BANZAI ENVIRONMENTAL

PALAEONTOLOGICAL DESKTOP ASSESSMENT

THE PROPOSED GLENCORE WESTERN CHROME MINE EXPANSION NEAR RUSTENBURG, NORTH-WEST PROVINCE

September 2024

COMPILED FOR: Environmental Impact Management Services (EIMS)

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

Table 1:Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**The relevant section in the report**	**Comment where not applicable**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 2 – refer to **Appendix A**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Methods and Terms of Reference	-
(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 7	-

(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Executive Summary, Section 7 & 8	-
(e) A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 4 Approach and Methodology	-
(f) Details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative	Executive Summary, Section 7 & 8	-
(g) An identification of any areas to be avoided, including buffers	Executive Summary, Section 7 & 8	-
(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 4 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Executive Summary, Section 7 & 8	
(k) Any mitigation measures for inclusion in the EMPr	Executive Summary, Section 8	

(l) Any conditions for inclusion in the environmental authorisation	Executive Summary, Section 8	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Executive Summary, Section 8	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Executive Summary, Section 8	
(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	Executive Summary, Section 8	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process was handled as part of the Environmental Impact Assessment (EIA) and Environmental Managemen

		t Plan (EMP) process
(p) A summary and copies of any comments that were received during any consultation process	N/A	Not applicable. To date, no comments regarding heritage resources that require input from a specialist have been raised
(q) Any other information requested by the competent authority	N/A	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by EIMS to conduct the Palaeontological Desktop Assessment (PDA) to assess the proposed New Developments for Glencore Western Chrome Mines near Rustenburg, North-West Province. This PDA is required to confirm if fossil material could potentially be present in the approved development area and to evaluate the potential impact of the proposed changes to the development on the Palaeontological Heritage under the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA).

The proposed Glencore Western Chrome Mine Expansion near Rustenburg in North-West Province is underlain by Mathlagame Norite-Anorthosite and Bronzitite, Harzburgite and Norite of the Rustenburg Layered Suite (Bushveld Complex). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of the Rustenburg Layered Suite (Bushveld Complex) is Zero (Almond and Pether, 2009; Almond *et al*., 2013, Groenewald et al 2014). The suggested location is classified as having a Medium Palaeontology Theme Sensitivity in the DFFE (Department of Forestry Fisheries and the Environment) Screening Report. Updated Geology (Council of Geosciences) refined the geological map and indicate that the proposed development is underlain by the Schilpadnest and Vlakfontein Subsuite (Rustenburg Layered Subsuite of the Bushveld Complex).

Desktop research (National Database and published data) concluded that fossil heritage of scientific and conservational interest in the development area is rare. A low significance has thus been allocated to the development footprint. This is in agreement with the Zero Palaeontological Sensitivity allocated to the development area by the SAHRIS Palaeontological Sensitivity Map.

A Low Palaeontological Significance has been allocated for impacts associated with the construction phase of the Infrastructure Expansion pre-mitigation and post-mitigation. The mining phase will be the only development phase with the potential of impacting Palaeontological Heritage, and no significant impacts are expected to impact the Decommissioning phase. As the No-Go Alternative considers the option of 'do nothing' and maintaining the status quo, it will have a Neutral impact on the Palaeontological Heritage of the development. The Cumulative impacts of the Infrastructure Expansion is considered to be Low (as the area is not highly fossiliferous), and falls within the acceptable limits for the project. It is therefore considered that the proposed Infrastructure Expansion will not lead to damaging impacts on the palaeontological resources of the area. The Infrastructure Expansion may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources. 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.

Recommendations:

- In the unlikely event that, Palaeontological Heritage is uncovered during surface clearing and excavations, the ECO/site manager must report the find to the South African Heritage Resources Agency (SAHRA) (Contact details: Heritage Western Cape, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. 3rd floor Protea Assurance Building, 142 Longmarket St, Cape Town City Centre, Cape Town, 8000; Private Bag X9067, Cape Town, 8000 Tel: 021 483 9598. Fax: +27 (0) 21 483 9845. Web: www.hwc.org.za) so that mitigation (recording and collection) can be carried out.
- Before any fossil material can be collected from the development site, the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).

These recommendations should be incorporated into the Environmental Management Programme (EMPr) for this Glencore Western Chrome Mine Project near Rustenburg in the North-West Province.

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GLOSSARY OF TERMS

Fossil

A fossil is the preserved remnants or vestiges of a long-dead organism, generally from millions of years ago. Fossils can be mineralized skeletons, shells, or other hard pieces of ancient animals and plants, as well as impressions, moulds, and casts left in sedimentary rock when the organism's remains decomposed and left an impression. Fossils provide valuable insights into the evolution and biodiversity of ancient species, allowing scientists to study and understand their evolution and biodiversity.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act No 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.

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 comprises of fossilised remains or traces of past life.

LIST OF ABBREVIATIONS

BA	Basic Assessment
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
CA	National Competent Authority
ECO	Environmental Control Officer
EMPr	Environmental Management Programme
ESO	Environmental Site Officer
HIA	Heritage Impact Assessment
Ma	Millions of years ago
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PIA	Palaeontological Impact Assessment
PSSA	Palaeontological Society of South Africa
RCM	Clover Alloys Rustenburg Chrome Mine
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SEF	Solar Energy Facility
S&EIA	Scoping & Environmental Impact Assessment
ToR	Terms of Reference
WCM	Western Chrome Mines

1 INTRODUCTION

Glencore Operations South Africa (Pty) Ltd – Western Chrome Mines (WCM) is in the process to acquire some of the mining and surface rights from Clover Alloys Rustenburg Chrome Mine (RCM) on Portion 62 of the farm Rietfontein 338 JQ. Both mines are under the jurisdiction of the Rustenburg Local Municipality and the Bojanala Platinum District Municipality (BPDM). The primary objective of this acquisition is to increase the mining facetime by reducing time taken to travel to the face at its Kroondal Mine. In addition, this will also assist Glencore Western Chrome Mines to increase productivity and remain in business.

In addition to utilising existing infrastructure at Clover RCM, Glencore WCM wishes to develop additional facilities to use in the life of mine. These will need relevant environmental authorisations as regulated by relevant South African legislation.

1.1 Kroondal Mine

Kroondal Mine is located in the North-West Province, approximately 10 km east of Rustenburg on portions of the farm Kroondal 304 JQ in the North-West Province. Historically, mining at Kroondal has consisted of both opencast and underground mining. At present, only underground mining remains as the old opencast areas have been closed and rehabilitated. The original mining rights were issued to Xstrata SA (Pty) Ltd. Glencore (Pty) Ltd merged with Xstrata and the companies name changed to Glencore (Pty) Ltd.

The underground mining is currently taking place in close proximity to the Clover Alloys RCM mining rights area. Acquiring these rights will enable Glencore WCM to reduce the miners travel time by approximately 50%, thereby increasing production and ensuring the long-term survival of the business

1.2 Requirements

Glencore WCM plans to transfer (parts or whole) the existing environmental authorisations (EMPr, WUL, WML, etc) issued to Clover RCM. In addition, Glencore wishes to construct additional facilities which, under relevant environmental legislation, require approval by a competent authority. The proposed new developments include, but are not limited to:

- Parking area for permanent employees (13 500 m^2),
- Parking area for visitors and contractors (1 200m^2),
- Employee drop-off/pick-up zone (1 000m^2),

- Salvage yard (temporary waste storage) (approx. 850m^2),
- Sewage plant (area 2 000 m^2 and a capacity of less than 15 000 m^3/day),
- Temporary explosives transfer area (3 000 m^2)
- Lekgotla Hall ((800 m^2) - this is a meeting venue used for large group meetings),
    - Access roads one road for employees & visitors (7m wide and 372m long)
    - one access road for delivery vehicles (7m wide and 750m long)
- 2x water storage dams each with a capacity of 400m^3.
- Compressor house
- 1x 11Kv Powerline
- Administration Offices
- Change houses (1x for females and 1x for males with a total area of 3 700 m^2)
- Temporary laydown area for contractors that will be doing the construction activities.

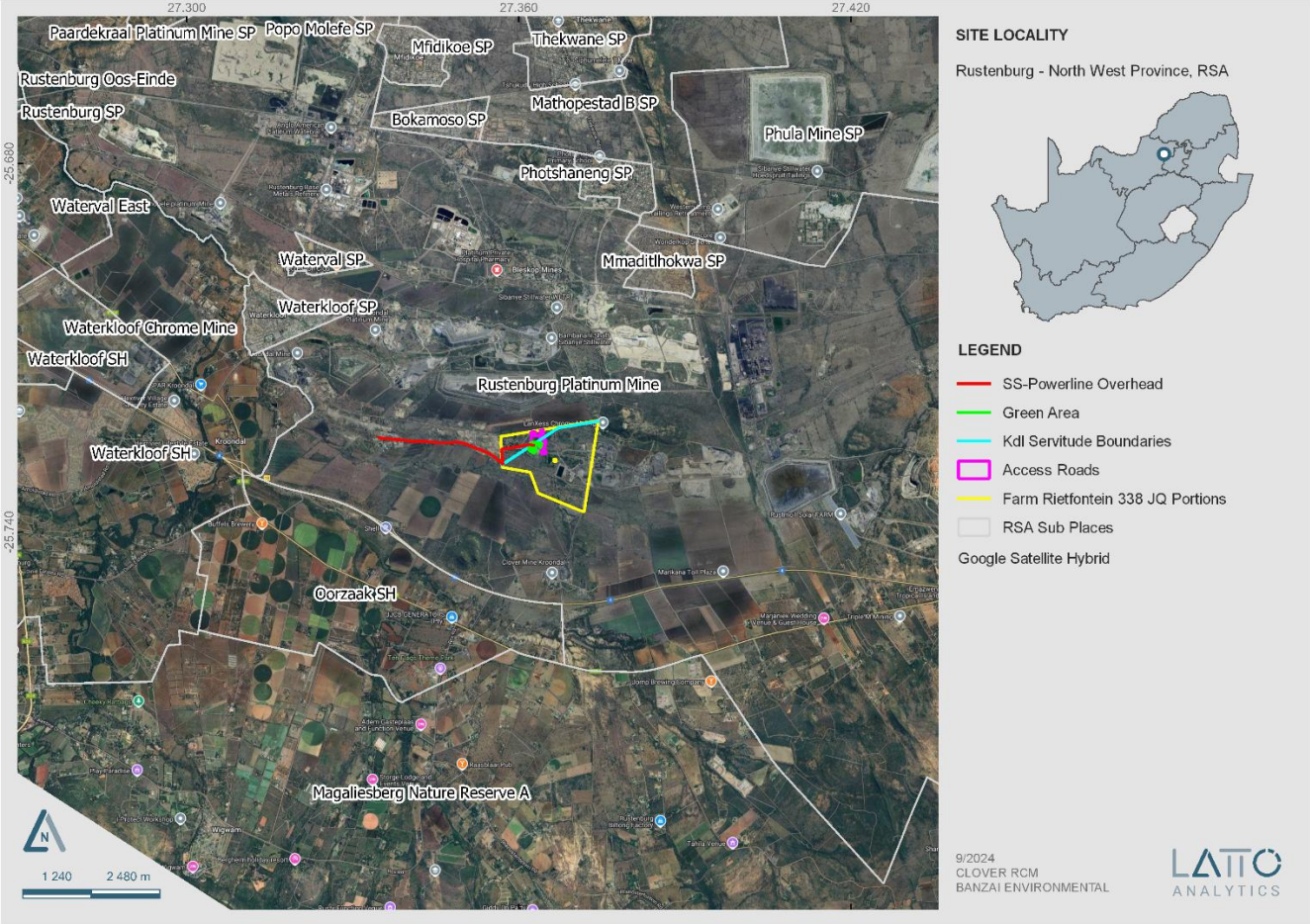


Figure 1: Regional Locality of the proposed Glencore Western Chrome Mine Expansion near Rustenburg, in North-West Province.

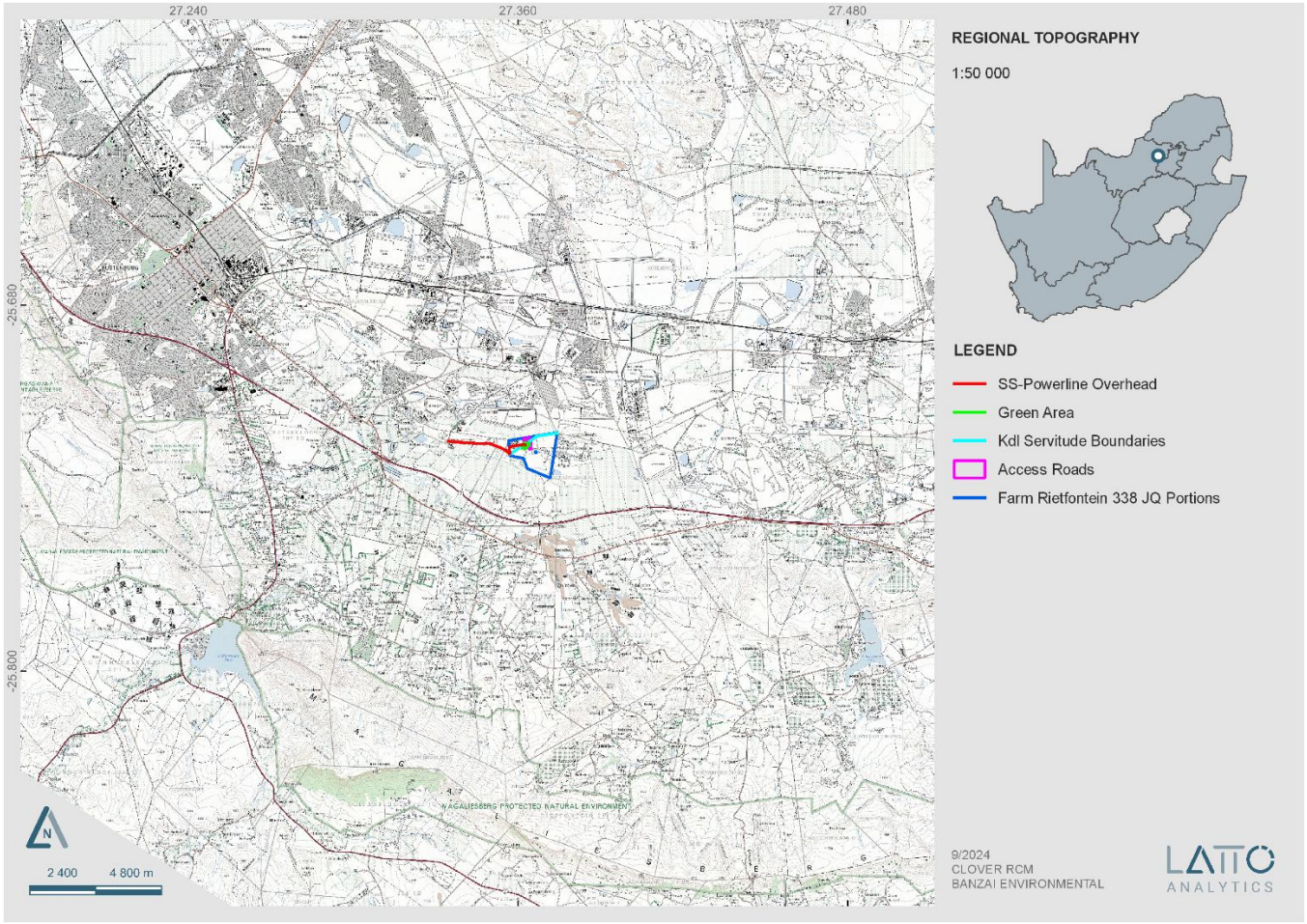


Figure 2: Regional topography of the proposed Glencore Western Chrome Mine Expansion near Rustenburg, in North-West Province.

2. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This study has been conducted by Mrs Elize Butler. She has conducted approximately 800 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, 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 thirty years. She has experience in locating, collecting, and curating fossils. 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 20
- Environmental Impacts Assessment (EIA) – Regulations 21 to 24

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. METHODS AND TERMS OF REFERENCE

This PDA assesses the development's potential impact on the fossil heritage. This Palaeontological Assessment is part of the HIA Report. The PIA's goals are to: 1) identify the palaeontological significance of the rock formations in the footprint; 2) evaluate the palaeontological magnitude of the formations; 3) clarify the impact on fossil heritage; and 4) make recommendations for how the developer might protect and minimize potential harm to fossil heritage, according to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports".

Calculations of the palaeontological state of each rock segment and the potential impact of development on fossil history take into account the palaeontological status of the rocks, the type of development, and the amount of bedrock removed.

The Provisional DFFE Screening Tool, the SAHRIS Palaeosensitivity map, all Palaeontological Impact Assessment reports for the same area, Google Earth images, topographical and geological maps, as well as academic articles about specimens from the development area and Assemblage Zones, are all used to create scoping reports.

When the development footprint has a moderate to high palaeontological sensitivity, a field-based assessment is necessary. A desktop or field assessment of the exposed rock is used to evaluate the significance of the proposed development's impact, and recommendations for more research or mitigation are made. Excavations for the project often only take place during the building phase, changing the terrain and destroying or permanently encasing fossils at or below the ground surface. Then, access to Fossil Heritage will no longer be available for academic study.

When doing a site investigation, a palaeontologist examines the local development as well as the quantity and variety of fossils found there. This can be demonstrated by looking at representative fossiliferous rock exposures (most igneous and metamorphic rocks are not fossiliferous, whereas sedimentary rocks contain fossil heritage). Examined rock exposures frequently contain a sizeable portion of the stratigraphic unit, which is primarily made up of recently exposed (unweathered) rock. These exposures may be man-made (such as quarries, open building excavations, even railway and road cuttings) or

natural (such as cliffs, and dongas as well as rocky outcrops along stream or river banks). It is usual practice for palaeontologists to record well-preserved fossils (GPS, and stratigraphic data) during field assessment examinations.

Although mitigation is often done prior to construction, it may take place if potentially fossiliferous bedrock is revealed. Fossil collection and documentation are examples of mitigation. A permit from SAHRA must be obtained before beginning any fossil excavation, and the material must be stored at an authorized facility. When mitigation is properly used, it is possible to have a positive impact by raising awareness of the palaeontological past of the area.

By physically evaluating bedrock outcrops to determine their lithology and fossil richness and crisscrossing the development footprint, one can assess an area's fossil potential. Because the presence of fossils at the surface is so unexpected, an average sample size of the region is investigated. To be clear, however, the lack of fossils in a development footprint does not automatically suggest that there is no palaeontologically important material present on the site (on or below the ground surface).

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;
- Describe of the proposed project and provide information regarding the developer and consultant who commissioned the study;
- Describe location of the proposed development and provide geological and topographical maps
- Provide palaeontological and geological history of the affected area;
- Identify sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluate the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
    a. Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
    b. Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity.

c. Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.

- Fair assessment of alternatives (infrastructure alternatives have been provided);
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Detail the implications of specialist findings for the proposed development (such as permits, licenses etc).

4.1 Assumptions and Limitations

The geology of the area is the focal point of geological maps, and the sheet explanations of the Geological Maps were not intended to focus on palaeontological heritage. Many inaccessible areas of South Africa have never been examined by palaeontologists, and data is typically dependent solely on aerial pictures. Locality and geological information in museums and university databases is out of date, and data acquired in the past is not always adequately documented.

Comparable Assemblage Zones in other places are also used to provide information on the existence of fossils in areas that have not before been recorded. When similar Assemblage Zones and geological formations are used for Desktop studies, it is commonly assumed that exposed fossil exists within the footprint.

5. GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The geology of the study area is depicted on the 1:250 000 Rustenburg 2526 (1981) Geological Map (Council for Geosciences, Pretoria) (Figure 3, Table 2). The entire study area is underlain by Mathlagame Norite-Anorthosite (Vcm, green) and Bronzitite, Harzburgite and Norite (Vl, green) of the Rustenburg Layered Suite (Bushveld Complex). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of the Rustenburg Layered Suite (Bushveld Complex) is Zero (grey) (Almond and Pether, 2009; Almond *et al*., 2013, Groenewald et al 2014) (Figure 4, Table 3). The suggested location is classified as having a Medium (orange) Palaeontology Theme Sensitivity in the DFFE (Department of Forestry Fisheries and the Environment) Screening Report (Figure 5). Updated Geology (Council of Geosciences) refined the geological map and indicate that the proposed development is underlain by the Schilpadnest and Vlakfontein Subsuites (Rustenburg Layered Subsuite of the Bushveld Complex) (Figure 6).

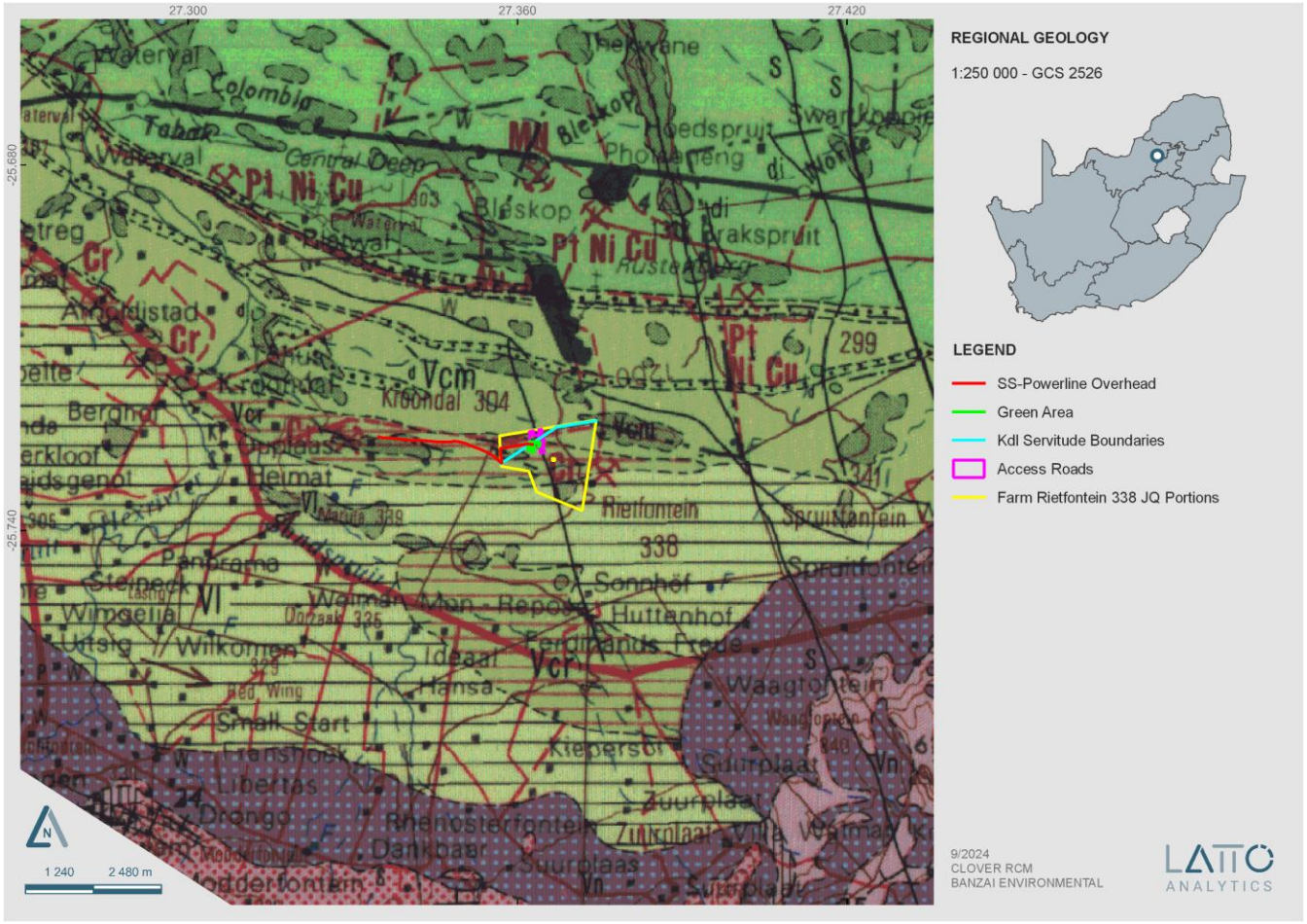
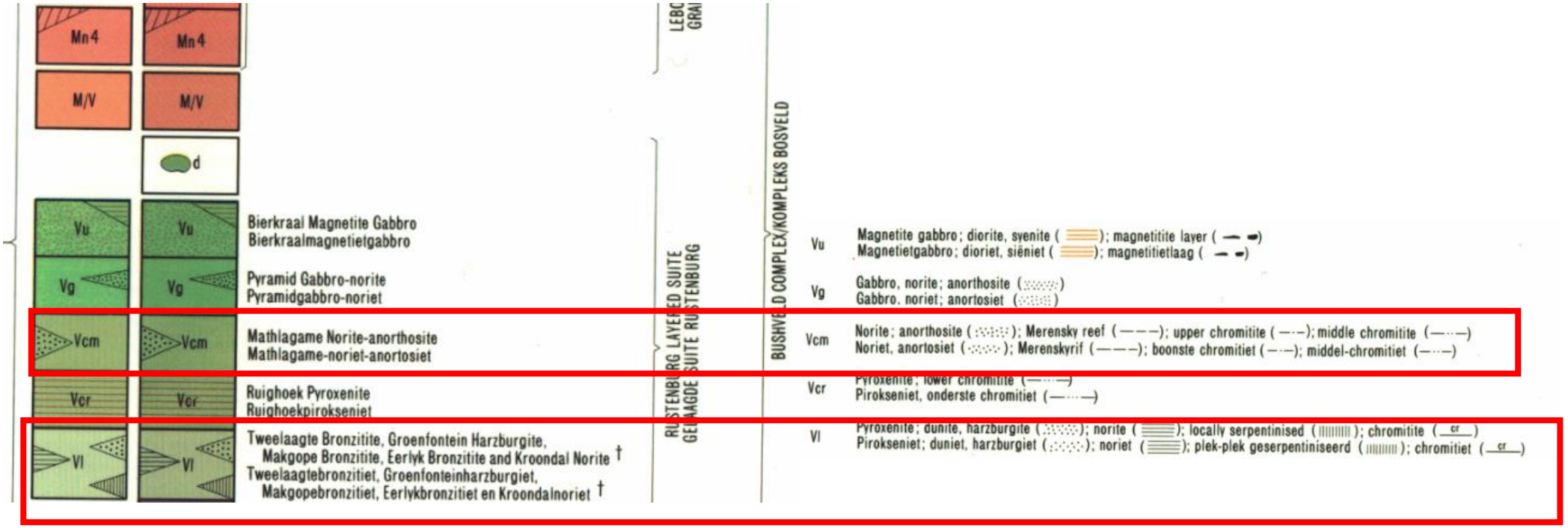


Figure 3: Extract of the 1:250 000 Rustenburg 2526 (1981) Geological Map (Council for Geosciences, Pretoria) indicating that the proposed study area is entirely underlain by the Rustenburg Layered Suite (Bushveld Complex).

Table 2: Legend to the Rustenburg 2526 (1981) Geological Map (Council for Geosciences, Pretoria).

Relevant lithology is indicated in red polygons.



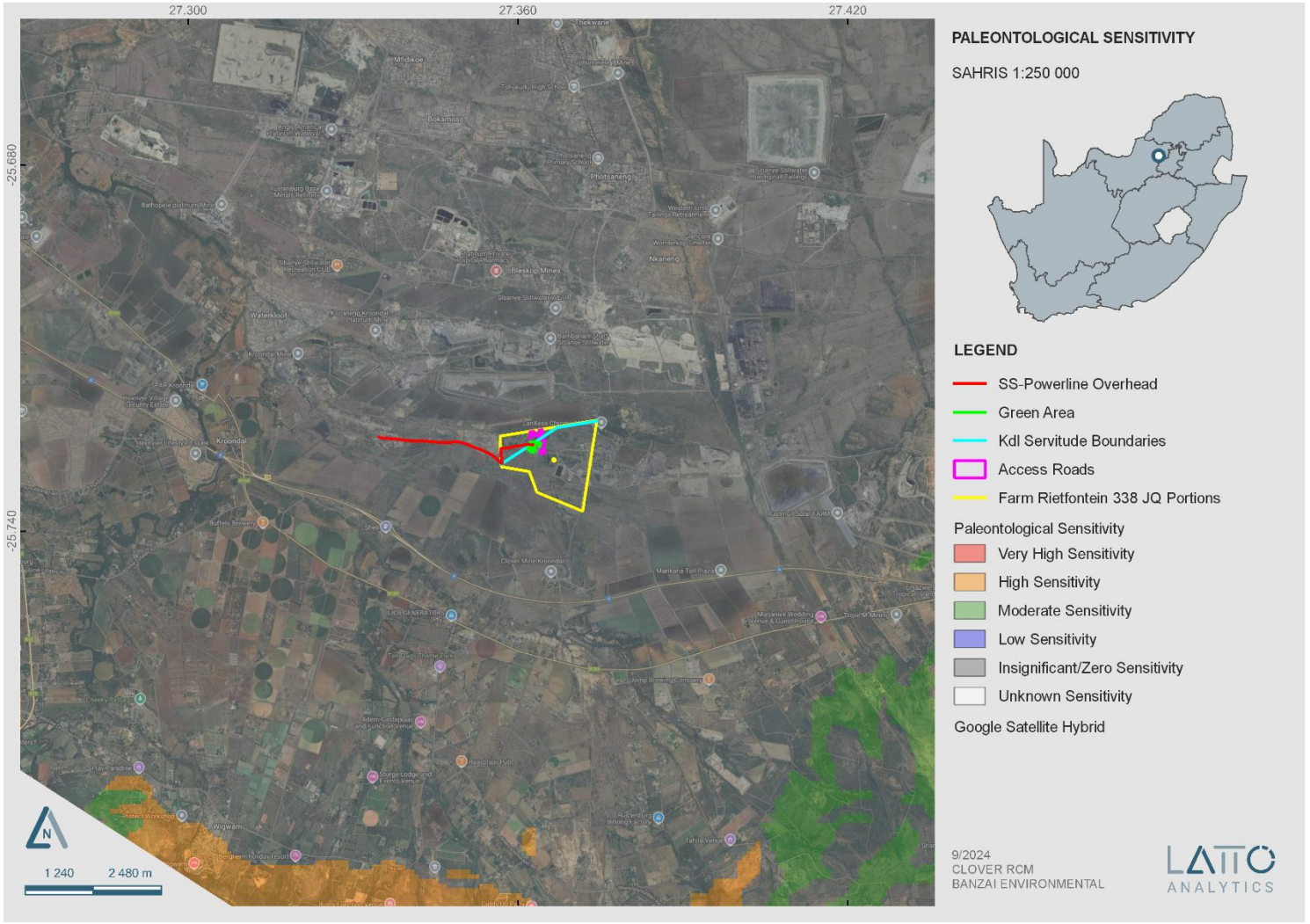


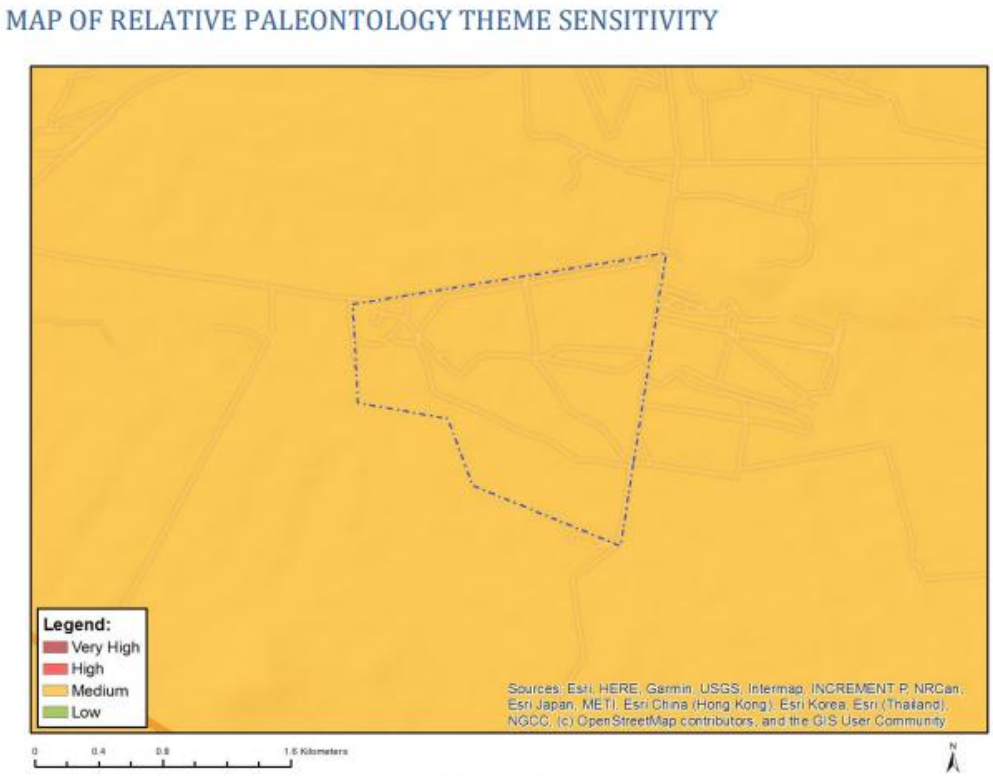
Figure 4: Extract of the 1 in 250 000 SAHRIS PalaeoMap (Council of Geosciences, Pretoria indicting the Zero (grey) Palaeontological Sensitivity of the proposed Glencore Mine Expansion near Rustenburg in the North West Province.

Table 3: Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website).

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

The PalaeoMap (Council of Geosciences, Pretoria) indicates that the proposed study area has a Zero (grey) Palaeontological Sensitivity.

The SAHRIS Palaeosensitivity map (Figure 4) indicates that the proposed development is underlain by sediments with a Zero (grey) Palaeontological Sensitivity, while the DFFE Screening tool indicates a Medium (orange) Palaeontological Sensitivity (Figure 5). The above-mentioned Palaeontological Sensitivities required a desktop assessment being conducted and thus the Palaeontological Sensitivity was not verified by a site investigation. However, desktop research has indicated that the proposed Mine Expansion has a Low to Zero Palaeontological Sensitivity.



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Features with a Medium paleontological sensitivity

Figure 5: Palaeontological Sensitivity of the Mine Expansion study area near Rustenburg in North-West Province by the National Environmental Web-based Screening Tool indicates a Medium (orange) Palaeontological Sensitivity.

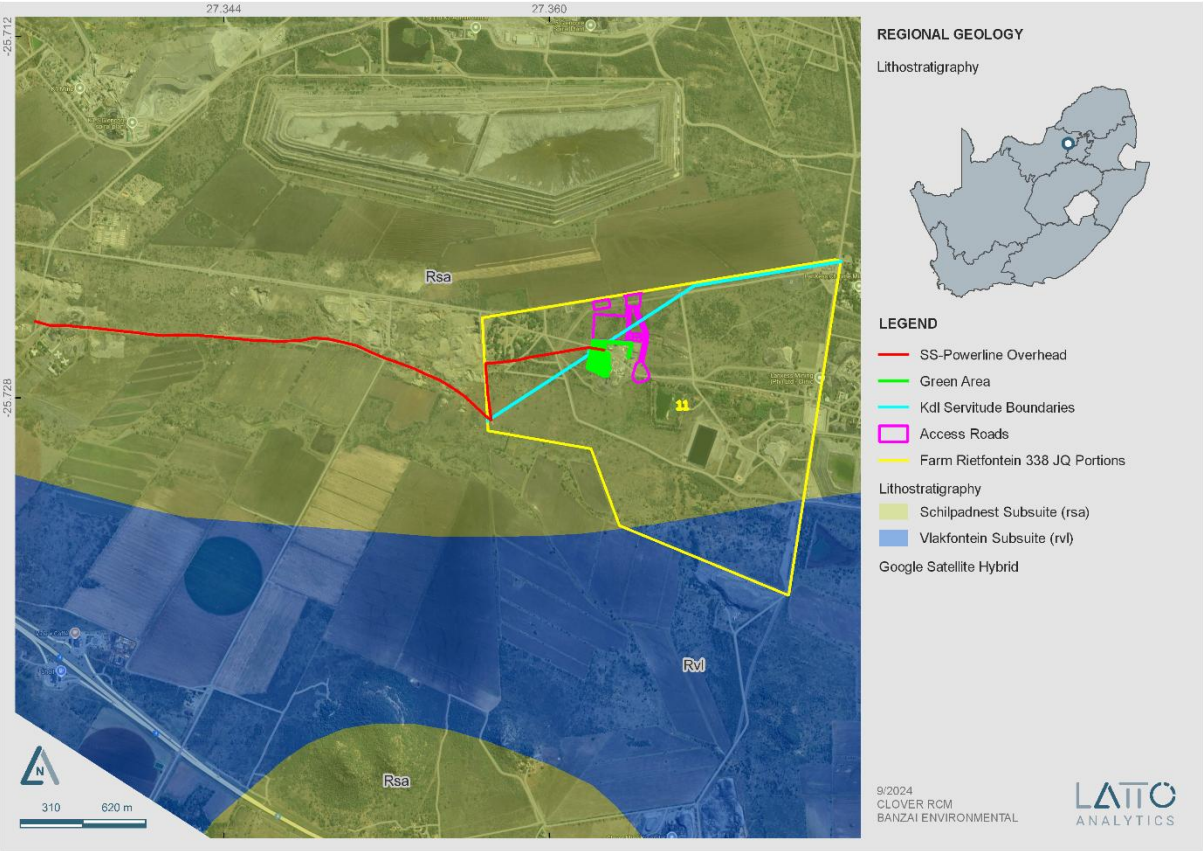


Figure 6: Updated Geology (Council of Geosciences, Pretoria) indicates that the proposed Mine Expansion study area near Rustenburg in the North-West Province is underlain by the Schilpadnest (rsa) and Vlakfontein (rvl) Subsuites of the Rustenburg Layered Suite (Bushveld Complex).

The Bushveld Complex comprise of the largest mafic intrusion in the world and underlie an area of almost 65 000 km^2. The maximum thickness of these rocks is almost 8 km while individual layers can be followed for about 150 km. This intrusion is world renowned for the ore reserves of platinum-group elements namely chromium and vanadium. The Bushveld Complex is divided in 4 groups namely the Lebowa Granite Suite, Rashoop Granophyre Suite, Rustenburg Layered Suite and Rooiberg Group (Table 6). The latter Group of felsic and minor volcanic rocks may be genetically closer related to the Bushveld event as to the Transvaal Supergroup (Hutton and Schweitzer, 1995). The Rustenburg Layered Suite reveals a complete differentiation sequence of magma and is made up of various rock layers ranging from dunite, gabbro, norite, and pyroxenite, and anorthosite to magnetite and apatite- rich diorite.

Table 4: Currently accepted nomenclature and subdivisions of the Bushveld Complex (Cawthorn et al, 2006).

	Standard zonal subdivision (informal)		Nomenclature recommended by SACS (1980), including subsequent additions					
	All areas		Eastern limb		Western limb		Northern limb	
RUSTENBURG LAYERED SUITE	Upper Zone	Subzone C	Roossenekal Subsuite[1]	Luipershoek Olivine Diorite		Bierkraal Magnetite Gabbro		Molendraai Magnetite Gabbro[1]
		Subzone B		Ironstone Magnetite Gabbro				
		Subzone A		Magnet Heights Gabbronorite				
	Main Zone	Upper Subzone[4]	Dsjate Subsuite[1]	Mapoch Gabbronorite		Pyramid Gabbronorite		Mapela Gabbronorite[1]
		Lower Subzone		Leolo Mountain Gabbronorite				
				Winnaarshoek Norite-Anorthosite				
	Critical Zone	Upper Subzone	Dwars River Subsuite[1]	Winterveld Norite-Anorthosite	Schilpadnest Subsuite[1]	Mathlagame Norite-Anorthosite		Grasvally Norite-Anorthosite[1]
		Lower Subzone		Mooihoek Pyroxenite		Ruighoek Bronzitite		
	Lower Zone[3]	Upper Pyroxenite Subzone	Croydon Subsuite[1]	Serokolo Bronzitite	Vlakfontein Subsuite[1]	Tweelaagte Bronzitite	Zoetveld Subsuite[1]	Moorddrift Harzburgite-Pyroxenite[2]
		Harzburgite Subzone		Jagdlust Harzburgite		Groenfontein Harzburgite		Drummondlea Harzburgite[2]
		Lower Pyroxenite Subzone		Rostock Bronzitite		Makgope Bronzitite		Volspruit Pyroxenite[2]
				Clapham Bronzitite		Eerlyk Bronzitite		
	Marginal Zone			Shelter Norite		Kroondal Norite / Kolobeng Norite		

[1]Walraven (1986)
[2]Hulbert and Von Gruenewaldt (1982)
[3]Teigler and Eales (1996) suggested that the top of the Lower Zone be taken at the top of the Harzburgite Subzone
[4]Kruger (1994) proposed, on the basis of initial Sr isotopic ratios, that the Upper Subzone of the Main Zone should be included in the Upper Zone

The Bushveld Complex is thus igneous in origin and thus unfossiliferous.

6. 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 EIMS
- Google Earth© satellite imagery.
- 1:250 000 Rustenburg 2526 (1981) Geological Map (Council for Geosciences, Pretoria)
- Updated geology of the proposed development (Council for Geosciences, Pretoria).
- Palaeosensitivity map on SAHRIS (South African Heritage Resources Information System) website
- Department of Forestry, Fisheries and the Environment Screening tool report
- The combined National Palaeontological Databases of the Museums and Universities of Southern Africa.
- Published geological and palaeontological literature

7. IMPACT ASSESSMENT METHODOLOGY

The entire study area is underlain by Mathlagame Norite-Anorthosite (Vcm, green) of the Rustenburg Layered Suite (Bushveld Complex). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of the Rustenburg Layered Suite (Bushveld Complex) is Zero (grey) (Almond and Pether, 2009; Almond et al., 2013, Groenewald et al 2014). Please note that only the mining Phase will be impacted on and no impacts are expected in the Decommissioning Phase.

Nature of the Impact

The excavations and site clearance of the Glencore Western Chrome Mine Project near Rustenburg, North-West Province will involve considerable excavations into the superficial sediments and also into the underlying bedrock. Existing topography will be modified while fossils may be destroyed or sealed-in, at the surface or below ground surface.

Geographical extent of the impact

Impacts on fossil heritage will only occur during the construction phase of the development. The extent of the area of potential impact is thus limited to the project site.

Sensitive areas

The Glencore Western Chrome Mine Project is completely underlain by the Mathlagame Norite-Anorthosite of the Rustenburg Layered Suite (Bushveld Complex), which is unfossiliferous.

Duration of the Impact

The expected duration of the impact is potentially permanent too long term. In the absence of mitigation procedures (and if fossils are present in the development area) the harm or destruction of palaeontological heritage will be permanent.

Potential Significance of the Impact

No significant impact will occur as the site is underlain by unfossiliferous Mathlagame Norite-Anorthosite (Vcm, green) of the Rustenburg Layered Suite (Bushveld Complex).

Severity/ Beneficial scale

No Impact

Intensity of impact occurring

Probable significant impacts on palaeontological heritage during the construction phase are Low/Zero.

Probability

According to the Geology of the proposed development, fossil heritage is scarce in the development footprint. The probability of significant impacts on palaeontological heritage during the construction phase are thus Low to Zero.

Mitigation

If fossil heritage is present in the development footprint any negative or detrimental impact on these fossils can be mitigated by describing and collecting of the well-preserved fossils (by a professional palaeontologist). Mitigation should take place after vegetation clearance and before the ground is levelled for construction. A SAHRA permit will be required for fossil collection and the fossil heritage must be housed in an accredited institution (university or museum). If fossil heritage cannot be excavated a buffer could be placed around the fossil heritage thus protecting the fossils and fossil locality.

Mitigation would involve the collection and describing of fossils within the development footprint by a professional palaeontologist. This would take place after initial vegetation clearance but *before* the ground is levelled for construction.

Degree of irreversible Loss

Impacts on fossil heritage are generally irreversible. Scientifically all well-documented records and palaeontological studies of any fossils exposed during construction would represent a positive impact. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate mitigation procedures. If mitigation is undertaken the benefit scale for the project will be beneficial.

Irreplaceable loss

Fossil heritage is scarce/absent in the Mathlagame Norite-Anorthosite (Vcm, green) of the Rustenburg Layered Suite (Bushveld Complex) underlaying the development. Significant loss of fossil heritage may be limited by taking a precautionary approach.

Table 5: Impact Table

Impact: Loss of Fossil Heritage		
Construction Phase		
	Pre-Mitigation	Post-Mitigation
Nature	-1	-1
Extent	2	2
Duration	5	5
Magnitude	1	1
Reversibility	5	5
Probability	1	5
ER	-3.25	-3.25

8. FINDINGS AND RECOMMENDATIONS

The proposed Glencore Western Chrome Mine Project near Rustenburg in North-West Province is underlain by Mathlagame Norite-Anorthosite and Bronzitite, Harzburgite and Norite of the Rustenburg Layered Suite (Bushveld Complex). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of the Rustenburg Layered Suite (Bushveld Complex) is Zero (Almond and Pether, 2009; Almond *et al*., 2013, Groenewald et al 2014). The suggested location is classified as having a Medium Palaeontology Theme Sensitivity in the DFFE (Department of Forestry Fisheries and the Environment) Screening Report. Updated Geology (Council of Geosciences) refined the geological map and indicate that the proposed development is underlain by the Schilpadnest and Vlakfontein Subsuite (Rustenburg Layered Subsuite of the Bushveld Complex).

Desktop research (National Database and published data) concluded that fossil heritage of scientific and conservational interest in the development area is rare. A low significance has thus been allocated to the development footprint. This is in agreement with the Zero Palaeontological Sensitivity allocated to the development area by the SAHRIS Palaeontological Sensitivity Map.

A Low Palaeontological Significance has been allocated for impacts associated with the construction phase of the project pre-mitigation and post-mitigation. The construction/mining phase will be the only development phase with the potential of impacting Palaeontological Heritage, and no significant impacts are expected to impact the Decommissioning phase. As the No-Go Alternative considers the option of 'do nothing' and maintaining the status quo, it will have a Neutral impact on the Palaeontological Heritage of the development. The Cumulative impacts of the project is considered to be Low (as the area is not highly fossiliferous), and falls within the acceptable limits for the project. It is therefore considered that the proposed project will not lead to damaging impacts on the palaeontological resources of the area. The project may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources. 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.

Recommendations:

- In the unlikely event that, Palaeontological Heritage is uncovered during surface clearing and excavations, the ECO/site manager must report the find to the South African Heritage Resources Agency (SAHRA) (Contact details: Heritage Western Cape, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. 3rd floor Protea Assurance Building, 142 Longmarket St, Cape Town City Centre, Cape Town, 8000; Private Bag X9067, Cape Town, 8000 Tel: 021 483 9598. Fax: +27 (0) 21 483 9845. Web: www.hwc.org.za) so that mitigation (recording and collection) can be carried out.
- Before any fossil material can be collected from the development site, the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).

These recommendations should be incorporated into the Environmental Management Programme (EMPr) for the Glencore Western Chrome Mine Project near Rustenburg in the North-West Province.

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APPENDIX A

CURRICULUM VITAE

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	30 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	National Museum, Bloemfontein

and Collection Manager 1998–2022

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