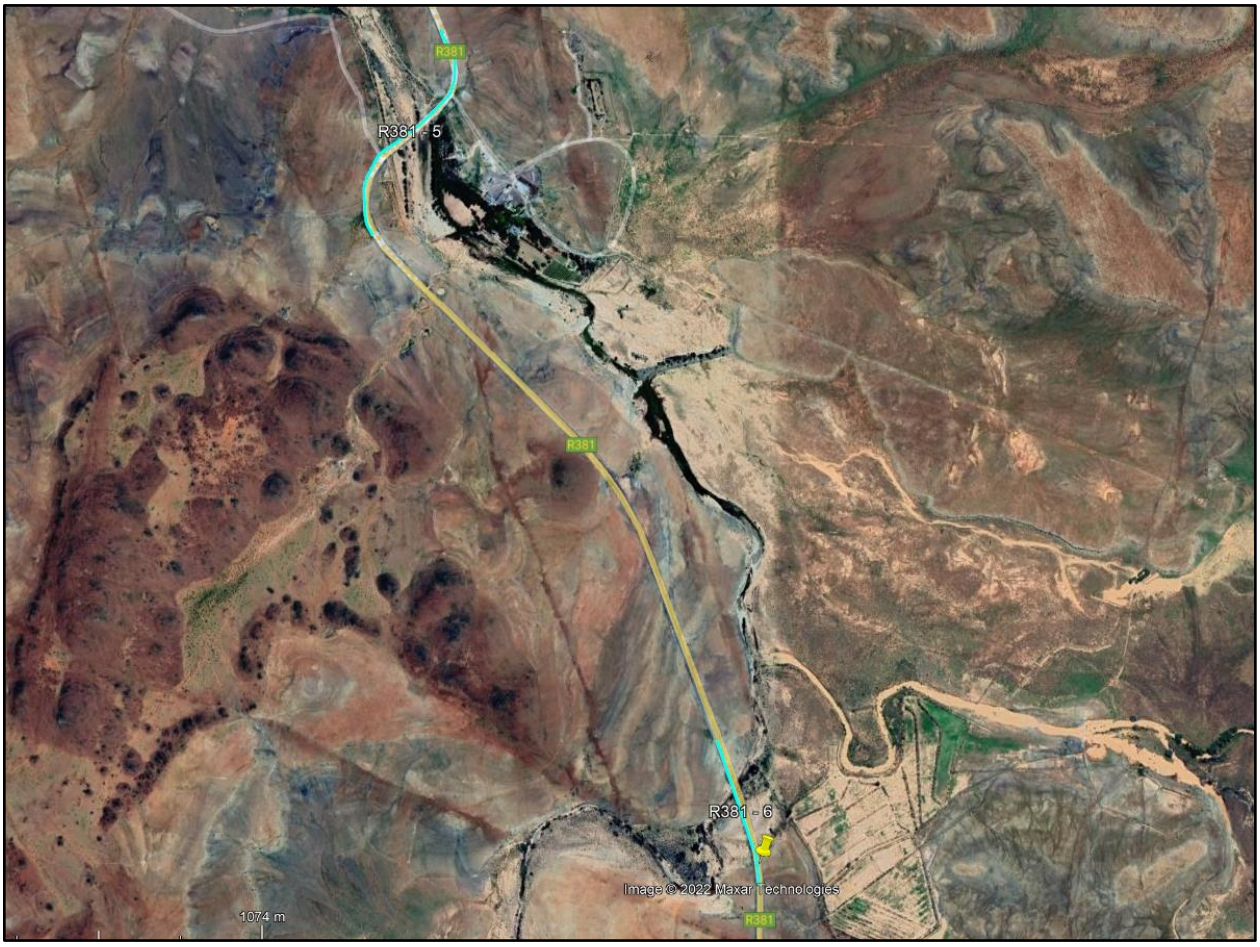


***Figure 36**: Fossiliferous area in the R381-6 watercourse crossing .*

***Figure 37**: Fossiliferous area in the DR02314 watercourse crossing.*

10 ASSESSMENT METHODOLOGY

10.1 METHOD OF ENVIRONMENTAL ASSESSMENT

The environmental assessment aims to identify the various possible environmental impacts that could results from the proposed activity. Different impacts need to be evaluated in terms of its significance and in doing so highlight the most critical issues to be addressed.

Significance is determined through a synthesis of impact characteristics which include intensity, duration and extent of an impact (consequence) in relation to its probability of occurring. Significance is calculated as shown in **Error! Reference source not found.**

10.2 IMPACT RATING

Potential impacts on local palaeontological heritage resources due to the Hoogland watercourse crossing upgrades in the Northern Cape are assessed in Table 5, using the system developed by SLR. Note the ratings are consistent with those applied by Almond (2022a) for the Hoogland Northern Cluster and Grid Connection.

Table 5: Summary of Construction Phase Impacts

Issue: Loss or degradation of local palaeontological heritage resources of scientific and / or conservation value		
Description of Impact		
Damage, disturbance, destruction or sealing-in of legally-protected, scientifically valuable fossil heritage at or beneath the ground surface within the road footprint, mainly due to ground clearance and excavations.		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	
Criteria	Without Mitigation	With Mitigation
Intensity	High	Medium
Duration	Permanent	Permanent
Extent	Site	Site
Consequence	High	Medium
Probability	Probable	Probable
Significance	High -	Medium -

Degree to which impact can be reversed	Impacts to palaeontological heritage are generally irreversible.
Degree to which impact may cause irreplaceable loss of resources	Medium, however if mitigation is properly implemented. New fossils would be accessible for research.
Degree to which impact can be mitigated	Medium. Most recorded fossil sites can be effectively mitigated by a professional palaeontologist in the pre-construction phase (recording / collection). Newly exposed fossils can be mitigated through a Chance Fossil Finds Procedure. However, residual impacts following mitigation may be locally high, given the unavoidable difficulties of identifying and sampling fossils from on-going construction phase excavations and site clearance.

11 CUMULATIVE IMPACTS

In relation to an activity, cumulative impact "means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may be significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities" (NEMA EIA Reg GN R982 of 2014).

Other than the proposed Nuweveld Wind Farms, there are currently no approved renewable energy EA applications within a 30km (or even 50km) radius of the project site (Figure 37). In addition, the South African Renewable Energy EIA Application Database (REEA) ("REEA_OR_2022_Q1") shows several renewable energy projects (solar) have been authorized close to Beaufort West. Further research confirmed that none of these projects are currently going ahead / have a valid EA (It is noted that the Beaufort West – Aberdeen area has recently been gazetted as a Renewable Energy Development Zone (REDZ) and that several new solar and wind farm projects are currently in the process of being assessed). The cumulative impact assessed by Almond (2022a) therefore includes the collective impact of the four Hoogland Wind Farms and Grid Connection applications and the three Nuweveld Wind Farm and Gridline applications (Figure 37).

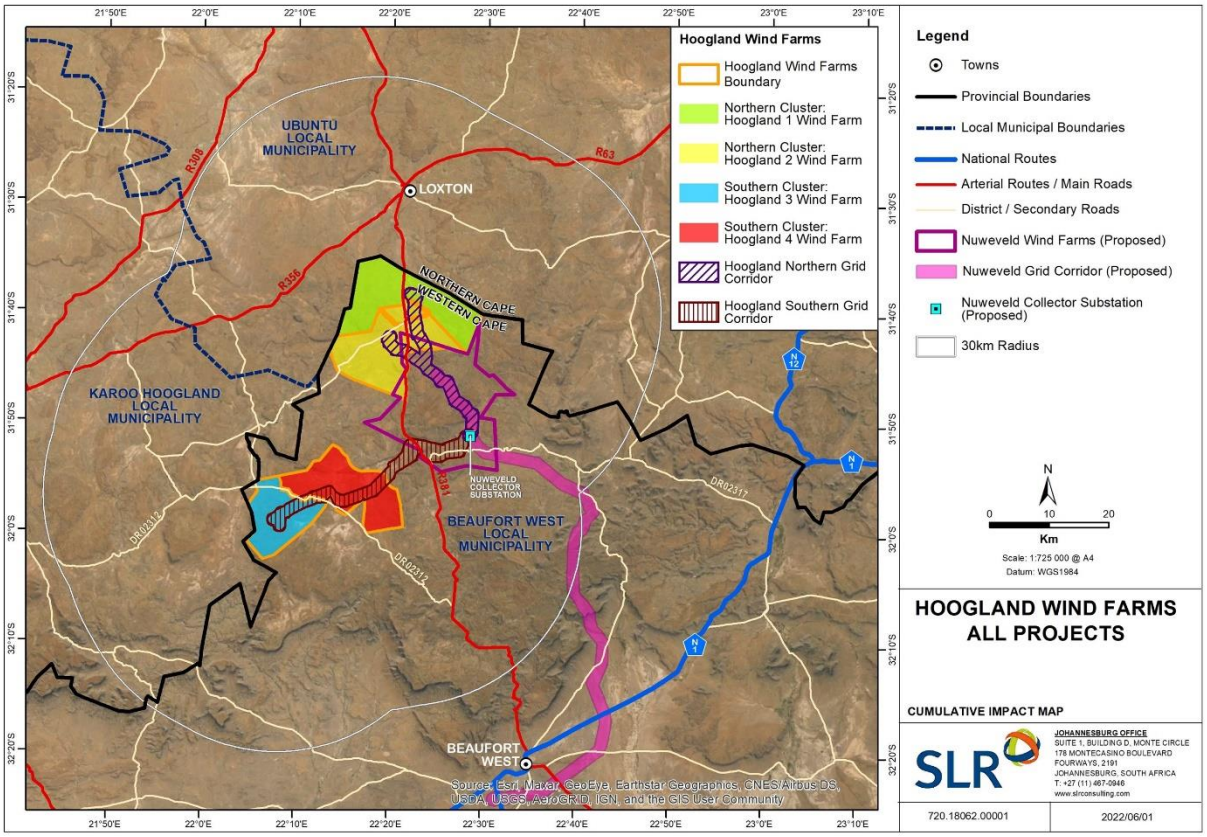


Figure 37: Cumulative Map indicating renewable energy facilities within the 30km buffer of the Hoogland Wind Farms and Grid Connection.

The significance of anticipated impacts on palaeontological heritage for each of the three Nuweveld Wind Farms as well as the associated Grid Connection has been assessed as **Moderate (-)** in each case (Almond 2020a-c, 2021), while all four proposed Hoogland Wind Farms as well as their Grid Connections have been assigned a **Medium (-)** impact significance regarding palaeontological heritage (Almond 2022a and 2022b).

Almond (2022a) has assessed that the overall impact significance may fall to **Low (-ve)** with full mitigation since impacts will then occur at a lower intensity and will be partially offset by valuable new scientific data, refer to Table 6. The analysis only applies *provided that* all the proposed monitoring and mitigation recommendations made for all these various projects are followed through. Unavoidable residual negative impacts may be partially offset by the improved understanding of Karoo palaeontology resulting from appropriate professional mitigation. This is regarded as a *positive* impact for Karoo palaeontological heritage.

Almond (2022a) concluded that the cumulative impacts on local fossil heritage anticipated for the various renewable energy projects in the Upper Karoo region south of Loxton – including the

proposed Hoogland and Nuweveld Wind Farms and their associated Grid Connections – fall within acceptable limits, *provided that* all recommended mitigation recommendations for these projects are followed through.

With regards to the Northern Cape watercourse crossing upgrades, the field-based findings as the basis of this PIA, will not be significant on their own to warrant a change in Almond's (2022a) cumulative impact ratings as shown in Table 6, and these ratings are therefore presented here.

Table 6: Assessment of potential cumulative palaeontological heritage impacts relating to the proposed Hoogland and Nuweveld Wind Farm and associated grid connection projects (Almond, 2022a).

Issue: Loss or degradation of local palaeontological heritage resources of scientific and / or conservation value		
Description of Impact		
Damage, disturbance, destruction or sealing-in of legally-protected, scientifically valuable fossil heritage at or beneath the ground surface within wind farm / grid connection project footprint, mainly due to ground clearance and excavations.		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	
Nature of cumulative impacts	Potential loss of a significant fraction of scientifically important, rare or unique, fossil heritage within the Palaeozoic bedrocks and Late Caenozoic superficial sediments in the Upper Karoo south of Loxton.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Medium -	Low -

12 FINDINGS AND RECOMMENDATIONS

The crossings are underlain by alluvium, Abrahamskraal Formation and Poortjie Member (Teekloof Formation) of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. According to the PalaeoMap of the South African Heritage Resources Information System the Palaeontological Sensitivity of the Adelaide Subgroup is Very High, that of the Cenozoic

Superficial deposits is Moderate and the Palaeontological Sensitivity of the Jurassic dolerite is Zero. Due to the Very High Sensitivity in the development area, a site visit was triggered.

In the last few decades extensive research and collecting have been conducted by palaeontologists in this part of the basin and the National Palaeontological databases indicate that the Loxton area is highly fossiliferous. A two day-site-specific field survey of the development footprint for the Northern Cape watercourse crossing upgrades was conducted on foot on 25 and 26 June 2022. A few fossiliferous sites were identified in the vicinity of the watercourse crossings. Many fossil taxa are known from only a single fossil and, thus, any fossil material is potentially highly significant. By implementing mitigation measures the significance of the impact will be reduced to low. A No-Go alternative for the road-crossings has been assessed as there is no alternatives to the existing road crossings. If mitigation measures are followed the upgrading of the watercourse crossings will not lead to detrimental impacts on the palaeontological reserves of the area and upgrade of the watercourse crossings may be authorised as part of the Northern Cluster Wind Farm development.

Recommendations:

- The Environmental Control Officer (ECO) for this project must be informed that sediments of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) have a Very High Palaeontological Sensitivity.
- Training of accountable supervisory personnel (ECO) by a qualified palaeontologist in the recognition of fossil heritage is very important and necessary.
- If Palaeontological Heritage is uncovered during surface clearing and excavations the Chance Finds Protocol attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources Agency (SAHRA) (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation (recording and collection) can be carried out.
- A well-preserved tetrapod skull and skeleton were observed near crossing DR02314-2&3 (-31.819436; 22.089300). Mitigation of this specimen is recommended.
- Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).
- These recommendations should be incorporated into the Environmental Management Programme for the proposed development.

.

13 CHANCE FINDS PROTOCOL

A following procedure will only be followed if fossils are uncovered during excavation.

13.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the National Heritage Resources Act (Act 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.

13.2 Background

A fossil is the naturally preserved remains (or traces) of plants or animals embedded in rock. These plants and animals lived in the geologic past 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.

13.3 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.

13.4 Chance Find Procedure

<table>
<tr><th colspan="3">HOOGLAND NORTHERN WIND FARM CLUSTER and GRID CONNECTION south of Loxton, Western Cape</th></tr>
<tr><td>Province & region:</td><td colspan="2">Western Cape (Central Karoo District): Beaufort West Local Municipality</td></tr>
<tr><td>Responsible Heritage Resources Agency</td><td colspan="2">Heritage Western Cape (Contact details: Heritage Western Cape. 3rd Floor Protea Assurance Building, 142 Longmarket Street, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 021 483 5959 Email: ceoheritage@westerncape.gov.za)</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Abrahamskraal & Teekloof Formations (Lower Beaufort Group), Late Caenozoic alluvium</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Fossil vertebrate bones, teeth, trace fossils including burrows, trackways, petrified wood, plant-rich beds in the Lower Beaufort Group bedrocks.
Fossil mammal bones, teeth, horn cores, freshwater molluscs, plant material in Late Caenozoic alluvium.</td></tr>
<tr><td rowspan="5">ECO/ESO protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
• Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
• Context – describe position of fossils within stratigraphy (rock layering), depth below surface
• Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
• Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation
• Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Agency for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
• Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
• Photograph fossils against a plain, level background, with scale
• Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
• Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
• Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Agency, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Agency</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Agency. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Agency minimum standards.</td></tr>
</table>

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APPENDIX A

ELIZE BUTLER

CURRICULUM VITAE

ELIZE BUTLER

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	29 years in Palaeontology
EDUCATION:	B.Sc Botany and Zoology, 1988
	University of the Orange Free State
	B.Sc (Hons) Zoology, 1991
	University of the Orange Free State
	Management Course, 1991
	University of the Orange Free State
	M. Sc. *Cum laude* (Zoology), 2009
	University of the Free State

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

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

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

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.

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	M.Sc. (Geology)	1977
	Ph.D. (Geochemistry)	1984

All degrees obtained at the University of the Free State.

Research

Research included the following visits:

1 Mineral Exploration Research Institute (Universities of Montréal and McGill) in Montréal (1986).
2 Study volcanic successions in Channel Islands, France, and Whales in 1986.
3 Visit Australia in 1988 to study gold deposits (Kalgoorlie).
4 Study gold deposits in Brazil in 1991.
5 Excursion to the active volcanoes of Sicily and the Aeolian islands (1994).
6 Mineral Resource Management (value tracking) symposium in Australia in 2002.
7 Excursion to study high-pressure metamorphic rocks in Turkey in 2005.
8 Excursion to northern Spain with students from Wales and South Africa 2008.
9 Attended workshop on gold mineralisation in Namibia (±2007).
10 Visited New Zealand in 2019 to investigate volcanological aspects of active volcanoes.

Research in southern Africa includes the Ventersdorp Supergroup, volcanology, mineralogy, geology of eastern Namaqualand, vanadium deposits in the Otavi Mountainland, Witwatersrand Supergroup and mineralisation.

Consulting work in South Africa, Namibia, Zimbabwe, and Malawi.

Author and co-author of more than 70 peer reviewed articles and more than 70 conference presentations at national and international level.

Positions held:

Employed by the University of the Free State since 1974. Started as technical assistant at the Institute for Groundwater Studies and then the Department of Geology. Promoted to X-ray fluorescence analyst in charge of the analytical laboratory and later to lecturer, senior lecturer, and associate professor.

Departmental chairperson (geology department) since 1998.

Professor and departmental chairperson from 2003 until 2013.

Supervised and co-supervised 16 M.Sc. students and 4 Ph.D. students. Involved with two more Ph.D. candidates.

Supervised 75 mini-dissertations from MRM (mineral resource management) students.

Retired end of 2015.

Appointed part-time 2016 – 2018.

Teaching

Taught courses in mineral exploration, geochemical exploration, economic geology, and analytical techniques (geochemistry).

Introduced a course in Mineral Resource Management at the University of the Free State in 2000 in collaboration with private sector (Comparex, now Business Connection) and Kumba.

Societies

Member of the following societies:

Fellow of the Geological Society of SA.

Archaeological Society of SA.

International Association of Volcanology and Chemistry of the Earth's Interior.

Spectroscopic Society of SA.

International Liaison Group on Gold Mineralisation.

Chairman Maccauw Gun Club (clay target shooting) for four years.

Registered as a professional scientist.

Most of above lapsed since retiring.

Business

Director Woodland Hills Wildlife Estate from 2001 until present (property development on the outskirts of Bloemfontein (includes houses, sectional title units and hospital).

Trustee of the Hillandale Homeowners association since inception (chairperson for four years).

Director and chairperson of the board of Hillandale Hospital (property investment and a private company leases the buildings.

Conducted some geotechnical and environmental work for Woodland Hills Wildlife Estate.

APPENDIX B

SLR IMPACT ASSESSMENT METHODOLOGY

The impacts of the proposed development (during the Construction, Operation and Decommissioning phases) are to be assessed and rated according to the methodology described below and which was developed by SLR to align with the requirements of the EIA Regulations.

Specialists will be required to make use of the impact rating matrix provided (in Excel format) for this purpose.

The criteria used to assess both the impacts and the method of determining the significance of the impacts is outlined in Table 1. This method complies with the method provided in the EIA guideline document (GN 654 of 2010). Part A provides the definitions of the criteria and the approach for determining impact consequence (combining intensity, extent and duration). In Part B, a matrix is applied to determine this impact consequence. In Part C, the consequence rating is considered together with the probability of occurrence in order to determine the overall significance of each impact. Lastly, the interpretation of the impact significance is provided in Part D.

Table 1: Impact Assessment Methodology

PART A: DEFINITIONS AND CRITERIA		
Determination of CONSEQUENCE	**Consequence is a function of intensity, spatial extent and duration**	
Determination of SIGNIFICANCE	**Significance is a function of consequence and probability**	
Criteria for ranking of the INTENSITY of environmental impacts	**Very High**	Severe change, disturbance or degradation caused to receptors. Associated with severe consequences. May result in severe illness, injury or death. Targets, limits and thresholds of concern continually exceeded. Substantial intervention will be required.
	High	Prominent change, or large degree of modification, disturbance or degradation caused to receptors or which may affect a large proportion of receptors, possibly entire species or community.
	Medium	Moderate change, disturbance or discomfort caused to receptors and/or which may affect a moderate proportion of receptors.
	Low	Minor (slight) change, disturbance or nuisance caused to receptors which is easily tolerated without intervention, or which may affect a small proportion of receptors.
	Very Low	Negligible change, disturbance or nuisance caused to receptors which is barely noticeable or may have minimal effect on receptors or affect a limited proportion of the receptors.
Criteria for ranking the DURATION of impacts	**Very Short-term**	The duration of the impact will be < 1 year or may be intermittent.
	Short-term	The duration of the impact will be between 1 - 5 years.
	Medium-term	The duration of the impact will be Medium-term between, 5 to 10 years.
	Long-term	The duration of the impact will be Long-term, between 10 and 20 years. (Likely to cease at the end of the operational life of the activity).
	Permanent	The duration of the impact will be permanent
Criteria for ranking the	**Site**	Impact is limited to the immediate footprint of the activity and immediate surrounds within a confined area.

EXTENT of impacts	**Local**	Impact is confined to within the project site / area and its nearby surroundings.
	Regional	Impact is confined to the region, e.g., coast, basin, catchment, municipal region, district, etc.
	National	Impact may extend beyond district or regional boundaries with national implications.
	International	Impact extends beyond the national scale or may be transboundary.

PART B: DETERMINING CONSEQUENCE						
		EXTENT				
		Site	Local	Regional	National	International
Intensity- Very Low						
DURATION	Permanent	**Low**	**Low**	**Medium**	**Medium**	**High**
	Long-term	**Low**	**Low**	**Low**	**Medium**	**Medium**
	Medium-term	**Very Low**	**Low**	**Low**	**Low**	**Medium**
	Short-term	**Very low**	**Very Low**	**Low**	**Low**	**Low**
	Very Short-term	**Very low**	**Very Low**	**Very Low**	**Low**	**Low**
Intensity -Low						
DURATION	Permanent	**Medium**	**Medium**	**Medium**	**High**	**High**
	Long-term	**Low**	**Medium**	**Medium**	**Medium**	**High**
	Medium-term	**Low**	**Low**	**Medium**	**Medium**	**Medium**
	Short-term	**Low**	**Low**	**Low**	**Medium**	**Medium**
	Very Short-term	**Very low**	**Low**	**Low**	**Low**	**Medium**
Intensity- Medium						
DURATION	Permanent	**Medium**	**High**	**High**	**High**	**Very High**
	Long-term	**Medium**	**Medium**	**Medium**	**High**	**High**
	Medium-term	**Medium**	**Medium**	**Medium**	**High**	**High**
	Short-term	**Low**	**Medium**	**Medium**	**Medium**	**High**
	Very Short-term	**Low**	**Low**	**Low**	**Medium**	**Medium**
Intensity -High						
DURATION	Permanent	**High**	**High**	**High**	**Very High**	**Very High**
	Long-term	**Medium**	**High**	**High**	**High**	**Very High**
	Medium-term	**Medium**	**Medium**	**High**	**High**	**High**
	Short-term	**Medium**	**Medium**	**Medium**	**High**	**High**
	Very Short-term	**Low**	**Medium**	**Medium**	**Medium**	**High**
Intensity - Very High						
DURATION	Permanent	**High**	**High**	**Very High**	**Very High**	**Very High**

	Long-term	**High**	**High**	**High**	**Very High**	**Very High**
	Medium-term	**Medium**	**High**	**High**	**High**	**Very High**
	Short-term	**Medium**	**Medium**	**High**	**High**	**High**
	Very Short-term	**Low**	**Medium**	**Medium**	**High**	**High**
		Site	Local	Regional	National	International
		EXTENT				

PART C: DETERMINING SIGNIFICANCE						
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**Very Low**	**Low**	**Medium**	**High**	**Very High**
	Probable	**Very Low**	**Low**	**Medium**	**High**	**Very High**
	Possible/ frequent	**Very Low**	**Very Low**	**Low**	**Medium**	**High**
	Conceivable	**Insignificant**	**Very Low**	**Low**	**Medium**	**High**
	Unlikely/ improbable	**Insignificant**	**Insignificant**	**Very Low**	**Low**	**Medium**
		Very Low	Low	Medium	High	Very High
		CONSEQUENCE				

PART D: INTERPRETATION OF SIGNIFICANCE		
Very High -	Very High +	Represents a key factor in decision-making. In the case of adverse effects, the impact would be considered a fatal flaw unless mitigated to lower significance.
High -	High +	These beneficial or adverse effects are considered to be very important considerations and are likely to be material for the decision-making process. In the case of negative impacts, substantial mitigation will be required.
Medium -	Medium +	These beneficial or adverse effects may be important but are not likely to be key decision-making factors. The cumulative effects of such issues may become a decision-making issue if leading to an increase in the overall adverse effect on a particular resource or receptor. In the case of negative impacts, mitigation will be required.
Low -	Low +	These beneficial or adverse effects may be raised as localised issues. They are unlikely to be critical in the decision-making process but could be important in the subsequent design of the project. In the case of negative impacts, some mitigation is likely to be required.
Very Low -	Very Low +	These beneficial or adverse effects will not have an influence on the decision, neither will they need to be taken into account in the design of the project. In the case of negative impacts, mitigation is not necessarily required.
Insignificant		Any effects are beneath the levels of perception and inconsequential, therefore not requiring any consideration.

The specialists are also required to include a comment on the following, the degree to which the impact:

1. Can be reversed;
2. May cause irreplaceable loss of resources; and
3. Can be avoided, managed or mitigated.