Palaeontological Impact Assessment for the NIA02 Isihlengeni Prospecting Right Application, Between Vryheid and Nongoma, KwaZulu Natal Province

Desktop Study (Phase 1)

Subcontracted by

Temvelo Consultants (Pty) Ltd

25 July 2025

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1. Executive Summary

A Palaeontological Impact Assessment was requested for the NIA02 Isihlengeni Prospecting Right Application on a cluster of twelve farms between Vryheid and Nongoma, on behalf of the applicant Niara Minerals (Pty) Ltd. They will be prospecting for coal, pseudo-coal, and torbanite/oil shale within a 14,772-hectare area in the Abaqulusi Local Municipality, under the Amajuba District Municipality, KwaZulu-Natal Province.

To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed site lies on the potentially very highly sensitive Vryheid Formation (Ecca Group, Karoo Supergroup) that might preserve fossil plants of the Glossopteris flora. Therefore, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, environmental officer or other designated responsible person once excavations or drilling activities have commenced.

The impact will be MODERATE pre-mitigation and VERY LOW post-mitigation as far as the palaeontology is concerned.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Very High	Moderate	Palaeontological Impact Assessment	Section 7.2. SAHRA Requirements

2. **Declaration of independence and summary of expertise**.

a. Declaration

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Temvelo Consultants (Pty) Ltd, Roodepoort, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision-making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

b. Expertise

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf, PSSA
Experience: 36 years research and lecturing in Palaeontology; over 28 years PIA studies and over 450 projects completed.

c. Specialist declaration of independence and statement of objectivity for the assessment.

Declaration of Independence
I, Marion Bamford, declare that –
General declaration:

- I act as the independent palaeontology practitioner 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 from a heritage practitioner in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realise that a false declaration is an offence 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.

d. **Summary of the specialist's expertise**

I, Marion Bamford, am a professional Palaeontologist with a PhD in Palaeontology (Wits University, 1990). I have more than 35 years of experience in palaeontological research and have published over 190 papers in peer-reviewed journals and published more than 14 scholarly book chapters. I review manuscripts for international and local journals and also review funding proposals for international funding bodies. Currently I am the Director of the Evolutionary Studies Institute, the only palaeontological institute in Southern Africa.

I have completed more than 450 palaeontological impact assessments (desktop and site visit studies) in the last 28 years for a variety of projects (solar energy projects, wind energy projects, powerlines, roads, infrastructure, housing and retail projects and from all over South Africa. I have been subcontracted by over 30 different companies. From my own projects and training provided by me and other staff in the ESI for Palaeontological Impact Assessments, I am familiar with the legislation.

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3. Project Background

Niara Minerals (Pty) Ltd is applying for a Prospecting Right in terms of Section 16 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA), for the exploration of coal, pseudo-coal, and torbanite/oil shale. The application area spans various farm portions, namely the Remaining Extent of Isihlengeni No. 689; the Remaining Extent of Demoina; Portion 1 of Weltevrede No. 540; Portion 1 of Misty Valley No. 831; and Portions 0, 3, 4, and 6 of Toovernaars Rust No. 518. The proposed prospecting area is located within the Abaqulusi Local Municipality, under the Amajuba District Municipality in the KwaZulu-Natal Province, covering a total area of approximately 15 hectares. The project area is situated approximately 3 km south of Ngenetseni and about 23 km south of Louwsburg.

Niara Minerals (Pty) Ltd has appointed Temvelo Consultants (Pty) Ltd as the independent Environmental Assessment Practitioner (EAP) to conduct the environmental authorisation process. The proposed prospecting activities will include both non-invasive and invasive techniques. The planned invasive activities will entail the drilling of boreholes to obtain sub-surface geological samples for analysis.

A total of approximately 10–15 boreholes are proposed, with each borehole expected to disturb a small surface footprint. The precise location of these boreholes will be determined following the completion of a desktop study, field mapping, and geophysical surveys. The boreholes will be strategically located within the designated 15-hectare prospecting area to ensure minimal environmental impact and to provide representative sampling across the application area.

The aim of drilling is to determine the presence, depth, thickness, and quality of the targeted mineral formations. Borehole drilling will be undertaken using rotary core drilling rigs and associated equipment, with support by small trucks and mobile water tanks. Drilling will be performed by a qualified drilling contractor in compliance with relevant safety and environmental standards.

The prospecting programme will be executed over four (4) phases within a total period of 60 months (five years). The prospecting right may be renewed for an additional three (3) years if the programme is not completed within the initial term.

The proposed prospecting project triggers activities listed in Listing Notice 1 of the National Environmental Management Act (NEMA), and therefore a Basic Assessment process in terms of Government Notice Regulation (GNR) 982 (as amended) is required. The environmental impacts of the proposed activities were assessed by identifying environmental aspects and conducting an environmental sensitivity analysis to determine significant issues. The environmental impact assessment covers all project phases, including site establishment, drilling operations, rehabilitation, and closure. A structured impact rating system was applied to evaluate the potential environmental effects and the effectiveness of proposed mitigation measures.

A Palaeontological Impact Assessment was requested for the Isihlengeni PRA project. To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999)

(NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 1: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6). Includes the requirements from GNR Appendix 6 of GN 326 EIA Regulation 2017.

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report,	Section 2
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Section 2
b	A declaration that the person is independent in a form as may be specified by the competent authority	Section 2
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 3
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 6
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 4
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 6
g	An identification of any areas to be avoided, including buffers	Section 6
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 6
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 8
k	Any mitigation measures for inclusion in the EMPr	Section 10, Appendix A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 10, Appendix A

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 8
nii	If the opinion is that the proposed activity 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	Sections 8, 10
o	A description of any consultation process that was undertaken during the course of carrying out the study	EAP
p	A summary and copies of any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A
2	Where a government notice 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.	N/A

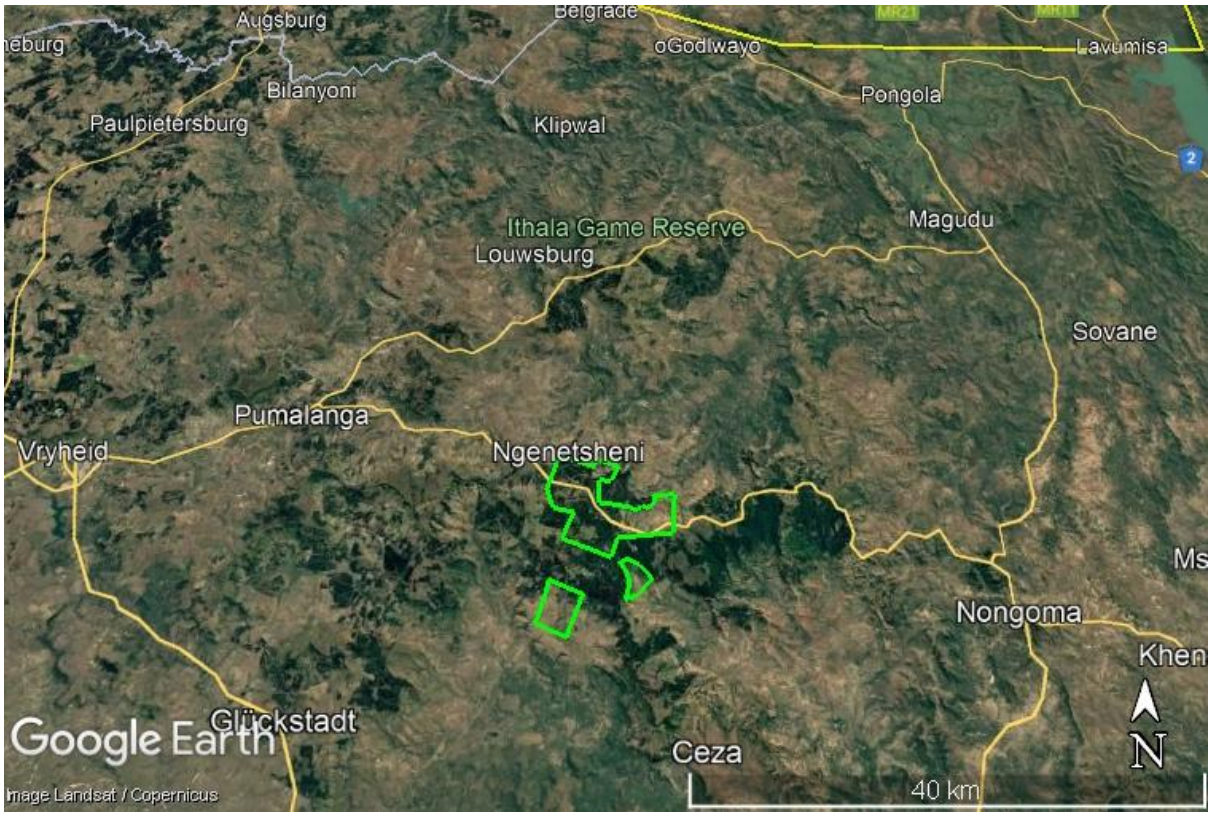


Figure 1: Google Earth map of the general area to show the relative landmarks. The NIA02 prospecting right area is shown by the green polygons.

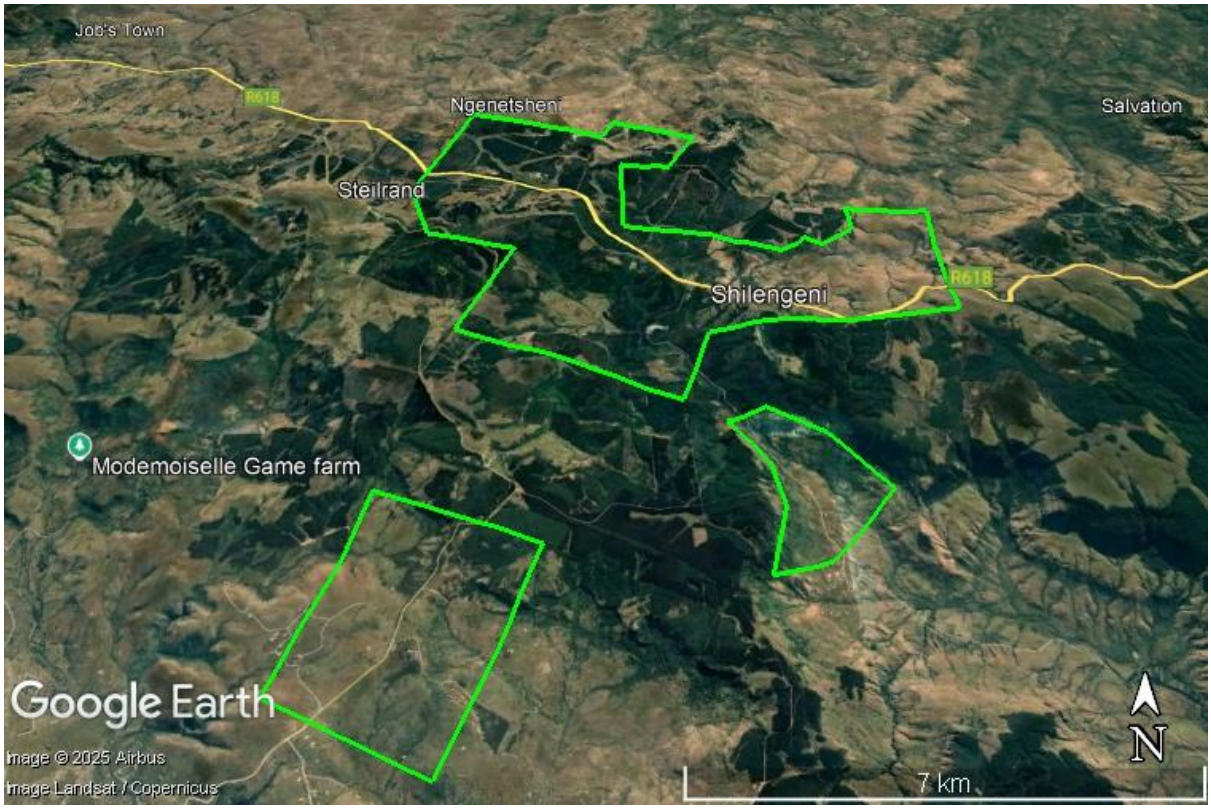


Figure 2: Google Earth Map of the NIA02 prospecting right area between Vryheid and Nongoma with the three sections shown by the green outlines, to be referred to as the Main cluster, the southwestern are and the southeastern area.

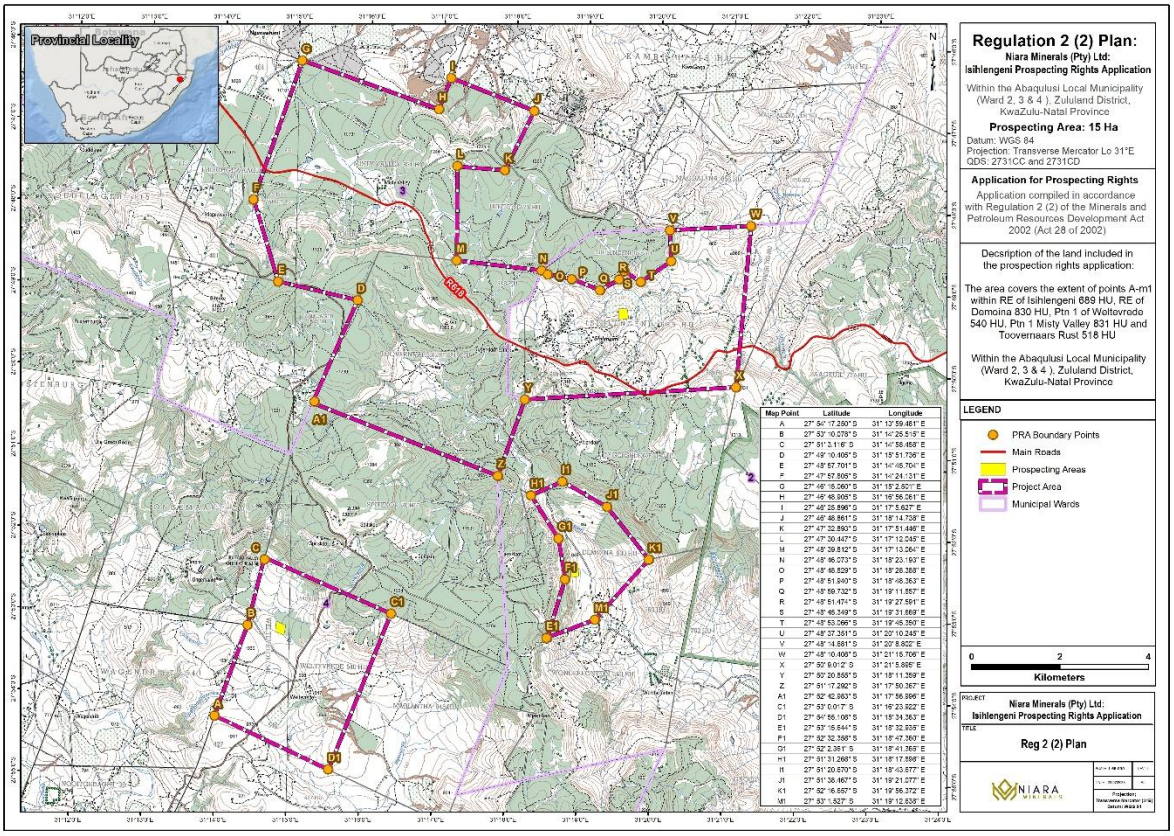


Figure 3: Regulation 2(2) map for the NIA02_Isihlengeni PRA.

4. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.
The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources include records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases; eg https://sahris.sahra.org.za/map/palaeo
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representativity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

5. Geology and Palaeontology

i. Project location and geological context

The project lies in the north-eastern part of the Karoo Basin where the basal rock unconformably overlie the much older granites of the Pongola Supergroup that are Mesoarchaean in age. The granites do not preserve any fossils (Figure 4).

The Karoo Supergroup rocks cover a very large proportion of South Africa and extend from the northeast (east of Pretoria) to the southwest and across to almost the KwaZulu Natal south coast. It is bounded along the southern margin by the Cape Fold Belt and along the northern margin by the much older Transvaal Supergroup rocks. Representing some 120 million years (300 – 183Ma), the Karoo Supergroup rocks have preserved a diversity of fossil plants, insects, vertebrates and invertebrates.

During the Carboniferous Period South Africa was part of the huge continental landmass known as Gondwanaland and it was positioned over the South Pole. As a result, there were several ice sheets that formed and melted, and covered most of South Africa (Visser, 1986, 1989; Isbell et al., 2012). Gradual melting of the ice as the continental mass moved northwards and the earth warmed, formed fine-grained sediments in the large inland sea. These are the oldest rocks in the system and are exposed around the outer part of the ancient Karoo Basin, and are known as the Dwyka Group. They comprise tillites, diamictites, mudstones, siltstones and sandstones that were deposited as the basin filled. This group has been divided into two formations with Elandsvlei Formation occurring throughout the basin and the upper Mbizane Formation occurring only in the Free State and KwaZulu Natal (Johnson et al., 2006).

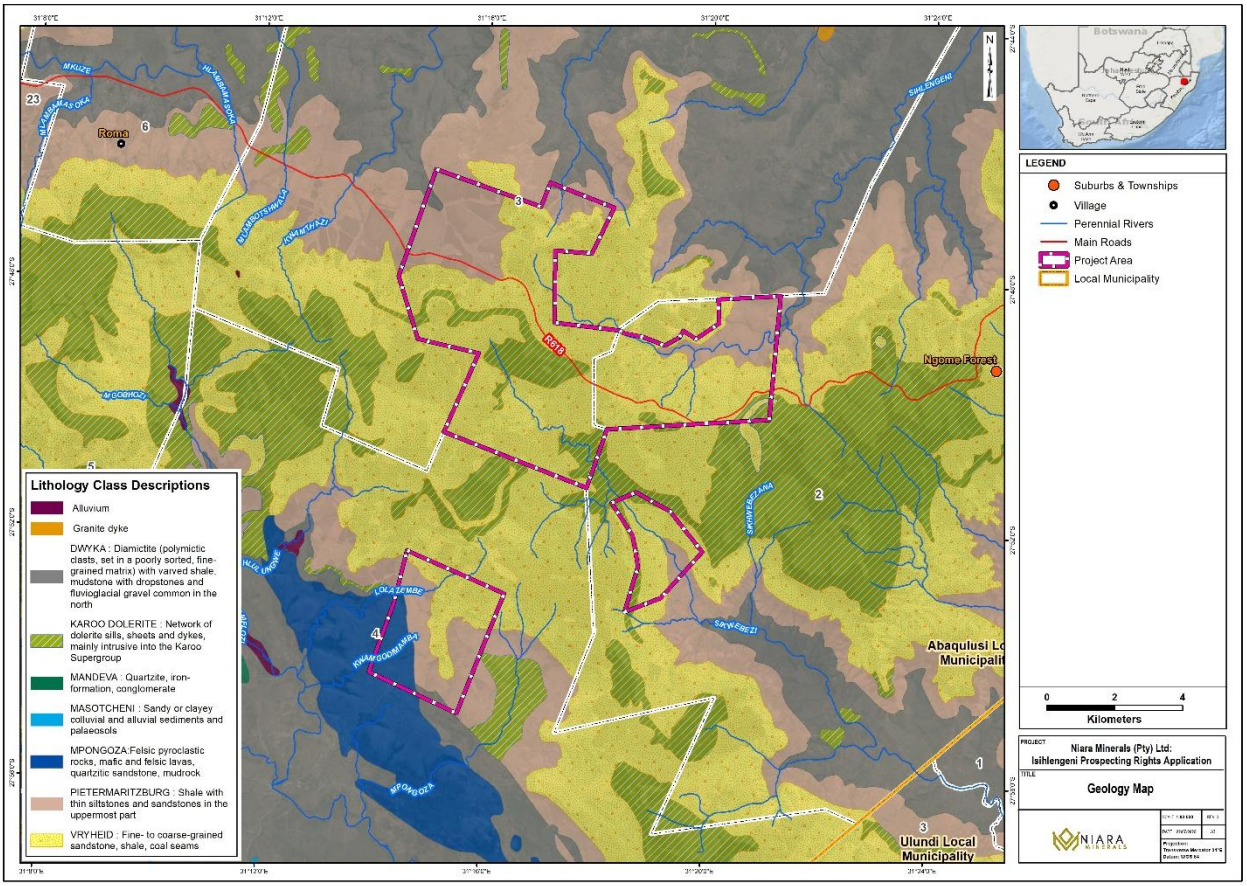


Figure 4: Geological map of the area around the NIA02 prospecting area with the three sections shown by the green outlines. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2730 Vryheid. Map supplied by Niara.

Table 2: Explanation of symbols for the geological map and approximate ages (Gold, 2006; Johnson et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, calcrete	Quaternary ca 1.0 Ma to Present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, Ca 183 Ma
Pv	Vryheid Fm, Ecca Group, Karoo SG	Shale, mudstone, coal, sandstone	Middle Permian ca 266 – 260 Ma
Pp	Pietermaritzburg Fm, Ecca Group, Karoo SG	Shale, siltstone, mudstone	Middle Permian ca 269 – 266 Ma
C-Pd	Mbizane Fm, Dwyka Group, Karoo SG	Tillites, diamictites, sandstone , mudstone, shale	Early Permian, ca 298 - 290 Ma
Zmp	Mpongoza Fm, Nsuze Group. Mfolozi Area, Pongola SG	Amygdaloidal acid lava, tuff, tuff breccia, sandstone, mudstone, orthoquartzite	Mesoarchaean Ca 2984-2940 Ma

Overlying the Dwyka Group rocks are rocks of the Ecca Group that are Early Permian in age. There are eleven formations recognised in this group but they do not all extend throughout the Karoo Basin. In the central and eastern part are the following formations, from base upwards: **Pietermaritzburg, Vryheid** and Volksrust Formations. All of these sediments have varying proportions of sandstones, mudstones, shales and siltstones and represent shallow to deep water settings, deltas, rivers, streams and overbank depositional environments.

Large exposures of Jurassic dolerite dykes occur throughout the area. These intruded through the Karoo sediments around 183 million years ago at about the same time as the Drakensberg basaltic eruption.

From uplift of the continent at various times in the past, weathering and erosion, sands alluvium and colluvium have washed down and been deposited on lower pediments, hillslopes and depressions. Some of these have become consolidated and in this area are known as the Masotcheni Formation (Partridge et al., 2006). These Late Pleistocene deposits are well represented in some parts of KwaZulu Natal but tend to erode easily and leave dongas (Botha, 2021). Along the rivers and valleys such sands are reworked and deposited and also are difficult to date.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figures 5-7. The sites for prospecting are in the potentially very highly sensitive Vryheid Formation (red) and the moderately sensitive Pietermaritzburg and Mbizane Formations (green).

The **Dwyka Group** is made up of seven facies that were deposited in a marine basin under differing environmental settings of glacial formation and retreat (Visser, 1986, 1989; Johnson et al., 2006). In the north and east these are called the Mbizane Formation, and the Elandsvlei Formation in the south and west. Described below are the seven facies (Johnson et al., 2006 p. 463-465):

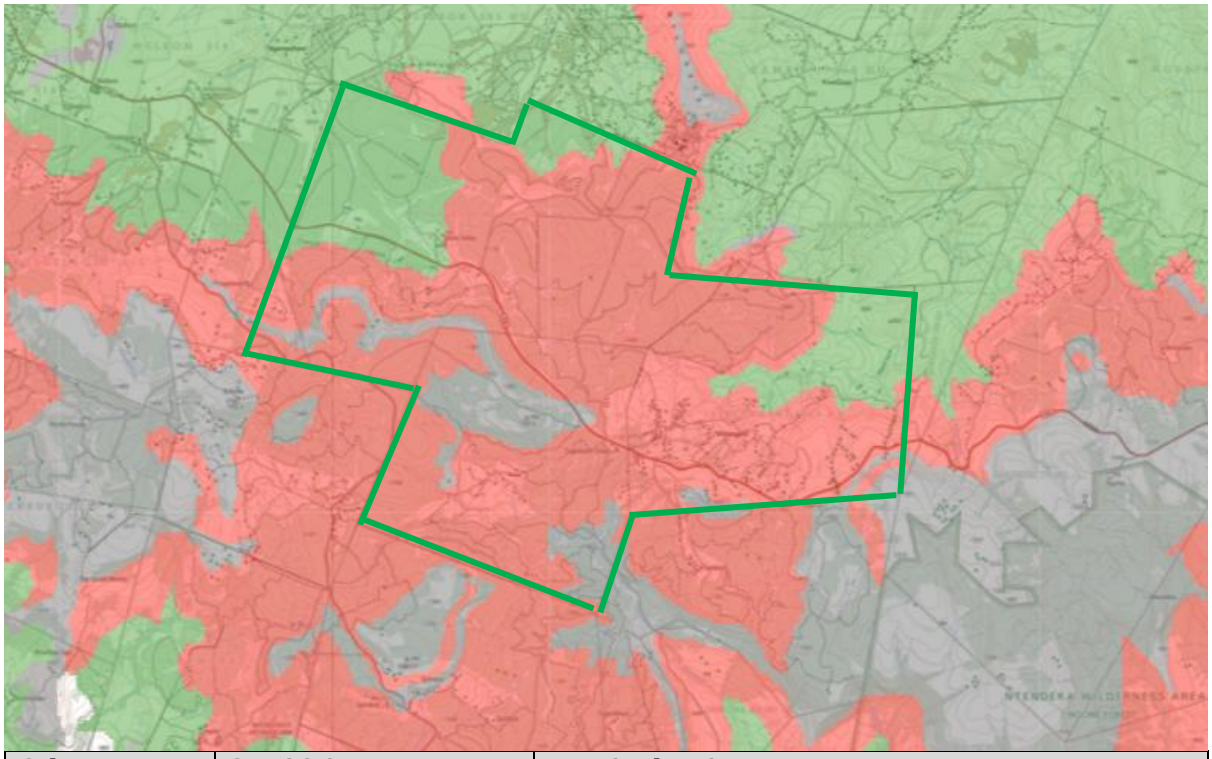
- The massive diamictite facies comprises highly compacted diamictite that is clast-poor in the north. It was deposited in subaqueous or subglacial positions.
- The stratified diamictite comprises alternating diamictite, mudrock, sandstone and conglomerate beds. They are interpreted as being rapidly deposited, sediment gravity flows but with some possible reworking of the subglacial diamictites.
- The massive carbonate-rich diamictite facies is clast-poor and was formed by the rainout of debris, with the carbonate probably originating by crystallisation from interstitial waters.
- The conglomerate facies ranges from single layer boulder beds to poorly sorted pebble and granule conglomerates. The boulder beds are interpreted as lodgement deposits whereas the poorly sorted conglomerates are a product of water-reworking of diamicton by high-density sediment gravity flows.
- The sandstone facies were formed as turbidite deposits.
- The mudrock with stones facies represents rainout deposits in the distal iceberg zone.

The **mudrock facies** consists of dark-coloured, commonly carbonaceous mudstone, shale or silty rhythmite that was formed when the mud or silt in suspension settled. This is the only fossiliferous facies of the Dwyka Group.

The Dwyka *Glossopteris* flora outcrops are very sporadic and rare. Of the seven facies that have been recognised in the Dwyka Group fossil plant fragments have only been recognised from the mudrock facies. They have been recorded from around Douglas only (Johnson et al., 2006; Anderson and McLachlan 1976) although the Dwyka Group exposures are very extensive.

The basal **Pietermaritzburg Formation** (Ecca Group) is composed of dark silty mudrock, that coarsens upwards with bioturbated and deformed sandy and silty beds at the top of the sequence (Johnson et al., 2006). This formation represents a major post-glacial transgression where carbonate concretions have formed sub-aqueously along an unstable shelf. The upper coarser sediments represent a prograding shoreline (Johnson et al., 2006). Trace fossils of invertebrates are present in the upper sediments along the ancient shorelines.

The formation extends over most of the KwaZulu-Natal Province but the description is mainly based on borehole records because due to its lithology and the local climate, it is usually poorly exposed (Bordy et al., 2017).



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.

Figure 5: SAHRIS palaeosensitivity map for the main section for the prospecting right application shown within the yellow rectangle. See figures 5-6 for the other sections.

The Pietermaritzburg Formation only has scattered, fragmentary plant fossil leaves (*Glossopteris*) and invertebrate trace fossils that are diagnostic of marine conditions (e.g. *Helminthopsis*). Using the sedimentary facies as well as the trace fossil assemblages, Bordy et al. (2017) have interpreted the unit as having been deposited under low energy conditions on a northerly shallowing marine shelf that initially experienced deepening waters and then shallowing in the middle Permian. Other trace fossils include *Skolithos* and bioturbation by invertebrates.

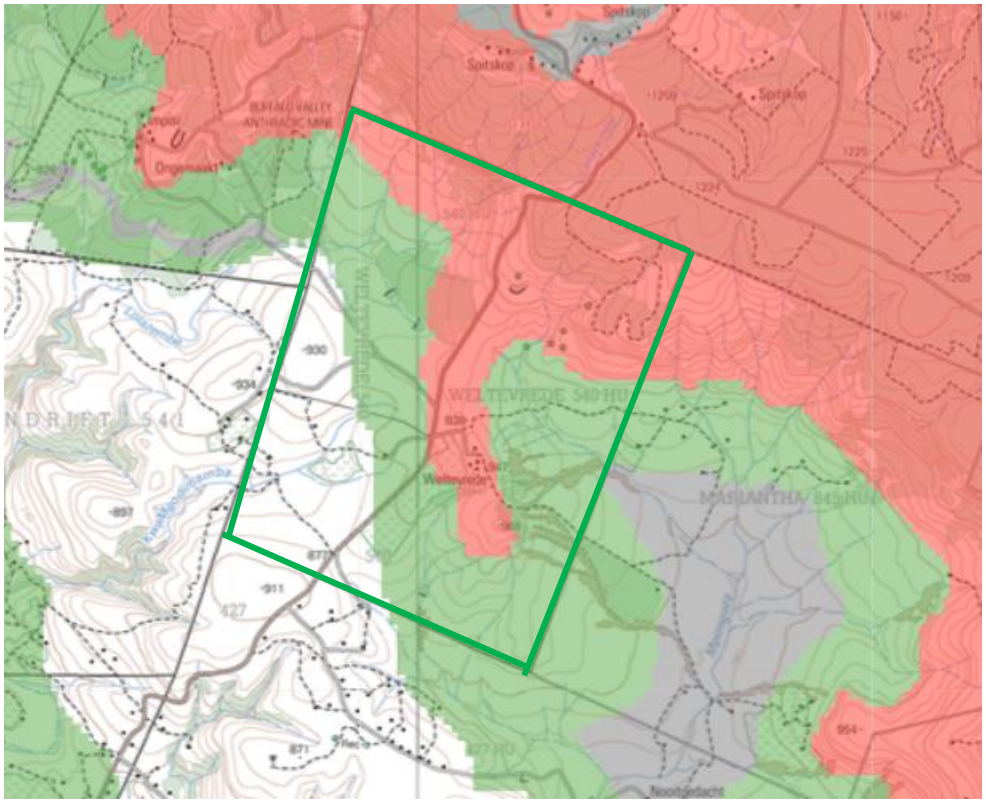


Figure 5: SAHRIS palaeosensitivity map for the southwest section on Farm Weltevrede 540 HU. See Figure 4 for colour codes.

The **Vryheid Formation** lies on the uneven topography of pre-Karoo or Dwyka Group rocks in the northern and northwestern margins, but lies directly on the Pietermaritzburg Formation in the central and eastern part. The lithofacies show a number of upward-coarsening cycles, some very thick, and they are essentially deltaic in origin. There are also delta-front deposits, evidence of delta switching, and fluvial deposits with associated meandering rivers, braided streams, back swamps or interfluves and abandoned channels (Cadle et al., 1993; Cairncross, 1990; 2001; Johnson et al., 2006). Coal seams originated where peat swamps developed on broad abandoned alluvial plains,

and less commonly in the backswamps or interfluves. Most of the economically important coal seams occur in the fluvial successions (ibid). In the east (Mpumalanga and northern KwaZulu Natal), the Vryheid formation can be subdivided into a lower fluvial-dominated deltaic interval, a middle fluvial interval, and an upper fluvial-dominated deltaic interval again (Taverner-Smith et al., 1988).

Fossil plants of the *Glossopteris* flora occur in the Vryheid Formation. This flora includes *Glossopteris* leaves, seeds, fructifications, roots and wood, as well other groups such as the lycopods, sphenophytes, ferns, cordaitaleans and early gymnosperms (Plumstead, 1969; Anderson and Anderson, 1985; Bamford, 2004).

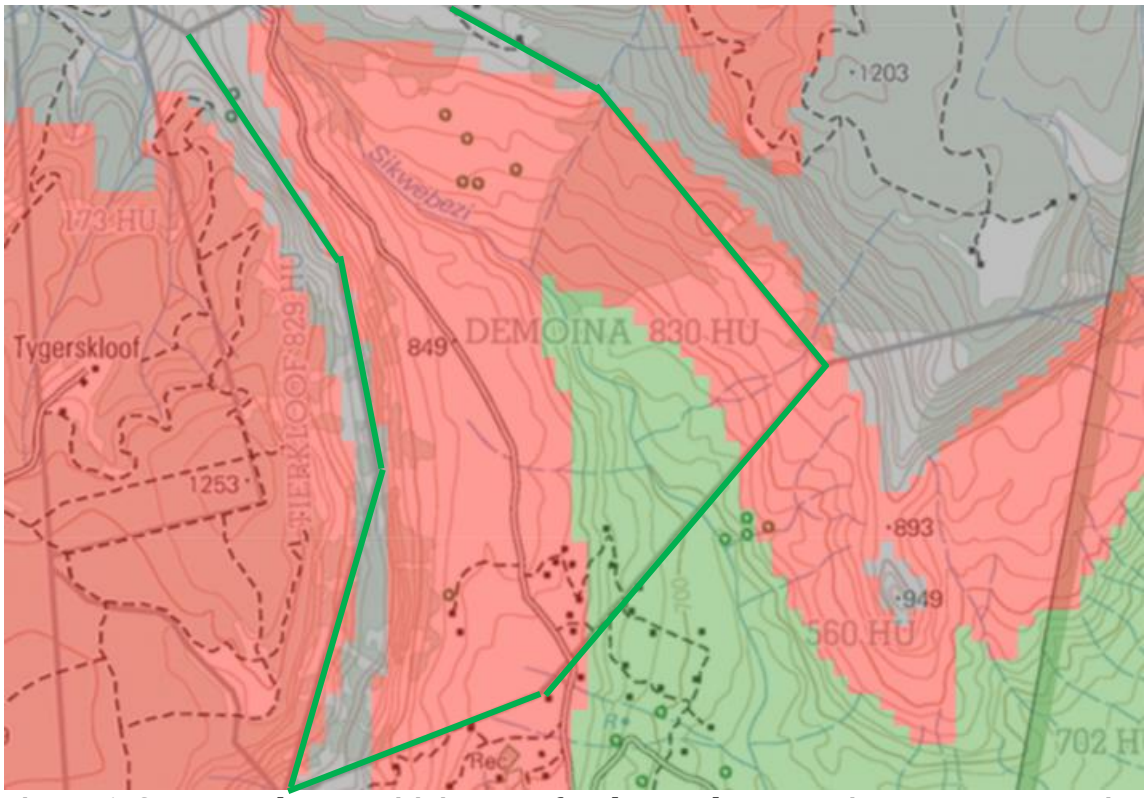


Figure 6: SAHRIs palaeosensitivity map for the southeast section on Farm Demoine 830 HU. See figure 4 for colour codes.

From the SAHRIS maps above the area is indicated as mostly very highly sensitive (red) and this the Vryheid Formation that is known to have coal seams. The Dwyka Group and Pietermaritzburg Formation are moderately sensitive (green) while the dolerite and granites are grey as they have zero to insignificant palaeosensitivities – and no coal seams.

6. Impact assessment

Temvelo methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks;

Criteria to Consider when Determining Severity of impacts:
The ranking of impacts/determination of significance is estimated using two criteria, namely Consequence and Probability. These consider the contributing factors / criteria listed in the legislation. The definitions of each are provided below.

The **Consequence** of an impact resulting from an aspect is expressed as a combination of:

- **Nature** of impact: An indication of the extent of the damage (negative impacts) or benefit (positive impacts) the impact inflicts on natural, cultural, and/or social functions (environment).
- **Extent** of impact: A spatial indication of the area impacted (i.e., how far from activity the impact is realised).
- **Duration** of impact: A temporal indication of the how long the effects of the impact will persist, assuming the activity creating the impact ceases. For example, the impact of noise is short lived (impact ceases when activity ceases) whereas the impact of removing topsoil exists for a much longer period of time.
- **Frequency** of the impact occurring: An indication of how often an aspect, as a result of a particular activity, is likely to occur. Note that this does not assess how often the impact occurs. It applies only to the aspect. For example, driving takes place daily whilst other activities take place monthly while the resultant frequency of the impacts occurring will vary based on a number of factors.
- **Magnitude**/Severity of an impact determines to what extent will the environment be destroyed or is functions be altered by the activity.
- **Significance** of the impact is an indication of the importance of the impact in terms of both the physical extent and the time scale. It indicates the level of mitigation required.

Table 3a: Consequences and Significance Rating

	Nature of Impact:		
CONSEQUENCE	Low	Impacts affect the environment in such a way that natural, cultural and / or social functions and processes are not affected.	1
	Low-Medium	Impacts affect the environment in such a way that natural, cultural And / or social functions and processes are affected insignificantly.	2
	Medium	Impacts affect the environment in such a way that natural, cultural and / or social functions and processes are altered.	3
	Medium-High	Impacts affect the environment in such a way that natural, cultural and / or social functions and processes are severely altered. Impacts affect the environment in such a way that natural, cultural	4
	High	and / or social functions and processes will temporarily or permanently cease.	5
	Scale/Extent of Impact:		
	Local	The impacted area will only extend as far as the activity being conducted, e.g., the activity footprint	1
	site	Impact occurs within a 20km radius of the site.	2

	Nature of Impact:		
	Regional	Impact occurs within a 100km radius of the site.	3
	National	Impact occurs within South Africa.	4
	Duration of Impact:		
	Short-term	The impact will either disappear with mitigation or will be mitigated through the natural processes in shorter time span.	1
	Medium-term	The impact will last up to the end of the project phases, where after it will be negated. The impact will cease within 5 years if the activity is stopped.	3
	Long-term	The impact will last for the entire operational phase and after the operational life of the operation but will be mitigated by direct human action or by natural processes thereafter.	4
	Permanent	Intervention will not occur in such a way or in such a time span that the impact can be considered transient.	5
	Frequency of the Occurrence of the Impact:		
	Annually or less	Impact occurs at least once in a year or less frequently.	1
	6 months	Impact occurs at least once in 6 months.	2
	Monthly	Impact occurs at least once a month.	3
	Weekly	Impact occurs at least once a week.	4
	Daily	Impact occurs daily.	5
PROBABIL ITY	Probability of the Occurrence of the impact:		
	Improbable	The possibility of the impact materializing is very low either because of design or historic experience.	1
	Probable	The possibility of the impact materializing will occur to the extent that provision must be made thereof.	2
	Highly Probable	It is most	4
	Definite	The impact will occur regardless of any prevention measures.	5
	Magnitude of the impacts:		
	Low	The impact alters the affected environment in such a way that the natural processes are not affected.	2
	Medium	The affected environment is altered; however, the functions and processes continue in a modified way.	6
	High	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.	8
SIGNIFICANCE	Significance of the impact: Sum (Duration, Extent, Magnitude) x Probability		
	Negligible	The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.	< 20
	Low	The impact is limited in extent, with low to medium intensity and whatever the probability of the occurrence may be, the impact will not have a material effect on the decision and is likely to require the management intervention with increased costs.	< 40
	Moderate	The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.	< 60
	High	The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation	> 60

This rating system is weighted in such a way as to set impacts that are very likely to occur, but have very little consequence, as Low significance. Similarly, impacts with serious consequences but that are unlikely to occur are rated lower, than impacts with serious consequences that are likely to occur.

The positive and negative impacts that the proposed activity and alternatives will have on the environment and the community that may be affected

The impacts assessed has highlighted potential risks, important management strategies and control measures associated with the Project. It is considered that there are opportunities to substantially enhance and improve the potential impacts by undertaking a well-planned and effective operation. The project has associated positive and negative impacts. Such impacts are described in Table 1.

Table 1: Positive and negative impacts of the proposed activity

Impact Category	Positive Impacts	Negative Impacts	Alternative Considered
Soil and Land Capability	- Temporary soil disturbance, which can be rehabilitated after activities.	- Potential for soil erosion and compaction due to machinery and access road construction.	- Minimal land disturbance through careful planning of access roads and site activities.
Vegetation	- Temporary vegetation clearance will be minimal and conducted in a controlled manner.	- Potential for loss of vegetation cover and local biodiversity in disturbed areas.	- Use of existing pathways and disturbed land for access to reduce new clearance.
Animal Life	- Minimal disturbance to wildlife, with efforts to avoid critical habitats.	- Possible disturbance to local wildlife due to machinery and noise from excavation activities.	- Trenching and activities to be planned during off-peak times for wildlife activity.
Surface Water	- Low impact on surface water, with no permanent water usage or discharge.	- Potential contamination of surface water from waste or accidental spills.	- Implementing strict waste management protocols and spill response systems.
Groundwater	- No significant impact on groundwater as no permanent water usage is required.	- Possible risk of contamination from waste or fuel storage.	- Using proper containment methods for waste and hazardous materials.
Air Quality	- Potential improvement in local air quality if vegetation is restored, reducing dust after rehabilitation.	- Increased dust and emissions from vehicles and machinery used in excavation and access road construction.	- Use of dust suppression methods such as water spraying and low-emission machinery.
Noise	- No significant positive impacts.	- Noise from machinery, vehicles, and excavation equipment may disturb wildlife and local communities.	- Limit noisy activities to specific hours of the day and use quieter equipment where possible.
Heritage	- No direct positive impacts unless new archaeological sites are discovered, in which case they would be preserved.	- Risk of damage to heritage sites if present, especially during excavation activities.	- Conduct a heritage assessment to avoid impacting any heritage resources.
Visual	- Temporary nature of activities means minimal lasting visual	- Visual disturbance from excavation	- Careful placement of infrastructure to reduce

Impact Category	Positive Impacts	Negative Impacts	Alternative Considered
	impact after rehabilitation.	activities, temporary roads, and site offices.	visibility from surrounding areas.
Safety	- Implementation of safety measures will protect workers from accidents and harm.	- Safety risks associated with excavation, equipment operation, and the movement of personnel.	- Comprehensive safety protocols and staff training to minimize accident risks.
Health	- No significant positive health impacts.	- Potential health risks related to dust inhalation, noise exposure, and handling of hazardous materials.	- Provision of personal protective equipment (PPE) and regular health monitoring for workers.
Waste	- Proper waste management ensures that minimal waste is generated and disposed of responsibly.	- Generation of waste during excavation and site preparation, including potential hazardous waste.	- Segregation of waste types and implementation of recycling initiatives.
Traffic	- Temporary increase in traffic may boost local economy through job creation and service demand.	- Potential traffic congestion and road safety risks from transportation of personnel, machinery, and materials.	- Scheduling work to avoid peak traffic times and coordinating with local authorities to manage traffic.

The possible mitigation measures that could be applied and the level of risk.
All possible mitigation measures that could be applied to risks regarding the site layout are discussed and considered as part of the EIA process. The proposed mitigation measures for the assumed risks are discussed in detail under section 10 and 13 of this report.

Motivation where no alternative sites were considered.
The prospecting activities are intended to be conducted in search of the minerals that are being applied for. These minerals occur in specific areas depending on the geology of the area. The historical data shows that there could be the occurrence of such minerals in the area, and therefore, the prospecting activities are ought to be undertaken in the proposed site. The proposed site has existing access roads that will be used during the operational phase of the project and minimal infrastructure will be established due the project requirements and the site location.
Statement motivating the alternative development location within the overall site
Based on the different studies conducted and the outcome from the public consultation during the public participation process, it has been concluded that all invasive prospecting activities will not be undertaken in sensitive areas wherein considerate buffer zones (100m) will be created from all identified environmental sensitive and 'no-go' area.

Description of aspects to be assessed as part of the EIA process
The EIA Phase will assess the overall environmental aspects affected by the proposed project in relation to listed project activities. The identified listed and specified activities for the project are the prospecting activities which include the following:

- Establishment of the office and equipment storage site.
- Installation of mobile offices and ablution facilities.

- Construction of temporal access road to the camp;
- Borehole drilling; and
- Rehabilitation and closure.

The EIA process assessed the overall aspects that will be affected by the proposed project in relation to the activities to be conducted. A sensitivity report has been conducted to determine the sensitivity of the proposed area to make sound decision on the consideration and implementation of the mitigation measures of the impacts posed by the proposed activity.

Extreme

These are unacceptable risks primarily critical in nature in terms of consequences in terms of the extensiveness and long-term environmental harm, permanent sacred site damage, fatality, and massive economic impacts that are effectively considered a possibility to almost certain to occur. Such risks significantly exceed the risk acceptance threshold and require comprehensive control measures, and additional urgent and immediate attention towards the identification and implementation of measures necessary to reduce the level of risk.

High

Typically relate to significant to critical consequences including a major amount of environmental or heritage damage, and considerable safety, social or economic impacts that are inclined to cut across the possible to almost certain likelihood ratings. These are also likely to exceed the risk acceptance threshold and although proactive control measures have been planned or implemented, a very close monitoring regime and additional actions towards achieving further risk reduction is required.

Medium

As suggested by the classification, medium level risks span a group of risk combinations varying from relatively low consequence / high likelihood to mid-level consequence / likelihood to relatively high consequence / low likelihood scenarios across environmental, social, and economic areas. These risks are likely to require active monitoring as they are effectively positioned on the risk acceptance threshold.

Low

These risks are below the risk acceptance threshold and although they may require additional monitoring in certain cases are not considered to require active management. In general, such risks represent relatively low likelihood and low to mid-level consequence scenarios.

Very Low

Impacts risks that are below the risk acceptance threshold and would at the most require additional monitoring and in many cases would not require active management. These risks can include unlikely to rare events with minor consequences and in essence relate to situations around very low probabilities of relatively minor impacts occurring.

Likelihoods have been categorised around the probability of occurrence, within the context of reasonable timeframes and frequencies given the nature of the anticipated project life. Levels of likelihood and the severity for the types of consequences that make up the risk rating determination are defined in the Table 3c below:

Table 3c: Likelihood rating system

Rating	Likelihood	Definitions
5	Almost Certain	The event is expected to occur in most circumstances (The event is likely to occur once per year).
4	Likely	The event will probably occur in most circumstances (The event is likely to occur once every 1 – 2 years).
3	Possible	The event might occur at some time (The event is likely to occur once every 2 – 5 years).
2	Unlikely	The event could occur at some time (The event is likely to occur once every 5 – 10 years).
1	Rare	The event may occur only in exceptional circumstances (The event is unlikely to occur in any 10-year period).

Risk Analysis Matrix

The risk controls are linked to the level of risk and opportunity for reduction to meet the project rehabilitation objectives and goals linked to an environmentally and socially responsible operation, and those requirements are part of the regulatory obligations and impact assessment guidelines. The table below provides a summary of the qualitative risk matrix adopted and the levels of risk for the various consequence and likelihood combinations.

Table 3d: Risk Analysis Matrix

		Severity of Consequence				
Likelihood of Consequence		Critical (5)	Major (4)	Significant (3)	Moderate (2)	Minor (1)
	Almost Certain (5)	Extreme	Extreme	High	High	Medium
	Likely (4)	Extreme	High	High	Medium	Medium
	Possible (3)	Extreme	High	Medium	Medium	Low
	Unlikely (2)	High	Medium	Medium	Low	Very Low
	Rare (1)	Medium	Medium	Low	Low	Very Low

The impact assessment will focus on the invasive activities of the project since they will have the potential to impact on the biophysical and the social environment of the proposed area. These activities include:

- Establishment of the office and equipment storage site;
- Installation of mobile offices and ablution facilities;
- Construction of temporal access road to the camp;
- Borehole drilling;
- Processing of materials; and
- Rehabilitation and closure.

Table 3e: Impact on the Palaeontological Heritage

Palaeontology	Pre-mitigation	Post-mitigation
Phase	Construction and prospecting	
Aspect	Palaeontological impact	

Impact	Damage to or destruction of fossil plants present in the rocks overlying or associated with the coal seams	
Mitigation	ECO or geologist must monitor the rocks removed and look for fossil leaf impressions. Rescue any well-preserved or unusual materials. An AMAFA permit is required before any fossils are removed from the site.	
Nature	Negative	Positive
Magnitude	3	1
Extent	1	1
Frequency	1	1
Duration	4	1
Probability	3	1
Significance	9x3 = 27	1x1 = 1
Risk Assessment	Low /	Negligible / Very Low
Likelihood of Consequence	Possible	Rare
Severity of consequence	Significant	Minor
Risk analysis	Moderate	Very Low

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are the correct type and age to contain fossils but are covered with soils. No fossils will be visible until the soils have been removed, therefore, a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is moderate

7. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and only some might contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period would not preserve fossils. The fossiliferous Vryheid Formation is covered with soil so it is not possible to determine the presence of any fossils until excavations commence.

8. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the overlying soils of the Quaternary. There is moderate chance that fossils may occur below the soil cover in the shales of the Vryheid Formation so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations and prospecting activities have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. The impact on the palaeontological heritage would be moderate, as far as the palaeontology is concerned, so the project should be authorised.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Very High	Moderate	Palaeontological Impact Assessment	Section 7.2. SAHRA Requirements

9. References

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10. Fossil Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations / drilling / mining activities begin.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations/mining commence.
2. When excavations begin the rocks and discard must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone or coal) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossil plants, vertebrates, invertebrates or trace fossils in the shales and mudstones (for example see Figure 8). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site an AMAFA permit must be obtained. Annual reports must be submitted to AMAFA as required by the relevant permits.
7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to AMAFA once the project has been completed and only if there are fossils.

8. If no fossils are found and the excavations have finished then no further monitoring is required.

11. **Appendix A** – Examples of fossils from the Vryheid Formation

Figure 8: Photographs of fossil plants from the Vryheid Formation shales, to assist the on-site responsible person.

Curriculum vitae (short) - Marion Bamford PhD
May 2025

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ii) **Academic qualifications**
Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) **Professional qualifications**
Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) **Membership of professional bodies/associations**
Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+
Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

v) **Supervision of Higher Degrees**

All at Wits University

Degree	Graduated/completed	Current
Honours	13	0
Masters	15	3
PhD	14	5

Postdoctoral fellows	14	4

vi) **Undergraduate teaching**
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 25 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 12 - 20 students per year.

vii) **Editing and reviewing**
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Associate Editor: Cretaceous Research: 2018-2020
Review of manuscripts for ISI-listed journals: 30 local and international journals

viii) **Palaeontological Impact Assessments**
28 years' experience in PIA site and desktop projects with over 350 projects completed.

Selected from recent projects only – list not complete:

- Wolf-Skilpad-Grassridge OHPL 2022 for Zutari
- Iziduli and Msenge WEFs 2022 for CTS Heritage
- Hendrina North and South WEFs & SEFs 2022 for Cabanga
- Dealesville-Springhaas SEFs 2022 for GIBB Environmental
- Vhuvhili and Mukondeleli SEFs 2022 for CSIR
- Chemwes & Stilfontein SEFs 2022 for CTS Heritage
- Equestria Exts housing 2022 for Beyond Heritage
- Zeerust Salene boreholes 2022 for Prescali
- Tsakane Sewer upgrade 2022 for Tsimba
- Transnet MPP inland and coastal 2022 for ENVASS
- Ruighoek PRA 2022 for SLR Consulting (Africa)
- Namli MRA Steinkopf 2022 for Beyond Heritage
- Adara 2 SEF 2023 for CTS Heritage
- Buffalo & Lyra SEFs 2023 for Nextec
- Camel Thorn Group Prospecting Rights 2023 for AHSA
- Dalmanutha SEFs 2023 for Beyond Heritage
- Elandsfontein Residential 2023 for Beyond Heritage
- Waterkloof Samancor 2023 for Elemental Sustainability
- Zonnebloem WTP 2023 for WSP
- Elders Irrigation 2023 for SRK
- Leghoya WEFS 2023 for Red Cap & SLR
- Aberdeen Solar 1,2,3 2024 for Beyond Heritage
- BeauNero Mining 2024 for Lwethuma
- Brakfontein 264 IR Mining 2024 for Eco-elementum
- Hugo & Khoa SEFs 2024 for TerraMare

ix) **Research Output**
Publications by M K Bamford up to July 2025 peer-reviewed journals or scholarly books: over 200 articles published; 5 submitted/in press; 15 book chapters.

Scopus h-index = 33; Google Scholar h-index = 41; -i10-index = 130 based on 8046 citations.
Conferences: numerous presentations at local and international conferences.