PALAEONTOLOGICAL FIELD ASSESSMENT FOR THE PROPOSED ENVIRONMENTAL AUTHORISATION AND AMENDMENT PROCESSES FOR ELANDSFONTEIN COLLIERY, NKANGALA DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE

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Executive Summary

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the **Palaeontological Field Assessment** (PIA) for the proposed Mining Right application Environmental Authorisation and Amendment Processes for Elandsfontein Colliery, Emalahleni Local Municipality, Nkangala District Municipality, Mpumalanga Province. The National Heritage Resources Act (No 25 of 1999, section 38) (NHRA) declares that a Palaeontological Impact Assessment (PIA) is crucial to verify the presence of fossil material within the planned development. This Assessment is thus necessary to evaluate the effect of the construction on palaeontological resources.

The geology of the proposed Elandsfontein Colliery is primarily underlain by the Vryheid Formation (Ecca Group), with a small portion which falls in the Dwyka Group. The study area is also underlain by very small areas of diabase rock which is unfossiliferous. According to the PalaeoMap on the South African Heritage Resources Information System database, the Palaeontological Sensitivity of the Vryheid Formation is Very High, while the Dwyka Group has a Moderate Palaeontological Sensitivity (Almond and Pether 2008, SAHRIS website). Four Alternatives for this development footprint have been considered. As the geology of these alternatives is the same as the rest of the development footprint, they all will have the same impact on the fossil heritage of the development, except for the No-Go alternative

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 30 November 2019. No visible evidence of fossiliferous outcrops was found, although Bamford (2018) had uncovered poorly preserved and unidentifiable small pockets of fossils on the Elandsfontein mining development for a previous PIA. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the Elandsfontein mining upgrade will be of a medium significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction of the development may be authorised in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.

However, if fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations, the **Chance Find Protocol** must be implemented by the ECO or site manager in charge of these developments.

Before any fossil material can be collected from the development site, the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university collection), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA.

Recommendations:

- The EAP and ECO/site manager must be informed that the Vryheid Formation of the Ecca Group has a Very High Palaeontological Sensitivity. There is thus a very high

chance that fossils could be present in the Vryheid Fm of the proposed Elandsfontein mining operations upgrade.

- If fossil remains are discovered during any phase of construction, the **Chance Find Protocol** must be implemented by the ECO in charge of these developments. These discoveries should be secured, and the ECO/site manager must alert SAHRA so that the proper mitigation (documented and collection) can be undertaken by a palaeontologist.
- These recommendations should be included in the Heritage Management Plan and EMPr for the Elandsfontein mining operations.

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Terminology and Abbreviations

Archaeological resources

This includes:

- material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artifacts, human and hominid remains, and artificial features and structures;
- rock art is any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- features, structures, and artifacts associated with a military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influences its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- carrying out any works on or over or under a place;
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- constructing or putting up for display signs or boards;
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Fossil

Mineralized bones of animals, shellfish, plants, and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures, and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa;

Holocene

The most recent geological time period which commenced 10 000 years ago.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Table 1: Abbreviations

Abbreviations	**Description**
EO	Environmental Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PIA	Palaeontological Impact Assessment
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

1 INTRODUCTION

Elandsfontein Colliery (Pty) Ltd. is owned by Anker Coal and Mineral Holdings S.A. (Pty) Ltd. (ACMHSA) which holds various Coal Mining Tenements in South Africa through its subsidiaries. Namane Resources holds 100 % of ACMHSA.

Elandsfontein Colliery (Pty) Ltd. (Elandsfontein) has approved:

- Mining Rights (MP 63 MR and MP 314 MR). These rights have been renewed.
- Environmental Management Programme under the National Environmental Management Act (NEMA),
- Water Use License under (Department of Water Affairs and Forestry (DWAF)) and
- a Social and Labour Plan under the Mineral and Petroleum Resources Development Act, Act 28 of 2002 (MRPDA),
- Elandsfontein Colliery's holding company, Anker Coal and Mineral Holdings South Africa (Pty) Ltd has a Richards Bay Coal Terminal (RBCT) export allocation.

Elandsfontein Colliery (Pty) Ltd. (Elandsfontein) is the holder of mining rights over the farm Elandsfontein 309 JS (Elandsfontein). Elandsfontein is applying to consolidate its existing mining rights over Elandsfontein into a consolidated Mining Right by submitting a Section 102 Application. The mine operation will be named the Elandsfontein Colliery (Pty) Ltd[1].

1.1 DOCUMENT STRUCTURE

This report has been compiled in accordance with the EIA Regulations, 2014 (Government Notice (GN) R982). A summary of the report structure, and the specific sections that correspond to the applicable regulations, is provided in Table 2 below.

Table 2: Report Structure

NEMA Regs (2014) - Appendix 6 (as amended 2017)	**Relevant section in report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix B Section 3
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix A
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 4

[1] [1]Information provided by Geo Soil and Water cc

NEMA Regs (2014) - Appendix 6 (as amended 2017)	Relevant section in report
(cA) an indication of the quality and age of base data used for the specialist report;	Section 8
(B) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 11
d) the date, duration and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 10
e) a description of the methodology adopted in preparing the report or carrying out the specialized process inclusive of equipment and modeling used;	Section 7
f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 8 and 9
g) an identification of any areas to be avoided, including buffers;	None
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 9
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 12
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 or activities;	Section 10
k) any mitigation measures for inclusion in the EMPr;	Section 11
l) any conditions for inclusion in the environmental authorization;	Section 11
m) any monitoring requirements for inclusion in the EMPr or environmental authorization;	Section 11
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorized; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 12 and 13

NEMA Regs (2014) - Appendix 6 (as amended 2017)	Relevant section in report
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable.
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not applicable.
q) any other information requested by the competent authority.	Not applicable.
2) Where a government notice *gazetted* 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 6- compliance with SAHRA guidelines

2 SPECIALIST DETAILS

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty-six years. She has extensive experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa for 14 years and has been conducting PIAs since 2014.

3 TERMS OF REFERENCE

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 purposes of the PIA are: 1) to **identify** the palaeontological importance of the rock formations in the footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) to determine the **impact** on fossil heritage; and 4) to **recommend** how the property developer should guard against and lessen damage to fossil heritage.

The terms of reference of a PIA are as follows:

3.1 GENERAL REQUIREMENTS:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended (2017).
- 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).

4 PROJECT DESCRIPTION

Historically Elandsfontein Colliery's EMP was approved in terms of the Minerals Act in 1999. Elandsfontein Colliery obtained new order mining rights (MP 314 MR and MP 63 MR) to undertake opencast mining to extract the No. 2 Seam coal above the No. 1 Seam.

Currently Elandsfontein Colliery is an existing mining operation approved under new order Mining Rights (MP 314 MR and MP 63 MR). It has an approved EMP under the Minerals Act, and subsequently recent amendments approved under the MPRDA and NEMA. Therefore, it is assumed that the activities at the mine are "listed activities" in terms of the Environmental Impact Assessment (EIA) Regulations of 2014. Refer to **Figure 2**.

Elandsfontein intends to undertake a Section 102 process in accordance with the MPRDA, in order to consolidate the mining rights MP 314 MR and MP 63 MR and an application for environmental authorisation for the future mining areas and activities.

Elandsfontein Colliery is an existing mine with opencast and underground sections. It produces coal for the local and the export market, at a rate of 500 000 t/annum. Coal has been produced from the No. 1 Seam (underground bord and pillar operation) and an opencast operation on the No. 4 Seam and on the No. 2 Seam.

During the last quarter of 1997 Anker Coal and Mineral Holdings South Africa (Pty) Ltd (ACMHSA) acquired the mine from Fraser Alexander and operated it under the name of Elandsfontein Colliery (Pty) Ltd. A second inclined shaft was developed into the No. 1 Seam and an additional washing

plant was commissioned to handle the increased production. Later the first plant was decommissioned. Since then ACMHSA has been taken over by Namane Resources (Pty) Ltd (Section 11 process underway).

The open pit on the No. 2 Seam is currently being mined.

The open pit on the No. 4 Seam is mined out. This Pit is approximately 64 ha in extent and between 7 and 30 m deep. Permission has been granted (Department of Water Affairs and Sanitation, Licence Number 04/B20G/CGI/3843) to fill the pit with discards. This backfilling is currently ongoing as part of the rehabilitation programme conducted by the mine.

The ROM is upgraded in the beneficiation plant.

4.1 PROPOSED ACTIVITIES

This section describes the current authorization process activities. The proposed project includes *inter alia* the following application processes with associated activities:

New Integrated Environmental Authorisation (Scoping and Environmental Impact Report (S&EIR)) for:

New opencast and underground mining areas;

New PCDs and stormwater management infrastructure;

New residue deposits and/or residue stockpiles (requiring Waste Management Licence); and

Various activities including the primary processing of a mineral resource related to the extended LoM.

Renewal of Integrated Water Use Licence (IWUL) and application for new water uses for:

- Residue stockpiles/deposits;
- Dewatering of pits and underground areas;
- New PCD's and stormwater management infrastructure; and
- GN704 exemptions.

MPRDA Section 102 Amendment:

- Revised Mine Works Programme;
- Revised Social and Labour Plan;
- Revised Regulation 2.2 Plan; and
- Revised consolidated EMPr.

4.1.1 RESIDUE STOCKPILES

This section provides information on the various planned residue stockpiles at Elandsfontein Colliery.

4.1.2 NON-CARBONACEOUS STOCKPILES

A new overburden stockpile of 5ha in size and up to 20m high is required The location of the new stockpile is indicated in **Figure 3** and is in the same area as the south-eastern discard dump which is in the process of being reclaimed via further processing.

4.1.3 CARBONACEOUS STOCKPILES

For the disposal of carboniferous wastes (wash plant waste rock, slurry and possibly filter cake), the option of disposal of carboniferous waste to pit (Process Alternative P1d) and disposal to a lined surface waste disposal facility located on a rehabilitated mine area (Process Alternative P1a) are to be modelled and comparatively assessed by the groundwater specialist. There are historic areas where carbonaceous material is deposited that will be actively cleaned up and returned during rehabilitation.

4.1.4 SOIL STOCKPILES

Stripped soils – topsoil and sub soil will be stockpiled separately until steady state roll over mining is achieved. Separation of topsoil and subsoil will ensure that the characteristics of soil stockpiles are suitable for the prevailing landscape and drainage conditions once they are replaced. Several existing topsoil stockpile areas are located at the site (**Figure 2**).

4.1.5 WATER TREATMENT PLANT

Treatment of excess water will be required. Treated water should meet the DWS resource quality objectives specification for discharge. A new WTP is proposed and the location included in the layout map in Figure 5. he following inflows from the mine will contribute to the PCD, whereafter it is treated by the WTP:

- Direct rainwater and surface runoff;
- Pit and underground dewatering;
- Washing and screening of product;
- Pit decanting;
- Precipitation infiltration for ROM (Run of Mine) and product stockpile area;
- Runoff from discard dump; and
- Seepage from rehabilitated areas.

The plant is predominantly built off-site and installed via skid mounted units. The plant is built in modules of 2 Ml/day where additional capacity is added to the system when and if required. In Elandsfontein's case, the plant will make use of 3 x 2Ml/day modules to meet the required 5.3Ml/day. The National Water Act, 1998 (Act No.36 Of 1998) Classes And Resource Quality Objectives Of Water Resources For The Olifants Catchment will determine the acceptable

parameters for discharging into the environment. The treated water will be discharged into the watercourse to the immediate northwest of the proposed WTP location.

4.1.6 SITE ACCESS AND CONTROL

The Elandsfontein Colliery can be accessed from the N4 National Road via the secondary provincial road (R547) through Clewer. All visitors to the mine are required to sign in at the security checkpoint at the mine's offices.

4.1.7 HAUL ROADS

An approved internal haul road network is in place. One new haul road towards the west of MR63 is required as well as an associated river crossing. required as access to new mining areas is already in place. Upgrades to existing roads may also be required.

4.1.8 WATER SUPPLY

A water use license is in place for sourcing water from water sources as stipulated in the WUL as well as approval of the required water storage facilities. Elandsfontein is in the process of updating its water use licence. Potable water is used in the mine offices, workshops and change house facilities and is sourced from Emalahleni Local Municipality. All water to be used for dust suppression and other mining related processes will be drawn from available process water facilities. Water for dust suppression will either need to be obtained from dirty water containment facilities (Process Alternative P2a) or available natural surface water resources (Process Alternative P2b). Both options will be assessed in the EIA phase**.**

4.1.9 CLEAN AND DIRTY WATER SYSTEMS

Management of clean and dirty water systems is required for effective pollution control. Pollution control will be maximised through facilitating the following:

- Controlling run-off and seepage entering the mining area;
- Controlling run-off emanating from stockpiles; and
- Controlling and separating the mixing of clean water and polluted water which is contained in the PCDs.

The collection of dirty water and diversion of clean water would typically be achieved with earthen channels and berms. These systems would be designed so that clean water is effectively diverted from dirty water and allowed to pass through to other downstream users.

Clean and Dirty Water will be separated by means of trapezoidal channels and compacted earth diversion berms which include associated culverts at road interception points. **Figure 1** below indicates a cross section of a typical earthen channel.

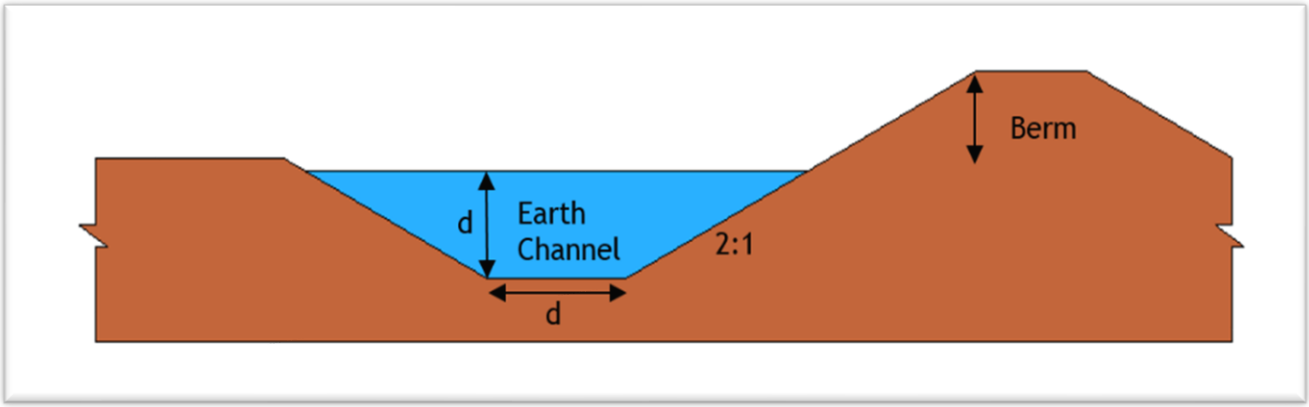


Figure 1: Cross section of typical earthen channel

As the clean water from the area is expected to be carrying sediments, the channel for clean water diversion would most likely include a gravel bed which will trap the sediments.

4.1.10 POLLUTION CONTROL DAMS AND ASSOCIATED DIRTY WATER MANAGEMENT

New PCD dams will be required for the new mining areas and the existing PCDs will be decommissioned. The current mining areas contain various dirty areas which would necessitate a total of 2 new lined PCD's as part of this application: PCD 1 with two silt traps and PCD 2 with one silt trap (Figure 5). By doing this side by side design, the dam safety risk is minimised. The volumes for the new PCDs are as follows:

- PCD 1: Two parallel PCDs with a combined capacity of 68 149m^3; and
- PCD 2: Capacity of 12 916m^3.

The location of the new PCDs and their associated catchments are indicated in **Figure 5**.

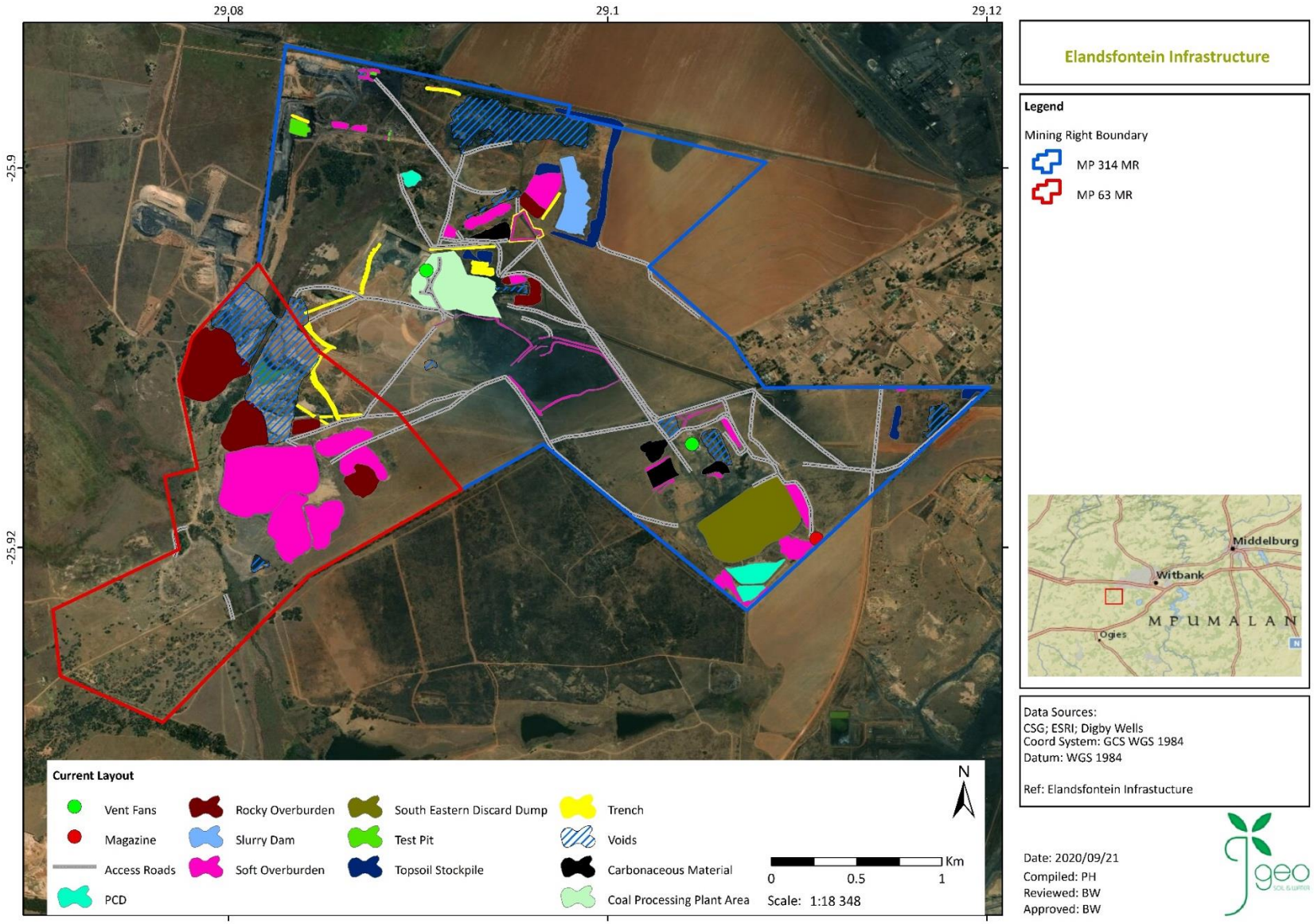


Figure 2: Current mining infrastructure

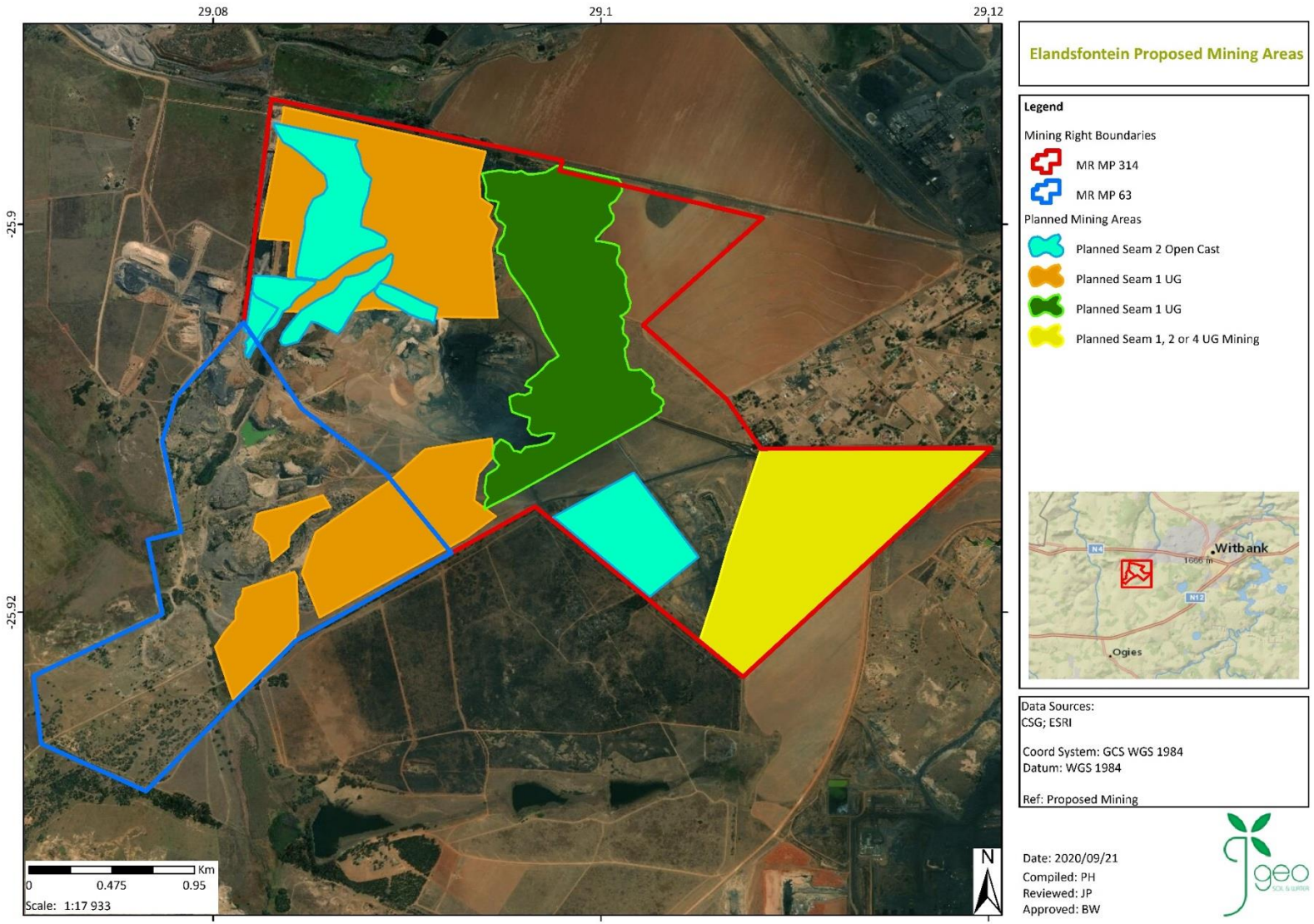


Figure 3: Planned new mining areas that form part of this application. (provided by GSW)

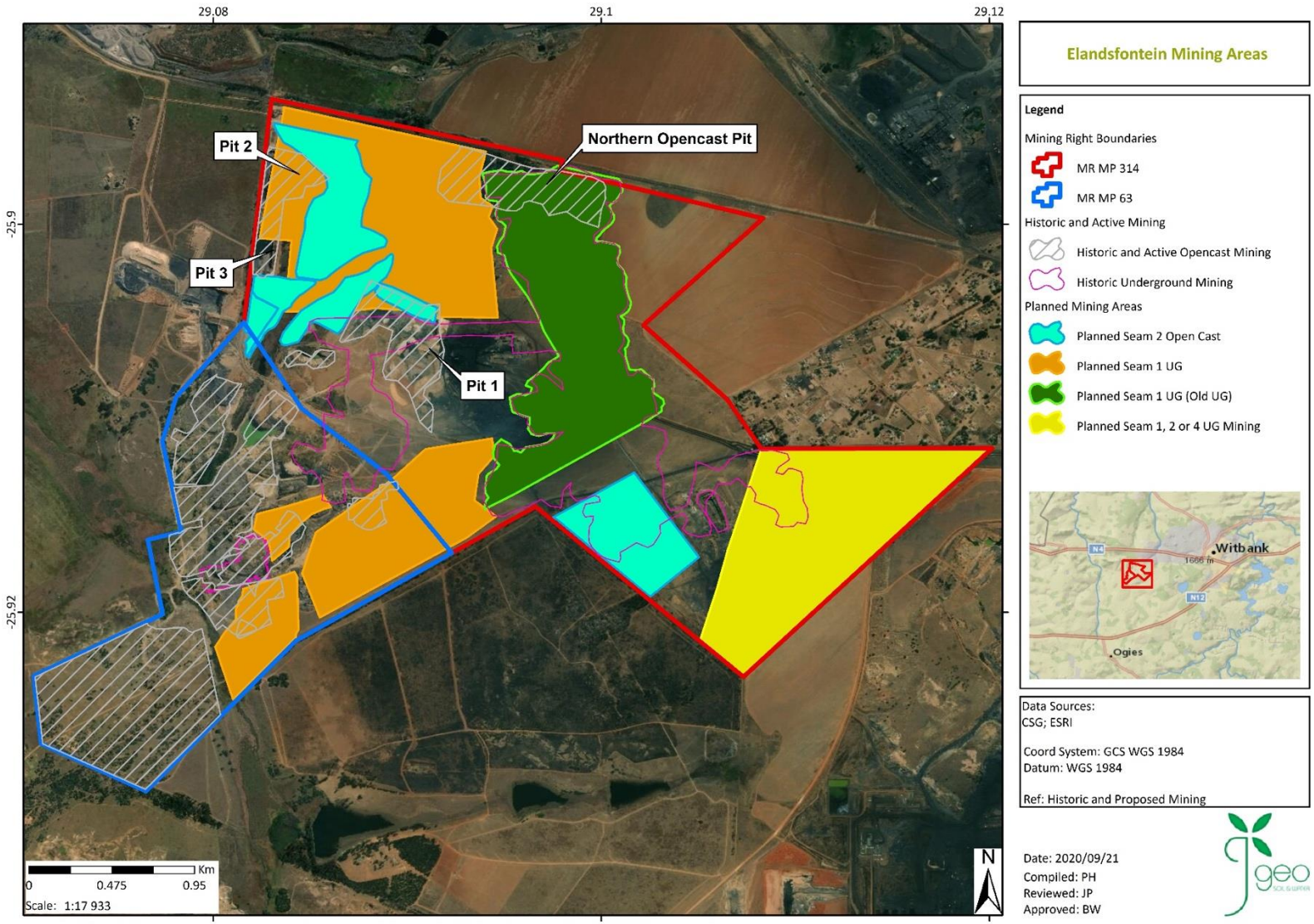


Figure 4: Layout Map indicating historic, current and proposed mining areas

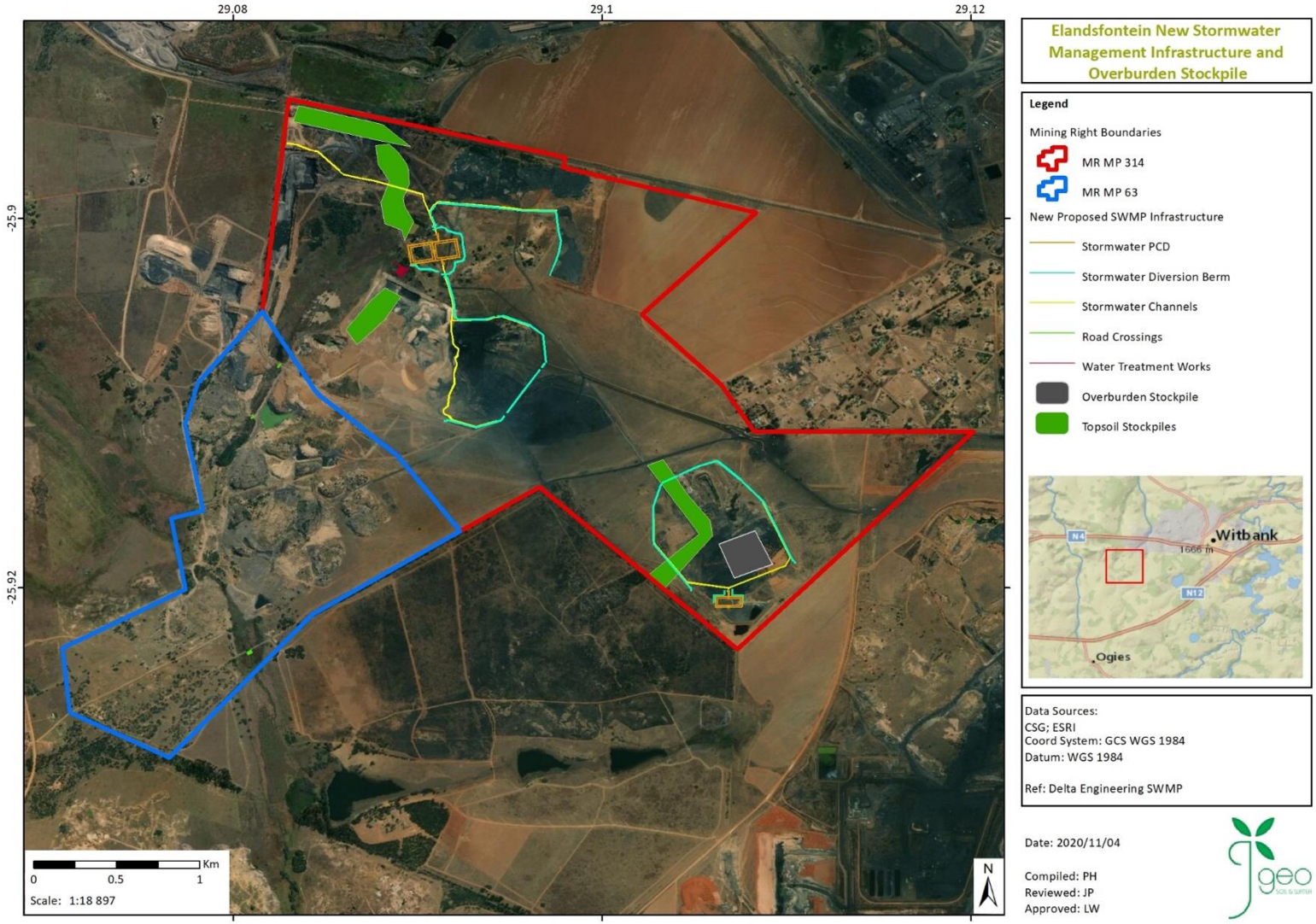


Figure 5: Updated Layout Map indicating new stormwater management infrastructure proposed as part of the Elandsfontein application as well as location of new overburden stockpile and topsoil stockpiles.

5 LEGISLATIVE AND POLICY FRAMEWORK

5.1 NATIONAL HERITAGE RESOURCES ACT (25 OF 1999)

Cultural Heritage includes all heritage resources and is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act comprise **"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 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 m^2 in extent;
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

6 METHODOLOGY

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

7 RECEIVING ENVIRONMENT

7.1 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The geology of the proposed Elandsfontein Colliery is shown on the 1:250 000 2528 Pretoria Geological Map (Council for Geosciences) (. The proposed development is primarily underlain by the Ecca Group (Vryheid Formation), while a small portion falls in the Dwyka Group (**Figure 9**). The study area is also underlain by very small areas of diabase rock which is unfossiliferous. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database the Palaeontological Sensitivity of the Vryheid Formation is Very High, while the Dwyka Group has a Moderate Palaeontological Sensitivity (Almond and Pether 2008, SAHRIS website). SAHRIS states that when rock formations of moderate to high Palaeontological Sensitivity are present in the study area a palaeontological field-based assessment is required. A field assessment is included in this study (Section 10).

Table 3: Rock formations present in the development

Symbol	Group/Formation	Lithology	Approximate Age	Palaeontological Sensitivity
Pv	Vryheid Fm, Ecca Group	Sandstone, shale, coal	Upper Carboniferous, Early Permian 295-290 Ma	High
C-Pd	Dwyka	Tillite, sandstone, mudstone, shale	Upper Carboniferous, Early Permian 295-290 Ma	Moderate
Di	Diabase	Basalt		Zero

7.1.1.1 DWYKA GROUP

The Permo-Carboniferous Dwyka Group is the oldest deposit in the Karoo Supergroup and spans the Late Carboniferous to Early Permian. The Dwyka Group overlies the glaciated Precambrian bedrocks in the north and overlies the Natal Group and Msikaba Formation unconformably while it overlies unconformably and paraconformably the Cape Supergroup in the south and east. Glacial pavements underlaying the Dwyka Group have well-developed striations (specifically in the north) (Johnson et al, 2006). According to Visser et al (1987) the Dwyka Group was deposited in a marine basin.

South Africa was covered by an ice sheet during the Dwyka period. These deposits were deposited in a cold, glacial environment. This Group consists mainly of gravelly sediments with subordinate vorved shales and mudstones with scraped and facetted pebbles. The retreating glaciers deposited dark-grey tillite (Visser et al, 1987) and thus the Dwyka is known for its rich assemblage of dropstones of various sizes.

The Permo-Carboniferous Dwyka Group is known for its track-ways (trace fossils), which are also known as iIchnofacies, that were formed by fish and arthropods, while fossilized faeces (coprolites) have also been recovered. Body fossils comprise gastropods, invertebrates and marine fish. Fossil plants include a rich diversity of conifers, cordaitaleans, glossopterids, ginkgoaleans, horsetails, lycopods, pollens and fern spores (Almond and Pether, 2008).

7.1.1.2 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.

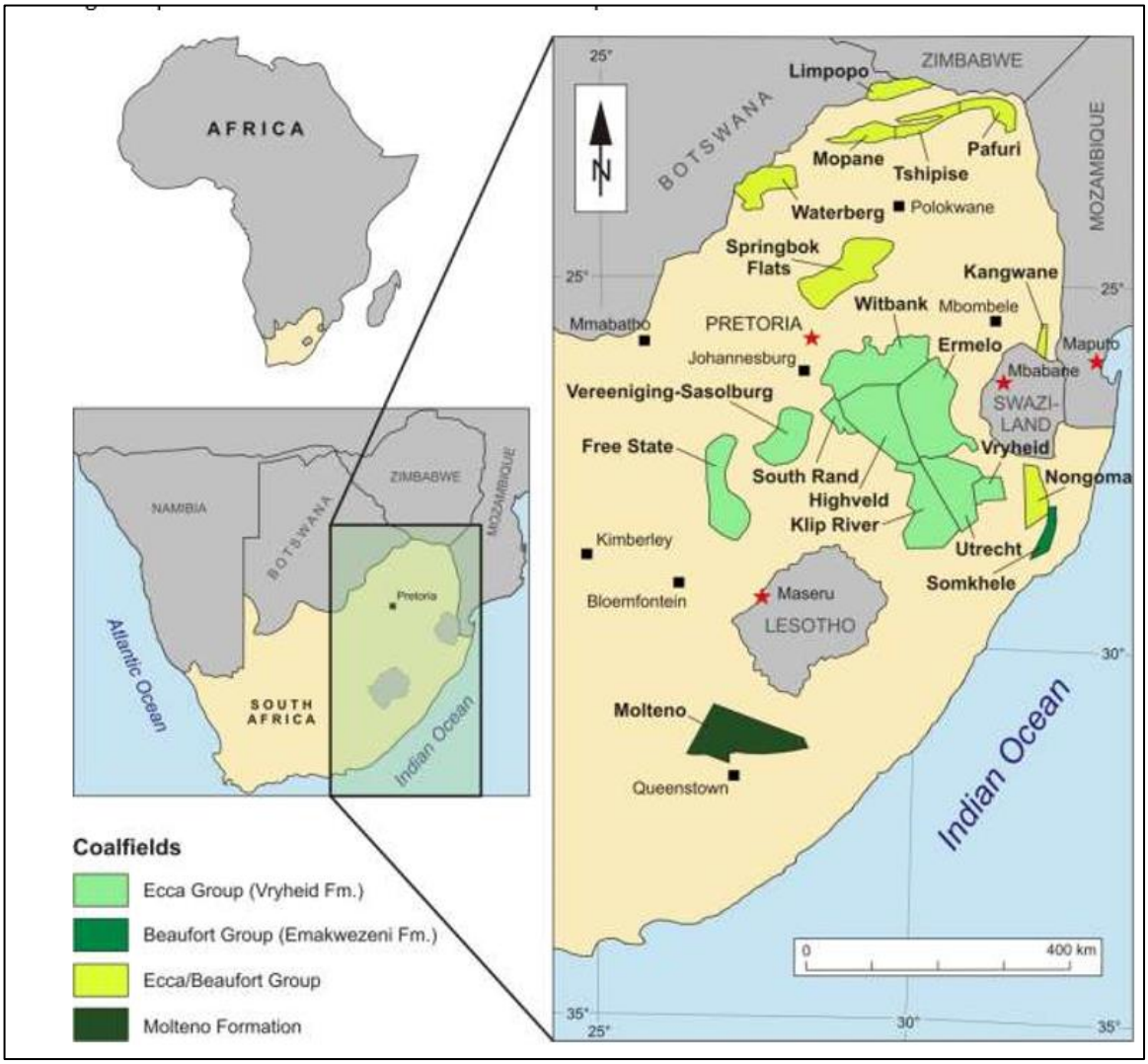


Figure 6: Coalfields of Southern Africa, taken from Hancox and Götz (2014).

Most of the coal mined in South Africa originates in the Permian Vryheid Formation (**Figure 9**). The depth of the Vryheid Formation in the main Karoo Basin varies from 70 m to 500 m near Vryheid and Newcastle in Kwazulu-Natal, where the basin was at its deepest. The main seams in the area are numbered 1-5, with one at the bottom and 5 at the top, while seams 2 and 4 are usually thicker than the rest (Snyman, 1998). Generally, Seam 5 is approximately 15 to 45 m below the surface. The overburden must be removed before the opencast mining can commence.

Table 4: 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 24° E</th><th>Formation East of 24° E</th><th>Formation 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>

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.

The Vryheid Formation comprise of a rich assemblage of Glossopteris flora. After continental deglaciation took place Gymnospermous glossopterids (**Figure 7**) dominated the peat and non-peat accumulating Permian wetlands (Falcon, 1986, Greb et al., 2006).

Recent paleobotanical studies in the Vryburg Formation include that of Bordy and Prevec (2008) and Prefec 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 has been reported. Trace fossils are found abundantly but the diversity is low. The mesosaurid reptile, Mesosaurus (**Figure 8**) 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.

Diabase is a Basalt and unfossiliferous and not further discussed in this report.

Figure 7: Glossopteris leaf. https://www.Mesosaurus

Figure 8: Mesosaurus sp. https://www.Mesosaurus

8 SPATIAL SENSITIVITY MAPPING

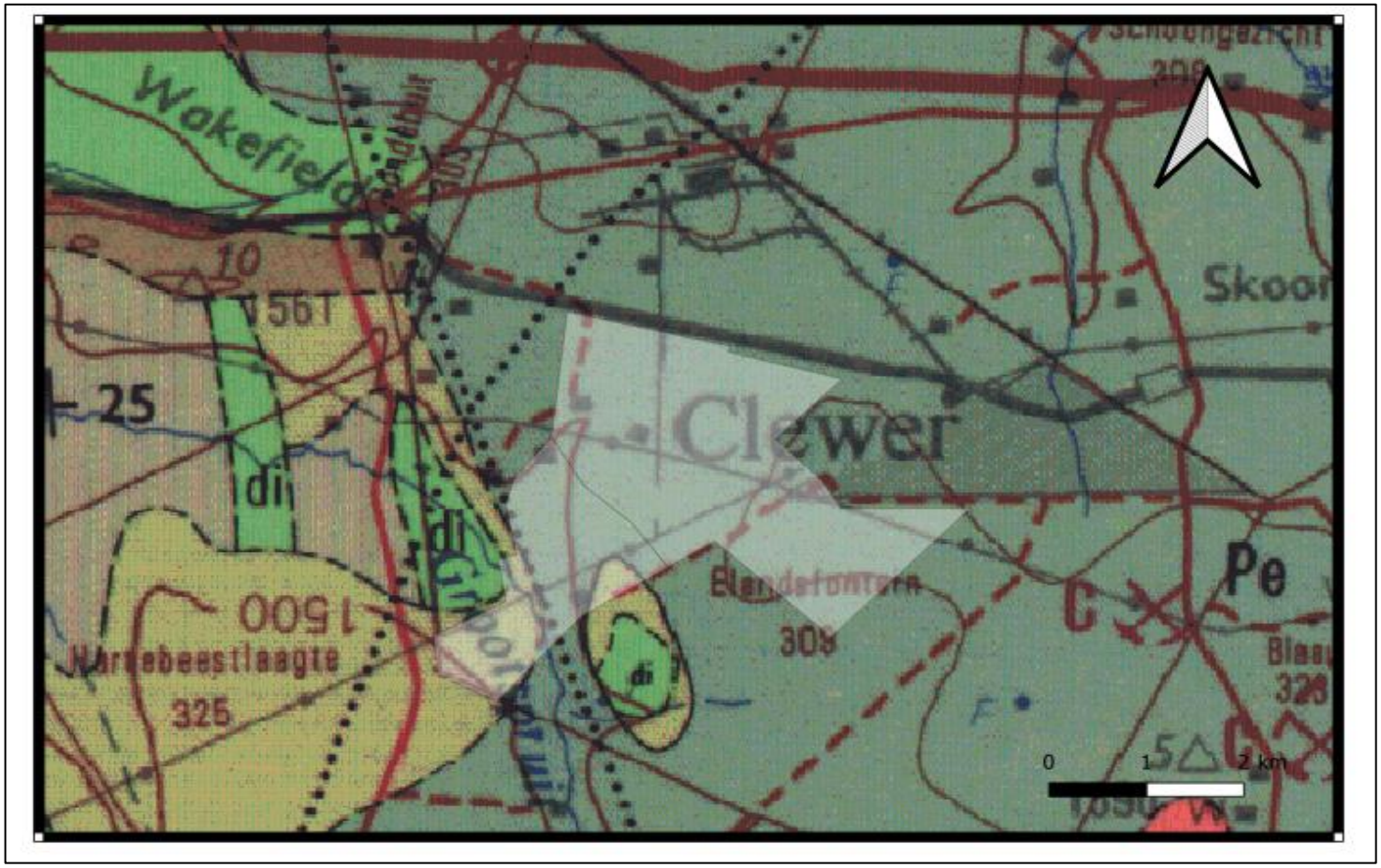
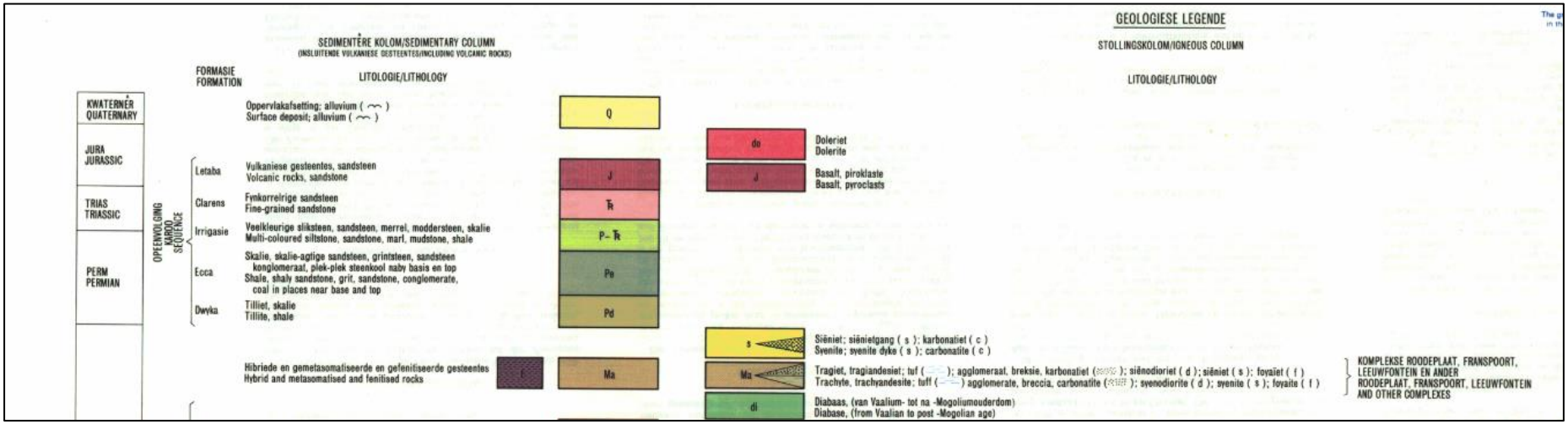


Figure 9: Surface geology of the proposed Elandsfontein Colliery, Emalahleni Local Municipality, Nkangala District Municipality, Mpumalanga Province.



Legend Clarification

Pe- Ecca; Vryheid Formation

Pd - Dwyka

di – Diabase

Mining

C-Coal

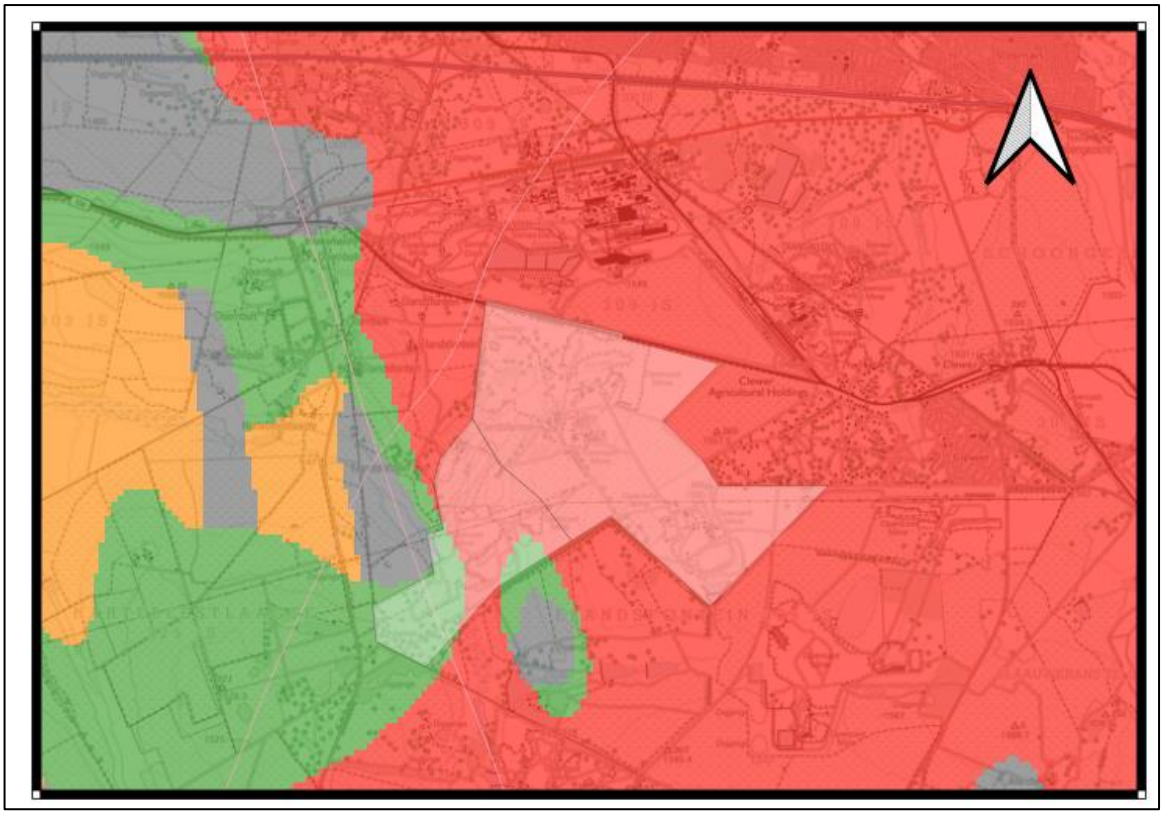


Figure 10: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed Elandsfontein Colliery.

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 8) there is very high possibility of finding fossils in the Vryheid Formation (Very High Palaeontological Sensitivity), while there is a moderate chance of finding fossils in the Dwyka Group and the basalt has a Zero Palaeontological Sensitivity.

8.1 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)
- A Google Earth map with polygons of the proposed development was obtained from PGS Heritage (Pty) Ltd.
- 1:250 000 2528 Pretoria Geological Map
- A few PIA's near the development site which were consulted include Bamford 2016 Bamford, 2017a, Bamford 2017b, Bamford 2018, Fourie 2015, Hancox 2011, 2014, Millsteed, 2013. See references.

9 SITE VISIT

As part of the PIA, a field-survey of the development footprint was conducted on 30 November 2019, to assess the potential risk to palaeontological material (fossils and trace fossils) in the proposed footprint of the development. A physical field-survey was conducted on foot and by motor vehicle within the proposed development footprint. The results of the field-survey, the author's experience, aerial photos (using Google Earth, 2018), topographical and geological maps and other reports from the same area were used to assess the proposed development footprint. No public consultations were undertaken for this Impact Assessment as it will be undertaken as part of the EIA process.

Figure 11: Opencast mine on Elandsfontein development facing westerly to the boundary

(- 25°53' 54"S 29°05' 05"E)

Figure 12: Stockpile on the mine with no evidence of fossils (MR MP 63)

(-25°54’ 26”S, 29°04’ 50”E)

Figure 13: Flat topography and low vegetation on the proposed Elandsfontein Mining upgrade area

(-25°55’ 15”S, 29°05’ 40”E)

Figure 14: Exposed coal seam

(-25°53’ 49” S, 29°04’ 59” E)

Figure 15: Coal stockpile

(-25°54’ 27” S, 29°05’ 38” E)

Figure 16: Grassy vegetation on a flat topography

(-25°58’ 45” S, 29°07’ 42” E)

Figure 17: Drill core indicating coal and sediments present in the stratigraphy (-25°55' 01" S, 28°57' 56" E)

10 IMPACT ASSESSMENT

10.1 IMPACT ASSESSMENT METHODOLOGY

10.1.1 INTRODUCTION

The impact significance rating methodology, as provided by EIMS, is guided by the requirements of the NEMA EIA Regulations 2014 (as amended). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/ likelihood (P) of the impact occurring. This determines the environmental risk. In addition, other factors, including cumulative impacts and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S). The impact assessment will be applied to all identified alternatives. Where possible, mitigation measures will be recommended for impacts identified.

Determination of environmental risk

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER). The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$\mathbf{C} = \frac{(\mathbf{E} + \mathbf{D} + \mathbf{M} + \mathbf{R}) * \mathbf{N}}{\mathbf{4}}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 5 below.

Table 5: Criteria for Determining Impact Consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)

Aspect	Score	Definition
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/ scored as per Table 6.

Table 6: Probability Scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

ER= C x P

Table 7: Determination of Environmental Risk

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in Table 8.

Table 8: Significance Classes

Environmental Risk Score	
Value	Description
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk).
≥9 - <17	Medium (i.e. where the impact could have a significant environmental risk),
≥17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

10.2 IMPACT PRIORITISATION

Further to the assessment criteria presented in the section above, it is necessary to assess each potentially significant impact in terms of:

1. Cumulative impacts; and
2. The degree to which the impact may cause irreplaceable loss of resources.

To ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 9: Criteria for Determining Prioritisation

Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/ definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable Loss of Resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.

	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in

Table 9. The impact priority is therefore determined as follows:

Priority = CI + LR

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (Refer to

Table 10).

Table 10: Determination of Prioritisation Factor

Priority	Ranking	Prioritisation Factor
2	Low	**1**
3	Medium	**1.125**
4	Medium	**1.25**
5	Medium	**1.375**
6	High	**1.5**

In order to determine the final impact significance, the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 11: Final Environmental Significance Rating

Environmental Significance Rating	
Value	Description
≤ -20	High negative (i.e. where the impact must have an influence on the decision process to develop in the area).
> -20 ≤ -10	Medium negative (i.e. where the impact could influence the decision to develop in the area).

Environmental Significance Rating	
> -10	Low negative (i.e. where this impact would not have a direct influence on the decision to develop in the area).
0	No impact
<10	Low positive (i.e. where this impact would not have a direct influence on the decision to develop in the area).
≥ 10 < 20	Medium positive (i.e. where the impact could influence the decision to develop in the area).
≥ 20	High positive (i.e. where the impact must have an influence on the decision process to develop in the area).

The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project.

10.3 PLANNING PHASE IMPACTS

No impacts will occur during the Planning Phase

10.3.1 CONSTRUCTION PHASE IMPACTS

10.3.1.1 1.3.1 IMPACT ON PALAEONTOLOGY

- The impact
  Destroy fossil heritage or permanently seal-in fossils at or below the ground surface. These fossils will no longer be available for research.
- Activities that can potentially contribute to the impact
  The site clearance and excavations of the Elandsfontein mine will include widespread diggings into the shallow sediment cover as well as into the underlying bedrock. The excavations will also change the topography of the development site. According to the Geology of the project site there is a Very High possibility of finding fossils. However, the impact rating is Medium negative before mitigation and becomes Low negative after mitigation.

10.3.1.2 MITIGATION MEASURES

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations, the **Chance Find Protocol** must be implemented by the ECO (site manager) in charge of these developments. These discoveries should be protected (if possible, in situ) and the

ECO must report the discovery 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 suitable mitigation (e.g. recording and collection) can be undertaken by a paleontologist.

Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university collection), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA.

10.3.2 CUMULATIVE IMPACTS

Various mining activities are present in the area and thus the cumulative impact is rated as high.

10.3.2.1 IRREPLACEABLE LOSS OF RESOURCES

Impacts on fossil heritage are irreversible. Scientifically, all well-documented reports and palaeontological studies of any fossils uncovered during construction would be a positive impact. A negative impact on the fossil heritage can be limited by the application of adequate damage mitigation procedures. If damage mitigation is properly undertaken the benefit scale for the project will lie within the beneficial category.

10.3.3 IMPACT ON ALTERNATIVES CONSIDERED

Four Alternatives for this development footprint have been considered namely:

- Activity Alternative A1 – the Mining option.
- Activity Alternative A2 – the No Go Option
- Process Alternative P3A – for the Opencast mining areas and
- Process Alternative P3B – for the Underground mining areas

As the geology of the mining alternatives is the same as the rest of the development footprint, they all will have the same impact on the fossil heritage of the development, except the No-Go option which will have no impact on the palaeontology.

10.3.3.1 ACTIVITY ALTERNATIVE A1 (MINING)

The impact rating is Medium negative before mitigation and becomes Low negative after mitigation.

10.3.3.2 ACTIVITY ALTERNATIVE A2 (NO-GO OPTION)

The No-go alternative will have a negligible impact on all the palaeontological resources.

10.3.3.3 PROCESS ALTERNATIVE P3A (OPEN CAST)

The impact rating is Medium negative before mitigation and becomes Low negative after mitigation

10.3.3.4 PROCESS ALTERNATIVE P3B (UNDERGROUND)

The impact rating is Medium negative before mitigation and becomes Low negative after mitigation.

10.3.3.5 STATEMENT ON PREFERRED ALTERNATIVE

As the geology of the mining alternatives is the same as the rest of the development footprint, they all will have the same impact on the fossil heritage of the development, except the No-Go option which will have no impact on the palaeontology.

10.3.4 OPERATIONAL PHASE IMPACTS

Similar Impacts will occur during the Operational Phase as apply for the Construction Phase, for all four alternatives considered.

10.3.5 DECOMMISSIONING PHASE IMPACTS

No Impacts will occur during the Decommissioning Phase

10.3.6 REHABILITATION AND CLOSURE PHASE IMPACTS

No Impacts will occur during the Rehabilitation and Closure Phase

10.4 SUMMARY OF IMPACT TABLES

The proposed Elandsfontein Colliery is primarily underlain by the Ecca Group (Vryheid Formation), and a small portion in the Dwyka Group, . According to the PalaeoMap on the SAHRIS database, the Palaeontological Sensitivity of the Vryheid Formation is Very High, the Dwyka Group has a Moderate Palaeontological Sensitivities (Almond and Pether 2008, SAHRIS website). Impacts on Palaeontological Heritage are only likely to happen within **the construction and operation phases**. No impacts are expected to occur during the operation phase or decommissioning phase.

The impact is likely to have a negative impact on fossil heritage (-1). The extent of the area of potential impact is restricted to the project site (2). The expected duration of the impact is assessed as potentially permanent to long term (5). Since no palaeontological heritage was seen in the development (and Bamford 2018, recovered poorly preserved fossils) the probability of significant impacts on palaeontological heritage during the construction phase are medium to high (4). Magnitude is very high (5). Impacts on fossil heritage are irreversible (5). The probability

of significant impacts on palaeontological heritage during the construction phase are thus negative medium (-17).

Four Alternatives for this development footprint have been considered namely:

- Activity Alternative A1 – the mining option.
- Activity Alternative A2 – the No Go Option
- Process Alternative P3A – for the Opencast mining areas and
- Process Alternative P3B – for the Underground mining areas

As the geology of these alternatives is the same as the rest of the development footprint, they all will have the same impact on the fossil heritage of the development, except for the No-Go option which will have low to no impact on the palaeontological resources.

11 SPECIALIST MANAGEMENT PLAN

Table 2. Mitigation measures including requirements for timeframes, roles and responsibilities etc.

No.	Mitigation Measures	Phase	Timeframe	Responsible Party for Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)
Palaeontological Resources							
A	The EAP and ECO (site manager) for this project must be informed that the Vryheid Formation of the Ecca Group has a Very High Palaeontological Sensitivity. There is thus a very high chance that fossils could be present in the Vryheid Fm of the proposed Elandsfontein mining operations upgrade.	Construction Operation	Prior to construction and ongoing throughout lifespan of mine	The EAP / ECO of the mine	ECO (as determined by the mine and palaeontologist)	Ensure compliance with relevant legislation	(ECO Monthly Checklist/Report)
B	If fossil remains are discovered, the **Chance Find Protocol** must be implemented by the ECO. Fossils must be secured; SAHRA must be informed of the find and a palaeontologist must undertake mitigation measures. Before fossil material can be collected from the development site, the specialist would have to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA	Construction Operation	Prior to construction and ongoing throughout lifespan of mine	The EAP / ECO of the mine	ECO (as determined by the mine and palaeontologist))	Ensure compliance with relevant legislation	ECO Monthly Checklist/Report

12 CONCLUSION

The geology of the proposed Elandsfontein Colliery is primarily underlain by the Vryheid Formation (Ecca Group), with a small portion in the Dwyka Group. The study area is also underlain by very small areas of diabase rock which is unfossiliferous. According to the PalaeoMap on the SAHRIS database, the Palaeontological Sensitivity of the Vryheid Formation is Very High, while the Dwyka Group has a Moderate Palaeontological Sensitivity (Almond and Pether 2008, SAHRIS website). Four Alternatives for this development footprint have been considered. As the geology of these alternatives is the same as the rest of the development footprint, they all will have the same impact on the fossil heritage of the development, except the No-Go option which will have no impact on the palaeontology.

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 30 November 2019. No visible evidence of fossiliferous outcrops was found, although Bamford (2018) had uncovered poorly preserved and unidentifiable small pockets of fossils on the Elandsfontein mining development for a previous PIA. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the Elandsfontein mining upgrade will be of a medium significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction of the development may be authorised in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.

If fossil remains are discovered during any phase of construction or operation either on the surface or exposed by excavations, the **Chance Find Protocol** must be implemented by the ECO (site manager) in charge of these developments. These discoveries should be protected (if possible, *in situ*) and the ECO must report the discovery 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 suitable mitigation (e.g. recording and collection) can be undertaken by a paleontologist.

Before any fossil material can be collected from the development site, the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university collection), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA.

Recommendations:

- The EAP and ECO/site manager must be informed that the Vryheid Formation of the Ecca Group has a Very High Palaeontological Sensitivity. There is thus a very high chance that fossils could be present in the Vryheid Fm of the proposed Elandsfontein mining operations upgrade.
- If fossil remains are discovered during any phase of construction, the **Chance Find Protocol** must be implemented by the ECO in charge of these developments. These discoveries should be secured, and the ECO/site manager must alert SAHRA so that the proper mitigation (documented and collection) can be undertaken by a palaeontologist.

These recommendations should be included in the Heritage Management Plan and EMPr for the Elandsfontein mining operations.

13 CHANCE FINDS PROTOCOL

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

13.1 LEGISLATION

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

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

13.2 CHANCE FIND PROCEDURE

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.

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 uncovered fossil material.

It is the responsibility of the Environmental Control Officer (ECO) 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 ECO, 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.

- If a chance find is made the person responsible for the find must immediately **stop working** and all work 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 who in turn must report the find to his/her manager and the ECO or site manager. The ECO 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. Website: 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 (as many as possible) 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 ECO (site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary. In the interim, until a response has been received from SAHRA, the following measures must be implemented by the ECO (site manager):

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

14 ASSUMPTIONS AND LIMITATIONS

When conducting a Palaeontological Impact Assessment several factors can affect the accuracy of the assessment. 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 not been reviewed by palaeontologists and data is generally based on aerial photographs. 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 are used to provide information on the existence of fossils in an area which has not yet been documented. When similar Assemblage Zones and geological formations are referenced for Desktop studies it is generally **assumed** that exposed fossil heritage is present within the footprint. A field-assessment is thus necessary to improve the accuracy of the desktop assessment.

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Appendices

Appendix A: Specialist Declaration Form

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

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

Disclosure of Vested Interest

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

PALAEONTOLOGICAL CONSULTANT: *Banzai Environmental (Pty) Ltd*

CONTACT PERSON: *Elize Butler*

Tel: +27 844478759

Email: elizebutler002@gmail.com

***SIGNATURE*:**

Appendix B: Specialist 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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