



**PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE 490M MV POWERLINE FOR
MOGOHLWANENG VILLAGE, IN THE MORETELE LOCAL MUNICIPALITY OF BOJANALA
DISTRICT MUNICIPALITY, NORTH WEST PROVINCE**

SAHRA CaseID: CaselD: 16507

Compiled for:
NCC Environmental Services (Pty) Ltd
26 Bell Close
Westlake Business Park
Westlake
Cape Town

Prepared by
Banzai Environmental
August 2021

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:

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Email: info@Banzai-group.com

SIGNATURE:

A handwritten signature in black ink, appearing to read 'Elize Butler', is positioned to the right of the 'SIGNATURE:' label.

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 1 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 2 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 1-2 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 environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 10	
(k) Any mitigation measures for inclusion in the EMPr	Section 1 and 10	
(l) Any conditions for inclusion in the environmental authorisation	Desktop Study	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Desktop Study	
(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 11	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by **NCC Environmental Services (Pty) Ltd** to conduct the Palaeontological Desktop Assessment to assess a 490m MV powerline for Mogohlwaneng village in the Moretele Local Municipality, Bojanala District Municipality, North West Province. In accordance with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PDA is necessary to confirm if fossil material could potentially be present in the planned development area and to evaluate the impact of the proposed development on the Palaeontological Heritage.

The proposed electrification project is entirely underlain by the Clarence Formation of the Stormberg group (Karoo Supergroup). According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Clarence Formation is High (Almond *et al*, 2013; SAHRIS website). Although a high Palaeontological Sensitivity has been allocated to the Clarence Formation in the North West Province surface exposure is poor and generally data is acquired from borehole cores (Groenewald *et al*, 2014). The Palaeontological Significance allocated to the proposed development is medium. It is therefore considered that the electrification project may proceed and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction of the electrification project may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

However, if fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Officer (EO) in charge of these developments. These discoveries ought to be protected and the EO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carry out by a paleontologist.

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

TABLE OF CONTENT

1	INTRODUCTION.....	8
2	QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR	8
3	LEGISLATION	11
3.1	National Heritage Resources Act (25 of 1999)	11
4	OBJECTIVE.....	12
5	GEOLOGICAL AND PALAEOLOGICAL HISTORY	14
6	GEOGRAPHICAL LOCATION OF THE SITE	19
7	METHODS	19
7.1	Assumptions and Limitations	19
8	ADDITIONAL INFORMATION CONSULTED	19
9	IMPACT ASSESSMENT METHODOLOGY AND HIERARCHY	20
9.1	Impact Rating System	20
9.2	Summary of Impacts	23
10	FINDINGS AND RECOMMENDATIONS.....	24
11	CHANCE FINDS PROTOCOL.....	24
11.1	Legislation	24
11.2	Background	25
11.3	Introduction	25
11.4	Chance Find Procedure	25
12	REFERENCES	26

List of Figures

Figure 1: Google Earth Hybrid Image (2020) of the proposed electrification project in Mogohlwaneng village on Portion 3 Syferkuil 15-JR in Moretele Local Municipality of Bojanala District Municipality of North West Province. The project is indicated in blue. The project is indicated in blue..... 9

Figure 2: Locality of the proposed electrification project in Mogohlwaneng village on Portion 3 Syferkuil 15-JR in Moretele Local Municipality of Bojanala District Municipality of North West Province. The project is indicated in blue..... 10

Figure 3: Extract of the 1:250 000 2528 Pretoria Geological Map (1978) (Council of Geosciences, Pretoria) indicating the proposed electrification project of a Borehole in Mogohlwaneng village on Portion 3 Syferkuil 15-JR in Moretele Local Municipality of Bojanala District Municipality of North West Province. The proposed development is indicated in blue and is completely underlain by the Clarence Formation (T_R) of the Karoo Supergroup..... 16

Figure 4: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences). Approximate location of the proposed development is indicated in blue. 18

List of Tables

Table 1: NEMA Table..... 3

Table 2: The rating system..... 20

Appendix A: CV

1 INTRODUCTION

Eskom Holdings SOC Ltd, intends to electrify the new 490m MV which will be connected from pole number WP191/62 and will supply a borehole in Mogohlwaneng village on Portion 3 Syferkuil 15-JR in Moretele Local Municipality of Bojanala District Municipality of North West Province (Figure 1-2). **NCC Environmental Services (Pty) Ltd** was appointed to oversee the Palaeontological Desktop Assessment requested by SAHRA (CaseID: 16507).

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

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



Figure 1: Google Earth Hybrid Image (2020) of the proposed electrification project in Mogohlwaneng village on Portion 3 Syferkuil 15-JR in Moretele Local Municipality of Bojanala District Municipality of North West Province. The project is indicated in blue.

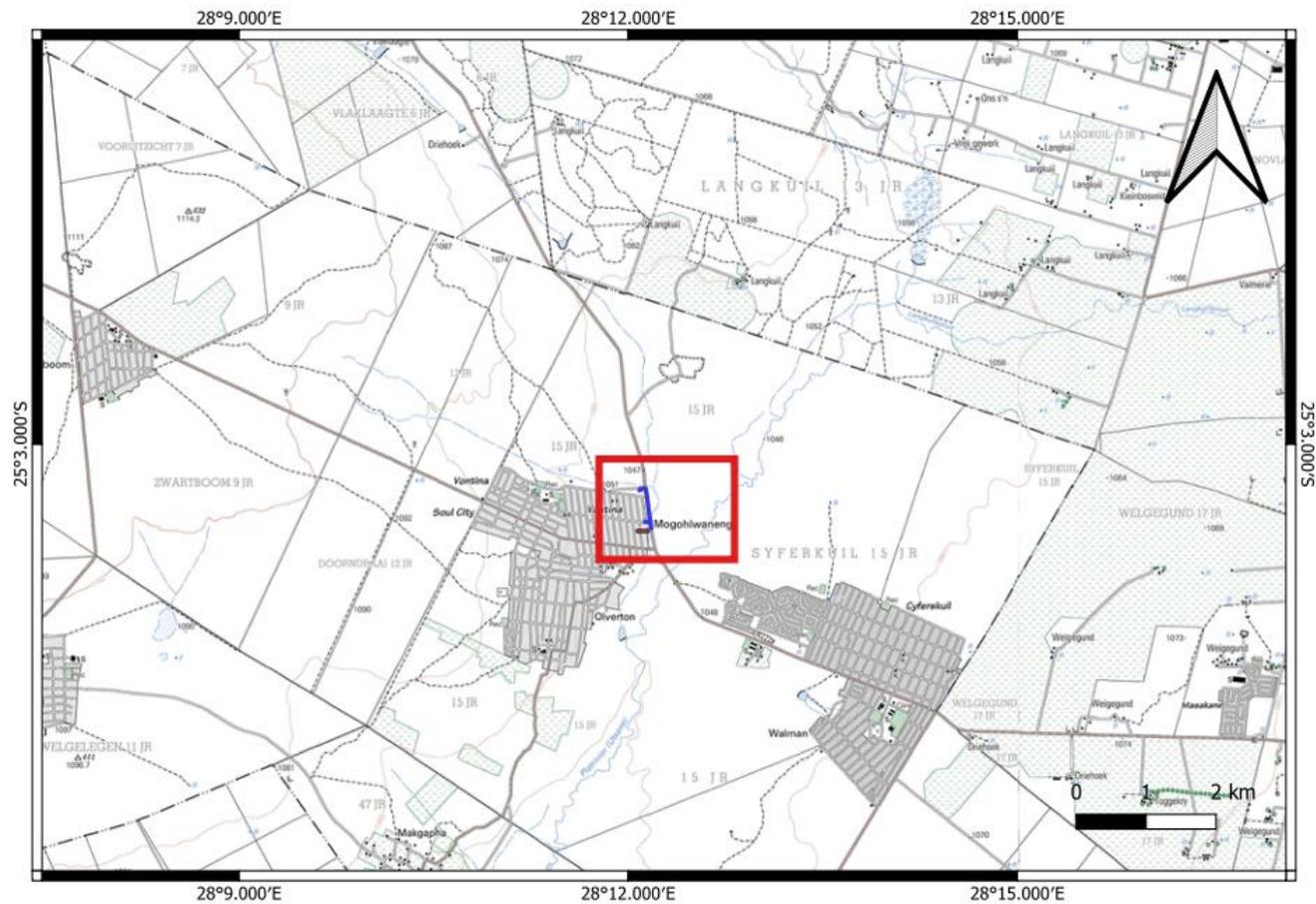


Figure 2: Locality of the proposed electrification project in Mogohlwane village on Portion 3 Syferkuil 15-JR in Moretele Local Municipality of Bojanala District Municipality of North West Province. The project is indicated in blue.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

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

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

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

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

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

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

National Heritage Resources Act (NHRA) Act 25 of 1999

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

MPRDA Regulations of 2014

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

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

The NEMA (No 107 of 1998) states that an integrated EMP should (23:2 (b)) “...*identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage*”.

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

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

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

4 OBJECTIVE

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

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

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

The terms of reference of a PIA are as follows:

General Requirements:

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

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

5 GEOLOGICAL AND PALAEOONTOLOGICAL HISTORY

The proposed electrification project in Mogohlwaneng village on Portion 3 Syferkuil 15-JR in Moretele Local Municipality of Bojanala District Municipality, North West Province is indicated in the 1:250 000 2528 Pretoria Geological Map (1978) (Council of Geosciences) (Figure 3) and is underlain by the Clarence Formation of the Stormberg Group. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Clarence Formation is High (Almond *et al*, 2013; SAHRIS website; Figure 4).

The Lower Jurassic Clarens Formation is dominated by sandstones. This Formation is underlain by the red beds of the Elliot Formation and overlying flood basalts of the Drakensberg/Lebombo Groups. The Clarence Formation is the youngest unit of the Stormberg Group (upper Karoo Supergroup) and is categorized by the presence of cream or pink, white, fine-grained sandstone as well as silty sandstone beds. Fossils from this formation is relatively diverse and has a wide geographical distribution. Vertebrate and invertebrate fossils are better known from the more accessible lower portion of the Formation. Known fossils include insects, freshwater crustaceans, freshwater fish (*Semionotus capensis*), cynodonts, crocodylomorphs, as well as sauropodomorphs and ornithischian dinosaurs (e.g., Houghton, 1924; Jubb, 1973; Forey and Gardiner, 1973; Tasch, 1984; Kitching and Raath, 1984; Knoll, 2005).

Invertebrate trace fossils are generally plain, straight to gently curved and unbranched. Gastropod trails as well as trackways of arthropods and even tetrapods, particularly dinosaurs, have been described, Houghton, 1924; Ellenberger, 1970; van Eeden and Keyser, 1971; van Dijk, 1978; Eriksson, 1981; Olsen and Galton, 1984.

The Irrigasie Formation is present west of the proposed project. This Formation comprise of brownish-red mudstone with green mottling. A change of color occurs towards the base when the sediments change to purple with a thin grey mudstone zone with shale directly above the Coal Zone. Sandston of up to 45m is generally present within the purple and grey mudrock. This unit includes sequences of conglomerate grade upwards into siltstone or erosive base fining upwards. This Formation ma reach a

maximum thickness of approximately 200m (Johnson *et al.*, 2006). This Formation was deposited by sluggish, ephemeral suspension-load rivers and demonstrate extensive bioturbation by trace fossils. Dinosaur fossils have been uncovered and is possibly remains of “Euskelesaurus” while remains of the so-called *Gigantoscelus* have also been found. The latter is an intermediate sauropod that may come from the Clarens Formation.

The Karoo Igneous Province lies east of the proposed development and contains a large volume of flood basalts as well as silicic volcanic rocks. These units comprise of rhyodacite and rhyolitic magma and crops out along the Lebombo monocline. Individual units span up to 60 km and sometimes show massive pyroclastic structures and classified as rheoignimbrites. The basal lavas lie conformable on the Clarens Formation but in specific localities sandstone erosion occurred before the volcanic eruptions took place. Lock *et al* (1974) found that in the early stages of volcanism magma interacted with ground water to produce volcanoclastic deposits as well as phreatic and phreatomagmatic diatremes. In 1984 Eales *et al* found evidence of aqueous environments during early volcanism by the existence of pillow lavas and associated hyaloclastite breccias and thin lenses of fluvial sandstones interbedded with the lowermost magmas. This Suite is unfossiliferous.

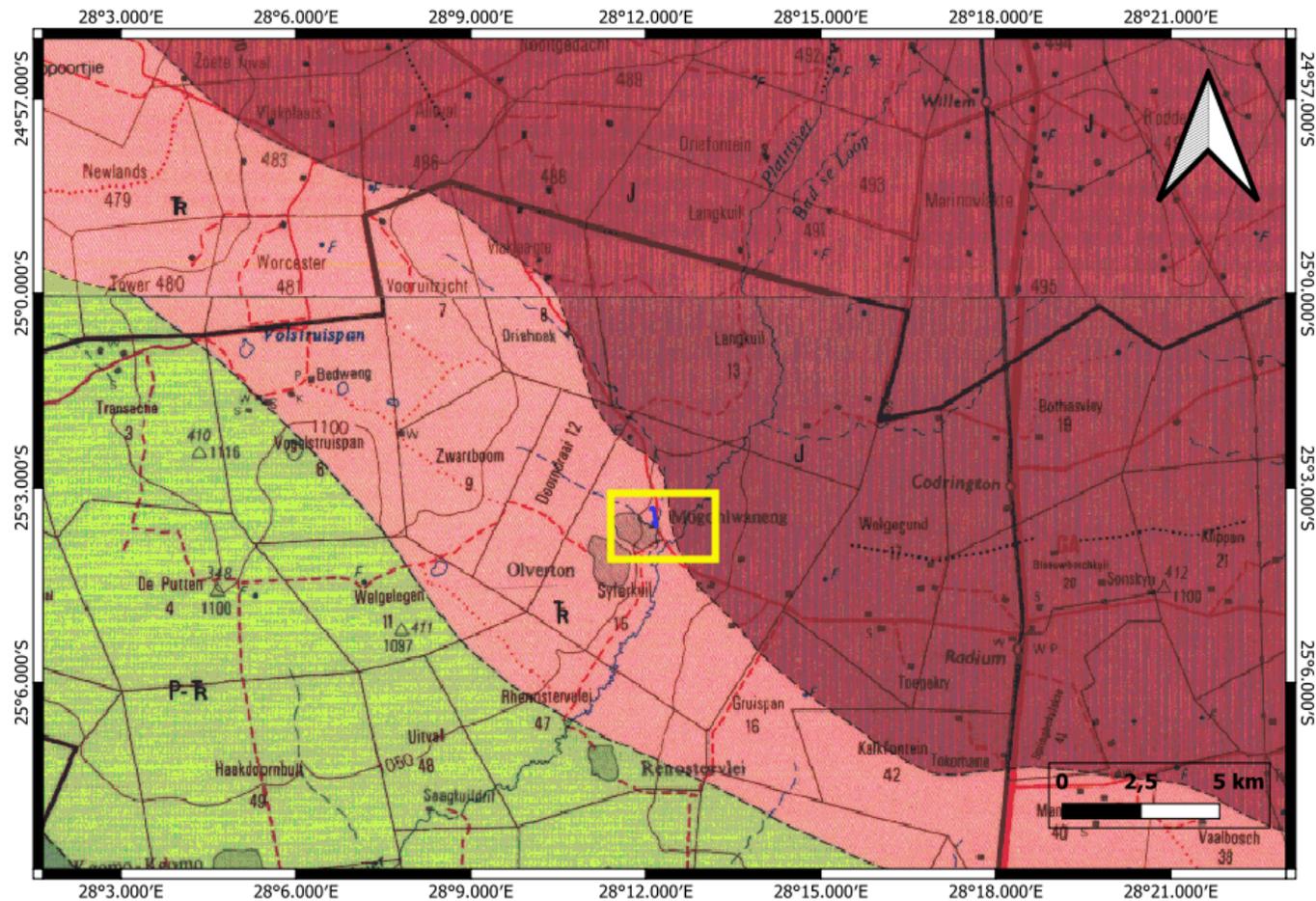
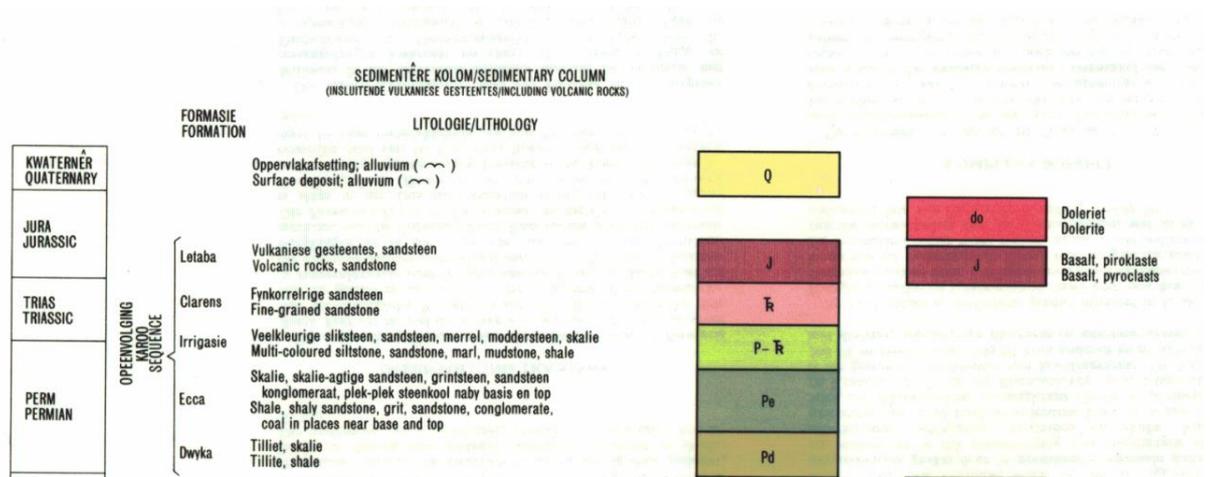


Figure 3: Extract of the 1:250 000 2528 Pretoria Geological Map (1978) (Council of Geosciences, Pretoria) indicating the proposed electrification project of a Borehole in Mogohlwaneng village on Portion 3 Syferkuil 15-JR in Moretele Local Municipality of Bojanala District Municipality of North West Province. The proposed development is indicated in blue and is completely underlain by the Clarence Formation (TR) of the Karoo Supergroup.

Legend and short explanation of the 1:250 000 2528 Pretoria Geological Map (1978) (Council of Geosciences)



Abbreviation	Group/Formation (Fm)	Lithology
J (maroon)	Jurassic Basalt, Letaba Formation	Basalt, pyroclasts
Tr (pink)	Clarence Formation of the Karoo Supergroup	Fine-grained sandstone
P-Tr (light green)	Irrigasie Formation, Karoo Supergroup	Multi colored siltstone, sandstone, marl, mudstone and shale

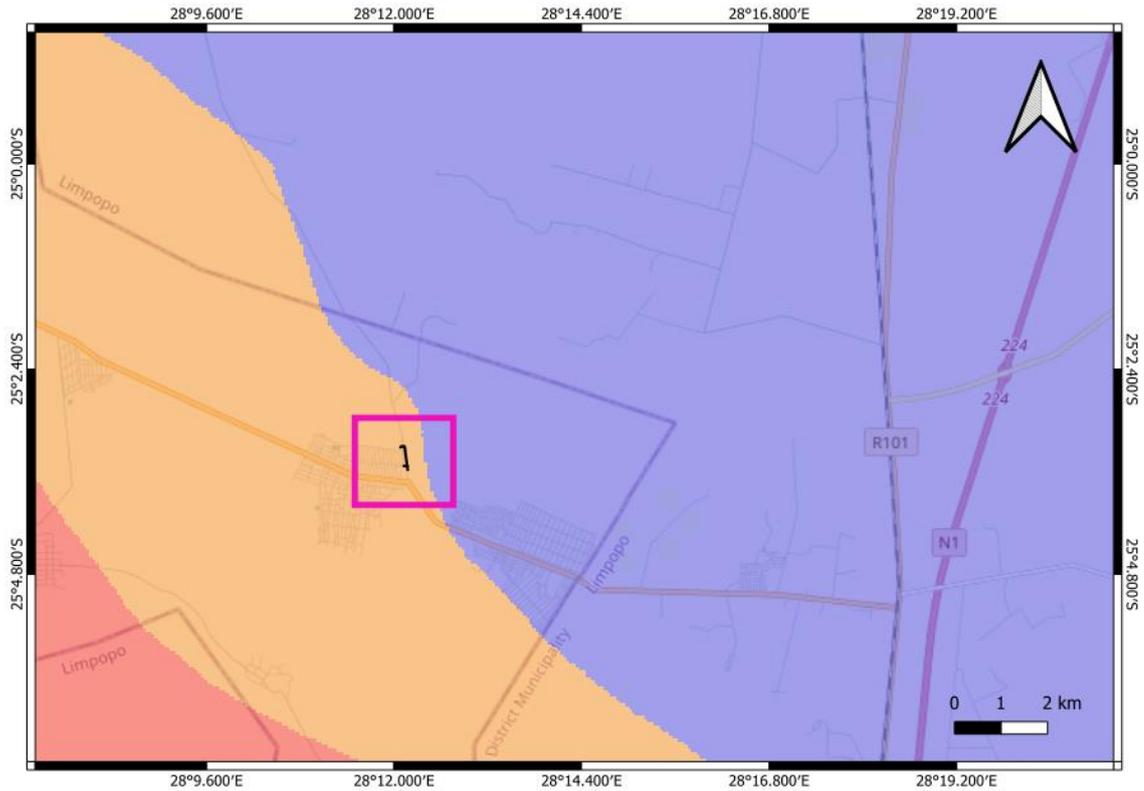


Figure 4: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences).
Approximate location of the proposed development is indicated in blue.

Colour	Sensitivity	Required Action
RED	VERY HIGH	Field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

According to the SAHRIS PalaeoSensitivity map (Figure 4) there is High chance of finding fossils in this area. But according to the Palaeotechnical Report of the North West Province (Groenewald et al, 2014). Surface exposure is poor and generally data is acquired from borehole cores.

6 GEOGRAPHICAL LOCATION OF THE SITE

Study Area GPS Coordinates -	Northern point: Borehole S - 25.055311° E - 28.201457°	Southern point: Pole number WP191/62 S - 25.059697° E - 28.201457°
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7 METHODS

A desktop study was assembled to evaluate the possible risk to palaeontological heritage (this includes fossils as well as trace fossils) in the proposed development area. In compiling the desktop report aerial photos, Google Earth 2020, topographical and geological maps and other reports from the same area as well as the author's experience were used to assess the proposed development footprint.

7.1 Assumptions and Limitations

The accuracy of Palaeontological Desktop Assessments is reduced by several factors which may include the following: the databases of institutions are not always up to date and relevant locality and geological information were not accurately documented in the past. Various remote areas of South Africa have not been assessed by palaeontologists and data is based on aerial photographs alone. Geological maps concentrate on the geology of an area and the sheet explanations were never intended to focus on palaeontological heritage.

Similar Assemblage Zones, but in different areas is used to provide information on the presence of fossil heritage in an unmapped area. Desktop studies of similar geological formations and Assemblage Zones generally **assume** that exposed fossil heritage is present within the development area. The accuracy of the Palaeontological Impact Assessment is thus improved considerably by conducting a field-assessment.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- The Palaeosensitivity Map from the SAHRIS website.
- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- 1:250 000 2528 Pretoria Geological Map (1978) (Council of Geosciences)

9 IMPACT ASSESSMENT METHODOLOGY AND HIERARCHY

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.
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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
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

(Extent (1) + probability (3) + reversibility (4) + irreplaceability (4) + duration (4) + cumulative effect (1)) x magnitude/intensity (2) = 34.

The impact on Fossil Heritage is DIRECT NEGATIVE. Only the study site will be affected by the proposed development. The expected duration of the impact is assessed as potentially permanent. The impact is highly destructive but will only occur during the construction phase. The significance of the impact occurring will be **medium**. As fossil heritage will be destroyed the impact is **irreversible** but the degree to which the impact can cause irreplaceable loss of resources is Moderate if proper mitigation is to undertaken.

10 FINDINGS AND RECOMMENDATIONS

The proposed electrification project is entirely underlain by the Clarence Formation of the Stormberg group (Karoo Supergroup). According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Clarence Formation is High (Almond *et al*, 2013; SAHRIS website). Although a high Palaeontological Sensitivity has been allocated to the Clarence Formation in the North West Province surface exposure is poor and generally data is acquired from borehole cores (Groenewald *et al*, 2014). The Palaeontological Significance allocated to the proposed development is medium. It is therefore considered that the electrification project may proceed and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction of the electrification project may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

However, if fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Officer (EO) in charge of these developments. These discoveries ought to be protected and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carry out by a paleontologist.

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

11 CHANCE FINDS PROTOCOL

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

11.1 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.

11.2 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.

11.3 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.

11.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a

3) description of the fossil and its context (depth and position of the fossil), GPS coordinates.

- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO (site manager). Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

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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 *Daptocephalus 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

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