PALAEONTOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED NBC COLLIERY GLISA AND PAARDEPLAATS MINING PROJECTS NEAR EMAKHAZENI (BELFAST), IN MPUMALANGA

Compiled for:

Commodity Inspections Group (Pty) Ltd
PO Box 90482
Bertsham
2013

Prepared by
Banzai Environmental
31 August2021

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

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

Disclosure of Vested Interest

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

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

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SIGNATURE: 

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	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum 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 10	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1 and 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 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 11	
(g) An identification of any areas to be avoided, including buffers	None Section 1 and 11	
(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	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(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 12	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 12	
(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 will be conducted as part of the EIA and EMPr process.
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(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 Commodity Inspections Group (Pty) Ltd (CIGroup) to conduct the Palaeontological Impact Assessment (PIA) to assess the Proposed Realignment of the D 2809 Provincial Road as well as the Mining Right Application for the Glisa and Paardeplaats Sections of the NBC Colliery (NBC) near Belfast (eMakhazeni), eMakhazeni Local Municipality, Nkangala District Municipality, Mpumalanga Province. To comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PIA is necessary to verify if fossil material could potentially be present in the planned road alignment and Mining right Application and to evaluate the impact of the proposed development on the Palaeontological Heritage.

The proposed development is primarily underlain by the Permian Vryheid Formation of the Ecca Group (Karoo Supergroup) while two isolated patches of Quaternary alluvium is also present. According to the South African Heritage Resources Information System, the Palaeontological Sensitivity of the Vryheid Formation is Very High. This Formation is known for its rich assemblage of Glossopteris flora which is the source vegetation for this formation. Fish scales, non-marine bivalves and trace fossils are found in this formation.

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 21 August 2021. No visible evidence of fossiliferous outcrops was identified. For this reason, an overall low palaeontological sensitivity is allocated to the development footprint. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the proposed development will be of a low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area. 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.

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

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1 INTRODUCTION

The following information was provided by CIGroup

1.1 The Section 102 Consolidation and IEA application focus on the following:

- Consolidation of the Glisa Section MR and Environmental Management Plan (EMP) into the Paardeplaats Section (MP 30/5/1/2/2/10090 MR);
- Inclusion of Portion 24 of the farm Paardeplaats 380 JT into the Paardeplaats Section MR; and
- IEA for listed activities triggered in terms of the NEMA and NEMWA within the MR areas and Portion 24 of the farm Paardeplaats 380 JT.

1.2 Changes to existing infrastructure:

- Expansion of the Crushing, Screening and Washing Plant (CSWP) on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- Expansion of the existing Water Treatment Plant (WTP) pipeline network on all farm portions associated with the Integrated Paardeplaats Section; and
- Widening of haul roads between the mining sections and processing plants.

A Palaeontological Desktop assessment was conducted for the project in May 2021 by the author (Butler, 2021). The study found that the proposed development is underlain by the Vryheid Formation of the Ecca Group (Karoo Supergroup) as well as two isolated patches of Quaternary Alluvium. The South African Heritage Resources Information System indicates that the Vryheid Formation if the proposed development is in an area of very high Palaeontological Sensitivity and a full Environmental Impact Assessment (EIA) was recommended. This study is a result of the recommendation.

1.3 Project description

NBC consists of three (3) mining sections namely the Eerstelingsfontein Section, the Glisa Section, and the Paardeplaats Section. The focus of this report will be on the Glisa and Paardeplaats Sections (Error! Reference source not found. **-** Error! Reference source not found.**).**

A total of thirteen (13) farm portions relate to the Integrated Paardeplaats Section. Portion 1, 2, 3, 4, and 5 of the farm Paardeplaats 380 JT, apply to the Glisa Section MR, whilst the Remaining Extent of Portion 13, Portion 28, 29, 30 and 40 of the farm Paardeplaats 380 JT, and the Remaining Extent (RE) and Portion 2 of the farm Paardeplaats 425 JS, apply to the Paardeplaats Section.

Portion 24 of the farm Paardeplaats 380 JT is the additional portion being requested through this process.

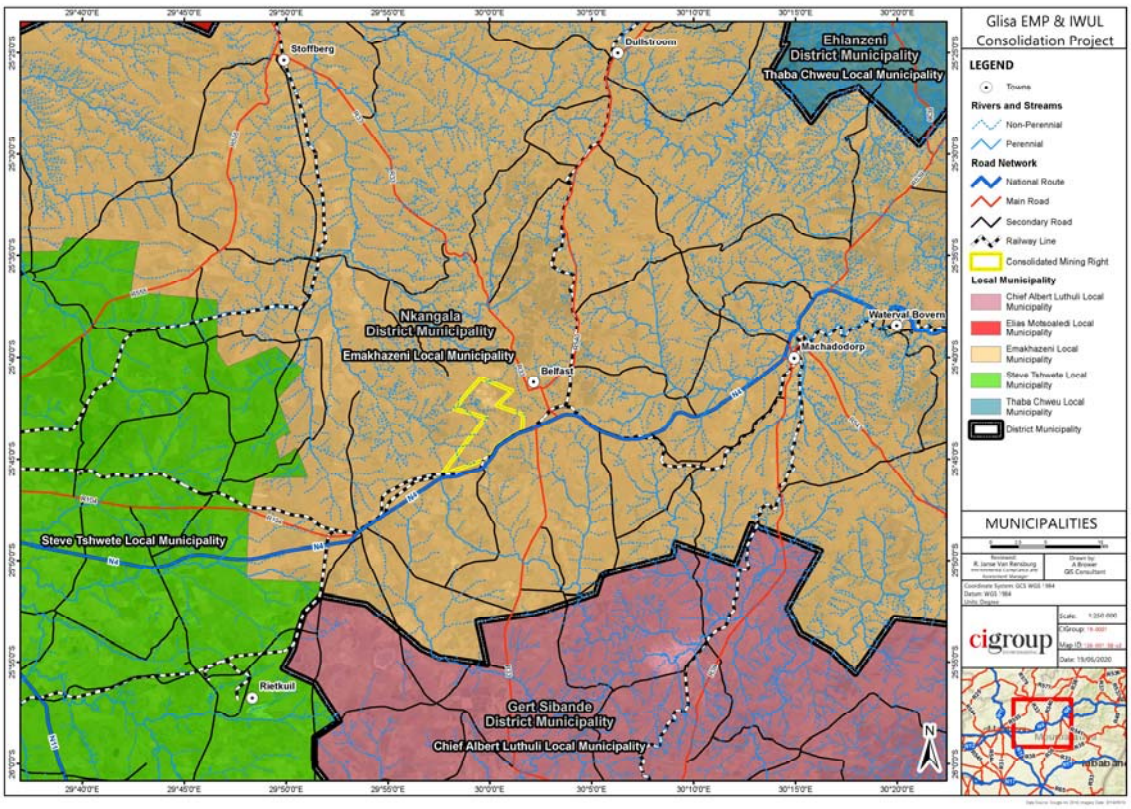


Figure 1: Municipal Location of the NBC Glisa, Paardeplaats and Eerstelingsfontein Sections.

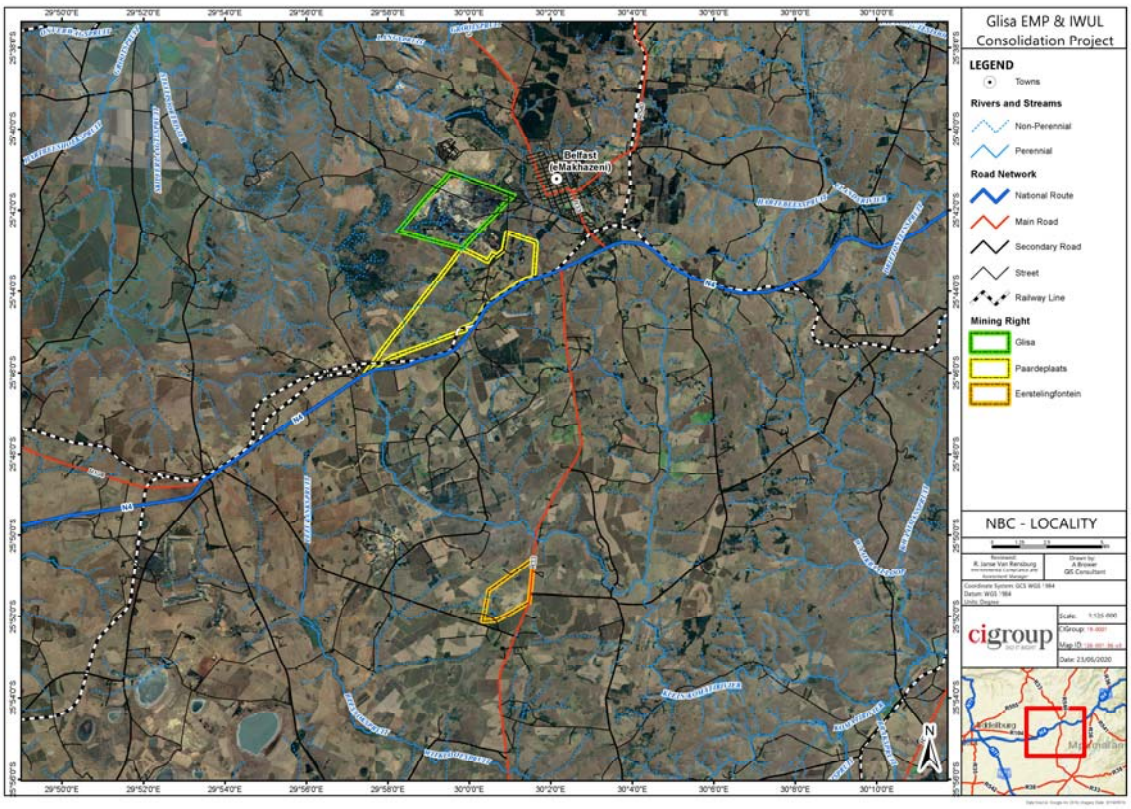


Figure 2: Location of the NBC Glisa, Paardeplaats and Eerstelingsfontein Sections.

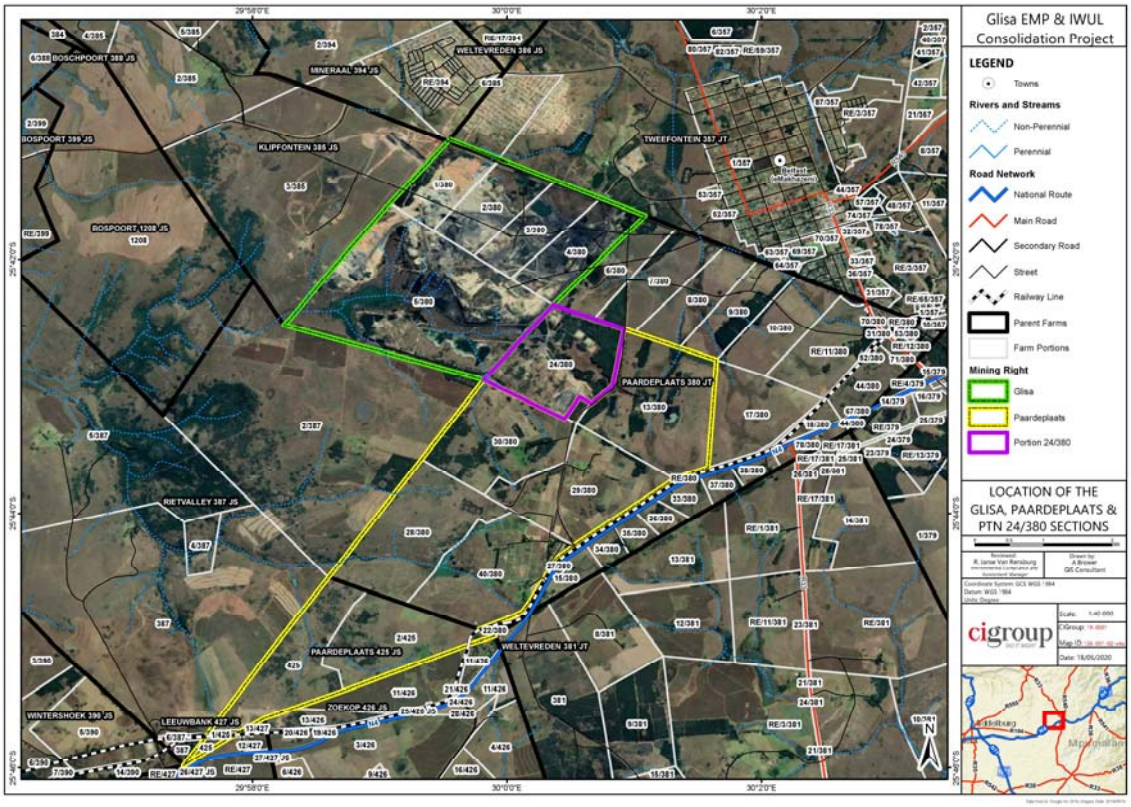


Figure 3:Location of the Glisa Section, Paardeplaats Section and Portion 24.

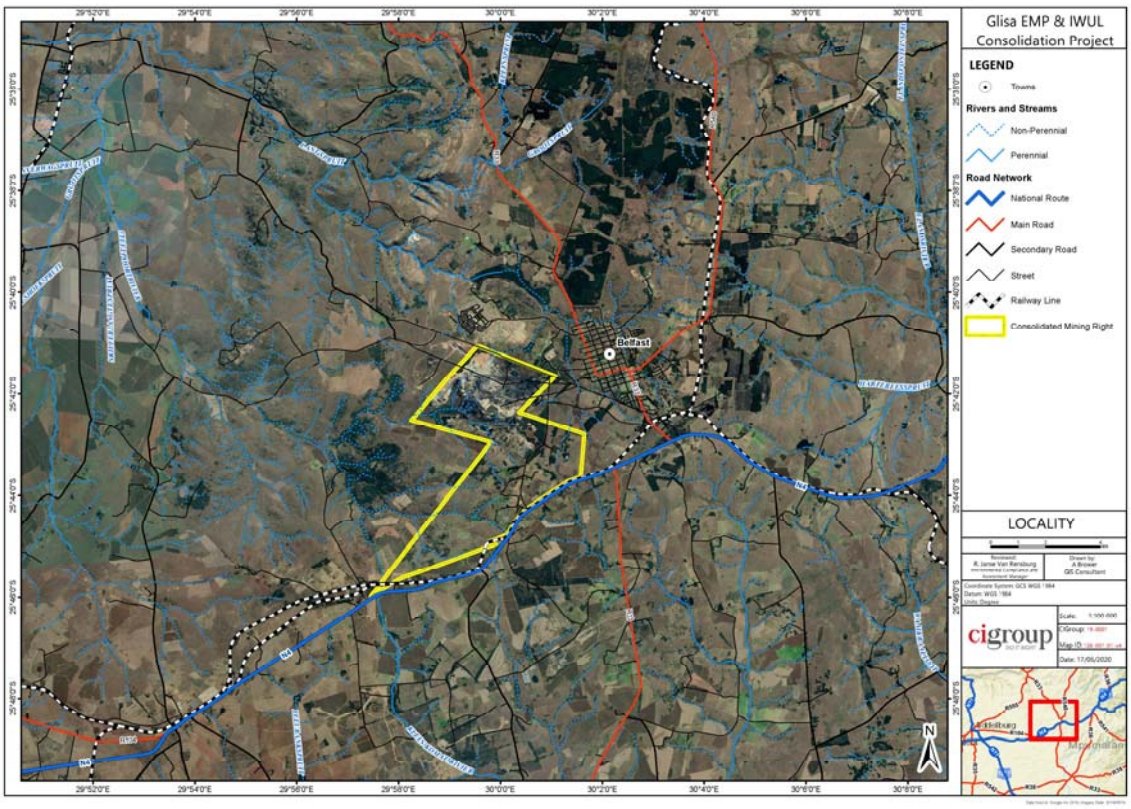


Figure 4: Location of the Integrated Paardeplaats Section.

1.4 Current Activities

1.4.1 Glisa Section

Mining started at the Glisa Section in 1890 using underground mining methods. From 2006 mining was undertaken by opencast mining methods with underground pillars being reclaimed. This opencast mining method is still in force at the Glisa Section. Coal is crushed and screened at stationary plants whilst other coal products are processed at the main Crushing, Screening and Washing Plant (CSWP) located in the Glisa Section. In addition to mining and coal processing, the Glisa Section also consists of infrastructure such as roads, offices, workshops, stockpiles, pipelines, and a Water Treatment Plant (WTP).

NBC has an existing supply agreement with Eskom to supply steady and secure coal for selected Eskom coal fired power stations. The Glisa Section has been the source of this coal for many years; however, the Glisa Section Life of Mine (LoM) is nearing its end and a resultant reduction in Run of Mine (RoM) coal is occurring. In order to meet its contractual obligations to Eskom, NBC intend to supply Eskom with coal from the adjoining Paardeplaats Section.

NBC, through the utilisation of the Glisa Section infrastructure, intends to limit the disturbance of additional natural areas in the Paardeplaats Section. In so doing, the utilisation of the existing

infrastructure at the Glisa Section is paramount. Existing infrastructure at the Glisa Section is licensed in terms of the MPRDA and the NEMA and all of the existing infrastructure at the Section will continue to be used in support of mining activities in the Integrated Paardeplaats Section. The infrastructure that will continued to be used and which does not require licensing in terms of this application includes, the following (Error! Reference source not found.):

- RoM stockpile areas at the crushing and screening plants, e.g. Gijima, and the main CSWP;
- Product stockpiles at the crushing and screening plants and main CSWP;
- Haul roads, including existing river diversions, culverts, and drains;
- Stormwater management infrastructure, including existing dams and channels;
- Magazine and explosives area;
- Workshops, administrative offices, mining contractor offices, and security offices, including ablution facilities, septic tanks, and French drains;
- Fuel bays, above and below ground diesel storage tanks, wash bays, and salvage areas; and
- Waste management areas.

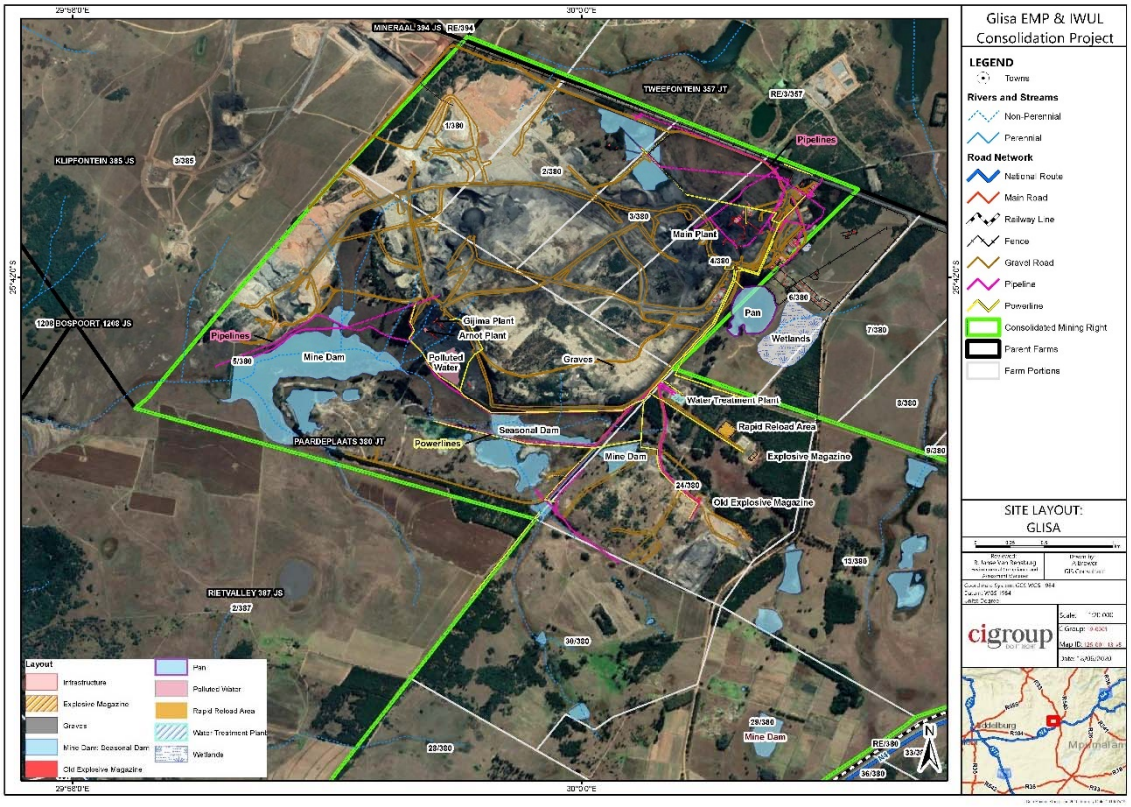


Figure 5: Existing Infrastructure Layout at the Glisa Section.

1.4.2 Water Treatment Plant

The WTP for the Glisa Section spans an area of approximately 0.67 ha on Portion 24 of Paardeplaats 380JT and is fully operational. The design treatment capacity of the WTP is 1.5 megalitres per day (Ml/d) on average over a 30-day cycle, equating to an average of 62.5 cubic metres per hour (m^3/h). Proxa designed and constructed the WTP on behalf of the previous mine owner, Exxaro, and have been operating the WTP since 2017. The WTP processes entail chemical precipitation in combination with Ultrafiltration (UF) and Reverse Osmosis (RO) technologies. Additional brine treatment is designed for to ensure a zero-brine discharge.

RO is a water treatment process whereby dissolved salts, such as sodium, chloride, calcium carbonate, and calcium sulphate may be separated from water by forcing the water through a semi-permeable membrane under high pressure. The water diffuses through the membrane and the dissolved salts remain behind as the liquid by-product. The liquid by-product generated by the WTP process is routed to a filter press which produces *Gypsum by-product* (25% moisture content) which is stored within a concrete based, bunded storage area on site.

The process water pipelines (dirty water collection and product water pipelines) traverse Portions 2, 3, 4, 5 and 24 of Paardeplaats 380JT. The purpose of the WTP is to treat water within the dams and voids at the Glisa and Paardeplaats Sections which have been impacted on by historical and current mining activities. The WTP is supported by a significant pipeline network to transfer feed water from the collection points to the WTP for treatment, as well as the pipeline routes from the plant to the discharge point and clean water storage locations. The location of the WTP and the layout of the associated pipelines are shown in **Figure 6.** The collection points, represented by the red dots in Error! Reference source not found., are referred to as:

- Blue Gum Evaporation Dam;
- Block B, Void B1;
- Block C, Void C1; and
- Dirty Water Dam.

The collection points are located within un-rehabilitated voids from historical opencast mining by previous owners of the mine. These voids contain poor quality water mainly from runoff. The voids are licensed in terms of the current Glisa IWUL (License No.: 06/B41A/ABCFGIJ/1002; File No.: 27/2/2/B141/3/9). Water is collected from the collection points by means of sumps within which pumps are located.

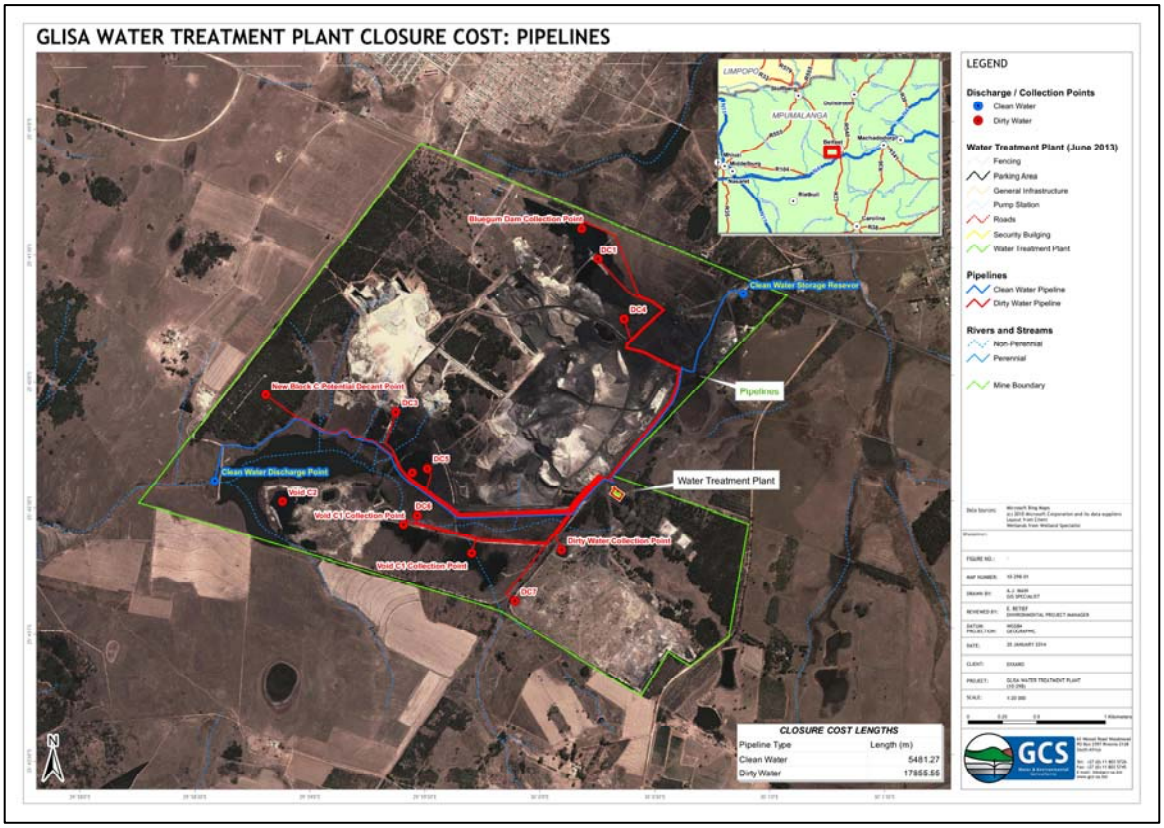


Figure 6: WTP and Pipeline Location (GCS, 2014).

Existing infrastructure at the WTP in the Glisa Section is licensed in terms of the MPRDA and the NEMA and all of the existing infrastructure for the WTP will continue to be used in support of the Paardeplaats Section mining activities. The infrastructure that will continued to be used and which does not require licensing in terms of this application includes, the following (Error! Reference source not found.):

- WTP and pipeline reticulation system, including discharge pipeline and electrical supply through a 500 Kilovolt Ampere (kVA) mini-substation;
- Gypsum storage areas at the WTP; and
- Waste management areas.

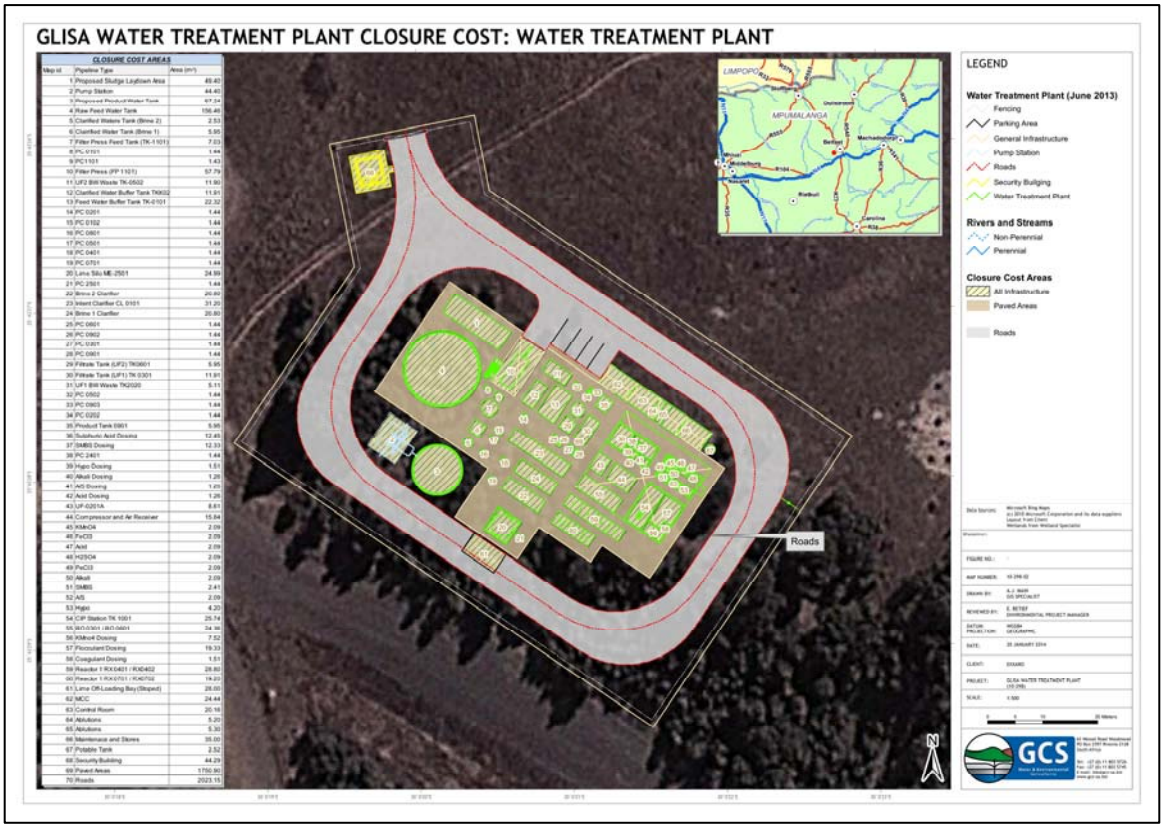


Figure 7: Existing Infrastructure Layout for the WTP (GCS, 2014).

1.4.3 Paardeplaats Section

The Paardeplaats Section is an operational section which adjoins the Glisa Section. Mining is undertaken by opencast mining methods. Mining at the Paardeplaats Section will focus on Portion 30 of the farm Paardeplaats 380 JT for the first ten (10) years of the MR, before expanding to other farm portions.

As RoM reduces at the Glisa Section, the shortfall will be addressed through coal mined at the Paardeplaats Section. The Paardeplaats Section is an open cast mining operation where bench mining techniques are employed to access the coal seams. The 2 Seam Burden is removed with Dozers doing roll-over of the 2 seam burden into the previous 2 seam voids, and the upper burden seams are removed with the truck and shove mining method. Coal seams 4, 3 and 2 will be mined for processing. Seam 1 appears in certain areas only and is highly weathered and contaminated with inseam shales and is not suitable to mined and will be left in situ in the pit. The Paardeplaats Section has an estimated RoM supply rate of 4.2 – 4.4 mtpa which relate to 2.4 – 2.6 mtpa of product, supplying Eskom's Komati and Arnot power stations, as well as an estimated RoM supply rate of 1.7 mtpa of export coal which equates to 1.0 mtpa of export product.

1.5 Mining Method

Mining at the Paardeplaats Section entails opencast mining. The open cast mining method was selected due to the shallowness of the target coal seams present within the MR area. The open cast mining will be undertaken as a hybrid of roll-over and bench/box cut mining techniques. The use of the two respective techniques is dependent on the number of seams present as well as the overburden thickness. The roll-over technique will be utilised where only a single seam is present and where the overburden has a corresponding thickness of less than 20 m. The bench/box-cut technique will be utilised where two or more seams are present, and the overburden has a thickness of greater than 20 m.

The creation of the opencast was initiated through a stripping operation which removes topsoil and exposes the overburden of the first proposed cut. Initial topsoil was hauled to a designated area and stored for use in rehabilitation. When steady state is reached, topsoil will be replaced in a continuous operation. The overburden is then drilled and blasted. The removal of overburden is undertaken in two phases namely, the top portion will be loaded and hauled, and the lower portion dozed. This will ensure that backfilling is adequately addressed, and that concurrent rehabilitation may take place.

Once the overburden has been removed and dozed, the coal seams are drilled and blasted and then transferred to the Glisa Section for mineral processing by means of standard load and hauls operations. It is anticipated that after the first four (4) cuts, a steady state will be reached.

At this point the pit is now in a ready state and no more material is stockpiled as it can now be accommodated in the pit. Concurrent rehabilitation can now logically follow as soon as the subsoil gets stripped in the front and replaced in the back. The same is true for the topsoil which gets placed over the subsoil in a continuous process.

Due to the proximity of the Glisa and Paardeplaats Sections, all mineral processing and waste disposal for the Paardeplaats Section is being undertake at the Glisa Section. For this reason, NBC require the consolidation of the Sections into the Integrated Paardeplaats Section to align with the Paardeplaats Section LoM which currently extends until 25 September 2038. Coal will be crushed at stationary plants prior to processing being undertaken at the main CSWP located in the Glisa Section. Water treatment will also be undertaken at the WTP in the Glisa Section. The 2021 LoM plan is presented in **Figure 8.**

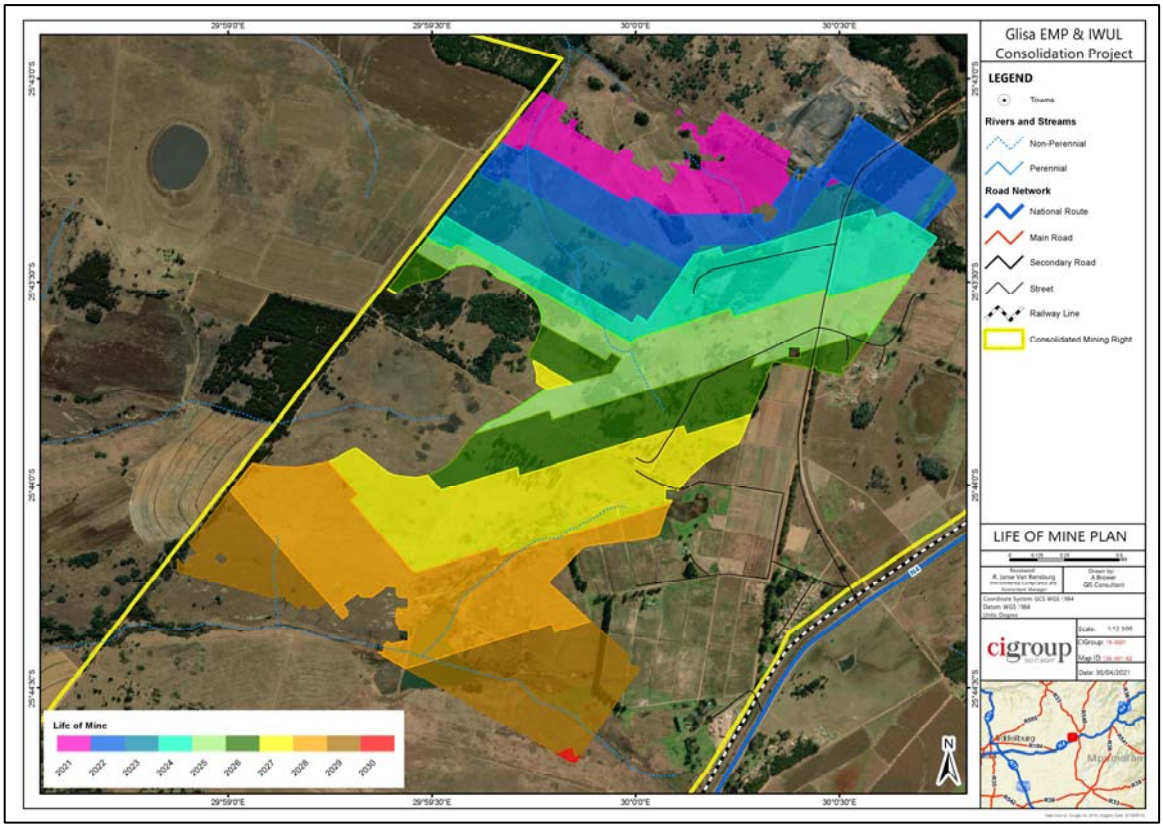


Figure 8: 2021 LoM Plan

1.6 Proposed Activities

1.6.1 Existing Infrastructure Changes

NBC require the following changes to existing infrastructure:

- Expansion of the CSWP on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- Expansion of the existing WTP pipeline network on all farm portions associated with the Integrated Paardeplaats Section; and
- Widening of haul roads between the mining sections and processing plants.

1.6.2 New Infrastructure Required

In order to ensure the continuation of mineral processing and water treatment activities for the Integrated Paardeplaats Section in support of the mining activities taking place, NBC require new infrastructure within the Integrated Paardeplaats Section in support operation activities in the Section. This new infrastructure includes the following:

- A RoM pad on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- A PCD at the CSWP on Portion 3 and 4 of the farm Paardeplaats 380 JT;

- Additional stormwater management infrastructure including diversion channels around the CSWP, and diversion channels around the administrative, contractor, workshop, and security offices on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- Rerouting of a powerline at the CSWP on Portion 3 and 4 of the farm Paardeplaats 380 JT to ensure a clear footprint area for the PCD;
- A RoM pad on Portion 24 of the farm Paardeplaats 380 JT;
- An additional crushing and screening plant on Portion 24 of the farm Paardeplaats 380 JT;
- A mining contractors office, workshop, and conservancy tank on Portion 24 of the farm Paardeplaats 380 JT;
- A PCD on Portion 24 of the farm Paardeplaats 380 JT;
- Stormwater management infrastructure, including diversion channels, for the above-mentioned infrastructure on Portion 24 of the farm Paardeplaats 380 JT;
- A powerline extension from the existing network to supply power to the infrastructure on Portion 24 of the farm Paardeplaats 380 JT;
- Pipelines between the PCD, Plant and the WTP on Portion 24 of the farm Paardeplaats 380 JT;
- A conveyor between the RoM Pad on Portion 24 of the farm Paardeplaats 380 JT and the CSWP on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- An emulsion silo adjacent to the magazine yard on Portion 24 of the farm Paardeplaats 380 JT;
- Haul roads and a dewatering pipeline within the active mining area on Portion 30 of the farm Paardeplaats 380 JT and planned mining areas on Potion 13, 28, 29 and 40 of the the farm Paardeplaats 380 JT and Portion 2 and Remaining Extent of the farm Paardeplaats 425 JS;
- Backfill areas on Portion 1, 3, 4 and 5 of the farm Paardeplaats 380 JT; and
- Discard Management Facility (DMF) on Portion 24 of the farm Paardeplaats 380 JT.

Figure 9 presents the expansion, upgrade and new infrastructure that are required in and around the CSWP located in the Glisa Section. **Figure 10** presents the expansion and new infrastructure that are required on Portion 24. Error! Reference source not found. **11** presents the backfill areas in the Glisa Section and the proposed DMF on Portion 24. Finally, Error! Reference source not found. **12** presents the gravel roads and dewatering pipeline in the active mining area (Portion 30) and planned mining areas (Potion 13, 28, 29 & 40 of the farm Paardeplaats 380 JT and Portion 2 & RE of the farm Paardeplaats 425 JS).

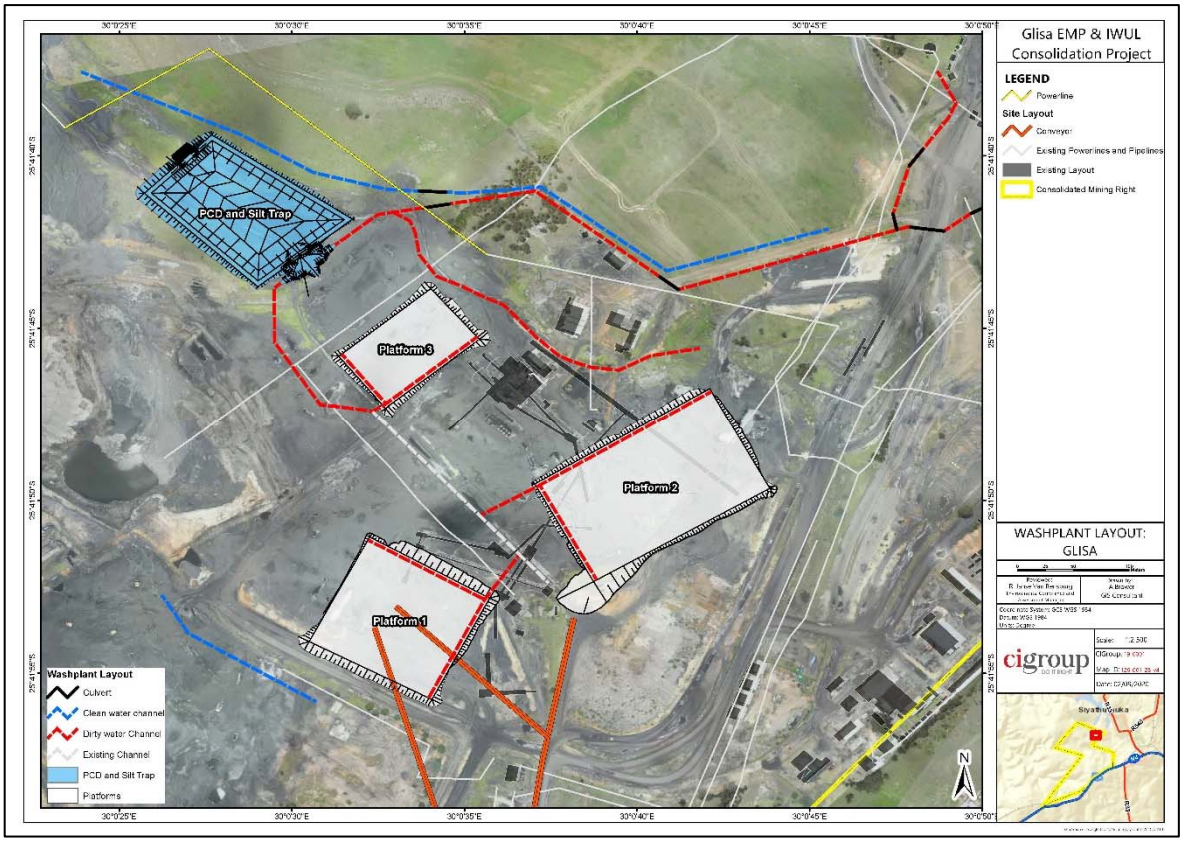


Figure.9: Proposed Site Layout around the Glisa Section CSWP.

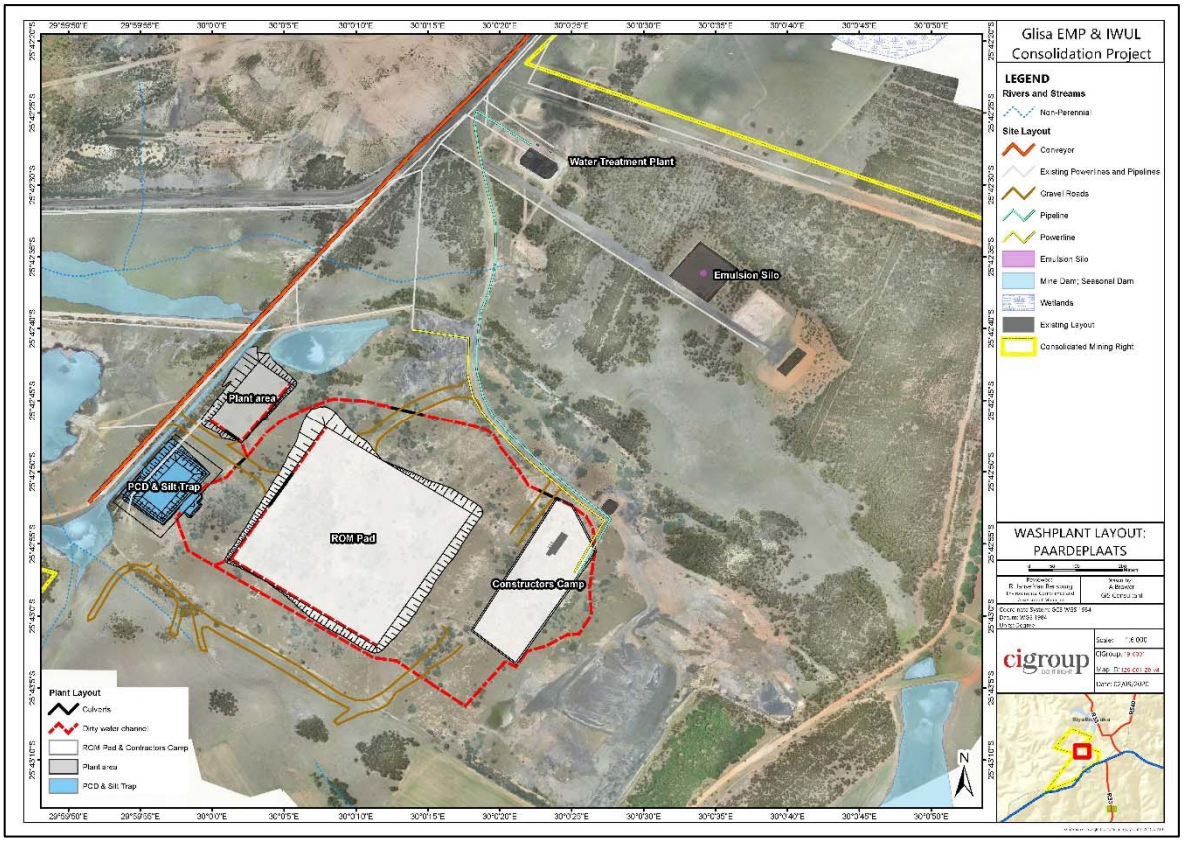


Figure 10:Proposed Site Layout on Portion 24.

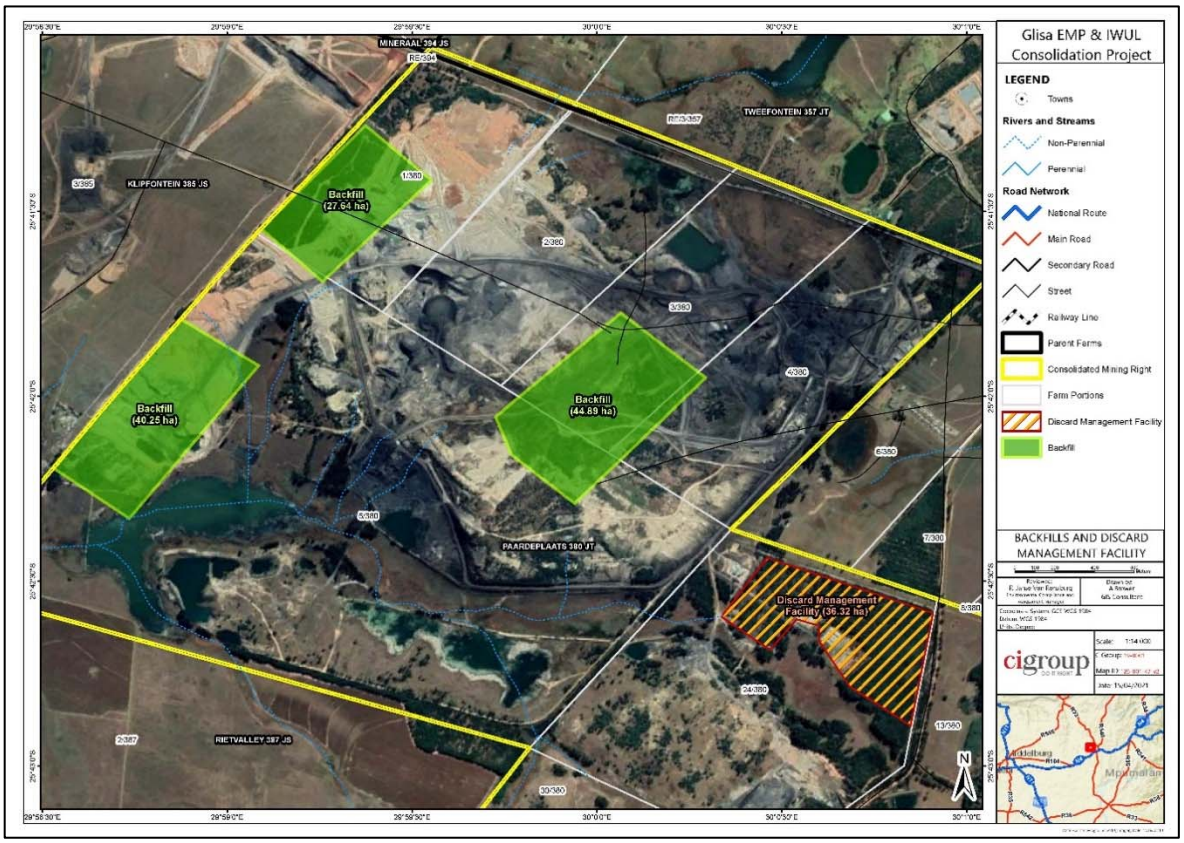


Figure 11:: Proposed Backfill Areas in the Glisa Section and DMF on Portion 24.

Figure 12:: Proposed Gravel Roads and Dewatering Pipeline in the Active and Planned Mining Areas.

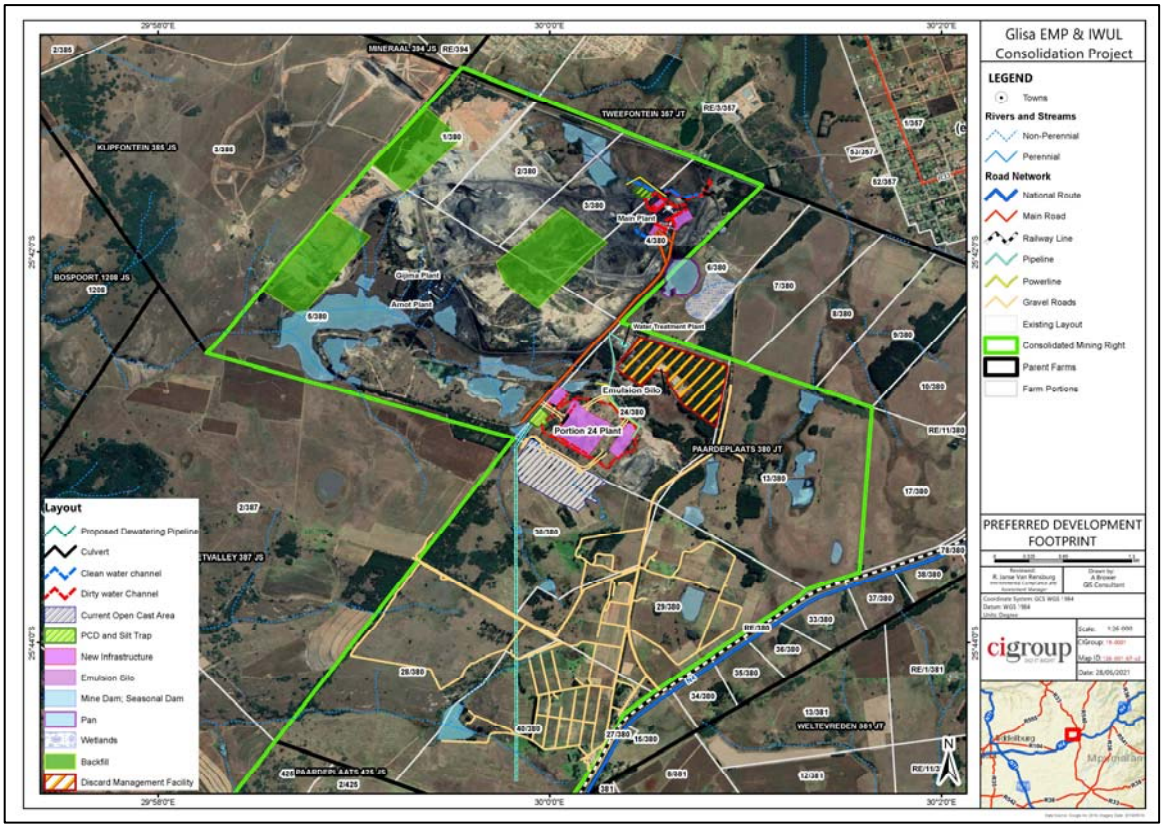


Figure 13: Location of Listed Activities.

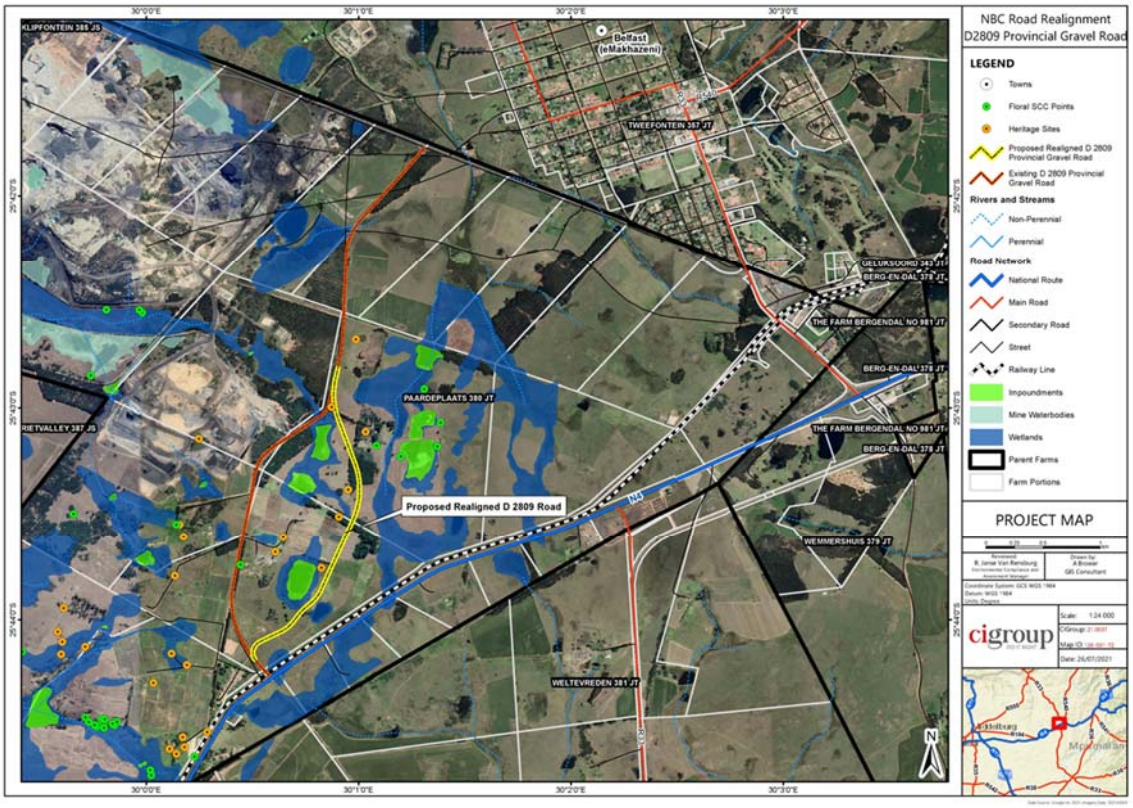


Figure 14:NBC Road re-alignment

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.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

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

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

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

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

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

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

National Heritage Resources Act (NHRA) Act 25 of 1999

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

MPRDA Regulations of 2014

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

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

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

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

Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

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

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
- the construction of a bridge or similar structure exceeding 50 m in length;
- any development or other activity which will change the character of a site—
- (exceeding 5 000 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 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 PALAEONTOLOGICAL HISTORY

The proposed Glisa EMP and IWUL Consolidated Project near Emakhazeni, in Mpumalanga is depicted on the 1: 250 000 2528 Pretoria (1978) and 2530 Baberton (1986) Geological Map (Council for Geosciences, Pretoria) (Figure 14). The area is underlain by rocks of the Transvaal Supergroup (Rooiberg and Pretoria Groups) that is overlain by the Vryheid Formation (Ecca Group, Karoo Supergroup). Isolated areas are mantled by Quaternary alluvium (Figure 15).

The proposed development is close to the north-eastern margin of the main Karoo basin and located in the Witbank Coalfield. This Coalfield supplies more than 50% of South Africa's saleable coal. The Witbank Coalfield extends 190 km west-east between Brakpan and Belfast an approximately 60km north-south between Middelburg and Ermelo. In the Witbank Coalfield the coal-bearing Vryheid Formation reaches a thickness of between 70m to 200m.

Information provided by (CIGroup)

All five coal seams of the Witbank Coal Field occur within the Integrated Paardeplaats Section. The number 2 and 4 seams are more extensively developed than seams 1, 3 and 5. In the far north–east portion of the Paardeplaats Section a dolerite sill, likely a post depositional feature related to the Lesotho Basalts, is believed to have completely displaced coal seams (EIMS, 2014). The coal seams are relatively flat-lying, and the average seam thickness is as follows:

- The Number (No.) 1 seam has an average thickness of 0.34 metres (m);
- The No. 2 seam has an average thickness of 5.37 m;
- The No. 3 seam has an average of 0.78 m;
- The No. 4 seam has an average thickness of 3.04 m; and
- The No. 5 seam has an average thickness of 0.62 m.

The No. 1, 2, 4 and 5 seams can be mined whilst the No. 3 seam, although persistent across the entire coal filed, has been determined to be too thin to be considered an economically viable resource.

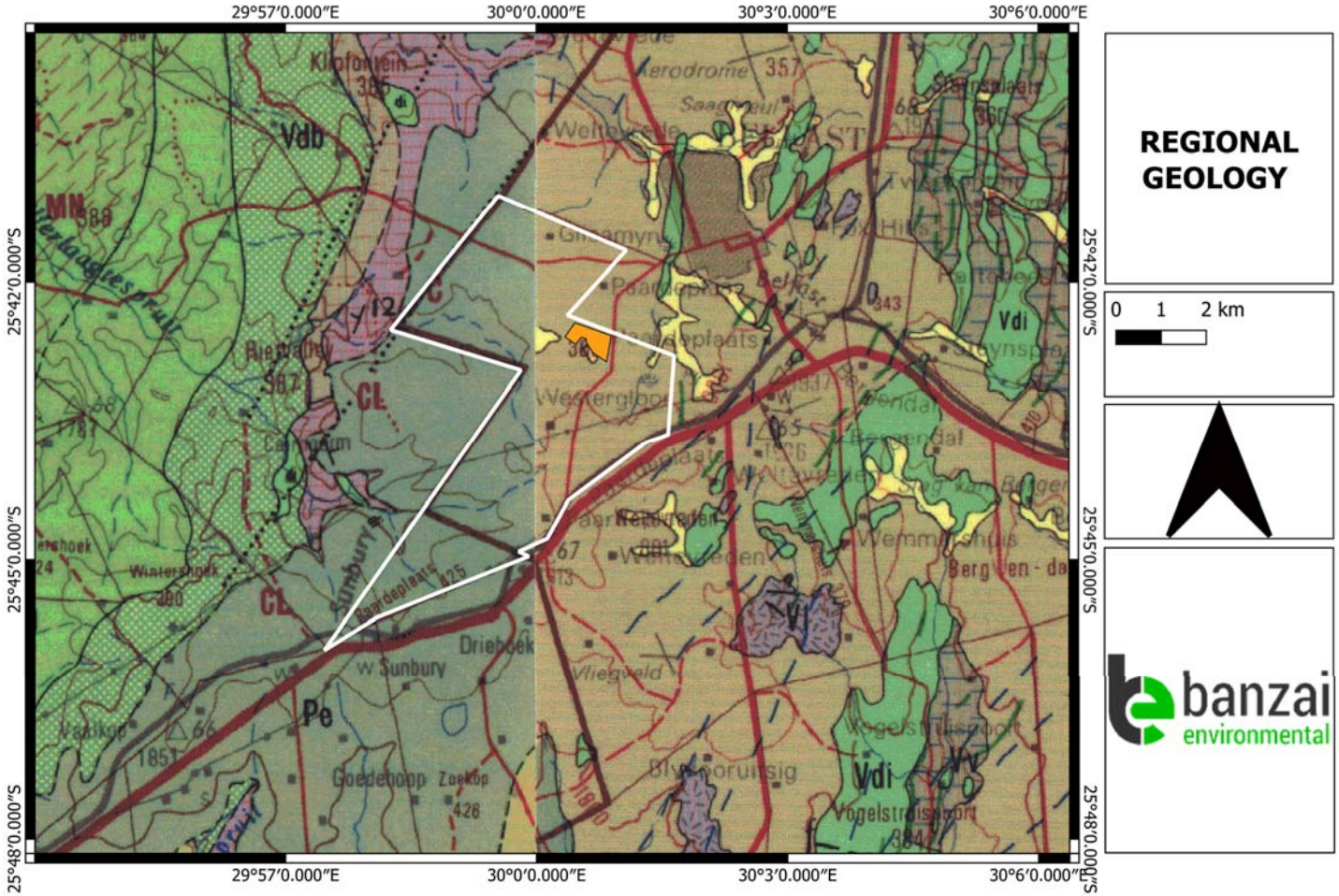
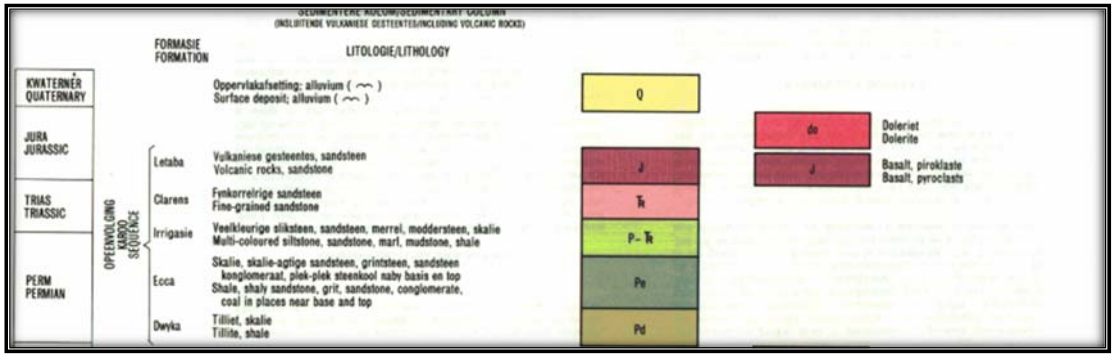


Figure 15: Extract of the 2528 (Pretoria) and 2530 (Baberton) Geological Map (Council of Geoscience) indicating the surface geology of the proposed development in white and orange.


SEDIMENTÊRE REEKS/SEDIMENTARY SEQUENCE
(INSLUITENDE VULKANIESE GESTEENTES/INCLUDING VOLCANIC ROCKS)
FORMASIE
FORMATION
LITOLOGIE/LITHOLOGY
KWATERNÊR
QUATERNARY
JURA
JURASSIC
TRIAS
TRIASSIC
PERM
PERMIAN
OPEENVOLGING KAROO SEQUENCE
Oppervlakafsetting; alluvium ( )
Surface deposit; alluvium ( )
Letaba
Vulkaniese gesteentes, sandsteen
Volcanic rocks, sandstone
Clarens
Fynkorrelrige sandsteen
Fine-grained sandstone
Irrigasie
Veelkleurige slikstein, sandsteen, merrel, moddersteen, skalie
Multi-coloured siltstone, sandstone, marl, mudstone, shale
Ecca
Skalie, skalie-agtige sandsteen, grintsteen, sandsteen konglomeraat, plek-plek steenkool naby basis en top
Shale, shaly sandstone, grit, sandstone, conglomerate, coal in places near base and top
Dwyka
Tilliet, skalie
Tillite, shale
Q
J
Tk
P-Tk
Pe
Pd
do
J
Doleriet
Dolerite
Basalt, piroklaste
Basalt, pyroclasts

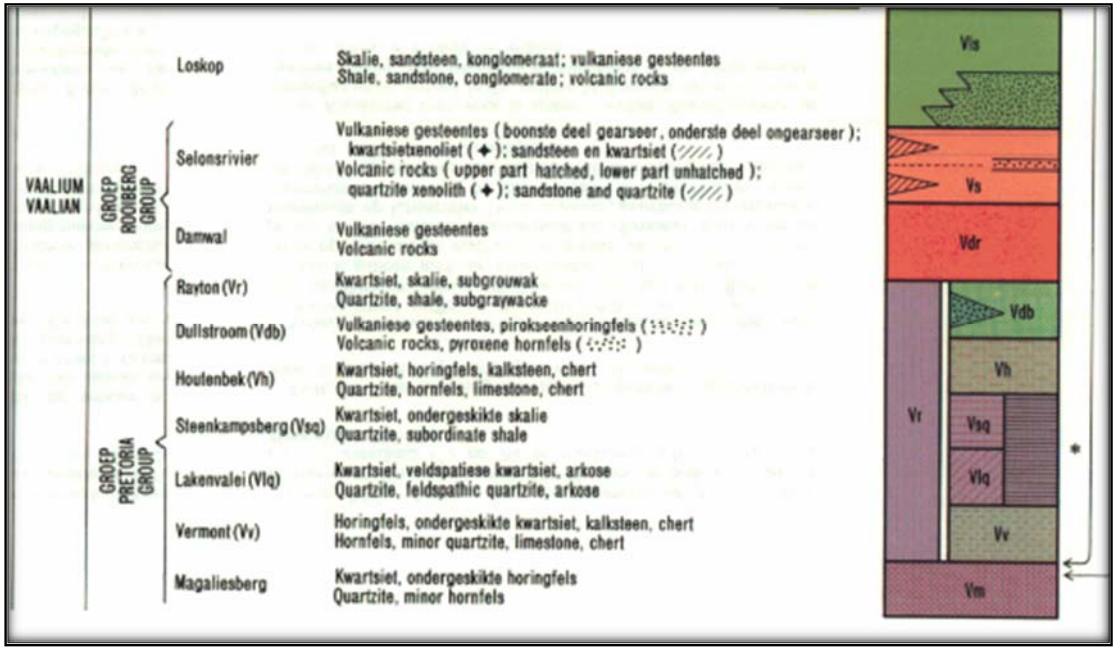
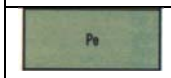

VAALIUM
VAALIAN
GROEP
RODIBERG
GROUP
GROEP
PRETORIA
GROUP
Loskop
Skalie, sandsteen, konglomeraat; vulkaniese gesteentes
Shale, sandstone, conglomerate; volcanic rocks
Selonsrivier
Vulkaniese gesteentes (boonste deel gearseer, onderste deel ongearseer); kwartsietxenoliet (✦): sandsteen en kwartsiet ( )
Volcanic rocks (upper part hatched, lower part unhatched); quartzite xenolith (✦); sandstone and quartzite ( )
Damwal
Vulkaniese gesteentes
Volcanic rocks
Rayton (Vr)
Kwartsiet, skalie, subgrouwak
Quartzite, shale, subgraywacke
Dullstroom (Vdb)
Vulkaniese gesteentes, pirokseenhoringfels ( )
Volcanic rocks, pyroxene hornfels ( )
Houtenbek (Vh)
Kwartsiet, horingfels, kalksteen, chert
Quartzite, hornfels, limestone, chert
Steenkampsberg (Vsq)
Kwartsiet, ondergeskikte skalie
Quartzite, subordinate shale
Lakenvalei (Vlq)
Kwartsiet, veldspatiese kwartsiet, arkose
Quartzite, feldspathic quartzite, arkose
Vermont (Vv)
Horingfels, ondergeskikte kwartsiet, kalksteen, chert
Hornfels, minor quartzite, limestone, chert
Magaliesberg
Kwartsiet, ondergeskikte horingfels
Quartzite, minor hornfels
Vls
Vs
Vdr
Vdb
Vh
Vr
Vsq
Vlq
Vv
Vm

Table 2: Legend to Map and short explanation (Modified from the *1:250 000 2528 Pretoria (1978) and 2530 Baberton (1986) Geological Map (Council for Geosciences, Pretoria))*.

Symbol	**Lithology**	**Stratigraphy**	**Age**
	Surface deposit, alluvium		Quaternary
	Shale, Shaley sandstone, grit, sandstone, conglomerate, coal in places near top and bottom	Vryheid Formation, Ecca Group, Karoo Supergroup	Permian
	Diabase		Vaalian to post Mogolian Age
	Volcanic rocks, pyroxene hornfels	Dullstroom Formation, Pretoria Group, Transvaal Supergroup	Vaalian
	Quartzite, subordinate shale	Steenkampsberg Formation, Pretoria Group, Transvaal Supergroup	

Quaternary superficial deposits are the youngest geological deposits formed during the most recent period of geological time (approximately 2.6 million years ago to present). Most of the superficial deposits are unconsolidated sediments and consist of gravel, sand, silt and clay, and they form relatively thin, often discontinuous patches of sediments or larger spreads onshore. These sediments may include stream, channel and floodplain deposits, beach sand, talus gravels and glacial drift sediments (Partridge *et al*, 2006). Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. In the past palaeontologists did not focus on 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).

Vryheid Formation

The coalfields of South African occur in the Main Karoo Basin or its associated sub-basins. The Main Karoo Basin forms part of a series of Gondwanan basins that was established along the southern boundary of Gondwana (Cole, 1992; De Wit and Ransome 1992; Veevers *et al*. 1994; Catuneanu *et al*. 1998). These basins include Beacon Basin in Antarctica, Bowen Basin in Australia as well as the Paraná Basin in South America. The Basins were formed between the Late Carboniferous and Middle Jurassic and their joint stratigraphies portray the best non-marine sedimentation record globally.

Most of the coal mined in South Africa originates in the Permian Vryheid Formation (Figure 15).
The **Vryheid Formation** comprises mudrock, rhythmite, siltstone and fine- to coarse-grained sandstone (pebbly in places). The Formation contains up to five (mineable) coal seams. The different lithofacies are mainly arranged in upward-coarsening deltaic cycles (up to 80m thick in the southeast). Fining-upward fluvial cycles, of which up to six are present in the east, are typically sheet-like in geometry, although some form valley-fill deposits. They comprise coarse-grained to pebbly, immature sandstones - with an abrupt upward transition into fine-grained sediments and coal seams.

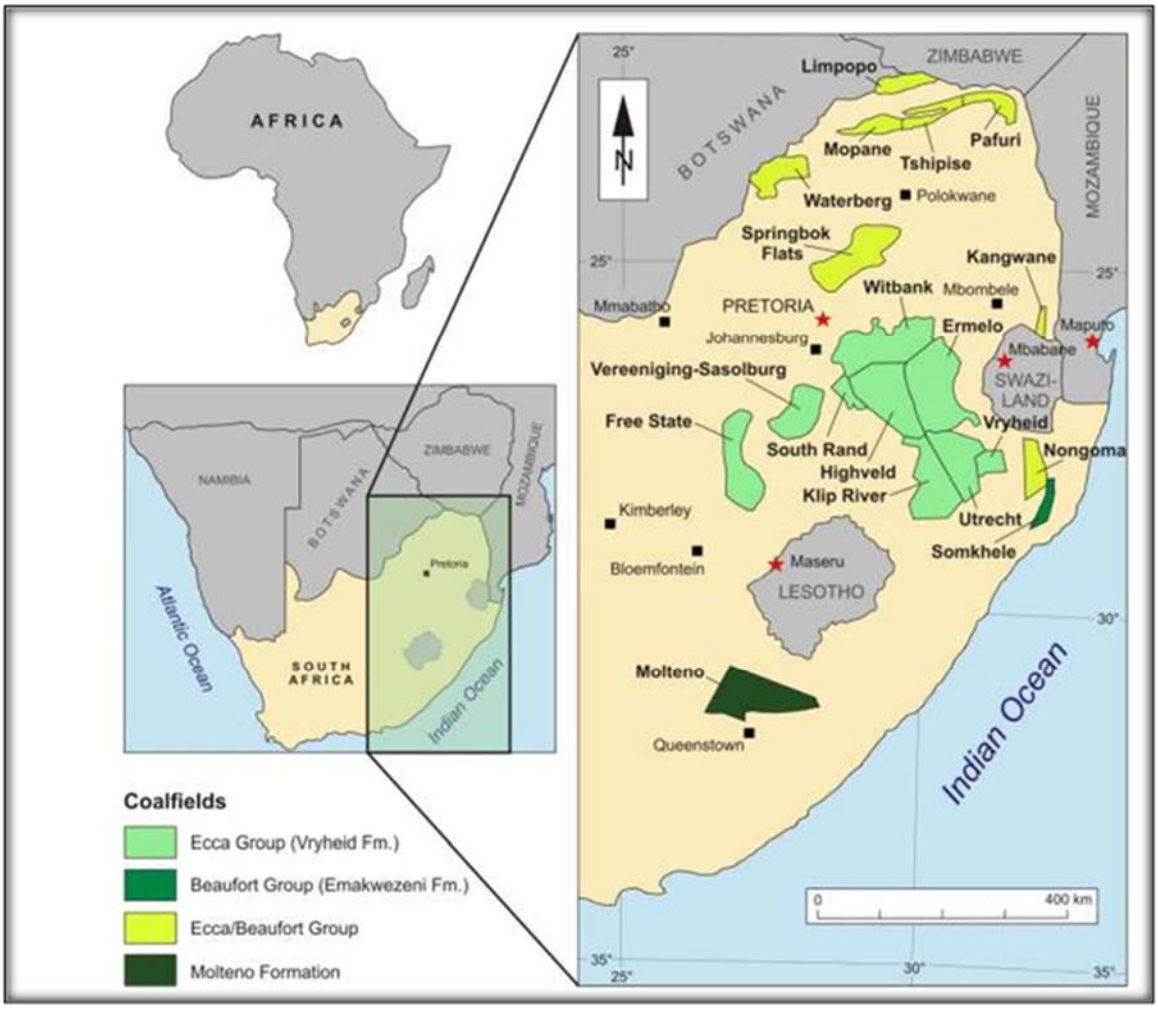


Figure 16: Coalfields of Southern Africa, taken from Hancox and Götz (2014).

The Vryheid Formation comprise of a rich assemblage of Glossopteris flora. After continental deglaciation took place Gymnospermous glossopterids (**Figure 17**) dominated the peat and non-peat accumulating Permian wetlands (Falcon, 1986, Greb *et al*., 2006).

Table 3: Ecca Group and Formations. (Modified from Johnson et al, 2006).

<table>
<tr><th>Period</th><th>Supergroup</th><th>Group</th><th>Formation West of 24º E</th><th>Formation East of 24º E</th><th>Formation Mpumalanga / Free State / KwaZulu Natal</th></tr>
<tr><td rowspan="8">Permian</td><td rowspan="8">Karoo Supergroup</td><td rowspan="8">Ecca Group</td><td>Waterford Formation</td><td>Waterford Formation</td><td rowspan="2">Volksrust Formation</td></tr>
<tr><td>Tierberg / Fort Brown Formation</td><td>Fort Brown Formation</td></tr>
<tr><td>Laingsburg / Rippon Formation</td><td>Rippon Formation</td><td>Vryheid Formation</td></tr>
<tr><td>Collingham Formation</td><td>Collingham Formation</td><td rowspan="3">Pietermaritzburg Formation</td></tr>
<tr><td>Whitehill Formation</td><td>Whitehill Formation</td></tr>
<tr><td rowspan="2">Prince Albert Formation</td><td rowspan="2">Prince Albert Formation</td></tr>
<tr><td>Mbizane Formation</td></tr>
<tr><td></td></tr>
</table>

Recent paleobotanical studies in the Vryburg Formation include that of Bordy and Prevec (2008) and Prevec *et al.* (2008, 2009, 2010) and Prevec, (2011). Bamford (2011) described numerous plant fossils from this formation (e.g. *Azaniodendron fertile*, *Cyclodendron leslii, Sphenophyllum hammanskraalensis, Annularia sp., Raniganjia sp., Asterotheca spp., Liknopetalon enigmata, Hirsutum* sp., *Scutum* sp., *Ottokaria* sp., *Estcourtia* sp., *Arberia* sp., *Lidgetonnia* sp., *Noeggerathiopsis* sp., *Podocarpidites* sp as well as more than 20 Glossopteris species.

In the past, palynological studies have focused on the coal-bearing successions of the Vryheid Formation and include articles by Aitken (1994, 1998), and Millsteed (1994, 1999), while recent studies focussed on the Witbank Coalfield were conducted by Götz and Ruckwied (2014).

Bamford (2011) is of the opinion that only a small amount of data has been published on these potentially fossiliferous deposits and that most likely good material is present around coal mines and in other areas the exposures are poor and of little interest. When plant fossils do occur, they

are usually abundant. According to Bamford, it is not feasible to preserve all the sites but in the interests of science these sites ought to be well documented, researched and the collected fossils must be housed in an accredited institution.

To date no fossil vertebrates have been collected from the Vryheid formation. The occurrence of fossil insects is rare, while palynomorphs are diverse. Fish scales and non-marine bivalves have been reported. Trace fossils are found abundantly but the diversity is low. The mesosaurid reptile, *Mesosaurus* (Figure 18) has been found in the southern parts of the basin but may also be present in other areas of the Vryheid formation. Regardless of the rare and irregular occurrence of fossils in this biozone, a single fossil may be of scientific value as many fossil taxa are known from a single fossil.

Figure 17: Glossopteris leaf.

Figure 18: Mesosaurus sp. (National Museum, Bloemfontein specimen NMQR 3536)

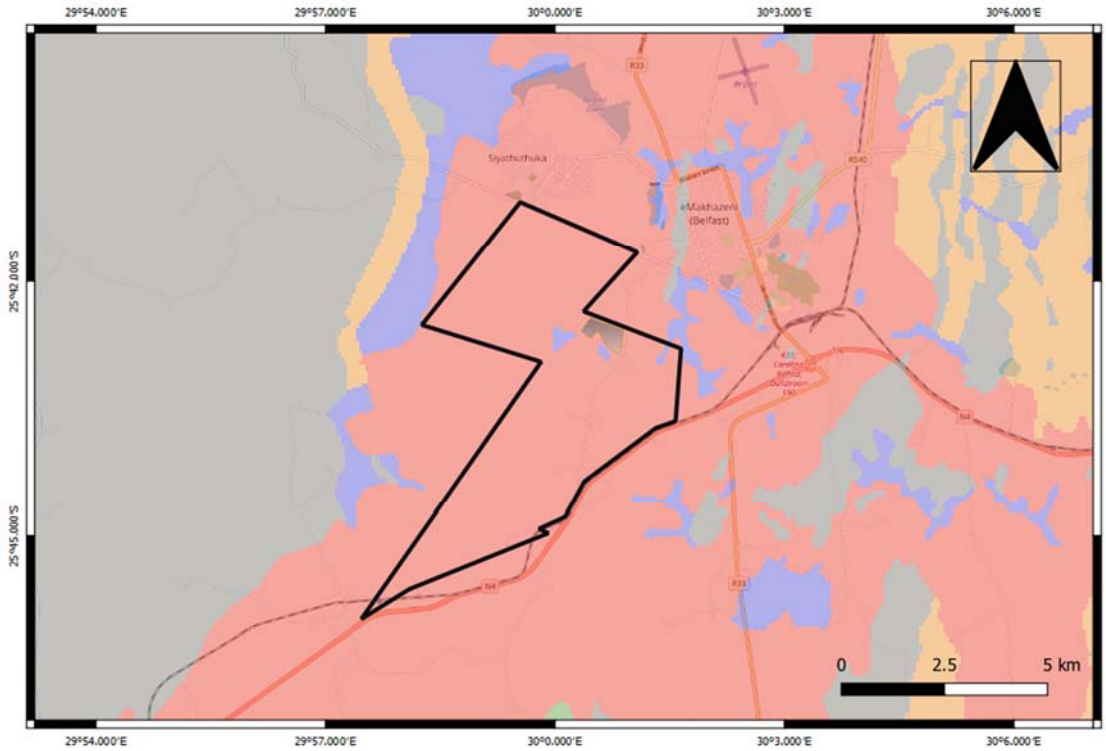


Figure 19: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in black.

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 Palaeo Sensitivity map (**Figure** 19**19**) there is a very high chance of finding fossils in the red area.

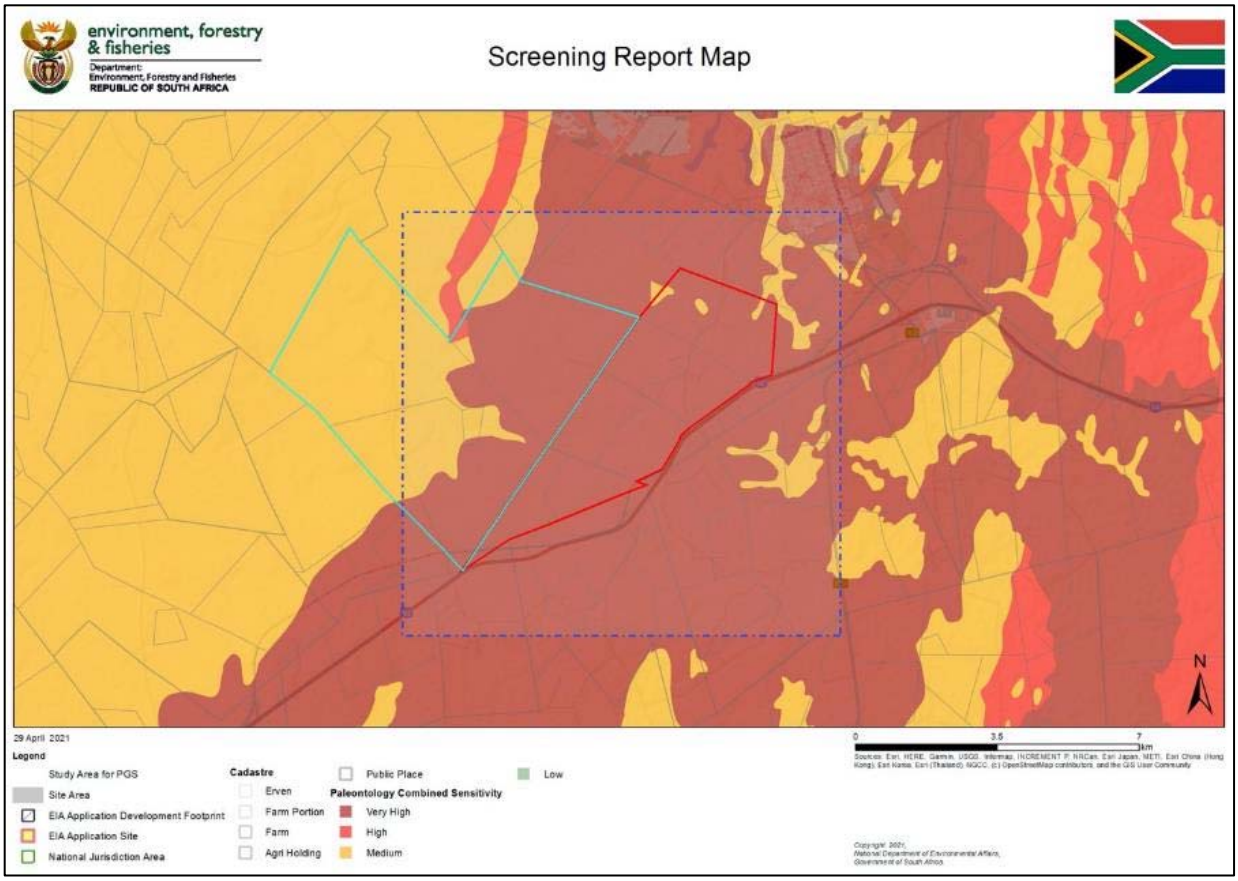


Figure 20: Environmental screening tool's depiction of the palaeontological sensitivity of the study area and surroundings.

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development is near eMakhazeni (Belfast) in the Emakhazeni Local Municipality, Nkangala District Municipality, Mpumalanga Province. The proposed development area is about 3 km south of eMakhazeni (Belfast), and 33 km south-west of Dullstroom, while the N4 is situated on the eastern boundary of the proposed development.

The proposed development is situated on Portion 1, Portion 2, Portion 3, Portion 4, Portion 5, Portion 13, Portion 24, Portion 28, Portion 29, Portion 30 and Portion 40 of the farm Paardeplaats 380 JT, and the Remaining Extent and Portion 2 of the farm Paardeplaats 425 JS
The development is about 2,463.78 ha intent.

The D2809 Provincial Road is runs from the Siyathuthuka Road in a southerly direction reaching the N4 toll road. The existing road lies east of the existing NBC opencast mining operations and traverses' portion 13, 29 and 30 of the Farm Paardeplaats 380 JT. The latest (2021) Life of Mine (LoM) plan from NBC runs beyond the current road, requiring permanent realignment of the road.

Table 4:Position of the D 2809 Provincial Road realignment

	Latitude [S]	**Longitude [E[**
Beginning	25° 42' 51.9"	30°00'53.41"
Middle	25° 43' 43.63	30°00'52.99"
End	25° 44' 11.67	30°00'31.02"

7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a desktop study and includes Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

7.1 Assumptions and Limitations

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

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

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- 1: 250 000 2530 Baberton Geological Map (1986) (Council of Geoscience)
- 1: 250 000 2528 Pretoria Geological Map (1978) (Council of Geoscience)
- A Google Earth map with polygons of the proposed development was obtained from PGS Consultants.
- Information provided by NBS Colliery (Universal Coal).

9 SITE VISIT

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 21 August 2021. No visible evidence of fossiliferous outcrops was identified.

Figure 21: Starting point of the NBC Road re-alignment (D2809)
GPS coordinates 25.712778S 30.042778E

Figure 22: Middle section of the proposed NBC Road re-alignment (D2809).

Figure 23: End section of the proposed NBC Road re-alignment (D2809).
GPS coordinates 25.736111S 30.008333E

Figure 24: Grass covering the proposed mining development in the central portion of the development

Figure 25: Tall as well as burnt grass in the proposed mining development (central portion)

Figure 26: Example of vegetation in the proposed development.

Figure 27: Example of old shaft openings present on the development footprint
GPS coordinates: 25,836389S, 29,990556E

10 IMPACT ASSESSMENT METHODOLOGY

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined above, used to evaluate impact significance.

The impacts will be ranked according to the methodology described below. Where possible, mitigation measures will be provided to manage impacts. In order to ensure uniformity, a standard impact assessment methodology will be utilised so that a wide range of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the aforementioned criteria is given in **Table 5**.

Table 5: Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	Proposed site	Incidental
2	LOW	Study area	Short-term
3	MODERATE	Local	Medium/High-term
4	HIGH	Regional / Provincial	Long-term
5	VERY HIGH	Global / National	Permanent

A more detailed description of each of the assessment criteria is given in the following sections.

10.1 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1 000 km2) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given below.

Table 6: Description of the significance rating scale

RATING		DESCRIPTION
5	Very high	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	High	Impact is of substantial order within the bounds of impacts, which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	Moderate	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	Very low	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	No impact	There is no impact at all - not even a very low impact on a party or system.

10.2 Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail below**.**

Table 7: Description of the significance rating scale

RATING		DESCRIPTION
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of impacts possible and will be felt at a regional scale (District Municipality to Provincial Level).
3	Local	The impact will affect an area up to 10 km from the proposed site.
2	Study Site	The impact will affect an area not exceeding the NBC property.
1	Proposed site	The impact will affect an area no bigger than the ash disposal site.

10.3 Duration Scale

In order to accurately describe the impact, it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in **Table 8**.

Table 8: Description of the temporal rating scale

RATING		DESCRIPTION
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium/High term	The environmental impact identified will operate for the duration of life of facility.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

10.4 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in **Table 9** below.

Table 9: Description of the degree of probability of an impact occurring.

RATING	DESCRIPTION
1	Practically impossible
2	Unlikely
3	Could happen
4	Very Likely
5	It's going to happen / has occurred

10.5 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in **Table 10**. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 10: Description of the degree of certainty rating scale

RATING	DESCRIPTION
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.
Don't know	The consultant cannot, or is unwilling, to make an assessment given available information.

10.6 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus, the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

Impact Risk = (SIGNIFICANCE (5)**+** *Spatial* (2)**+** Temporal(5)) X Probability4_)

3 **5**

An example of how this rating scale is applied is shown in **Table 11**.

Table 11: Rating Ratings of the proposed development

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
	Very High	Study site	Permanent	Unlikely	
Impact	5	2	5	2	1.6

Note: The significance, spatial and temporal scales are added to give a total of 12, that is divided by 3 to give a criteria rating of 4. The probability (2) is divided by 5 to give a probability rating of 0,4 The criteria rating of 4 is then multiplied by the probability rating (0,4) to give the final rating of 1.6.

The impact risk is classified according to five classes as described in the **Table 12** below.

Table 12: Impact Risk Classes

RATING	IMPACT CLASS	DESCRIPTION
0.1 – 1.0	1	**Very Low**
1.1 – 2.0	2	**Low**
2.1 – 3.0	3	**Moderate**
3.1 – 4.0	4	**High**
4.1 – 5.0	5	**Very High**

Therefore, with reference to the example above, an impact rating of 3.2 will fall in the **Impact Class 2,** which will be considered to be a **Low impact**.

10.7 SUMMARY OF IMPACT TABLES

Only the site will be affected by the proposed development. The proposed development will have a negative impact on Fossil Heritage. The expected duration of the impact is assessed as potentially permanent to long term. It is Very Likely that the impact could occur. The significance of the impact occurring will be High.

11 FINDINGS AND RECOMMENDATIONS

The proposed development is primarily underlain by the Permian Vryheid Formation of the Ecca Group (Karoo Supergroup) while two isolated patches of Quaternary alluvium is also present. According to the South African Heritage Resources Information System, the Palaeontological Sensitivity of the Vryheid Formation is Very High. This Formation is known for its rich assemblage of Glossopteris flora which is the source vegetation for this formation. Fish scales, non-marine bivalves and trace fossils are found in this formation.

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 21 August 2021. No visible evidence of fossiliferous outcrops was identified. For this reason, an overall low palaeontological sensitivity is allocated to the development footprint. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the proposed development will be of a low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area. 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.

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

12 CHANCE FINDS PROTOCOL

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

12.1 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.

12.2 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.

12.3 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.

12.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

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

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.

- 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

MEMBERSHIP

Palaeontological Society of South Africa (PSSA)	2006-currently

EMPLOYMENT HISTORY

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

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